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Palestine Technical University – Kadoorie (PTUK): Official Opening of Virtual Learning Labs within the Erasmus Wasec Funded Project

by Nawaf Abu-Khalaf &
Saed Khayat (PTUK)



Fig 1. Official opening of Virtual Learning Lab

Palestine Technical University – Kadoorie and Al-Quds University have officially inaugurated the water technology learning laboratories that are administered by Palestine Technical University – Kadoorie (PTUK) and funded by the European Union’s Erasmus programs.

The inauguration ceremony was attended by the Vice President for Academic Affairs, Prof. Saed Mallak, the Erasmus Programs Coordinator in Pal-

estine, Dr. Nidal Jayyousi, Wasec Project Coordinator, Prof. Saed Khayat, Palestine Technical University – Kadoorie (PTUK) staff in addition to a delegation from the Palestinian Water Authority, and the project’s partners from European universities: Greece, Amsterdam, Cyprus and Madrid.

Prof. Mallak welcomed the guests and thanked the Erasmus programs’ coordinator for the continuous support to the university announcing the launch of the first European and regional cooperative master in the water field, generously funded by the European Union through Erasmus.

Dr. Jayyousi praised the program’s outcomes as a unique step forward to exchange knowledgeable and technological expertise in the lively water sector, expressing pride in having this type of projects in the State University in Tulkarm as a first true academic experience, partnered between the Palestinian universities.

Prof. Khayat showed the project’s achievements including the academic VLP portal with its developed educational materials and the students’ unique experiences, from Jordan University of Science and Technology, in the program and the extent of their appreciation for the blended learning, and the evaluation and solution methodologies that depend on the presentation of water problems in an innovative manner.



Fig 2. Virtual Learning Lab



Fig 3. Discussion about the project’s achievements



Fig 4. Prof. Khayat presentation



WASEC PROJECT WORKSHOP: "INNOVATIONS IN WATER EDUCATION PROGRAMS IN THE EASTERN MEDITERRANEAN"

by Clara Cordón Trujillo, Jose Luis Garcia Rodriguez & Martin Gimenez (UPM)



WASEC PROJECT WORKSHOP: "INNOVATIONS IN WATER EDUCATION PROGRAMS IN THE EASTERN MEDITERRANEAN".

ETSI MONTES, FORESTAL Y MEDIO NATURAL

DECEMBER 13
9 a.m. to 1:00 p.m.
SALA DE GRADOS

SUPPORTED BY:

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Erasmus+ Programme
of the European Union



WASEC PROJECT

"INNOVATIONS IN WATER EDUCATION. ENHANCING WATER SECURITY AND SOCIO-ECONOMIC DEVELOPMENT IN THE EASTERN MEDITERRANEAN UNDER CLIMATE CHANGE"

This Project is about the know how to conserve and eliminate the waste of water while considering potential climate change impacts, to enhance water resources management plans new innovative tools and methods need to be used.

The main scope is to teach new technologies and methods to students that will incorporate them in water resources management plans and that eventually will be adopted in the water relevant organizations and businesses. Another major concerns are the many different services that water can offer.

Fig 1. The leaflet of the workshop

On December 13th, 2019, the WASEC PROJECT WORKSHOP was held in Madrid, Spain, at Universidad Politécnica de Madrid.

The workshop was attended by several speakers related to water management and water challenges in arid areas. The general public attended the workshop, as well as participants in the WASEC meeting.

More than 60 people attended the event that was introduced by José Luis García Rodríguez, who is the UPM project manager.

Fernando Magdaleno, from the Ministry for the Ecological Transition, spoke about the managing of extreme events in Spain (new paradigms and case studies). Miguel Marchamalo and Leonor Rodríguez, from UPM, spoke about "UPM Water": alliances for R&D in water management and engineering. Enrique Fernandez, from TRAGSA group, spoke about the integrated management and artificial recharge of aquifers in arid and semi-arid areas, and



Fig 2. Photos from the presentations

finally Natalia García Estévez and Carolina Ferrandis Pomés, both from ACCIONA, explained the reuse of treated wastewater in Palestinian territories.

The attendees to the workshop had the opportunity to network during the coffee break.

After the coffee break, Subhi Samhan, from PWA-Palestinian Water Authority spoke about the enhance and enactment of private sector in water research and challenges for public private participation, and finally José María González Ortega, from TRAGSA Group explained the issues about water and irrigation in Spain.

