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WP1: Preparation

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Fundació Solidaritat Universitat Barcelona (UB)	Spain
World University Service of the Mediterranean (WUSMED)	Spain
Institut de Recherche pour le Développement (IRD)	France
Université Paul Sabatier Toulouse III (UPS)	France
Hanoi University of Science – Vietnam National University (HUS)	Vietnam
Can Tho University (CTU)	Vietnam
National University of Laos (NUOL)	Laos
Souphanouvong University (SU)	Laos
Institute of Technology of Cambodia (ITC)	Cambodia
University of Battambang (NUBB)	Cambodia

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Abstract

This report identifies the specific water management challenges faced by the PCs and define the academic emphases in each PC, based on the HEI's fields of expertise. For this purpose, two questionnaires have been elaborated by WP1 Leaders (FSUB and NUBB); completed and validated for all partners. The first questionnaire (in google form) aims to identify the water challenged faced in Cambodia, Laos and Vietnam. This survey was distributed to INOWASIA Academic Professional Committee. (APC) members. The second questionnaire (word sheet) goal is to gather information on PC partner's topics expertise and available material for teaching and modules elaboration offer in the field of water. This report includes the two questionnaire templates, the responses and the main outputs.

Document History

Version	Date	Comments
V0.1	06-10-2021	First draft
V0.2	13-01-2022	Second draft
V0.3	29-01-2022	Final Version

Contents

Acronyms

PC	Partner Country
HEIs	Higher Education Institutions
WP	Work Package
APC	Academic Professional Comitee

Identification specific water management challenges faced by the PCs

Methodology

A joined questionnaire **Questionnaire 1: Water Challenges and Academic-Labour Market Competences in Cambodia, Laos and Vietnam** has been elaborated by WP1 Leaders (FSUB and NUBB); completed and validated for all partners. The survey intends to compile information on both academic and labor market requirements (for D1.2. Report on defined academic and labour-market requirements) and the water challenges (And D1.7. Report on local emphasis). Due Covid-19 restrictions the survey has been elaborated in google form and has been distributed to INOWASIA Academic Professional Committee (APC) members (Annex 1).

Objectives:

- To gather the basic information about the water challenges faced by the country and at local level in case there are strong water challenges specificities at local scale. We understand as a local scale the closest territorial area of the institution (Deliverable D1.7)

- To anticipate academic and labour market competencies on water in order to build the water modules which adapts and innovates from current academic offer, and tackles local water challenges and employability demands (Deliverable D1.2)

Target audiences:

- Public Administration with water competencies

- Private companies working on water management

- Water related research and education institutions/Platforms

- Water-Environment and/or development NGOs (foundations, and associations; grassroots community-based organizations; international NGOs present in the country...)

Goal:

- At least 2 replies from each type of target audience (replies will express individual opinions, unless it is manifested otherwise).

Questionnaire Template

PART A- WATER CHALLENGES

1. **What is the general current state of water resources in your country in terms of quantity and quality?**

2. **What are the main current water challenges in your country?**

3. **What are the main current water challenges at local scale*?** Only fill if your local area is facing specific water challenges (*We understand as a local scale the closest territorial area of the institution).

4. **What are the strengths (if any) in water management in your country?**

5. **What are the most water demanding sectors in your country? (two or three sectors are enough)**

6. **What are the causes of water pollution in your country? Rate from 0 (low) to 4 (high):**

Causes of water pollution	**0**	**1**	**2**	**3**	**4**
Poor urban sanitation					
Poor sanitation in rural areas					
Industry					
Agriculture					
Tourism					
Others (specify)					

7. **Future: what are the main factors that can affect the water resource's state in your country in the mid-long term (10-20 years prediction)?** (e.g. climate change, demography, urban growth, energy transition, governance issues, ecological and landscape changes, tourism development, industry development, agriculture growth/recession, …)

Results

Total responses: 16

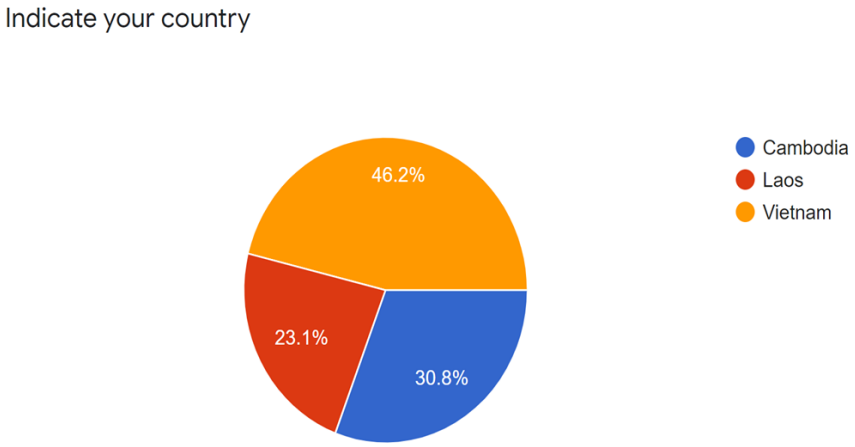


Figure 1. Percentage answers per country

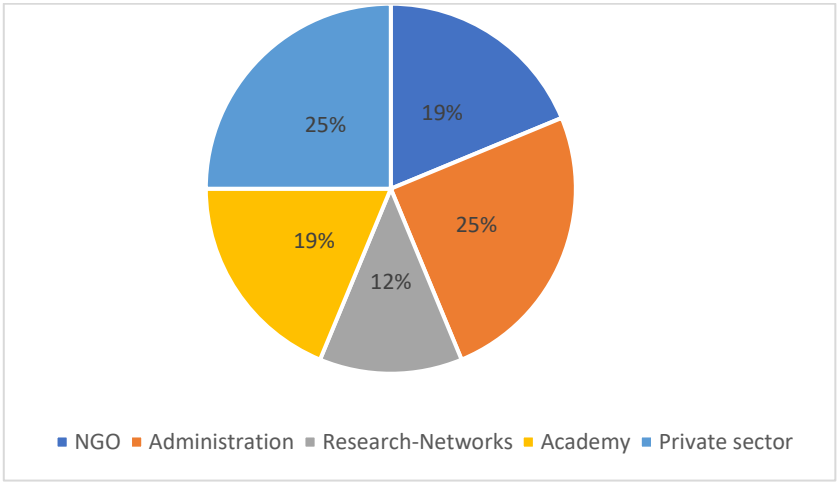


Figure 2. Percentage answers per organisation profile

1. **What is the general current state of water resources in your country in terms of quantity and quality?**

