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AFRICA SPECIAL

IAHR AIRH
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EDITORIAL
BY ANGELOS N. FINDIKAKIS

Africa, the richest continent in many natural resources, but yet the poorest economically, faces many water related challenges. Water resources are scarce in more than a third of the continent, while in many other parts with ample water resources economic constraints and conflict have prevented their development. The result is that hundreds of millions of people are deprived of access to safe drinking water and live in poverty. This situation is aggravated by the pollution contaminating many water sources. The development of additional water resources and the implementation of better resource management and pollution control measures to serve the needs of local populations in several parts of Africa is still hindered by financial constraints, poor governance, lack of transparency, conflict, and national or international disputes about resource allocation.

Angelos N. Findikakis
Hydrolink Editor

Since the turn of the millennium there are positive signs of efforts to improve this situation through both local and international aid and economic collaboration programs, more cooperation between nations and steps towards better water governance and more transparency. This issue of Hydrolink includes eight articles that address different aspects of water development and management in Africa.

The Millennium Development Goals (MDG) adopted in the Millennium Declaration by the member States of the United Nations include a reduction to half the proportion of people without sustainable access to safe drinking water by the year 2015 (from 1990) brought global attention to the subject, especially in Sub-Saharan Africa. It mobilized many local and international agencies, as well as many non-government organizations to work towards achieving this goal. Even though the goal was not met in Sub-Saharan Africa, significant progress was made. In a recent assessment of the MDGs, UNICEF estimated that the percentage of people lacking access to improved drinking water sources in Sub-Saharan Africa was reduced from 52 percent in 1990 to 32 percent in 2015. Even though more than 400 million people in this region gained access during the MDG period, more than 300 million people still lack access to safe drinking water. Northern Africa and Southern Africa fare much better with only 7 percent of their population lacking access to safe drinking water in 2015. The article by Awulachew discusses the MDGs and the new goal set by the United Nations for universal and equitable access to safe and affordable drinking water for all by 2030. Achieving this goal will be a real challenge considering the lack of economic resources and the high population growth rate, which in most African countries is of the order of 2 to 3 percent.

Contamination of both surface water and groundwater from mining activities not following environmental best practices, improper disposal of hazardous wastes and the lack of wastewater treatment facilities have been the cause of public health problems and negative impact on aquatic life. In addition to its contribution to water pollution, solid waste disposal in streams and rivers in and around urban areas affects drainage and causes severe flooding damage in cities such as Accra in Ghana, as explained in the article by Osei-Twumasi. Recognizing this problem, some large and rapidly growing cities have started developing plans for improving waste disposal practices and stormwater management, as is the case of Libreville in Gabon, discussed in the article by Cougard and Butruille.

Progress has also been made in developing the large hydropower potential of Africa, one tenth of which has been harnessed so far. Hydropower can provide a major boost to the socio-economic development of many countries in the continent, as demonstrated by the recently completed Kaléta dam and 300 MW hydroelectric Station in Guinea described in the article by Chen and Zhang. This project is also interesting because it is an example of another noticeable trend, the increasing technology transfer and investment in Africa by China.

Another major hydro development the Great Ethiopian Renaissance Dam (GERD) on the Blue Nile, now under construction, described in the article by Seleshi, which when completed with its 6000 MW installed capacity will be the largest hydropower project in the continent. In addition, with its 59 billion cubic meters of active storage it will be the second largest reservoir in Africa after Lake Nasser formed by the High Aswan Dam in Egypt. The GERD and other upstream storage projects offer the possibility of more efficient use of the water resources of the Nile by reducing evaporation losses and providing more flood protection. This of course can be achieved only through closer cooperation between the countries sharing the Nile basin towards more integrated management of its water resources. One of the first steps in this direction was the Nile Basin Initiative, which started with the effort to develop shared water management tools for use by the countries of the basin and led to the development of the Nile Basin Decision Support System described in the article by Sørensen et al.