To conclude the workshop, a panel discussion was held, chaired by Prof. José Luis García Rodríguez (UPM), Dr. Saed Khayat (PTUK, and WASEC Project Coordinator), Dr. George Zaimes (IHU/EMaTTech), Prof. Fahmi Abu Al-Rub (JUST) and Prof. Amer Marei (AQU), where the experience of Jordanian and Palestinian in water innovation and research was exposed.



Water Education Curricula of Universities in Eastern Mediterranean

by Ahmed Al-Salaymeh
& Rasha Al-Baik (UJ)

One of the goals of the WaSec project was to review the current university curricula concerning water education. An emphasis was given on curricula in the Eastern Mediterranean, also focusing on current pedagogical techniques. To achieve this an online survey was designed to target the faculty members of different universities in Eastern Mediterranean and Europe to provide an overview on existing water curricula for bachelors, masters and doctoral programs from different disciplines. This would allow to determine the current water education in Eastern Mediterranean Universities and transfer new ideas for water education from European universities. Approximately 60 institutions from 32 countries participated with 92 responses (45 from EU, 47 from MENA) in the survey. Most of the participant responses (44%) were from Engineering faculties, followed by Science faculties (30%), Agriculture and Forestry faculties (23%) (see Figure 1). There were also limited participants (2%) from multi-disciplinary faculties (2%) and Graduate faculties (1%).

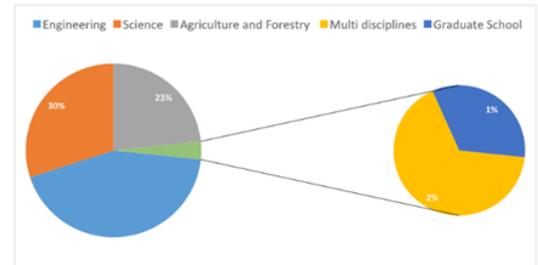


Figure 1: Participated Faculties in the Survey

In regard to the water programs/courses (Bachelors/Masters/Doctoral) offered in the Eastern Mediterranean the survey initially tried to identify if these had been developed through EU Projects. For Jordanian Universities, some water courses such as Climate Change and Water Recourses courses had been developed by EU funded projects. However, no water courses had been developed in the Palestinian universities through EU funded project. Another important aspect was if the water enterprises offer internships for students in these educational programs. In Jordan most of bachelor water programs offer internships with enterprises, while in Europe they include internships but a smaller degree, in Palestine there are no internships with water enterprises (Figure 2).

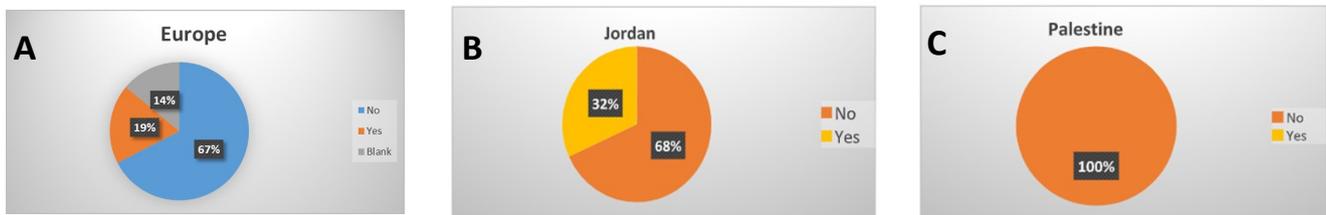


Figure 2a,b,c: Enterprise Internships offered to students in the Water Programs/Courses

Moving on to the subject matter of the programs, we will focus on courses that the participants highlighted that are missing currently from curricula in Jordan and Palestine. The courses with the highest percentage of not being covered in water related programs in Jordanian universities. were water/environment politics (41%) and water/environment laws (36%). In contrast in Palestinian universities, water/environment politics (67%) and water/environment laws (41%) were covered in most programs. At European Universities with water related programs, most covered water/environment politics (66%) although many didn't cover water/environment laws (30%). To see the results of the survey in regard to water/environment politics and water/environment laws, check figures 3 and 4, respectively.