VIETNAM

- In general, the water resources in Vietnam are much different from the past. They're more polluted and the annual flood doesn't usually come anymore rich water resources but poor water quality.
- The quantity of water supply in dry season declines drastically in many rural areas. There is no adequate water procedure or treatment plant before the waste water flow to natural water source which is causing water pollution. For quantity, surplus water flow in rainy season but shortage water flow in dry season. For quality, acidity water appear

in acid sulfate soil areas in the Mekong delta of Vietnam, salty water excess to inland when high tide in dry season, polluted water from such sources of agriculture, aquaculture, industry, services, domestic, etc.

- Still good quantity.

LAOS

- Lao PDR has rich water resources, mainly good quality fresh water. Water is an essential part of the life and culture of Lao people, and also contributes to the socio-economic development goals of the country. Ultimately the welfare of Lao PDR is bound up with water and all development plans will depend on water resources in some way. The contribution of the water sector has been examined through water sub-sectors: Irrigation, Hydro-power, Navigation, Fisheries, Urban Water Supply, and Rural Water Supply which are major users and the amount of water uses by these sub-sectors are being significantly increased. The total of annual water flow in Lao PDR is estimated at 270 billion cubic meters, equivalent to 35% of the average annual flow of the whole Mekong Basin. The monthly distribution of the flow of the rivers in Lao PDR closely follows the pattern of rainfall: about 80% during the rainy season (May-October) and 20% in the dry season, from November to April. For some rivers in the central and southern parts of the country (particularly Se Bang Fai, Se Bang Hieng and Se Done) the flow in the dry season is less: around 10 to 15% of the annual flow. The rivers outside the Mekong Basin flow through Viet Nam into the South China Sea. These rivers are Nam Ma, Nam Sam, and Nam Neune. The limited information on these rivers restricts assessment of their potential. Average annual rainfall ranges from 1,300 mm per year in the northern valleys 3,700mm per year at higher elevations in the South. This corresponds to an annual rainfall of 434 billion m^3, of which less than half is estimated to be runoff. The Mekong tributaries in Lao PDR contribute some 35% of the whole lower Mekong Basin; annual national supply of renewable fresh water is 270 billion m^3, or about 600,000 m^3 per person, while current demand is only 259m^3/person. Water usage is predominantly agricultural 82%, followed by industrial 10%, and domestic 8%. Usages of other sectors are negligible. There is available water of 270 Billion cubic meters and 5.7 billion has been used and the remaining amount of 264.3 Billion cubic meters' flows in the natural rivers. (Heston, A., Summers, R and Aten, B. (2011) In Lao PDR consist one main river is Mekong river and its tributaries about 39 main tributaries in the Mekong River basin. Besides the main river we still have two rivers located in the northern part of Lao PDR. Generally, the water quality of rivers within our country is still good, based on international standards.

- Laos has access to abundant water resources as there are many rivers draining into the Mekong river basin. However, there are a large number of hydropower dam projects in process, and monsoon rainfall patterns are becoming unpredictable with climate change, affecting river flow. Pollution from untreated urban waste water and farm chemical

runoff are causing water quality to become worse.

CAMBODIA

- The situation of water resource management in Cambodia is fairly good both quantitively and qualitatively. Upstream development in the Mekong basin in combination with climate change has driven certain recurrent flood and drought, affecting agricultural production and Tonle Sap great lake's floodplains linked to affect biodiversity in the wetland. Meanwhile, a significant sign of water quality degradation has been observed as well due to agricultural intensification, industry and urbanization. Accordingly, water waster management is also an important issue in the major cities, where many sewage systems flow directly to freshwater systems with primary treatment.
- Cambodia has plenty of water resources. However, the huge difference of its availability at different seasons requires proper water resources management. Also, the status of water quality at most areas is unknown.
- Cambodia have many big rivers which are the main source of fresh water. However, quantity and quality are challenging during the dry season.

2. What are the main current water challenges in your country?

VIETNAM

- Polluted water from industry sector.
- Flooding and sanitation.
- Untreated wastewater.
- Pollution.
- Management of waste water from industrial zones, especially waste water from craft villages; there are also challenges in water resources management as there are pollution sources from mine industry, agriculture.

LAOS

- Water resources management planning depends on the position of the Lao PDR and is not yet integrated as much as it should be, despite the establishment of the Water Resources and Environment Organization. - Implementing policies related to water. - Resources into legislation is still possible. - The division of responsibilities in the organization . - Complexities in water resources development and management. - Legal and regulatory bends do not yet reflect organizational changes.
- The main current water challenges in Laos are how to benefit from hydropower development without destroying river functions across the country. Too many dams are being built too quickly and there will be serious impacts for the whole population. The country also needs to control farm chemical use and build more urban waste water treatment plants, and store more water in the rainy season for farmers to use.

- Water management and wastewater treatment.

