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## Educating water professionals for the Arab world: Archetypes, change agents and complex realities

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### Abstract

Water education relevance and courses have grown over the last couple of decades, and incorporated more interdisciplinary and integrated contents. This is due to the increasing relevance of water management issues, particularly in regions with extreme water scarcity such as the Middle East. The concept of Integrated Water Resources Management (IWRM) represents a global consensus on the right way to address water challenges. It has been translated into graduate programs that follow the archetypes of integration (e.g. with energy and land sectors), interdisciplinarity, collaboration and diversity. IWRM programs should also incorporate context specificity, impact orientation and problem-solving using practical and scientific competences. This paper evaluates the implementation challenges of the IWRM agenda in a unique intercultural master program. While such programs are highly relevant for the MENA region, educating change agents in a normative sustainability agenda is challenging. The water sectors in the region are still driven by jobs in the international cooperation field and a lack of appreciation of modern sustainability concepts. The water professions are also dominated by the old paradigms of the engineering based promotion of water resources.

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*Keywords:* Water education; Integrated water resources management (IWRM); Middle east; Environmental education; Sustainability transition

### 1. Introduction

Water education has become an increasingly important element in universities' repertoires of courses and degrees related to sustainable development and environmental education [1]. Although complete graduate programs on water might not be commonplace, water related subjects are now being taught beyond the curricula of classical fields such as civil and environmental engineering or environmental sciences. The factors behind the expansion of water education are threefold. First, water management and scarcity problems are becoming more evident in many places

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around the world, and more complex to solve. As a response to the global water challenge of this 21st century, there is a need to educate water professionals who operate across disciplinary, functional and organizational boundaries, i.e. who innovate, collaborate and lead to solve non-typical water issues [2]. In fact, this is a trend in sustainability science in general, an academic field that is characterized by the principles of holistic thinking (e.g. systems thinking), transdisciplinarity (cross-disciplinary and industry-academia cooperation) and diversity (e.g. cultural and disciplinary diversity of water professionals) [3]. Second, since the late 20th century, water education has been intensively promoted by international actors, particularly by the United Nations Education, Scientific and Cultural Organization (UNESCO). UNESCO has supported several water institutes across the World, and its flagship publication “the World Water Development Report” by UNESCO’s own World Water Assessment Program (WWAP) is widely read. UNESCO’s global engagement through the Intergovernmental Hydrological Program (IHP) in promoting international cooperation and water education, is particularly important for water-scarce regions such as the Arab World [4].

Third, the way we solve water problems has changed. Water management issues are increasingly linked to the land and energy issues [5]. For example, huge amounts of energy are required for water pumping and the production of freshwater through desalination. The energy footprint is receiving increasing attention, especially in the case of water scarcity. Besides, water is used to produce energy through the construction of dams, or as an input in fossil fuels production or renewable energies (e.g. for cleaning solar panels). The water–land interactions are plenty and include for example water use efficiency in irrigation or the virtual water that is embedded in the international agricultural trade. Virtual water is now even more relevant for supplementing Arab countries with water needed for food consumption, i.e. through importing food items. Furthermore, water management need to balance supply and demand issues. For example, regulating water consumption in order to achieve water savings is as important as providing adequate water supplies. This is particularly important for countries with very high water consumption per capita, e.g. for the Arab Gulf countries which exhibit some of the world’s highest per capita water consumption rates, sometimes over 500 litres per day in comparison to less than 150 litres in most developed countries.

The concept of Integrated Water Resources Management (IWRM) has been globally adopted in the early 1990s as a way to tackle water supply and demand problems across water related sectors, disciplines and management instruments (e.g. legislations, economic instruments, institutional reforms). Despite the moderate success, IWRM thinking has been considered “the way” to solve water issues, and therefore it was used for reforming the water sector in both developed and developing countries [6]. IWRM-based graduate programs and educational platforms have been initiated by many universities, mainly in the developed parts of the world [2,7,8]. Considering that many of IWRM programs target professionals from developing countries due the urgency of water problems, how do we design a collaborative graduate water education based on the common norms or archetypes brought about by the international consensus on IWRM? Using first-hand experiences from the design and implementation of a bilateral IWRM graduate program between Germany and Jordan with focus on the Middle East and North Africa region (MENA) in Cologne, Germany (2006–now), this paper discusses the challenges of educating future water professionals in the specific reality of the MENA region.