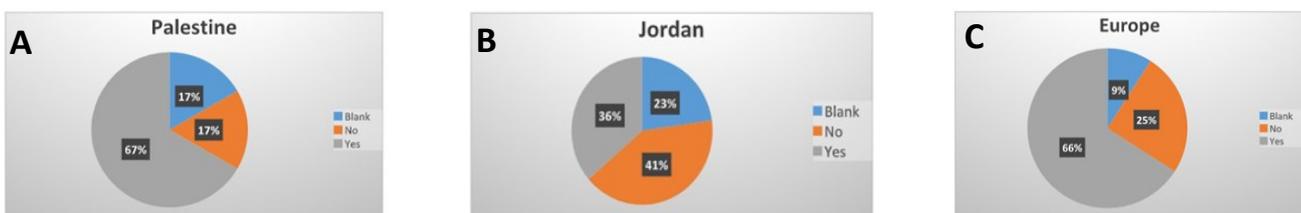


Figure 3a,b,c: Water/Environment Politics in Jordanian Palestinian and European Programs



Another important aspect of the survey was to highlight software programs that were currently used. In Jordanian universities, the most common are hydrologic models, statistical software (e.g., Matlab), graphical software (e.g., Simulink), and Geographical Information Systems (GIS). In Palestinian universities the most common programs were Geographical Information Systems (GIS), groundwater models, statistical software (e.g., Matlab), graphical software (e.g., Simulink), landfill programs (e.g., HELP), wastewater treatment plant simulation software (e.g., WWTP), and life cycle assessment software (e.g., SimaPro).

Looking into the laboratories and facilities at the Partner Universities in WaSec, the University of Jordan has GIS Lab, Water Lab, Soil Lab, Microbiology Lab, Fluid Mechanics, Hydraulics Lab, and Environmental Engineering Lab in its Agriculture and Engineering Schools. The Princess Sumaya University for Technology has a Hydraulics Lab and Environmental Engineering Lab. Finally, the Jordan University of Science and Technology has a processing Lab, and a Chemical Analysis of Water Lab. In Palestine, Al-Quds University has a Soil and Hydrology research lab, Water and Environment Lab, Radiation Research Lab and Aquaculture Lab while, the Palestine Technical University Kadoorie has an Agricultural Research Laboratory that deals with soil and water analysis.

The survey results also indicated that the vast majority of the participated universities (93.2%) have water related research in their departments in fields such as Water Resources Management, Environ-

mental Assessment, Water Treatment, Water Pollution Prevention, Wastewater Treatment, and Environmental Technology. Finally, several different topics were recommended to be included in a new master's program developed by WaSec for the region that included: Watershed Management, Water Quality, Water Harvesting, Water Ecology, Small River Ecology, Virtual Water, Urban Sanitation, Groundwater and Solid Waste Management. Overall, the survey revealed that while there are water programs in the Eastern Mediterranean countries, the development of a new master's or including new courses in already established master's program is necessary to help train the new generation of water managers to achieve sustainable water management in the region under the news condition due to climate change.