CAMBODIA

- Water resource management for sufficient water availability for users/farmers is the main challenge in Cambodia. Water quality would be the next challenge.
- Water governance (quantity and quality), Water quality management; Waste water treatment.
- To improve water resources management, it requires clear and proper coordination mechanism which needs to be improved. Limited knowledge among local community and authority about water quality and water resource management.

3. **What are the main current water challenges at local scale*?** Only fill if your local area is facing specific water challenges (*We understand as a local scale the closest territorial area of the institution).

- At local scale farmers have difficulty to manage variable rainfall every year for rain fed crops, and also need advice about how to use chemical inputs. Villages near rivers are gradually growing in population and number and this is starting to increase waste water in rivers. Farmers are gradually increasing groundwater use which can eventually lower the water table
- The division of responsibilities in the village-level organization. - There is complexity in the policy and structure of water resources. - Lack of participatory mechanisms of organizations and the private sector, society and other stakeholders in water resources development and management.
- The level of understanding on the context of water quality, availability and management is limited. Relevant policies need to be promoted. Shortage of water in dry season and flooding in rainy season. Community does not have knowledge on water quality.
- Waste water from households in the capital release to the drainage canal resulted to the drainage canal deteriorate.
- Water resources for the production of drinking water, waste water management.
- Lack of clean water during dry season in the rural community.
- Polluted water from industry sector and domestic use.
- Waste water treatment and water quality monitoring.
- Poor water quality (in Hanoi city).
- River basin management.

4. What are the strengths (if any) in water management in your country?

VIETNAM

- There are a lot of government departments and staff working on water resources and these also receive international support including from the Mekong River Commission and international donors. However, they still need to be supported more to manage water resources more sustainably and to slow down the rate of damming to be able to conserve some natural rivers in the country.
- Government issued laws and regulations on water management, active private section working on water management.
- Environmental protection laws and a system of environmental agencies are available.
- Good & Clear laws.

LAOS

- There is a responsible unit Such as: 1. Institutional framework of water governance in Lao PDR 2. Ministry of Natural Resource and Environment 3. Department of Water Resources - There are many freshwater resources that are groundwater and groundwater. - Adequate water resources available to different sectors
- Environmental education/hygiene education promotion plan.

CAMBODIA

- Comprehensive policy and regulations on water resource management. Numbers of agencies and sub-agencies have roles related to water resource management with complement mandates.
- Existing water management institutions and policies are the key strengths. Cambodia has plenty source of water.
- We have many big rivers across in almost every province of the country.

5. What are the most water demanding sectors in your country? (two or three sectors are enough)

VIETNAM

- In the agricultural sector such as irrigation, fisheries, plantations and livestock watering. In addition, the water is used for hydro-power in the tourism.
- Both agri-aquaculture and industry.
- Agriculture; Aquaculture.
- Water demand for agriculture, inhabitants, industry.

LAOS

- Agriculture.
- In the agricultural sector such as irrigation, fisheries, plantations and livestock watering.

In addition, the water is used for hydro-power in the tourism.

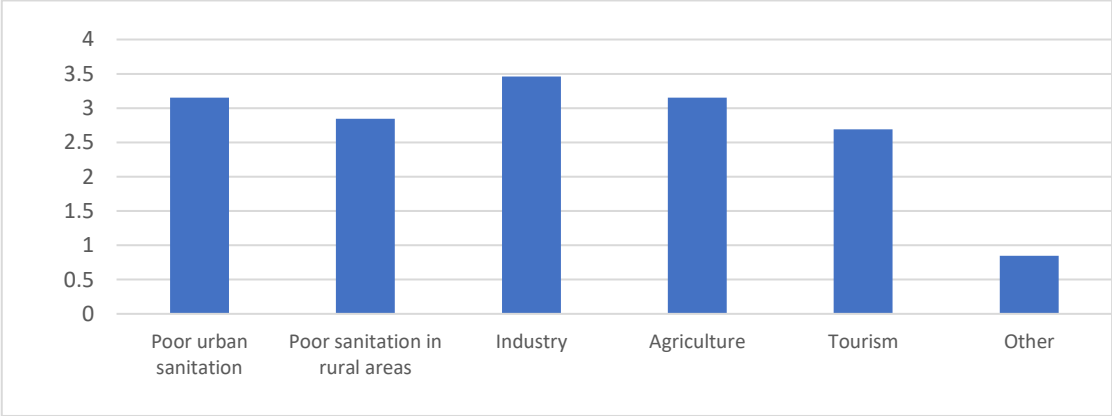
- Hydro power, fisheries, irrigation, navigation, urban and rural water supplies.