## 2. Water professions in the MENA region: status-quo, transitions and reforms

In many parts of the (developing) world, water management has been dominated by engineers while technical concerns and infrastructure development through water authorities have been the main issues in water education since the 1970s [9]. This is true for the MENA region even now, since the water profession remains a male-dominated career and is oriented towards technical issues. In fact, since the early 1990s, the water sectors in the MENA region and across developing countries have started to move away from the idea of “developing” water resources (e.g. through engineering nature, pumping groundwater and damming rivers) and towards sustainably “managing” these resources. However, there is still a clash between the two cultures in the today’s water sectors, with the water development (i.e. supply-side management) being advocated by powerful and old-standing agricultural institutions (e.g. agriculture and irrigation ministries) [6]. The proponents of (integrated) water management are represented by nascent water institutions guided by the IWRM agenda and supported by international donors. These institutions have high demands for more IWRM-based knowledge, staff and capacity development. In this transition context, the German–Arab master program on IWRM was established in 2006 by the German donors (Ministry of Development Cooperation or BMZ) as one of four degrees in fields central to the German international cooperation in the Arab Region. Since then, it has been hosted at TH-Köln – University of Applied Sciences with initially Jordan

University, and later the German Jordanian University. This program has been redesigned in different formats from a double degree program to a joint degree and later on joint exchange program to adjust and optimize the program according to changing requirements. Currently, the program is expanded to the whole MENA region.

### 3. Grounding archetypes for the 21st century water education

In this part, key categories representing the ideal requirements for (IWRM-based) water education are introduced briefly, while their reflections in the program design of the German-MENA region IWRM Msc. are explained.

#### 3.1. Integrated management for complex systems

The notions of integration and complexity of water-based ecosystems are two important premises of the IWRM idea. They represent a key narrative in IWRM education, as the IWRM paradigm adopts a systemic view that emphasizes the larger whole in applying water management to analysis units such as the watershed as a system (e.g. watershed management as a sub-idea of IWRM) [7]. Alongside thinking in terms of water systems, integrated management is reflected in IWRM through the Dublin Principles, which were globally adopted in 1992 as the normative core of IWRM. These principles include proclamations on the need for integrated approaches, participation, involvement of women and economic instruments. They were translated into three IWRM pillars: an enabling environment (i.e. laws, legislations, plans), institutional roles (i.e. water institutions and participation at different levels), and management instruments (i.e. information systems, economic incentives, assessments). To enable these outcomes, IWRM education need to incorporate softer issues, e.g. non-coercive elements (e.g. good governance, collaboration or conflict management) [7], innovation capacity and management [2], critical thinking and sustainability values [10], and experiencing or immersion [11].

Responding to the IWRM education demands, the IWRM program was designed in 2006 with the aim of supporting the individual advancement of young water professionals to become effective decision makers and change agents in the water sector. These change agents should address the multi-dimensional needs of the water sector and their societies. The IWRM program followed a holistic approach based on tangible scientific contents, and non-tangible impacts. It was thought as a channel not only to transfer the latest knowledge and existing experience to the younger generation but also to create the fundamentals for innovation and new thinking in systems that can incorporate the complexity of the water issues.

The program has evolved to target not only the Arab region but also the wider MENA region, which, depending on the definition, can include Iran as well. This region has comparable geo-climatic conditions and a high level of water scarcity, the latter leading to local conflicts. The concept of the current IWRM MENA program is designed in response to the high demand of different stakeholders in the MENA region for highly qualified water professionals. The core courses of the program provide the basic ideas on systems' understanding, governance and management. Further core courses include international cooperation and business management. Elective courses represent a wide variety of tools and special topics, which are then used in practical, problem-based projects done usually in collaboration with stakeholders providing case studies or projects from the MENA region. The adaptive structure of the program allows for adjustments of the curricula, contents and focus of the program in line with the evolving demands of the stakeholders across the MENA region (see Fig. 1 for the program structure). The needs are identified through stakeholder meetings with main actors in the water sector in different countries of the MENA region. The latest stakeholder meetings in Sudan and in Egypt (2019) revealed a lack of an interdisciplinary understanding of water related issues at managerial and decision-making levels (e.g. lack of representation of social issues such as behavioral issues or inequalities in water use), and the need for strengthening such an understanding in the graduate profiles. The meeting in Jordan (2019) exposed the need to intensify interactions between academia and other stakeholders in order to design demand oriented research topics and knowledge transfer modes.