Managing and sharing the water resources of rivers crossing national borders is a challenge in other parts of the continent besides the Nile basin, as illustrated in the article by Stephenson which gives an overview of how the countries of southern Africa approach the development and use of shared water resources.

Finally, in a world of increasing water scarcity due to population and economic growth in combination with the uncertainty posed by changes in the temporal and spatial distribution of precipitation, managing the available water resources efficiently and transparently is of paramount importance. The article by Loudyi and Oubalkace discusses how Morocco is working to achieve this goal through improved water governance. Over the last twenty years Morocco has been working on reforming its water sector by adapting the principles of decentralized and participatory management, emphasizing the need for demand management and planning to improve information sharing among all stakeholders.

IAHR through its Africa Division is aiming at contributing to addressing the many challenges in the development and management of water resources of Africa by facilitating the sharing of information and ideas among practitioners and researchers working on these issues. Those interested in involvement in the IAHR Africa Division should contact the IAHR Executive Director Dr. Christopher George.

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Cover picture: Above: The Katse dam in Lesotho. *Photo: Thinkstock*
Middle: African women fetch water in the village of Salima, Malawi. *Photo: Dreamstime*
Below: NSC Pipeline to convey water to Gaborone. *Credit: Bigen Africa*

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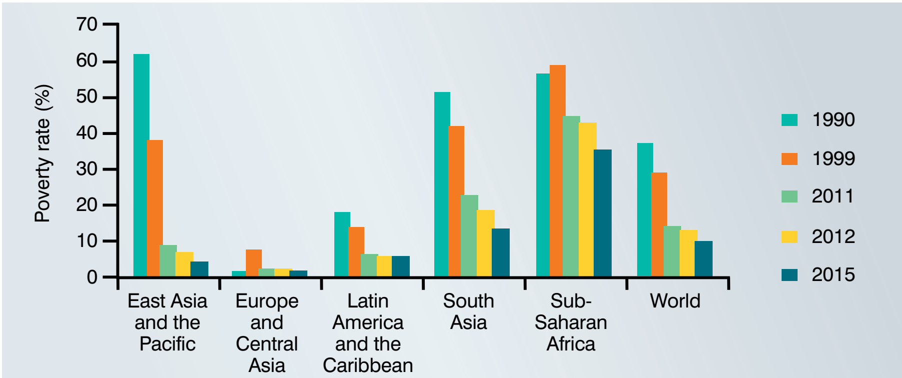
IN THIS ISSUE

AFRICA SPECIAL

SUSTAINABLE DEVELOPMENT GOALS: AN OPPORTUNITY FOR CLEAN WATER ACCESS FOR ALL IN AFRICA[1]

BY SELESHI B. AWULACHEW

At the turn of the new millennium, world leaders gathered at the United Nations to shape a broad vision to fight poverty. The vision was translated to the Millennium Development Goals (MDGs), packaged under eight goals dealing with i) poverty and hunger ii) universal primary education iii) gender equality and women empowerment iv) reducing child mortality v)improving maternal health vi) combatting HIV/Aids, malaria and other diseases vii) ensuring environmental health viii) developping global partnership for development.



Poverty rate around the World

The MDGs have immensely helped to tackle significant social and some environmental challenges particularly in developing countries. They have helped to lift more than one billion people out of extreme poverty, and enabled better access to education, health, water and sanitation, etc. They enabled more girls to attend schools, saved life of children and improved food and nutrition and enabled significant strides to protect our planet.