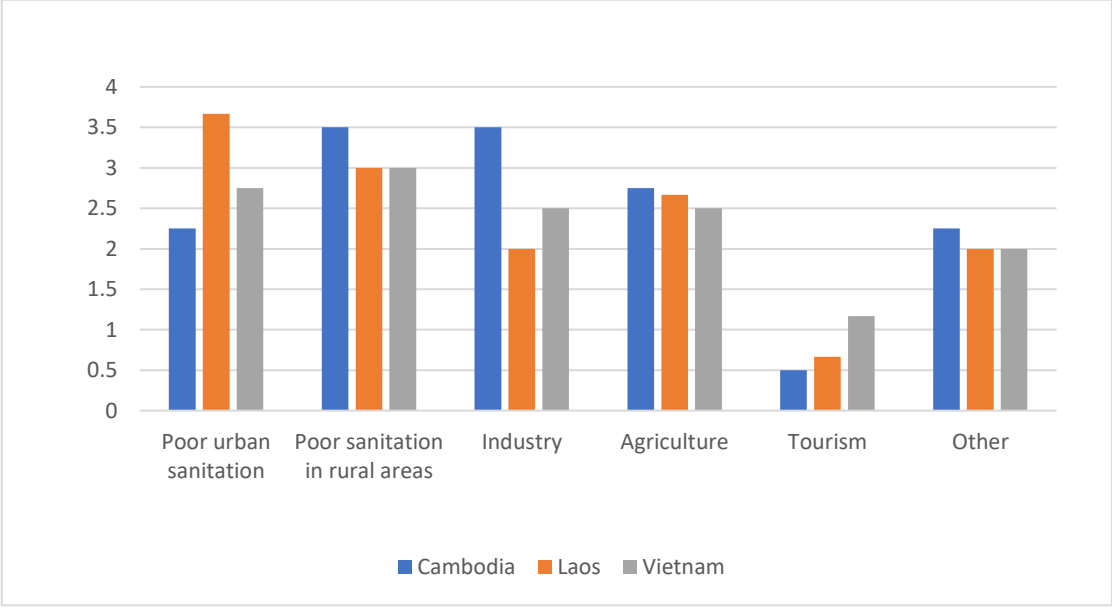
CAMBODIA

- 1. Irrigation farming 2. SME manufacturing 3. Urban consumption
- Agriculture, industry and tourism.
- Agriculture, fisheries, energy, urban water supply.

6. What are the causes of water pollution in your country? Rate from 0 (low) to 4 (high):

Causes of water pollution	**0**	**1**	**2**	**3**	**4**
Poor urban sanitation					
Poor sanitation in rural areas					
Industry					
Agriculture					
Tourism					
Others (specify)					





7. **Future: what are the main factors that can affect the water resource's state in your country in the mid-long term (10-20 years prediction)?** (e.g. climate change, demography, urban growth, energy transition, governance issues, ecological and landscape changes, tourism development, industry development, agriculture growth/recession, …)

VIETNAM

- Domestic, industrial and agricultural wastewater
- Salinity intrusion in the Mekong Delta.
- Industry development and urban growth.
- Climate Change; Dams from the upstream; Agriculture growth.
- Climate change, industry development, urban growth, demography, aquaculture growth.
- Urban growth, governance issues, industry development, agriculture growth.

LAOS

- There are some problems related to waste and polluted water in major urban areas from varied community use (residential density, hotels, hospitals and entertainments centers). In addition there is water pollution from agricultural and industrial sectors, including mineral exploitation. the problem could escalate. The degradation of natural water and water catchments from sedimentation, land erosion and drying out continues.
- Climate change, agriculture growth, economic growth, land use change.
- Climate change, urban growth, ecological and land scape change, agriculture growth, industry and tourist development.

CAMBODIA

- Governance issues, climate change, industry development, agriculture.
- Agriculture growth, Urban growth, Governance issues, climate change.
- Climate change and miss-management approach.
- Industrialization, urbanization and agricultural intensification.

Main questionnaire outputs on water challenges in Cambodia, Laos and Vietnam

Key water strengths, weakness and challenges

Common in all countries:

- rich water resources
- high access to potable water
- water quality problems specially near big cities, and growing with time
- poor sanitation (other than basic sanitation)
- governance issues, policy complexities
- high water demand for agriculture
- agricultural and industrial pollution
- flooding and climate change

Specific:

Cambodia	Laos	Vietnam
• Management problems of the existing WWTP • Agriculture: high water demand and pollution from agricultural intensification • Water governance • Financial issues	• Water governance • Limited financial support • Floods -monsoons -climate change • How to benefit from hydropower development with minimum impacts • Main source pollution: agriculture and urban wastewater (mainly capital)	• Problems of pollution: industry, agriculture, urban wastewater, tourism • Transboundary/coastal waters

Figure 3. Specific water challenges

Main factors that can affect the water resource's state in the mid-long term (10-20 years prediction)

- urban growth
- climate change
- industry development
- agricultural intensification

Identification of PC HEIs expertise

Methodology

A word questionnaire has been elaborated by WP1 Leaders (FSUB and NUBB); and sent to all PC HEIs partners.

Objectives:

- To gather information about INOWASIA EU partner's expertise and available material for teaching and modules elaboration

Target audiences:

- PC HEI partners

Goal:

- 1 reply per partner

Questionnaire

1. **MODULES TOPICS.** In the INOWASIA proposal we have defined specific water modules topics for the INOWASIA formation programs: Basic modules intended as basic online courses and advanced modules intended as Problem Based Learning Courses. **Please add any other module topic you find is really important and missing in others*.**

Water modules
Basic Modules
Water quality
Water and wastewater treatment technologies
Water microbiology
Water management and recycling in small and large water companies
Water monitoring and control
Natural services related to water regulation and provision
Others:*
Advanced modules
Alternative water resources
Management tools-ITCs for water management
General concepts on water sustainable management
Nature based solutions for water management and resilience
Eco-hydrology and ecological engineering
Soil and water dynamics
Water and tourism management
Innovative technologies and new trends on sanitation
Circular economy in the context of water

Water governance and socio-economic aspects in the water field
Water economy and entrepreneurship
Sustainable Water management in agriculture: rural and urban areas
Ecological engineering and water management
Ecosystems services and benefits to people valuation and payment for ecosystem services
Water and smart cities: sustainable water management and smart cities
Others:*

Please feel free to add any comments in regards to the modules topics

2. **MODULES EXPERTISE.** Please mark with a cross (X) in which courses your HEI has expertise and could participate in the module contents elaboration or training and the expertise rank level. Add the name of the experts if possible.

Water modules	**Mark with a cross (X)**	**Expertise level** (0-10) 0:low-10:high	**Expert name/s**
Basic Modules			
Water quality			
Water quality			
Water and wastewater treatment technologies			
Water and wastewater treatment technologies			
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control			
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience”			
Eco-hydrology and ecological engineering			

Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			

Please feel free to add any comments in regards to the modules expertise

3. **MODULES MATERIAL. Please mark with a cross (X) in which courses your HEI has some available material that could be useful for the module contents elaboration or training.** In case you have some available material that can be used for INOWASIA specify in which format (eg. Word, Pdf, Pptx., Online, Video...) and language.