#### 3.2. Interdisciplinary diversity in collaborative teams

As earlier mentioned, IWRM requires interdisciplinary cooperation of diverse teams in terms of perspectives, knowledge domains or sectors. This is also in line with insights from sustainability science that emphasize the need for transdisciplinarity, integration of diverse domains of knowledge and interactive delivery [3,12]. In implementing this archetype of water education, the IWRM MENA program was designed to address young professionals of

Program Overview			
1st Semester	2nd Semester	3rd Semester	4th Semester
<b>Problem Definition and Analysis</b>	<b>Concepts and Solutions</b>	<b>Contextual Implementation</b>	<b>Practical Semester</b>
Project I	Project II	Project III	Master Thesis Research
Management of Natural Resources System	Project and Business Management	Master Thesis Preparation	
Natural Resources Economics and Governance	International Cooperation and Development		
Elective Modules (3)	Elective Modules (3)	Elective Modules (4)	Master Thesis Defense

*The curriculum is complimented by field visits, expert seminars, and interdisciplinary group work.*

**Fig. 1.** IWRM MENA program structure.

various academic backgrounds who are interested in the MNEA region and have experience related to the water sector. The selected students aim to deepen their knowledge in IWRM and to acquire management and leadership skills as well as regional and intercultural competences. Important for all participants are good communication skills, fluency in English and a high interest in the other cultures. On average, each year, 12 students participate in the program. Multidisciplinary backgrounds foster interaction and exchange among participants from different disciplines and create an interdisciplinary classroom space. So far, 160 students have registered for the program. In total, 34% of the participants of the last four intakes (2016–2019) are self-payment students, while the rest receive scholarships, mostly from the German Academic Exchange Service (DAAD). During the selection of the program participants, a special consideration is given to the distribution of gender. The female applicants are especially promoted and encouraged. On average, the ratio of male and female students have been around 62% to 38%.

Based on a survey conducted among the program's Alumni in 2016 (with 59% respond rate of all alumni), 93% of the graduates have either a job or they studies PhD; 69% work in a topic relevant to their academic background (29% in a leading position; 16% in consultancy); 5% work in a field other than their academic background; and 19% do a PhD. The unemployment rate is 7%, which indicated the success of the program, especially considering the unemployment situation in the MENA region. The highest share of the respondents (34%) work in the private sector mostly associated with development work; 21% in international organizations such as GIZ, FAO, Oxfam; and 9% in governmental organizations. The high rate of employment in international organization in the region as well as in bilateral projects between Germany and the MENA region indicates the success of the program in educating experts qualified in positions relevant to the program's objectives. The graduates usually have skills in project management and leadership as well as in intercultural communication. They are also familiar with the culture, language and politics of both German and the MENA region. In addition, 43% of the graduates live in one of the countries from the MENA region, which can imply a positive role of the program in the development of the region. In addition, 19% live in Germany, 24% in other European countries and the rest in other regions.

### 3.3. Competency-oriented, inquiry-based and problems-centered

A key requirement for the IWRM program was to develop clear graduate competencies and linking them to the water professions in the MENA region or to international cooperation with this region. Further, water education based on the idea of holistic and integrated management of complex water-based ecosystems requires

experimentation and exposure to real-world issues based on the pedagogical principles of inquiry or problem-based education [13]. In this sense, the IWRM MENA program has tried to assure a high quality of the program by implementing innovative didactic concepts including case study based learning as well as practice oriented and interactive teaching. Students are exposed to real life case studies as in order to apply the teaching method “Inquiry Based learning” (EBL). The didactic concept of the program is constantly being updated according to the feedback from students and lecturers, requirements of the study modules as well as latest didactic approaches.

Interactive and practice oriented teaching, guest lecturers (from the private industry, public administration, or ongoing development assistance projects), field visits and team works are among the teaching techniques and strategies to ensure the successful implementation of the didactic concept and to address requirements of a highly interdisciplinary and intercultural group.

Through the IWRM MENA program network, joint projects and collaboration possibilities between the partners from Germany, Jordan and the MENA region have been initiated. This contributes to the success of the IWRM MENA program’s in strengthening the international profile of the involved universities and program participants. As an example of a recent project developed out the collaboration, the Water Security from Data to Decision in Jordan is a research project financed by the German Education and Research Ministry (BMBF) towards demand-oriented and market oriented research. This project offers master thesis topics, student projects as well as the possibility to take part in market events, stakeholder meetings and scientific excursions jointly with international and local project partners. Another example of the good external outreach of the program is the IWRMnet initiative. A network of the universities interested in developing compatible master programs in IWRM to foster students and lecturer exchange and to jointly develop and share teaching and learning materials. The initiative also supports the expansion of the program elective modules according to the expertise of each network member.