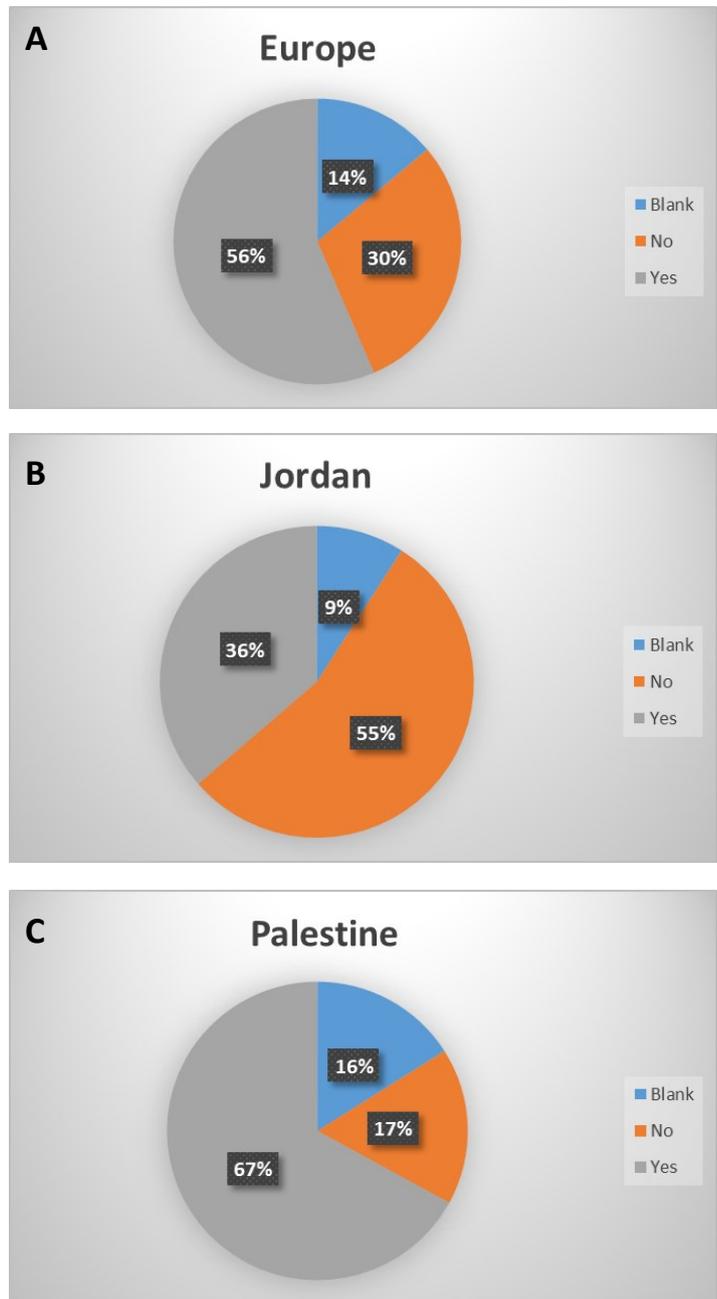


Figure 4a,b,c: Fundamental Knowledge in Water/Environment Law in Jordan, Palestine and Europe

Designing and building new courses based on pedagogical and learning methods

by Vassilis Litskas (OUC)

Courses' design: The Open University of Cyprus (OUC) with the support of the WaSec partners designed a new, complete, 2-year, 120 ECTS M.Sc/M.Eng. program on water resources management based on:

- A review of the existing EU programs and courses for Water, which examined MSc and MEng programs.
- A review of the existing EMME (East Mediterranean & Middle East) programs and courses for Water.
- The views, needs, and opportunities of the non-university stakeholders, i.e., the public and the private sector.
- International directives and recommendations (such as UNESCO's sustainability).
- The experience of the consortium partners and the feedback from the scientific committee of the project.
- Contributions solicited from Palestinian and Jordanian stakeholders not in the consortium.
- Learning design included goals (competencies), learning units and activities, learning and assessment material, and teaching approach.



Fig 1. The first page of the online educational platform

The tuning workshop: After designing the WaSec courses, the WaSec tuning workshop was implemented in order to coordinate the partners in a common way of creating the necessary teaching material. The tuning workshop was initially scheduled to be held in Open University of Cyprus facilities in Nicosia but was implemented on-line, due to the COVID-19 pandemic. Its main purpose was to introduce the participants in the teaching approach that it is followed in OUC.

Courses' building: The next step was the building of the courses in the OUC eclass and then transferred to the WASEC virtual learning platform (WASEC VLP). A total of nine different courses were developed. Moreover, from the material collected to build the MSc course, several types of courses could be developed, according to the partners and stakeholders needs for training/ education. Therefore, WaSec scope includes more than MSc degree program development focusing on educating people from Middle East and Europe on the topic of Climate Change and management of water resources. During the final year of the project, the courses will be piloted to students and stakeholders. Already, feedback from stakeholders regarding the courses is being collected to improve them.