Water modules	**Mark with a cross (X)**	**Format**	**Language**
Basic Modules			
Water quality			
Water and wastewater treatment technologies			
Water and wastewater treatment technologies			
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control			
Natural services related to water regulation and provision			
Others:			
Advanced modules			

Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience”			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others			

Please feel free to add any comments in regards to the modules material (eg. copyright/intellectual property issues,…)

Questionnaire results

NUOL

1. **MODULES TOPICS.** In the INOWASIA proposal we have defined specific water modules topics for the INOWASIA formation programs: Basic modules intended as basic online courses and advanced modules intended as Problem Based Learning Courses. **Please add any other module topic you find is really important and missing in others*.**

Water modules
Basic Modules
Water quality
Water and wastewater treatment technologies
Water microbiology
Water management and recycling in small and large water companies
Water monitoring and control
Natural services related to water regulation and provision
Others:*
Advanced modules
Alternative water resources
Management tools-ITCs for water management
General concepts on water sustainable management
Nature based solutions for water management and resilience
Eco-hydrology and ecological engineering
Soil and water dynamics
Water and tourism management
Innovative technologies and new trends on sanitation
Circular economy in the context of water
Water governance and socio-economic aspects in the water field
Water economy and entrepreneurship
Sustainable Water management in agriculture: rural and urban areas
Ecological engineering and water management
Ecosystems services and benefits to people valuation and payment for ecosystem services
Water and smart cities: sustainable water management and smart cities
Others:*

Please feel free to add any comments in regards to the modules topics

Both basic and advanced module topics are great.
However, it would be better if there should be seminars for both modules. In the seminars, the relevant stakeholders from various sectors in water-related aspects are invited to give lectures on their experiences, current and future perspectives. This will link between macro-sides (academic) and sector-sides (economic).

2. **MODULES EXPERTISE.** Please mark with a cross (X) in which courses your HEI has expertise and could participate in the module contents elaboration or training and the expertise rank level. Add the name of the experts if possible.

Water modules	**Mark with a cross (X)**	**Expertise level** (0-10) 0: low-10: high	**Expert name/s**
Basic Modules			
Water quality	X	5	Dr. Santi Kongmany Dr. Vanseng Chounlamany Dr. Davone Keomany
Water and wastewater treatment technologies	X	5	Dr. Santi Kongmany Dr. Vanseng Chounlamany Dr. Davone Keomany
Water microbiology	X	5	Dr. Chanda Vongsombath Ms. Oulay Phoupasong
Water management and recycling in small and large water companies			
Water monitoring and control	X	5	Dr. Santi Kongmany Dr. Vanseng Chounlamany Dr. Davone Keomany
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience"			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and			

entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			

Please feel free to add any comments in regards to the modules expertise

3. **MODULES MATERIAL. Please mark with a cross (X) in which courses your HEI has some available material that could be useful for the module contents elaboration or training.** In case you have some available material that can be used for INOWASIA specify in which format (e.g., Word, Pdf, Pptx., Online, Video...) and language.

Water modules	Mark with a cross (X)	Format	Language
Basic Modules			
Water quality	X		Lao
Water and wastewater treatment technologies	X		Lao
Water microbiology	X		Lao
Water management and recycling in small and large water companies			
Water monitoring and control			
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience"			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			

Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			

Please feel free to add any comments in regards to the modules material (eg. copyright/intellectual property issues, …)

SU

1. **MODULES TOPICS.** In the INOWASIA proposal we have defined specific water modules topics for the INOWASIA formation programs: Basic modules intended as basic online courses and advanced modules intended as Problem Based Learning Courses. **Please add any other module topic you find is really important and missing in others*.**

Water modules
Basic Modules
Water quality
Water and waste water treatment technologies
Water microbiology
Water management and recycling in small and large water companies
Water monitoring and control
Natural services related to water regulation and provision
Others:* *Water shed management*
Advanced modules
Alternative water resources
Management tools-ITCs for water management
General concepts on water sustainable management
Nature based solutions for water management and resilience
Eco-hydrology and ecological engineering

Soil and water dynamics
Water and tourism management
Innovative technologies and new trends on sanitation
Circular economy in the context of water
Water governance and socio-economic aspects in the water field
Water economy and entrepreneurship
Sustainable Water management in agriculture: rural and urban areas
Ecological engineering and water management
Ecosystems services and benefits to people valuation and payment for ecosystem services
Water and smart cities: sustainable water management and smart cities
Others:* 1. Soil and water resource management 2.Waste water analysis 3. Groundwater analysis 4.Waterlogging analysis

Please feel free to add any comments in regards to the modules topics

All modules topics are important but new added subject is a course related and will be involved in laboratory development of the project

2. **MODULES EXPERTISE.** Please mark with a cross (X) in which courses your HEI has expertise and could participate in the module contents elaboration or training and the expertise rank level. Add the name of the experts if possible.