### *3.4. Context specified, relevance identified, and impact maximized*

For developing a water graduate program oriented towards the MENA region, it is important to make students familiar with the specific practical, developmental and cultural contexts of this region. The aim is to make education relevant and to maximize the impact of graduates as future change agents in the water sectors in the MENA region. In fact, IWRM considers the interrelation of technological, environmental, economic, social and political aspects of water management. The IWRM MENA program sought to meet this challenge by implementing a variety of teaching forms and methodological approaches. The didactic concept of the program is based on five pillars.

- Providing an adaptive and interactive learning environment by using different teaching methods and tools.
- Promoting interdisciplinary thinking and holistic understanding through employing real life case studies.
- Ensuring the intercultural exchange of experiences through providing platforms and environments of exchange.
- Promoting practice and demand-oriented education and research and fostering information and knowledge transfer through IWRM MENA program.
- Empowering the students with the required knowledge and skills to become young professionals.

The IWRM MENA program serves as a showcase of a demand-oriented and bilateral master course between Germany and the MENA region with a wide recognition and important spin-offs in terms of new collaborations and projects. A unique feature of the IWRM MENA program is its success to establish a strong network with the involved actors in the water related sectors including international, regional and local public and private organizations. Alongside scientific and practical input, this bilateral program familiarizes the students with the culture, language and politics of Germany and the MENA region, mainly through intense intercultural communication pre-courses. It targets applicants with a strong affinity of the MENA-region and previous work experience in public institutions and authorities as well as enterprises in the water sector. This work affinity with the MENA region is particularly important for receiving a study scholarship through the program.

## **4. A water education reality check: merits and challenges of the IWRM case**

In this part, a critical reflection on key impediments, constraining factors and adverse developments is provided based on the experiences from implementing the IWRM MENA program.



#### 4.1. *The change agents*

Most of the countries in the MENA region are low-income countries and have limited investment capacities in infrastructure and institutions that can foster sustainable economic development without an extra burden on water resources. The great hope for the MENA region to get out of the vicious cycle of underdevelopment and resource scarcity is the youth that could unlock innovative forces. Over 50% of the population in the region are below 27 years old. Therefore, postgraduate education is one of the most cost efficient and effective ways to improve the managerial power of the water sector and contribute to regional development. The water sector in the MENA region needs experts with a sound and broad knowledge based in key subjects related to IWRM in order to assess water resources and develop appropriate solutions considering the complex linkages of water resources use to economic, social and ecological aspects, e.g. affordability of water services or environmental requirements in the use of lakes or rivers. Experts ought to be able to appropriately communicate with actors from different sectors and disciplines. They should be capable of knowledge based decision-making at different managerial and levels. This understanding of the interdisciplinary and management-related competencies of the change agents has several implications. Through educating a next generation of water professionals based on the broad and cross-sectoral knowledge of IWRM, there is an expected positive impact on problem-solving in the water sector, e.g. through linking water issues to land and energy, and incorporating more social considerations in water solutions [14]. Furthermore, water cooperation in education can enhance the water professional sector in the Arab region, e.g. through contributing to the German–Arab cooperation or to water cooperation among Arab states [14].

Considering the important contribution of IWRM education through young and competent change agents, some challenges need to be overcome. First, the male and engineering dominated field of water is still not quite receptive of ideas that go beyond technical issues. For examples, social sciences, gender issues (e.g. gender mainstreaming policies in the water sector) or interdisciplinary project designs are still not adequately incorporated in the practice of water management in the region. Furthermore, the water sectors in the MENA region still suffer from corruption and clientelism, thus making job placement for graduates of MENA region origins more difficult. In fact, some of these IWRM graduates might end up working with German or Western development aid agencies. Others might choose to continue their stay in Germany although this path is embedded in many bureaucratic hurdles, which German graduates of the program naturally do not have. While some German or non-MENA region graduates might choose to join development agencies in the MENA region, they can still face intercultural difficulties despite the good preparation of the IWRM program. This is due to the fact that intercultural competencies are oriented towards the long-term and difficult to fully grasp within the course of a two-year program or a several-months stay in the MENA region.