As examples, 47% of people in 1990 lived on less than $1.25 a day and that number dropped to 14% in 2015; and the global number of people living in extreme poverty has declined from 1.9 billion in 1990 to 836 million in 2015[2]. Water supply and sanitation was under Goal vii of the MDGs. In 2015, 91% of the global population is using an improved drinking water source, compared to 76 % in 1990; out of the 2.6 billion people who have gained access to improved drinking water since 1990, 1.9 billion gained accesses to piped drinking water on premises; 2.1 billion people have gained access to improved sanitation. Globally, 147 countries have met the drinking water target, 95 countries have met the sanitation target and 77 countries have met both. The world has met the MDG drinking water target five years ahead of schedule but work is not yet completely done. Despite success, progress has been uneven across regions and countries, leaving significant gaps. Millions of people are being left behind, especially the poorest and those disadvantaged because of their sex, age, disability, ethnicity or geographic location. Most of the disparities occur in Sub-Saharan Africa (SSA), and the actual disparities are masked in the averages of global figures. The poverty figure from 1990 to 2015[3], clearly demonstrates the slow progress

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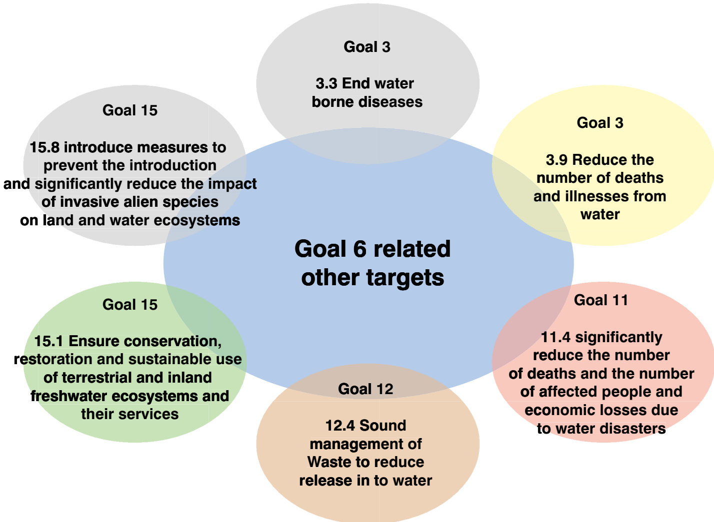

in SSA compared to the rest of the world, and extreme poverty still remains well above 30%, and where over 40 % of all people without improved drinking water live. In this part of the world, the disparity between urban and rural populations is also high.

The Sustainable Development Goals (SDG) and Water

In September 2015, a high level plenary meeting of the United Nations General Assembly adopted the 2030 Agenda of Sustainable Development Goals (SDGs) including 17 Goals shown in the figure of previous page, and 169 targets[4]. The agenda is holistic and includes the economic, social and environmental dimensions of development, with a number of principles such as universality, people and planet focus.

Water is established as an independent goal number six of the SDGs. It has six targets and two means of implementation. Besides being proposed as an independent goal, water has been identified as a target or sub-target in a number of other SDGs, due to its overarching and enabling roles, as shown in the figures on the right hand side.

Furthermore, water is also implicitly linked to other goals as it is one of the most overarching resource as well as economic, social and environmental good and as such can be linked to each and every other goal. Its development influences the success of other goals and the progress of other goals also influence the development of water resources. For example, progress on health targets (goal 3), depends on infrastructure targets (goal 9) that gives everyone access to safe water and improved sanitation. Zero hunger and nutrition targets (goal 2), gender equality targets (goal 5) and many other goals are not achievable without access to clean water.

Opportunities for Clean Water and Sanitation for All

The MDGs played an important role in helping to mobilize and galvanize the efforts of development community. The 15 years of MDGs experience will serve the achievement of the newly endorsed SDGs. MDG 7 on ensuring environmental sustainability, that was encompassing water and sanitation, has been expanded into five dedicated SDGs such as SDG 6, 12, 13, 14 and 15 as well as featured in other SDGs like 8, 9, 11 and off course goal 1 on poverty. The SDGs not only bring new dimensions of development but also enable completion of the unfinished business of the MDGs and they provide significant continuity as we transition to the new era of the 2030 Agenda. The first two particular targets of SDG 6 are to "by 2030, achieve universal and equitable access to safe and affordable drinking water for all" and "by 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations". These two targets, while they are specially showing the continuity of MDG, they are also highly aspirational in that the world will reach these targets leaving no one behind, and a promising opportunity for ending the gap in SSA. ■