Water modules	**Mark with a cross (X)**	**Expertise level** (0-10) 0:low-10:high	**Expert name/s**
Basic Modules			
Water quality	X		
Water and wastewater treatment technologies	X		
Water microbiology			
Water management and recycling in small and large water companies	X		
Water monitoring and control	X		
Natural services related to water regulation and provision			
Others: *Water shed management*	X		

Advanced modules			
Alternative water resources	X		
Management tools-ITCs for water management	X		
General concepts on water sustainable management	X		
Nature based solutions for water management and resilience"	X		
Eco-hydrology and ecological engineering	X		
Soil and water dynamics			
Water and tourism management	X		
Innovative technologies and new trends on sanitation			
Circular economy in the context of water	X		
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship	X		
Sustainable Water management in agriculture: rural and urban areas	X		
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities	X		
Others: 1.Waste water analysis 2. Groundwater analysis 3. Waterlogging analysis	X		

Please feel free to add any comments in regards to the modules expertise

Modules expertise is a very important topic in the development of personnel and equipment related to water education. Related to hydro-power industry, development of dams along Mekong River, dam construction on tributaries and water have been conducted in various levels in the northern Laos. Water plays very important role for people and their livelihood since it is a food source and transportation along the rivers. Modules related to water and related managements will support sustainable management, lowering the risk in water utilization, protecting water resource and supporting to get rid of long term crisis.

3. **MODULES MATERIAL. Please mark with a cross (X) in which courses your HEI has some available material that could be useful for the module contents elaboration or training.** In case you have some available material that can be used for INOWASIA specify in which format (eg. Word, Pdf, Pptx., Online, Video...) and language.

Water modules	Mark with a cross (X)	Format	Language
Basic Modules			
Water quality	**X**	Pdf	Lao Language
Water and wastewater treatment technologies			
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control			
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience"			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			

Others:			

Please feel free to add any comments in regards to the modules material (eg. copyright/intellectual property issues,…)

In term of water laboratory (previously for bachelor degree), lack of specific equipment's and tools existed is considered in our institution. In the faculty of Agriculture and Forest Resource, there are particular 4 departments consisted. Water related subject is dependently included in some departments. However, researchers show their interests in water and management system, developing water research and management, developing Laboratories and expert/specialists.

For the development of graduate course, we need to develop and involve more the lab materials.

NUBB

1. **MODULES TOPICS.** In the INOWASIA proposal we have defined specific water modules topics for the INOWASIA formation programs: Basic modules intended as basic online courses and advanced modules intended as Problem Based Learning Courses. **Please add any other module topic you find is really important and missing in others*.**

Water modules
Basic Modules
Water quality
Water and wastewater treatment technologies
Water microbiology
Water management and recycling in small and large water companies
Water monitoring and control
Natural services related to water regulation and provision
Others:*
Advanced modules
Alternative water resources
Management tools-ITCs for water management
General concepts on water sustainable management
Nature based solutions for water management and resilience
Eco-hydrology and ecological engineering
Soil and water dynamics
Water and tourism management
Innovative technologies and new trends on sanitation
Circular economy in the context of water
Water governance and socio-economic aspects in the water field
Water economy and entrepreneurship

Sustainable Water management in agriculture: rural and urban areas
Ecological engineering and water management
Ecosystems services and benefits to people valuation and payment for ecosystem services
Water and smart cities: sustainable water management and smart cities
Others:*

Please feel free to add any comments in regards to the modules topics

Machine learning/decision support system (DSS) can be useful module for water resource management and planning.

2. **MODULES EXPERTISE.** Please mark with a cross (X) in which courses your HEI has expertise and could participate in the module contents elaboration or training and the expertise rank level. Add the name of the experts if possible.

Water modules	**Mark with a cross (X)**	**Expertise level** (0-10) 0:low-10:high	**Expert name/s**
Basic Modules			
Water quality	X	7	Dr Ratha Chea Mr Socheat Chrea Dr. Loïc Tudesque Dr. Ratha Sor
Water and wastewater treatment technologies			
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control	X	7	Dr Ratha Chea Mr Socheat Chrea Dr. Loïc Tudesque Dr. Ratha Sor
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			

Nature based solutions for water management and resilience"			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			

Please feel free to add any comments in regards to the modules expertise

Our research team has experience and expertise on monitoring and assessing surface water quality based physico-chemical properties of water. Besides, we have been working on biomonitoring of river ecosystem using benthic diatom (algae) as bio-indicator for water quality assessment or river ecological health assessment.

3. **MODULES MATERIAL. Please mark with a cross (X) in which courses your HEI has some available material that could be useful for the module contents elaboration or training.** In case you have some available material that can be used for INOWASIA specify in which format (eg. Word, Pdf, Pptx., Online, Video...) and language.

Water modules	Mark with a cross (X)	Format	Language
Basic Modules			
Water quality	X	Lecture (PPT) on biomonitoring, catalog of algae specifically for Tonle Sap; publications	English

Water and wastewater treatment technologies			
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control			
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience"			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			

Please feel free to add any comments in regards to the modules material (eg. copyright/intellectual property issues,…)

ITC

1. **MODULES TOPICS.** In the INOWASIA proposal we have defined specific water modules topics for the INOWASIA formation programs: Basic modules intended as basic online courses and advanced modules intended as Problem Based Learning Courses. **Please add any other module topic you find is really important and missing in others*.**

Water modules
Basic Modules
Water quality
Water and wastewater treatment technologies
Water microbiology
Water management and recycling in small and large water companies
Water monitoring and control
Natural services related to water regulation and provision
Others:* *Watershed hydrology*
Advanced modules
Alternative water resources
Management tools-ITCs for water management
General concepts on water sustainable management
Nature based solutions for water management and resilience
Eco-hydrology and ecological engineering
Soil and water dynamics
Water and tourism management
Innovative technologies and new trends on sanitation
Circular economy in the context of water
Water governance and socio-economic aspects in the water field
Water economy and entrepreneurship
Sustainable Water management in agriculture: rural and urban areas
Ecological engineering and water management
Ecosystems services and benefits to people valuation and payment for ecosystem services
Water and smart cities: sustainable water management and smart cities
Others:* - *Dissension support system for water resources management* - *Low impact development* - *Resource Recovery and Reuse (RRR) Business Options in the Sanitation Sector*

Please feel free to add any comments in regards to the modules topics

- We are not sure for the module topic "Management tools-ITCs for water management". Is it about supporting tools such as GIS, Modelling, remote sensing?
- "Circular economy in the context of water" should add "environment"
- Entrepreneurship Development in Integrated Water Resource Management is also interesting soft-skill building up for student, we believe that "Water economy and entrepreneurship" has the same purpose.