#### 4.2. *The water and development sectors*

As earlier highlighted, the water sector in the MENA region are often dominated by old-standing agricultural interests that are clearly opposed to new IWRM institutions, or to donor-driven projects related to water sustainability. While IWRM popularity seems to be on the rise, water institutions remain relatively weak – e.g. in comparison to irrigation, agricultural or industrial institutions which represent the interests of the main water users. However, IWRM is reflected in most of the new water strategies in the MENA region. Alone in Jordan, the national water strategy is built on two pillars of IWRM and WASH (Water, Hygiene, Sanitation and Health), thus indicating the importance of these topics. The IWRM MENA graduates are joining the water sectors in the midst of this transition. Often, the recruitment of the new students happens through the IWRM MENA network of stakeholders from different countries, development agencies and local public institutions. This network is also strengthened by several satellite research projects that have emerged from the collaboration based on the IWRM MENA programs. Still, the development cooperation sector is one of the main anchor points in the professional career of the graduates.

#### 4.3. *Societal context and translations*

Sustainability is still an emerging issue in the MENA region, and this is even true for the very basic concepts of conservation and resource use efficiency. With regard to the water sector, IWRM has been implemented across MENA countries, resulting in the establishment of water ministries, national water legislations, national water

laws, water basin organizations or water planning authorities [15]. IWRM reforms meant the creation of many new water professions that demand holistic competencies and non-technical expertise. Despite this, IWRM is still poorly understood in the MENA region, often due to translation and awareness issues about new concepts such as the need to do independent (economic) sector regulation. For example, independent water regulatory authorities can face opposition since the word “regulation” translates in Arabic into “nizam”, which means “order” or “framework”. This translation spontaneously implies more legislative or bureaucratic burden, which is something different from the economic regulation idea of IWRM, i.e. using key performance indicators or incentives to improve the water utilities’ performance [16]. Similarly, the word “governance” is translated into “hawkamah”, a word that most Arabs have never heard of its use. Further, the newly created or decentralized institutions suffer from the lack of resources and technical capacities while IWRM can be hijacked by political agendas, thus leading to adverse outcomes [17]. All of these aspects can make promoting state-of-the-art concepts of water education in the MENA region a difficult task.

## 5. Conclusions

Water education programs are becoming increasingly relevant as a response to the global water challenge that is even more important in the 21st century. Driven by the interdisciplinary and holistic premises of sustainability science, water education programs are incorporating more issues and integrated approaches. The IWRM paradigm is highly influential across developing and developed countries, although its implementation still faces many setbacks and resistances. In the MENA region, water education based on IWRM needs to be seen within a wider transition from water development to sustainable water management. IWRM education has important spillovers on such a transition and the region’s prospects of resource use sustainability in general. The IWRM MSc. program presented in this paper is an exemplary education offering which aims at educating future change agents in the water sectors while harnessing values of German-MENA region collaboration, diversity and intercultural understanding. Education archetypes based on IWRM have been well transferred. The ideas of integrated management and socio-ecological systems for analyzing water basins (e.g. river or groundwater basins) as well as regional settings meant incorporating diverse case studies, local stakeholders and interdisciplinary knowledge-leveling courses in the IWRM curriculum. Interdisciplinarity and collaboration are best reflected in project-based works and the selection of diverse cohorts of students. The IWRM program has been heavily focused on development related competencies based on real-world water management challenges faced by practitioners in the MENA region and their counterparts in development agencies. While the IWRM program has had a tangible impact in terms of job placement of graduates and building a large network of science-practice network, the water professions in the MENA region remain challenging. Since much of IWRM related efforts in the MENA region’s water sectors are associated with projects of international donors, international development is a popular job field for the graduates. This is also due to the high demand in the development aid sector for graduates with such interdisciplinary and applied management backgrounds. Although this bias is expected, professional career development in local water institutions needs to be strengthened in order to avoid reinforcing existent asymmetries in the North–South development cooperation. Such asymmetries are reflected in aid dependency or the inability of local stakeholders to adopt and translate sustainability paradigms/concepts arising from international cooperation based on global sustainability paradigms. Furthermore, jobs in sectors that are critical for knowledge reproduction (e.g. research, teaching and capacity development) should be to be targeted in water or IWRM education in order to create a lasting knowledge transfer in the MENA region.

## CRedit authorship contribution statement

**Sudeh Dehnavi:** Conceptualization, Investigation, Formal analysis, Validation, Writing - original draft, Writing - review & editing. **Mohammad Al-Saidi:** Conceptualization, Investigation, Formal analysis, Validation, Writing - original draft, Writing - review & editing.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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