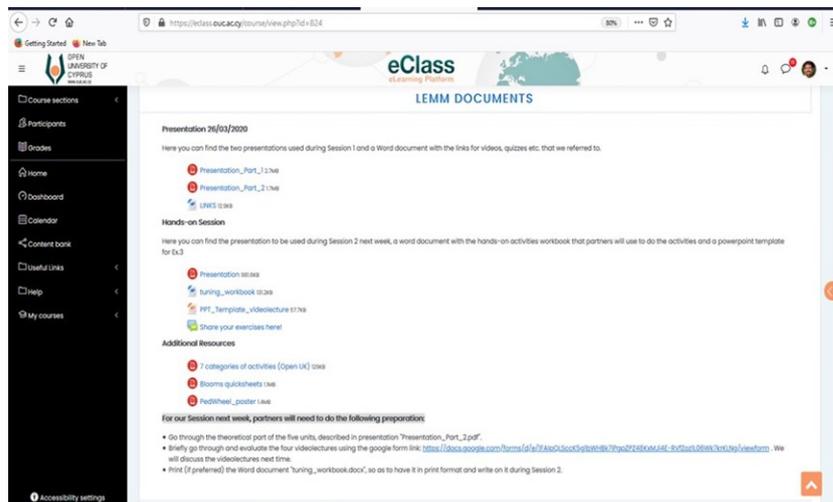


Fig 2. The eclass with the online courses for the virtual learning platform



**New MSc program and course for sustainable water management for the
 Eastern Mediterranean**

by **George N. Zaimes &
 Valasia Iakovoglou (IHU)**

Education can lead to the adoption and implementation of sustainable water management. This particularly true in water-scarce region e.g., Eastern Mediterranean. WaSec has developed new courses at the Master's level to train the future generation of water managers in the region that will have the knowledge and tools on the innovative approaches and technologies on the sustainable management of water resources and climate change mitigation / adaptation. The course will soon be offered by universities in Palestine and Jordan. A brief description of the nine courses follows:

WASEC512 - Water Quality: The Physical, chemical and biological dimensions of the water quality will be introduced. The implication of water quality will also be highlighted. Traditional water quality monitoring and assessment will be taught along with new innovative ones such as environmental isotopes applications.

WASEC513 - Water Energy Food Nexus: Will introduce to students to the fundamental concepts of the nexus approach and present an analysis for food production and distribution, water and energy management, focusing when possible, in arid and semi-arid areas. The course will contribute to decision making towards sustainable spatial planning by highlighting the tradeoffs among energy, water and land use. The course will also present an ecosystem services "point of view" in sustainable resources management.

WASEC521 - Water and wastewater treatment and Reuse: The students will be introduced to the various methods and processes used in the treatment of water and wastewater before human use. At the end of the semester, the students should be able to select the appropriate processes necessary to supply potable water or to treat wastewater system and illustrate the fundamentals of water and wastewater treatment.

WASEC522 - Climate change & water sustainability: Students will be able to differentiate between the climate change produced by natural phenomena and the human induced change in the climatic system. They will also become familiar to the climate change (CC) projections and relevant data generation that are used for the design of local and global policy related to CC mitigation and adaptation. In addition, they will be aware of the data requirements / limitation to assess climate change impacts in a country or local scale. Via selected case studies they will obtain knowledge on climate change and water quality and quantity aspects.

WASEC523 - Hydrology and Hydrogeology: A detailed study of water cycle is the core of this course, with special attention for semi-arid region. Numerical equations, and statistical methods will be presented for the calculation of precipitation, surface, near subsurface runoff, and infiltration. Special attention will be given for hydrological data mining, validation of data, and monitoring program. Student will be able to analyze input/output water sources within a catchment area. Student will also be introduced to different software.

WASEC611 - Integrated Water Resources Management: The goal of this course is to understand the importance of sustainable water management for the water security and socio-economic development of the region. This can only be achieved by understanding firstly the unique hydrologic conditions and semi-aquatic ecosystems of the region. Integrated water resources management, ecohydrological and ecosystem-based approaches and nature-based solutions will be taught. Proper management of riparian areas, wetlands and deltas will also be presented. Finally, new innovative methodologies (models and GIS) and technologies (UAVs) to promote sustainable water management will be learned.



WASEC612 -Water Policy and Governance -transboundary basin: The goal of this course is to highlight the interaction between hydrological and socio-economic factors in a transboundary river basin. Specifically, the course deepens the understanding of natural and controlled flows within a transboundary watershed with the objective of evaluating the impact of policy interventions on socio-economic conditions of households and on industry, with a special focus on agriculture as main water consumer. The course emphasizes the need for objective empirical water balances as starting point for policy analysis and introduces the use of water economy models for policy simulation.

WASEC621 - Entrepreneurship and Innovation in Water: Aims to provide students' knowledge on topics such as: a) the value chain of organizations related to water, b) design appropriate management strategies for the company, c) elaboration and management of business plans and studies of profitability of investments in water matters and d) market research processes related with water.