2. **MODULES EXPERTISE.** Please mark with a cross (X) in which courses your HEI has expertise and could participate in the module contents elaboration or training and the expertise rank level. Add the name of the experts if possible.

Water modules	**Mark with a cross (X)**	**Expertise level** (0-10) 0:low-10:high	**Expert name/s**
Basic Modules			
Water quality	**X**	7	Dr. EANG Khyeam
Water and wastewater treatment technologies	**X**	6	Dr. BUN Saret
Water microbiology	**X**	6	Dr. CHAN Rathborey
Water management and recycling in small and large water companies			
Water monitoring and control	**X**	6	Dr. EANG Khyeam
Natural services related to water regulation and provision			
Others: *Watershed hydrology*	**X**	7	Dr. CHHUON Kong
Advanced modules			
Alternative water resources	**X**	6	Dr. PEN Sytharith
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience"	**X**	6	Dr. CHHIN Rattana
Eco-hydrology and ecological engineering			

Soil and water dynamics	**X**	7	Dr. KET Pinnara
Water and tourism management			
Innovative technologies and new trends on sanitation	**X**	5	Dr. BUN Saret
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others: - *Dissension support system for water resources management* - *Low impact development* - *Resource Recovery and Reuse (RRR) Business Options in the Sanitation Sector*			

Please feel free to add any comments in regards to the modules expertise

The advance modules which are added in Other, such as Low impact development, RRR is really important for encouraging the learner to start new business in water and sanitation sector. But this module, ITC has no expertise.

3. **MODULES MATERIAL. Please mark with a cross (X) in which courses your HEI has some available material that could be useful for the module contents elaboration or training.** In case you have some available material that can be used for INOWASIA specify in which format (eg. Word, Pdf, Pptx., Online, Video...) and language.

Water modules	**Mark with a cross (X)**	**Format**	**Language**
Basic Modules			
Water quality	**X**	PPTX	English
Water and wastewater treatment	**X**	PPTX	English

technologies			
Water microbiology	**X**	PPTX	English
Water management and recycling in small and large water companies			
Water monitoring and control	**X**	PPTX	English
Natural services related to water regulation and provision			
Others: *Watershed Hydrology*	**X**	PPTX and modelling	English
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience"			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			

Please feel free to add any comments in regards to the modules material (eg. copyright/intellectual property issues,…)

Under faculty of hydrology and water resources engineering, there are several lecturers who can teach on some module topic which are similar to our existing courses. However, for the material, our lecturer has only for existing course. The basic module seems to be fine for our lecturer since most of them has taught in similar to this module. Particularly, the advance module will be limited capacity to take care by our lecturer in the regional context. For the new topic in Inow Asia module, they don't have material support to the specific topic. I think, they will be good to join project co-lecturer on any selection module

which fit too all need. Join lecturer between EU and ASEAN would be recommended.

HUS-VNU

1. **MODULES TOPICS.** In the INOWASIA proposal we have defined specific water modules topics for the INOWASIA formation programs: Basic modules intended as basic online courses and advanced modules intended as Problem Based Learning Courses. **Please add any other module topic you find is really important and missing in others*.**

Water modules
Basic Modules
Water quality
Water and wastewater treatment technologies
Water microbiology
Water management and recycling in small and large water companies
Water monitoring and control
Natural services related to water regulation and provision
Others:* *Economical and social aspect of waste water treatment and reuse*
Advanced modules
Alternative water resources
Management tools-ITCs for water management
General concepts on water sustainable management
Nature based solutions for water management and resilience
Eco-hydrology and ecological engineering
Soil and water dynamics
Water and tourism management
Innovative technologies and new trends on sanitation
Circular economy in the context of water
Water governance and socio-economic aspects in the water field
Water economy and entrepreneurship
Sustainable Water management in agriculture: rural and urban areas
Ecological engineering and water management
Ecosystems services and benefits to people valuation and payment for ecosystem services
Water and smart cities: sustainable water management and smart cities
Others:* Waste water treatment system design

Please feel free to add any comments in regards to the modules topics

2. **MODULES EXPERTISE.** Please mark with a cross (X) in which courses your HEI has expertise and could participate in the module contents elaboration or training and the expertise rank level. Add the name of the experts if possible.

Water modules	**Mark with a cross (X)**	**Expertise level** (0-10) 0:low-10:high	**Expert name/s**
Basic Modules			
Water quality	x	9	Prof. NGUYEN Minh Phuong
Water and wastewater treatment technologies	x	9	Prof. TRAN Dinh Trinh
Water microbiology	x	7	Dr. DANG Nhat Minh
Water management and recycling in small and large water companies	x	6	Dr. HA Minh Ngoc
Water monitoring and control	x	8	Prof. TRAN Dinh Trinh Dr. PHAM Thanh Dong
Natural services related to water regulation and provision			
Others			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management	x	7	Prof. DO Quang Trung
Nature based solutions for water management and resilience"	x	7	Prof. NGUYEN Van Noi
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation	x	7	Prof. DO Quang Trung
Circular economy in the			

context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas	x	6	Dr. NGUYEN Minh Viet
Ecological engineering and water management	x	5	Dr. Phuong Thao
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities	x		Dr. NGUYEN Minh Viet Prof. TRAN Dinh Trinh
Others:			

Please feel free to add any comments in regards to the modules expertise

3. **MODULES MATERIAL. Please mark with a cross (X) in which courses your HEI has some available material that could be useful for the module contents elaboration or training.** In case you have some available material that can be used for INOWASIA specify in which format (eg. Word, Pdf, Pptx., Online, Video...) and language.

