

THE DEVELOPMENT OF A COLLABORATIVE MASTER DEGREE PROGRAMME IN INTEGRATED WATER RESOURCES MANAGEMENT IN SOUTHERN AND EASTERN AFRICA

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Abstract *Water in Africa is a matter of life and death. Problems related to the management of the water resources are complex and closely related with human security and well-being. The key question addressed in this paper is: what can universities in Southern and Eastern Africa do to tackle the 'water problems'? There are urgent needs for a cadre of Integrated Water Resources Managers, trained to utilise not only knowledge and skills from the conventional water engineering disciplines, but also, major aspects of the humanities and social sciences. No single university is in the position to do justice to the required course programme depending solely on its own internal resources. An African Collaborative Programme which utilises the relative strengths of various universities in a complementary manner, is implied in this case. The paper describes an initiative to set up such a collaborative Master degree programme in Integrated Water Resources Management. The vehicle selected for the collaboration was that of a network supported by a regional membership organisation (WaterNet). Small teams of network members, usually from two or three countries (member universities) are responsible for the development of individual modules, while an international academic committee provides quality assurance. The paper describes the salient aspects of the Master degree programme.*

Index Terms *curriculum development, Eastern Africa, Southern Africa, water resources management*

INTRODUCTION

Water in Africa is clearly a matter of life and death in many instances. The early 1990s were characterised by a most devastating drought in Southern Africa, and the end of the decade saw extraordinary floods, the effects of which are still being felt. The growth of the urban and rural population have placed increasing demand on water for primary, urban industrial and agricultural use. Millions of people in Southern and Eastern Africa just don't have access to sufficient water of adequate quality within reasonable distance (see for East Africa [1]). The growth in water demand comes against a background where the cheaper sources of water for most countries of the region are already

in use and additional sources will be much more expensive to develop. Conflicting interests and demands are placed on the water resources, making integrated water resources management imperative.

The central question posed by this paper is: What can the universities of the region do to address these water challenges? The paper reports about an initiative to establish a collaborative Master degree programme in Integrated Water Resources Management, which will be jointly offered by a consortium of Universities and other academic institutions that have established WaterNet.

The paper first highlights the need for integrated management of water resources in Southern and Eastern Africa. It then focuses on the challenge for educational and academic institutions to adapt their capacity building activities to the identified needs in the region. The paper then describes the process towards the establishment of the curriculum of the Master degree programme in IWRM. Finally, some salient characteristics of the programme are highlighted and conclusions are drawn.

WATER RESOURCES MANAGEMENT IN SOUTHERN AND EASTERN AFRICA

Water resources and their sustained use are essential for human life. Access to reliable water sources both in quantity and quality is a prerequisite for the development of all forms of human civilisation and socio-economic activity. Hence the need for its effective management. While many people do not currently have access to safe water, without concerted action this situation may get worse in future, as water will inevitably become scarcer in per capita terms. The management of water resources thus becomes more critical than it ever was.

In Southern and Eastern Africa, the effective development and management of water resources is hampered by a number of institutional and legislative constraints, as well as by a lack of sufficient financial and human capacity to carry out integrated water resources management (IWRM) [5]. In many countries, water management initiatives are split among a number of ministries/departments. The fragmentation of responsibilities among sectoral ministries and administrative agencies have

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hindered co-ordination and impeded the attempts to integrate water management activities within the sector itself and with other sector development programmes at the national level. This is compounded by the fact that some countries distinguish different types of water, being managed in different legal and institutional contexts. The management of water is typically monopolised by government departments without any formal stakeholder participation beyond the level of user groups. Cost recovery is not often achieved, nor even aimed for. The cost of managing water is often paid from general government taxes. As budgets dwindle, maintenance of water infrastructure is neglected. Fragmented legal instruments pose another problem. In some countries the allocation of water follow rights systems that have become increasingly inefficient and inequitable with the increasing pressure on the water resource. Monitoring systems, and the generation of information on IWRM, are still in their infancy and limited by human and technical capacity. Finally, the environment has not been considered a legitimate water user itself.