1) The views and opinions expressed do not necessarily represent those of the Secretariat of the United Nations; the designations employed or terminology used concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of frontiers do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations.
2) The Millennium Development Goals Report 2015, United Nations (2015)
3) Global Monitoring Report 2015/2016, Transitioning from MDGs to SDGs, The World Bank and The International Monetary Fund (2016)
4) United Nations Department of Economic and Social Affairs (UNDESA), United Nations (2015), https://sustainabledevelopment.un.org/?menu=1300

WATER CHALLENGES FACING GHANA AND THE WAY FORWARD

BY ANTHONY OSEI- TWUMASI

Ghana is well endowed with water resources. The Volta river system basin alone covers about 70% of the area of Ghana, whereas the south-western river system watershed covers 22%, with the remaining 8% covered by coastal watersheds. The Volta Lake, which has a total surface area of 8,500 km^2, is one of the largest artificial lakes in the world. It is estimated that the total actual renewable water resources of the country are 53.2 billion m^3 per year. Surface water resources alone are sufficient to meet present and future consumptive water demand. Water demand for 2020 has been projected to be 5 billion m^3, which is equivalent to about 12% of the total surface water resources. However, some of the nation's water bodies have been highly polluted, leading to high treatment costs in the supply of drinking water to communities. It has been estimated that about 29% of the population are lacking access to safe drinking water and at least three million have no choice but to collect dirty water from unsafe water sources, especially in rural areas. Owing to this situation where communities are compelled to drink contaminated water, diarrheoal disease is the third most commonly reported illness at health centers across the country and 25% of all deaths in children under the age of five are attributed to diarrheoa.

In Ghana today, artisanal gold mining (AGM) activities are on the increase. Some of the river basins in Ghana are rich in alluvial gold and most of the activities of AGM are undertaken in the rivers, as well as along their banks. These activities have impaired the quality of the drinking water sources of many communities. These activities are not the only sources of river pollution, which include several other causes of water contamination such as local oil spills from garages.

Another challenge facing the nation is drainage. Most of the drainage systems in urban and semi-urban areas have all been choked with various forms of pollutants, including plastic waste and other debris. This has exacerbated flooding, leading to loss of life and property in the recent past. During a recent flood in the capital city of Accra, over 150 deaths were recorded on 3rd June 2015. The pain and anguish of relatives of the victims were overwhelming. Increasingly, this issue is taking a toll on the financial resources of the country. In assessing the recent Accra floods, AgboKlu (2015) noted that their causes are both hydro-logical and anthropogenic. They include heavy rainfall events, which are being exacerbated by climate change and variability and the associated extreme weather conditions; massive sprawling of buildings with accompa-nying paved areas; silted and polluted river courses; poor flows in drainage networks which are often due to insufficient, undersized, uncon-nected or improperly channeled drainage schemes.

The Volta estuary is about 1.2 km wide at the mouth. Two dams have been built on the River Volta at Akosombo and further downstream at Kpong, and these, to a large extent, influence the quality and quantity of water in the estuary. Before the construction of the Akosombo Dam in 1963, the Volta River transported 1 million m^3 sand per year to the coast, resulting in a dynamic river delta. Following the construction of the dam, the coastline eroded more than 150m and the river mouth tends to close (with numerous human and ecological conse-quences). The yearly retreat of the coastline is about 6 m/year and caused the destruction of many buildings. The severe erosion has also other negative effects like disappearing roads, abandoned housing near the retreating coastline, and steep erosion cliffs. The whole Volta delta is threatened by floods due to further erosion and sea level rise.