Water modules	**Mark with a cross (X)**	**Format**	**Language**
Basic Modules			
Water quality	x	word	Vietnamese
Water and wastewater treatment technologies	x	word	Vietnamese
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control	x	word	Vietnamese
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water			

management			
General concepts on water sustainable management			
Nature based solutions for water management and resilience"			
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable Water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			

Please feel free to add any comments in regards to the modules material (eg. copyright/intellectual property issues,…)

CTU

1. **MODULES TOPICS.** In the INOWASIA proposal we have defined specific water modules topics for the INOWASIA formation programs: Basic modules intended as Basic online courses and Advanced modules intended as Problem Based Learning Courses. **Please add any other module topic you find is really important and missing in others*.**

Water modules
Basic Modules
Water quality
Water and wastewater treatment technologies
Water microbiology
Water management and recycling in small and large water companies
Water monitoring and control
Natural services related to water regulation and provision
Others:*

Advanced modules
Alternative water resources
Management tools-ITCs for water management
General concepts on water sustainable management
Nature based solutions for water management and resilience
Eco-hydrology and ecological engineering
Soil and water dynamics
Water and tourism management
Innovative technologies and new trends on sanitation
Circular economy in the context of water
Water governance and socio-economic aspects in the water field
Water economy and entrepreneurship
Sustainable Water management in agriculture: rural and urban areas
Ecological engineering and water management
Ecosystems services and benefits to people valuation and payment for ecosystem services
Water and smart cities: sustainable water management and smart cities
Others:*
Impacts of hydraulic construction works to the environment
Adaptive water supply resource planning
Urban water network design
Hydrological Modeling
Transboundary Water Governance

Please feel free to add any comments in regards to the modules topics

2. **MODULES EXPERTISE.** Please mark with a cross (X) in which courses your HEI has expertise and could participate in the module contents elaboration or training and the expertise rank level. Add the name of the experts if possible.

Water modules	**Mark with a cross (X)**	**Expertise level** (0 - 10) 0: low, 10: high	**Expert name/s**
Basic Modules			
Water quality			
Water and wastewater treatment technologies	X	6 7	Dr. Ngo Thuy Diem Trang Dr. Kim Lavane
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control	X	8 7	Dr. Nguyen Van Cong Dr. Tran Sy Nam
Natural services related to water regulation			

and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools-ITCs for water management			
General concepts on water sustainable management	X	6	Dr. Nguyen Dinh Giang Nam
Nature based solutions for water management and resilience	X	6	Dr. Ngo Thuy Diem Trang
Eco-hydrology and ecological engineering			
Soil and water dynamics	X	6	Dr. Do Thi My Phuong
Water and tourism management	X	6	Dr. Huynh Van Da
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			
Impacts of hydraulic construction works to the environment	X	7	Dr. Nguyen Xuan Hoang
Adaptive water supply resource planning	X	5	Dr. Dinh Diep Anh Tuan
Urban water network design	X	6	Dr. Dinh Diep Anh Tuan
Hydrological Modeling	X	7 6	Dr. Tran Van Ty Dr. Huynh Vuong Thu Minh

Please feel free to add any comments in regards to the modules expertise

3. **MODULES MATERIAL. Please mark with a cross (X) in which courses your HEI has some available material that could be useful for the module contents elaboration or training.** In case you have some available material that can be used for INOWASIA specify in which format (eg. Word, Pdf, Pptx, Online, Video...) and language.

Water modules	Mark with a	Format	Language

	cross (X)		
Basic Modules			
Water quality			
Water and wastewater treatment technologies	X	Pdf, Ppt	Eng/Vie
Water microbiology			
Water management and recycling in small and large water companies			
Water monitoring and control	X	Pdf, Ppt	Vie
Natural services related to water regulation and provision			
Others:			
Advanced modules			
Alternative water resources			
Management tools - ITCs for water management			
General concepts on water sustainable management	X	Ppt	Eng/Vie
Nature based solutions for water management and resilience	X	Ppt	Eng/Vie
Eco-hydrology and ecological engineering			
Soil and water dynamics			
Water and tourism management			
Innovative technologies and new trends on sanitation			
Circular economy in the context of water			
Water governance and socio-economic aspects in the water field			
Water economy and entrepreneurship			
Sustainable water management in agriculture: rural and urban areas			
Ecological engineering and water management			
Ecosystems services and benefits to people valuation and payment for ecosystem services			
Water and smart cities: sustainable water management and smart cities			
Others:			
Impacts of hydraulic construction works to the environment	X	Ppt	Vie
Urban water network design	X	Ppt	Vie
Hydrological Modeling	X	Pdf, Ppt	Vie
Adaptive water supply resource planning		N/A	
Transboundary Water Governance		N/A	

Please feel free to add any comments in regards to the modules material (eg. copyright/ intellectual property issues…)

Main questionnaire outputs on PC HEIs expertise

Table 1. Summary: PC HEI's main water expertise

HUS-VNU	CTU	NUOL	SU	ITC	NUBB
Water and Wastewater treatment Technologies Water quality Water monitoring Nature based solutions for water management Eco. Engineering News material for water treatment	Nature based solutions for water management Water and Wastewater treatment Water monitoring Sustainable water management Soil and water dynamics Hydrological modelling	Water quality Water microbiology Water monitoring	Water monitoring Water-agriculture Sustainable water management	Water quality Water and WW treatment Water management and recycling in small and large water companies Water monitoring Watershed hydrology Low impact development Resource Recovery and Reuse (RRR) Business Options in Sanitation	Hydrology Soil-Water Marine coastal waters Water quality Water agriculture Water monitoring