In an attempt to address the above weaknesses, many countries in Southern and Eastern Africa have in the last five years or so embarked on thorough reforms of their water sectors. Legislation has been overhauled and institutional and administrative changes have been introduced, all with a view to better coordinate water management. A consensus is emerging of the need to manage water in more holistic way, in accordance with the Dublin Principles [4]. A landmark achievement for the water sector in Southern Africa was the adoption, after a long period of consultations, of a shared Water Vision for the 21st century, envisaging a desired future characterised by:

Equitable and sustainable utilisation of water for social and environmental justice, regional integration and economic benefit for present and future generations. [3]

Interestingly, the Water Vision is compatible with the definition of Integrated Water Resources Management, as proposed by the Global Water Partnership (GWP, 1999):

Integrated Water Resources Management (IWRM) is a process which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. [2]

In our reading, managing water resources in an integrated manner implies [8]:

- to consider the hydrological cycle in its entirety, both in qualitative and quantitative terms, taking into account downstream and upstream interests (basin-wide, also across national borders), as well as surface, soil and groundwater sources, and, most importantly, rainfall;

- to consider the full range of sectoral interests, including environmental interests, when making allocation decisions. Decision making would entail a process whereby all relevant objectives and constraints of society are considered, and, if necessary, priorities are set by weighing the objectives in an informed and transparent manner. Integrated management therefore requires close coordination between institutions that are often sectorally defined, the involvement of stakeholders, and taking into account those stakeholders without a voice (such as the environment);
- to consider future needs as legitimate claims of future generations.

CAPACITY BUILDING NEEDS FOR INTEGRATED WATER RESOURCES MANAGEMENT

It follows from the preceding section that integrated water resources management requires a conducive policy environment and a suitable institutional and legal setting. In addition, it requires:

1. an adequate understanding of the physical processes involved;
2. a comprehensive understanding of the variety of societal needs for water;
3. effective decision-making processes involved in influencing demand for and supply of water, as well as in allocating the water.

The people implementing this new mode of water management will:

1. consist of teams of professionals trained in an appropriate mix of disciplines relevant to water resources;
2. be able to facilitate meaningful information exchange and communication among staff, and between staff, stakeholders and policy-makers.

The latter two requirements can be partly addressed by investing in human resources through carefully designed capacity building programmes. Here we arrive at the question central to this paper, namely what the universities of the region should do to address the looming water challenges. First, our universities should continue to train *specialists* in relevant 'conventional' disciplines at undergraduate and postgraduate levels, while ensuring that the curricula are kept up-to-date of the fast developing water sciences. Second, we should also produce a new type of *generalists*, for which at present no suitable curriculum is available. Third, our universities should assist their sister institutions (polytechnics, technical training institutes etc.) with updating the curricula for water *technicians* (diploma and certificate holders). Fourth, we should facilitate the training of *decision-makers* (both professionals and elected) in the central concepts of integrated water resources management. These four types of capacity building needs are briefly elaborated below.

Specialist expertise

Any intervention in matters of water resources will increasingly require detailed, up-to-date, state-of-the-art, specialist expertise. This expertise will include the 'conventional' disciplines such as hydraulic engineering, hydrology, geology, chemistry, etc. Advantage should be taken of the rapid developments during recent years with regards to PC-based modelling and to the use of remotely sensed data. However, specialist expertise should be widened to include disciplines that hitherto were not considered relevant to water, such as natural resource economics, ecology, and law. Existing curricula should be the basis of this type of training, but these should be reviewed and updated when the need arises.

Generalist expertise

Apart from the urgent need for superior specialists, there is a need for generalists. These generalists should be the brokers' within the water sector (here understood in its broadest sense), and establish the links between the specialists in sectorally defined departments. These generalists thus occupy the 'middle-ground' in integrated water resources development and management. They should first of all have a global understanding of central concepts of the different disciplines involved, including not only engineering, hydrology, hydrogeology, chemistry etc., but also ecology, resource economics, law and management science. These generalists would furthermore be able to translate these into denominators in common with the other players. Here reference can be made to umbrella concepts such as 'virtual' water, 'green' and 'blue' water. Finally, these generalists should facilitate the complex decision-making processes referred to in the previous section. They should therefore have skills in team work, communication and conflict resolution, and some may have to specialise in the emerging field of decision support systems. At the moment, no suitable curriculum exists for the production of these generalists. The newly proposed Master degree programme in Integrated Water Resources Management is meant to fill this gap, and is further detailed in the next section.

Technical training

The eyes and ears, and hand and feet, of any water management organisation are the technicians, water bailiffs and other field staff who monitor water use, collect data, and have an intimate knowledge of the local reality. Traditionally the important role these technicians play has not been acknowledged. The skills of technicians should be urgently updated, not only in terms of technical expertise, but also in the (in many countries rapidly changing) legal and institutional context in which they operate. Existing curricula should be re-written, while those already trained should be able to attend short refresher courses. This type of training should in most cases best be carried out by technical training institutes, the role of universities being to feed these

institutes with new insights, concepts, based on the specialist and generalist academic curricula mentioned earlier. Clearly, partnerships between both types of academic and technical training institutions are required. In close consultation with the SADC Water Sector Coordination Unit, WaterNet will soon start a new initiative to facilitate this process.