WASEC701A, B – Master Thesis I, II: The students will be taught the specifications and objectives, to satisfy the requirements of the postgraduate level of study in terms of (a) knowledge, (b) research methodology and (c) scientific writing skills. The Master's Thesis must also meet the criteria for publication set by scientific journals or be suitable for publication at an international or national conference proceedings.

Showcased WaSec Course

Water policy and governance in transboundary basins

by Ben Sonneveld &
Wim van Veen (VU)



Fig. 1 Near the al-Auja springs, Jericho Governorate, West Bank

Transboundary water problems

Ensuring a fair distribution of water and maintaining the environmental quality of river flows are the two major goals of transboundary water governance. However, policy making faces problems of three kinds. The first problem is economic since indivisibility and non-excludability of the water resources make it hard to allocate property rights to individuals or even to communities. This may lead to free riding behavior: enjoying the benefits of the water without paying an adequate price and without liability for environmental damage. The second problem is geographical since upstream countries have a natural bargaining advantage over downstream countries. A third problem may come from differences in economic and military power across the riparian countries.

Aim of the course

Given the problems above, water allocation in transboundary basins is a potential source of huge conflicts. International law sets general rules but nothing more than that. Therefore, policy making in transboundary basins needs objective knowledge on water availability and water use in the basin if it wants to achieve maximal welfare for all stakeholders, now and in the future.



How to obtain this objective knowledge is the primary aim of the course.

Interconnectedness

Understanding water flows in a river basin starts from the geography of the basin and a schematic overview of the interconnectedness of the flows across locations and layers. The course distinguishes three layers, viz. the surface layer, the root zone and the aquifer zone. The surface layer is subdivided into the natural surface layer (with rainfall, surface run-off and percolation) and the man-made surface layer (with controlled flows and water use). Water quality of the flows is an essential additional aspect of the interconnectedness.

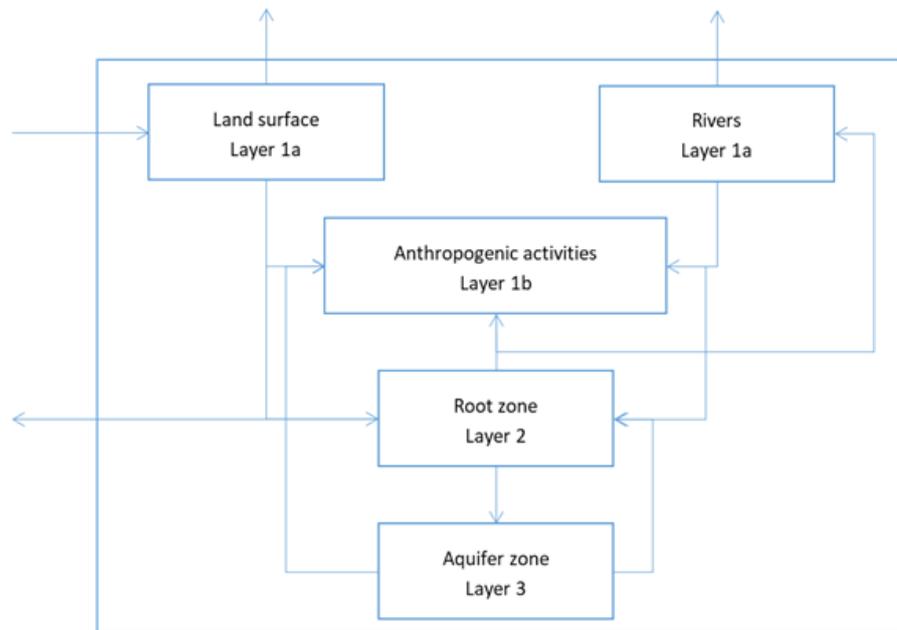


Fig. 2. Schematic overview of layers in the hydrology-economy JRB (Jordan River Basin) model.

Tools of analysis

In the course the objective knowledge of water flows is embodied in two quantitative tools of analysis. Empirical water balances provide insight in current water flows and water use in the basin, while simulation models go one step further by addressing what would happen with these balances under changes in natural conditions, man-made infrastructure and water allocation policies. The course discusses concept and practical application of these tools, illustrated with case studies for the Jordan River Basin. Recurrent theme is the interaction between hydrological and socio-economic factors in the basin.