Artisanal gold mining causing water pollution in some communities in Ghana

Anthony Osei-Twumasi is a Senior Lecturer in Sanitary Engineering at Kumasi Polytechnic in Ghana. Anthony holds a PhD in Civil Engineering from Cardiff University. After graduating in 1986 from University of Ghana with a degree in Physics/Mathematics, Anthony joined Ghana's Hydrological Service in 1988 as a trainee hydrologist. In 1992, Anthony obtained a Postgraduate Diploma in Hydrology from University of Nairobi, Kenya and a Masters degree in Environmental Resources and Management from Kwame Nkrumah University of Science and Technology, Ghana in 2001. Anthony joined the academic staff of the Civil Engineering Department in 2003 and has taken positions as the Dean of the Faculty of Engineering; Dean of Faculty of Built and Natural Environment and recently the Director of the newly created Institute of Technology Development and Transfer all at the Kumasi Polytechnic, Ghana.

This has also prevented the intrusion of seawater upstream during high tides. Alterations in the flow regime have led to physicochemical changes in the water and consequently, a gradual shift in the habitat of the clam Galatea paradoxa from the upper and mid-section of the lower Volta River towards the estuary, and with a substantial decline in abundance of the clam. The ensuing habitat modification, coupled with over-exploitation, has led to a significant reduction in the population of this commercially important species. This clam has for decades been an important source of protein for the riparian communities of the lower Volta River and provides employment to about 2000 people, especially women.
The fishing grounds have dwindled from 100 km from the pre-dam era to a narrow stretch of 10 km as a result of the development of sand bars at the estuary

In addition to power generation, Akosombo provides some degree of flood protection due to its very large storage capacity relative to inflow, and Kpong supplies a small amount of irrigation (only about 100 ha) for rice cultivation. Navigation and a robust fishing industry are important additional benefits of the reservoir. However, these hydropower dams have also devastated the livelihoods of the downstream communities and the physical ecosystem processes on which they depend. Before the impoundment of the river the force of the annual floods that occur during the rainy season cleared out any sand bars formed within the Volta estuary. With the cessation of annual floods, due to the construction of the dams, the sand bars gradually started to grow. Within a period of 20 years, the sand bars had partially blocked the estuary and saline water from the sea could no more penetrate the channel of the river during high tides. With the absence of salt water penetration into the river channel, fresh-water weeds started growing in the estuary. The impoundment and flow regulation has led to an increase in cases of malaria and urinary schistosomiasis, as well as an appearance of intestinal schistosomiasis which was not present prior to dam development

One of the approaches in addressing the management challenges in a country such as Ghana isto educate the communities living along these water bodies and drainage channels not to throw waste into these systems. Often people have not paid heed to these messages because there is no enforcement. Additionally governmental agencies must address the issues of uncontrolled mining in the communities.

Although, there are agencies involved in the planning of towns and cities in Ghana, often individuals are able to build dwellings and industrial structures without planning permission from these agencies, thereby violating building laws and regulations. These regulations must be enforced.
In Ghana today most of the open drains have become repositories of refuse, whereupon some communities dump their solid wastes into them. What needs to be done is the municipalities must desilt all drainage networks regularly before the onset of rains.

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A storm drainage system filled with plastic waste and other debris in one of the cities in Ghana