Training of decision-makers

The training of decision-makers is required to create the proper environment for the new specialists, generalists and technicians to effectively carry out their duties. Two types of training are envisaged here: the training of decision-makers with a professional background, and the training of the elected decision-makers (user representatives), such as the councillors in the catchment and sub-catchment councils in Zimbabwe (over 200 elected councillors). The role of universities could be to establish partnerships with the relevant government departments or parastatals, and to provide the kind of training curricula that these institutions require.

THE PROCESS TOWARDS A CURRICULUM FOR THE MASTER DEGREE PROGRAMME IN IWRM

The process towards the establishment of WaterNet and the curriculum of the Master degree programme in IWRM took four years. The process was triggered in May 1997 by the SADC-EU conference on the Management of Shared River Basins in Maseru, Lesotho, where ministers of water of Southern Africa and Europe emphasised the need to 'level the playing field' between riparian countries within each region and to develop capacity building programmes in order to achieve this goal [7].

Another trigger for creating WaterNet was the establishment, in January 1998, of the MSc programme in Water Resources Engineering and Management at the University of Zimbabwe, in collaboration with IHE Delft and the Institute of Water and Sanitation Development (IWSD) in Harare. This experience convinced us that pooling expertise among universities in the region would allow the establishment of a much broader programme with specialisations tailored to a wider spectrum of postgraduate students including lawyers, economists and social scientists. Concurrently, an assessment study was carried out in order to ascertain the capacity needs for water managers in Southern Africa [6]. In April 1998 a workshop was held with a selected number of potential partners for both the WaterNet initiative and the related initiative to establish the Water Research Fund for Southern Africa (WARFSA). This workshop formed the basis of the project documents for both projects, both of which eventually received funding from the Netherlands and the Swedish governments, respectively.

The WaterNet programme was endorsed by the SADC Water Sector Coordination Unit and the Global Water Partnership, and then presented at a large number of fora. Subsequently, 44 institutions in Southern Africa (university

departments and research and training institutes involved in various aspects of water) were approached with information about WaterNet and invited to fill out a questionnaire. Eighteen institutions responded positively, and these became the founding members of WaterNet during a workshop in Victoria Falls, Zimbabwe, held in March 2000. The structure of the WaterNet organisation as a membership organisation was agreed, operating through an annual general meeting, a steering committee, a small secretariat and a Trust fund. As of April 2001 WaterNet had 24 member institutions from 9 countries of Southern and Eastern Africa, as well as four 'supporting members' and 7 'candidate' member institutions. It was also decided during the workshop to establish a general Master degree programme in Integrated Water Resources Management. The distinguishing feature of this degree programme is that it has a fully modular structure, and that the course modules will be offered by various member institutions. On the basis of the needs in the region,

and the expertise among the members, 28 course modules were identified for the programme, as well as coordinating and contributing institutions for each module. Syllabi for 22 modules were defined by the members and finalised in October 2001 at a workshop during the First WARFSA/WaterNet Symposium, held in Maputo [9].

A Scientific Review Committee was then established by WaterNet, which carried out a comprehensive review of the entire Master degree programme and the individual course modules, and reported its findings in March 2001. The committee finalised the structure of the programme, amended the syllabi of the course modules and drafted the general regulations. The process of detailing the contents of the modules and the production of materials, lecture notes, readers, exercises etc. has now started. Table I chronicles the process towards the establishment of the Master degree programme.

THE MASTER DEGREE PROGRAMME IN INTEGRATED WATER RESOURCES MANAGEMENT

Some notable characteristics of the Master degree are:

- it is a **general** Master degree programme, not limited to engineering graduates, and offers a broad spectrum of courses relevant to Integrated Water Resources Management;
- it is a **modular** programme, whereby students can gradually build up their portfolio of course modules; it is therefore a flexible programme, with multi-entry and multi-exit (i.e. Course Certificates, Post Graduate Diploma and Master Degree);
- it is a **regional** programme, whereby WaterNet member institutions offer a limited number of course modules, focusing on their relative strength in terms of expertise.
- an international academic committee will ensure academic quality and facilitate a process of regular **peer review**.