Fig. 3. Ma'in hot springs waterfall, Jordan.



Policy and governance

Water governance goes beyond the formulation of water policy measures. Hydro-governance is the political process to get agreement with all stakeholders on proposed water policies and their implementation. Transboundary Diagnostic Analysis (TDA) is the prevailing strategic approach in UN-financed projects to guide this process and help the participating countries to ‘agree on the facts’. This course prepares students to contribute empirically and methodologically to a TDA trajectory.

Mathematics: linear algebra

Although for a single site and period water balances can be tabulated as in traditional economic bookkeeping (with incoming and outgoing flows), mathematical representation of the balances is indispensable for a comprehensive overview of all balances together, given the multiple dimensions and interconnectedness of the flows. Linear algebra operations (matrices, vectors, scalars) are crucial here, both for empirical accounting and for understanding model simulations. Four dimensions are considered: location, layer, time and quality. The course has a specific lecture to refresh all elementary linear algebra operations.

All water balances in one equation (outgoing on the left, incoming on the right)

$$V^T t + \sum_j e^j + \sum_i d^i + f^{ev} + f^{os} + z =$$

$$Vt + \sum_i C^i d^i + \sum_j B^j e^j + b^{np} + b^{sp}$$

Fig 4. The equation of the Water Balances

Course outline

Introduction	Building blocks	Comprehensive view	Policy Analysis
1. Water management in a transboundary basin	3. Representing natural flows in a river basin	7a. Water flow accounting river basin: concept and structure	9. Water policy making in a transboundary river basin
2a,2b. Linear Algebra; refresher/ mathematical specifics for water flows	4. infrastructural projects in a river basin	7b. Water flow accounting river basin: mathematics	10. Simulating water flows in river basin: analysis of shocks
	5. Water users: water quantity and quality	8. Water flow accounting in the JRB: empirical application	11. Simulating water flows: policy applications to the JRB
	6. Pollution control and mitigating measures		

Fig. 4. Not only volumes. The impact of water pollution

The course is divided into four parts. The first part introduces water policy problems in a transboundary basin and prepares for the use of linear algebra in representing water balances. The second part pays in-depth attention to four separate aspects, viz. (a) hydrology and natural flows, (b) infrastructure and controlled flows, (c) water use and water treatment and (d) pollution threats. Building on this knowledge, the third part

presents structure and derivation of comprehensive water balances for the whole basin. The final part explains the concept of water economy modeling and its application to concrete policy cases.

Dissemination Events

- Dr. Fahmi Abu Al-Rub presented the benefits of the WaSec programme at the Workshop on LUC Mapping hosted by the Water Diplomacy Centre at Jordan University of Science and Technology in Irbid, Jordan on March 21st 2021.
- George N. Zaimes (IHU/former EMaTTech) presented with a poster the WaSec results at the Mediterranean Scientific Expertise for Decision-Makers. Climate and environmental research to support sustainable development goals (Med2020). This was an online international conference, November 16th-18th, 2020.
- Nikos Zaimes and Georgios Gkiatas (IHU/former EMaTTech) presented part of the WaSec results at the XIV Balkan Conference on Operational Research (Virtual BALCOR 2020) “Operational Research in the Era of Digital Transformation and Business Analytics” 30th September – 3rd October 2020, Thessaloniki, Greece – ZOOM
- George N. Zaimes (IHU/former EMaTTech) present the WaSec project results at the International Conference “Environmental Toxicants in Freshwater and Marine Ecosystems in the Black Sea Basin” September 8th-11th, 2020, Kavala, Greece – ZOOM
- Paschalis Koutalakis (IHU/EMaTTech) presented the results of project to water resources scientists, managers and stakeholders that could provide substantial feedback on the project deliverables at the AgroClimaWater Conference “Water Efficiency & Climate Resilient Agriculture” July 15th –16th, 2020 Chania, GREECE – ZOOM



Photos from Events



Kick off meeting,
Dead Sea, Jordan, February 2019



First management meeting,
Kavala Greece, September 2019



Second management meeting,
Madrid Spain, December 2019



Social Media

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The purpose of WaSec “is to bring together and strengthen the cooperation between companies and HEIs through the development of courses in Water Resources Management, while taking into consideration potential climate change impacts, with adaptive learning and teaching methods”.

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