The management of such a situation has often been dealt with by engineers and planners using appropriate field studies to predict and monitor the situation as it evolves. In data-rich developed countries numerical modelling approaches have been widely used to address various environmental concerns. Such efforts are supported by trained expertsin computational environmental hydraulics. In confronting these challenges, most engineers and managers in developing countries, such as Ghana, have resorted to the use of imported computer models which are normally used to simulate the hydrodynamic and water quality conditions in the river basins. In many – if not most - cases that such models have been used by non-experts, the models have provided erroneous results owing to the fact that most of their users do not have the expertise and do not understand the underlying fluid mechanics, biochemistry, morphology and numerical methods associated with the complex models that they are using.Training in these fields is not well delivered in Ghanaian universities and other tertiary institutions. In Ghana most universities do not have state-of the art hydraulics laboratories and also do not have modern measuring equipment, such as Acoustic Doppler Velocimeters (ADVs) for measuring-velocities in the laboratory. The need therefore to train experts in the environmental water management sector in Ghanaian academic institutions cannot be overemphasised.
Owing to the numerous challenges facing Ghana in the environmental sector and the lack of training institutions in the country, the author was offered a scholarship to pursue a doctorate degreeatthe Hydro-environmental Research Centre in Cardiff University, UK. Cardiff University has a large Hydraulics laboratory for the study of environmental water management issues. The project which was on integrated water management studies in river basin systems, looked at flow and solute transport processes with the use of dye studies in idealised surface water-groundwater and estuarine sytems.The challenges at the Volta estuary enumerated earlier in this article require an integrated water management approach and the use of appropriate tools. Currently, university students in Ghana only take classes in basic environmental quality and sanitary engineering practices, but they are note exposed much to the use of advanced methods and toolsfor addressing environmental water management problems. This is is in part due to the lack of preparationof the students for that level of study and in part to the lack of the required facilities and other resources.


Fishing at the banks of the Volta estuary

Ghana's environmental water challenges are multi-faceted and require co-ordinated approaches from several fronts to address these challenges. To address these problems a major effort is needed in capacity development in the water sector. Among the technical areas in which training of local professionals is needed is the development and application of numerical or computational models that can help improve the management of water resources and environmental water quality in Ghana. This does not imply justimportingsuch models, but having home-based toolsthat can be used over time. Consequently, localexperts must come from thetraining institutionsin Ghana, which requiresthe provision of adequate infrastructure and resources to fosterthe training of the needed expertise to help address some of these challenges. That is what Ghana must do. Organisations such as IAHR have the potential to offer a valuable means of facilitating the delivery of improved water management training for the future. ■

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STORMWATER MANAGEMENT IN LIBREVILLE

BY TANGUY COUGARD & FLORENT BUTRUILLE

Libreville, the capital of Gabon, has experienced strong urban and demographic development since 1960. After becoming the political capital of the new state, Libreville gradually strengthened its position as economic capital and attracted most of the rural exodus and migration flow from Central Africa. The city thus passed from a population of 30 000 in 1960 to over 623 000 residents in 2003.

Urban development is driven by demographic factors, a population growth rate of 4.7% in 1993 and immigration from other regions or neighboring countries (only 2% of the people living in Libreville in 1993 were born there). The dominant urban habitat pattern is that called "built-in", which refers to the disorganized and spontaneous occupation of land, without taking into account any hazards associated with the topography or poor access to some urban public services (water, waste treatment, transportation, etc.). 80% of the urbanized area is occupied by this form of housing that in the absence of appropriate social housing policy has always represented the largest percentage of available housing units.

A major problem is the nature of urbanized land which is mostly in areas of steep slopes and areas prone to flooding (Figure 1). The natural hazards are exacerbated by unplanned urbanization without any provision for neither sewage nor stormwater collection networks, nor water treatment facilities, even though overall the state of water supply in Libreville is better than that of sanitation. The result is high exposure of these neighborhoods to flooding during the rainy season and poor access to basic hygiene standards. In addition, in these areas, any existing drainage infrastructure for stormwater and wastewater collection has either been damaged, is insufficient, or is completely absent.

A survey of 908 households found that 8% of them, had experienced at different times drowning incidents or injuries related to flooding in their neighborhood in the last five years. This percentage is higher in the low-lying areas (19%).
The current situation in flood areas was evaluated using the hydraulic model MIKE11 applied over the area of the city, using a digital

Figure 1 - Flooding in the district of Kinguélé

Figure 2 - Unplanned expansion of housing in the thalweg of a stream

Figure 3 - Streams filled with trash

Figure 4 - Examples of severe hydraulic restrictions of flow under two bridges caused by the disposal of trash

terrain model and the following assumptions:
- The 100-year return period hyetograph
- Sea-level conditions downstream at 2.50 m above mean sea level, and accounting for more severe future conditions considering a medium level scenario of sea-level rise due to climate change.