The degree programme consists of a taught part and a dissertation part. The taught part is made up of 11 course modules. Each course module will be taught on a full-time basis during a period of 3 weeks. At the end of each course module an exam is given. Prospective participants have therefore a number of options:

- participants may wish to follow individual course modules; for each course module that is successfully completed and the exam passed a 'Module Certificate' will be issued. If the exam is not passed a 'Certificate of Attendance' will be issued;
- participants may wish to obtain a 'WaterNet Postgraduate Diploma in IWRM'; for which they will have to follow (an approved combination of) 11 course modules;
- if the average mark of the WaterNet Postgraduate Diploma is 70 or better, participants may proceed with the Dissertation (6 months on a full-time basis) in order to obtain the 'Master Degree in IWRM'.

TABLE 1

THE PROCESS TOWARDS THE ESTABLISHMENT OF WATERNET AND THE MASTER DEGREE PROGRAMME IN INTEGRATED WATER RESOURCES MANAGEMENT (1997-2001)

May 1997	SADC-EU Conference on the Management of Shared River Basins, Maseru [7].
August 1997	The WaterNet concept is presented to the Global Water Partnership in Stockholm [8].
Nov.-Dec. 1997	Assessment study of Integrated Water Resources Management activities in Southern Africa by IWSD, based on a questionnaire sent out to 145 institutions of which 20 responded, and visits to 10 institutions [6].
January 1998	Launch of the MSc programme in Water Resources Engineering and Management (WREM) at the University of Zimbabwe.
April 1998	Stakeholder workshop for WaterNet and WARFSA in Harare, which formed the basis for project documents of both programmes.
December 1998	SADC endorses WaterNet during the SADC/UNDP Water Round Table Conference in Geneva.
May 1999	The WaterNet concept is presented during the Africa Water Resources Forum in Nairobi [5].
Aug.-Oct. 1999	WaterNet is presented in the SADC Water Week seminars in most SADC countries (Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe).
September 1999	The Netherlands government decides to fund, for four years, the WaterNet programme, which will be facilitated by IHE Delft.
November 1999	WaterNet approaches 44 academic and training institutions in the region as well as 6 regional networks, inviting them to express their interests in WaterNet.
December 1999	Eighteen institutions reply positively, on the basis of which the WaterNet Baseline Report is formulated. The report indicates the areas of expertise of the interested institutions, their envisaged inputs and outputs and the suggested priority activities.
March 2000	WaterNet Founding Workshop in Victoria Falls with the prospective members. The establishment of the regional, modular, and general Master degree programme in Integrated Water Resources Management was agreed and 28 course modules were identified.
October 2000	Syllabi of individual course modules are finalised during the 1 st WARFSA/WaterNet Symposium in Maputo.
March 2001	Comprehensive review of the Master degree programme in Integrated Water Resources Management.

The taught part consists of a core with 6 compulsory modules; a specialised programme with 3 prescribed course modules; and an elective part, with 2 elective course modules. The core modules are compulsory and include:

- Principles of Integrated Water Resources Management
- Principles of Hydrology
- Socio-Economics of Water & Environmental Resources
- Principles of Aquatic Ecology and Environmental Management
- Policies, Laws and Institutions
- Project

After having followed the core modules, students choose between the following 'specialised programme':

- A. Water resources management
- B. Water and environment
- C. Hydrology
- D. Water and land
- E. Water for people

Each specialised programme prescribes three course modules that have to be followed (Figure I). The student will in addition choose 2 course modules out of the remaining pool of available modules. There are no restrictions as to which two elective modules to choose.

For those participants who do not have English as their first or second language, a preparatory module is offered entitled 'English for Water Managers'. This course will combine conventional English lessons with regular lessons in subjects such as Math, Geography, History, Science, Biology etc.

The WaterNet member institutions will mutually accredit the course modules offered, through adoption at each institution of the Regulations of the Master of IWRM. UNESCO will be invited to facilitate the process of validation of the WaterNet Postgraduate Diploma in IWRM, and the Master Degree in IWRM.

PREPARATORY MODULE

0.0 English for Water Managers

CORE

0.1 Principles of IWRM
0.2 Principles of Hydrology
0.3 Socio-Econ. of Water & Env. Res.
0.4 Principles of Ag. Ecol. & Env. Mgt.
0.5 Policies, Laws and Institutions
0.6 Project

SPECIALISED PROGRAMMES

A. WATER RESOURCES MGT	B. WATER AND ENVIRONMENT	C. HYDROLOGY	D. WATER AND LAND	E. WATER FOR PEOPLE
6.1 Water Res. Analysis and Planning	2.2 Environmental Impact Assessment	3.1 Hydrogeology	4.1 Irrigation Design & Management	1.1 Water Supply and Sanitation
6.2 Catchment Management	8.1 Water Quality Management	5.1 Remote Sensing & GIS	4.2 Drainage & Soil Degradation	1.2 Utility Management
5.2 GIS and Database Management	2.4 Environmental Water Requirements	7.1 River Engineering	6.2 Catchment Management	8.2 Waste Water Management

ELECTIVES choose 2 out of remaining non-core course modules

ALL NON-CORE COURSE MODULES

WATER SUPPLY AND SANITATION	ENVIRONMENTAL MANAGEMENT	GROUNDWATER	AGRICULTURAL WATER USE	INFORMATION TECHNOLOGY
1.1 Water Supply and Sanitation	2.1 Wetlands, Ecology and Mgt	3.1 Hydrogeology	4.1 Irrigation Design & Management	5.1 Remote Sensing & GIS
1.2 Utility Management	2.2 Environmental Impact Assessment	3.2 Groundwater Modelling	4.2 Drainage & Soil Degradation	5.2 GIS & Database Management
	2.3 Coastal Zone Management	3.3 Groundwater Management		
	2.4 Environmental Water Requirements	3.4 Hydro-geochemistry		
WATER RESOURCES	SURFACE WATER	WATER QUALITY	CAPITA SELECTA	
6.1 Water Res. Analysis and Planning	7.1 River Engineering	8.1 Water Quality Management	9.1 Capita Selecta in IWRM	
6.2 Catchment Management	7.2 Early Warning for Droughts & Floods	8.2 Waste Water Management		
		8.3 Water Quality Modelling		

FIGURE I
STRUCTURE OF THE MASTER DEGREE PROGRAMME IN INTEGRATED WATER RESOURCES MANAGEMENT

Tuition Fees will be charged by the Institution teaching the particular course module. Also a tuition fee will be charged for the dissertation by the institution hosting the dissertation project.

CONCLUSION

The paper emphasises the urgency of implementing integrated water resources management in Southern and Eastern Africa. For this to happen, capacity building activities have to focus on providing tailor-made programmes for the specialist experts, the technicians, the decision-makers, as well as the generalists. The paper relates the experience of setting up a general Master degree programme in Integrated Water Resources Management that aims to produce generalist water managers. One of the main objectives of the post-graduate programme is to coin a common language of the central concepts in Integrated Water Resources Management. This will allow present and future water managers not only to effectively communicate with experts from other disciplines (such as resource economists, environmentalists, lawyers, planners, community representatives, scientists, health professionals, engineers etc.) but also across national borders. This may help to defuse potential conflict situations and turn these into opportunities for cooperation.

The process towards establishing the curriculum took four years of intensive consultations among parties and partners inside and outside Southern and Eastern Africa. The result is an innovative, flexible and collaborative programme that is provided by a consortium of African university departments and research and training institutes. It is innovative in that it offers a wide spectrum of course modules, with the common thread being a number of key concepts deriving from Integrated Water Resources Management. The programme is flexible in that it allows multi-entry and multi-exit. It is collaborative in that member institutions offer those course modules in which they have comparative strength, while accrediting courses that are offered by other member institutions. Pooling expertise is seen as the most efficient method towards a course programme that is truly inter-disciplinary, encompassing all the important aspects of Integrated Water Resources Management.

The expected benefits from such a collaborative approach in developing the degree programme are obvious, in that no single University in the region can mobilise the resources necessary to cost effectively develop and mount such a broad programme, and credibility to be brought about by team work and peer review. A given University gets a full peer reviewed course, by simply contributing a few modules to the degree programme. This is making effective use of available capacity in the region and beyond [10]. With

becoming a WaterNet member, an institution could offer both a specialist and a generalist postgraduate programme. For instance, the Department of Geology, University of Botswana, now offers a specialist programme in Hydrogeology but will also offer the general IWRM programme.

At the start, WaterNet requires outside financial support as seed money. It is hoped that WaterNet will soon become recognised as an important, reliable and effective vehicle for regional capacity building. The delivery mechanism of WaterNet will make it easy for sponsors from both within the region and from elsewhere, both government and private, to contribute to fellowships or specific funds for the benefit of particular target groups.

Having said this, it must be recognised that it is unlikely that the full cost of training and education in a field such as water management can ever be entirely borne by the beneficiaries themselves. Subsidies in the form of grants and fellowships will continue to be required, reflecting the public good value of investing in human resources development. The value to society of knowledge on water resources is greater than the direct economic benefits accruing from such knowledge; just as the value of water can never be entirely reduced to its economic worth [5].

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