Causes of flooding

The increase in population density near natural streams has increased the risk of flooding in many parts of Libreville in different ways. Specifically,
- the urbanization of the floodplains (and sometimes of the stream bed) by housing (including protection walls), has reduced and sometimes totally eliminated their role in flood control (Figure 2)
- the obstruction of the streams resulting from different human activities, such as the widespread dumping of garbage, which obstructs the flow, causes higher water levels (Figure 3 and Figure 4).

The consequences of flooding are more severe because of the increase in the number of affected people. There are different types of bridges over the streams that flow through the city, but in most of them the flow under them is significantly restricted by trash and different objects dumped in the streams.

A field survey estimated that about 40% of the linear streams and river network is affected significantly by obstructions caused by the disposal of solid wastes. This is the result of the local household waste management practices. The survey found that
- 40% of people throw their garbage outside of the collection points;
- 6% throw their garbage into the rivers.
- 70% of households have waste in their environment,

Flood protection measures

Two levels of flood protection were selected for different parts of Libreville corresponding to rainfall events with return periods of
- 25 years for the upstream part of the watershed of the city center and for watersheds in strictly residential areas and without any business and industrial districts, or government offices.
- (New Land, Nzeng Ayong, Lowé lai)
- 100 years for the downstream part of the catchment areas of the city center (St. Mary, St. Anne, Batavéa, Ogombié and Lowé).

Florent Butruille **started working at Cabinet Merlin in January 2013 after obtaining his Engineering Diploma in Hydraulics at the National School of Water and Environment at Strasbourg (ENGEES). The Stormwater Management in Libreville was his first work in Cabinet Merlin. He did it in coordination and under the direction of Tanguy Cougard. After that he worked on others Stormwater networks in Africa or France for the Cabinet Merlin like the Rainwater Management Project and Climate Change Adaptation (PROGEP) in Dakar or the Wastewater Master Plan for Lille European Metropolis (France).**

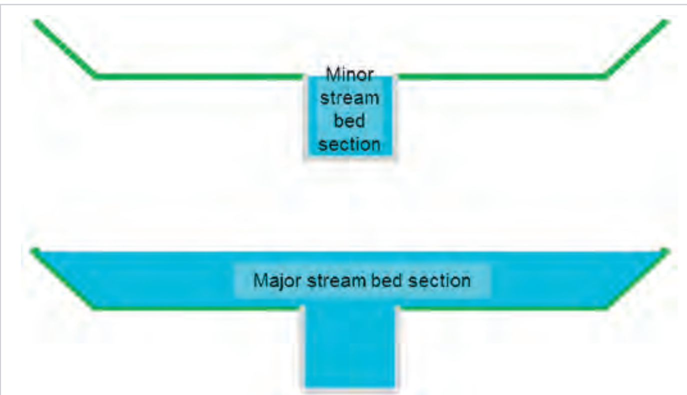
Tanguy Cougard **began working at Cabinet Merlin in 2006 after experiences in international NGOs and a Civil Engineering degree of French School of Mines. Initially involved in french projects France related to floods and pollution managements in urban and rural areas, he has gradually oriented towards sanitation, flooding and drinking water masterplan in Africa; Ivory Coast, Gabon, Tunisia and Algeria.**

The selection of a level of protection corresponding to the 100-year event in some downstream areas is linked to the plans for a major renovation of the downtown area and to the strategic importance of infrastructure in it, including the Oloumi industrial zone, the banks and ministries in Nombakélé, the buildings of major institutions in Sainte Marie, such as the Central Bank of Central African States (BCEAC), the Senate, and the National Assembly.

To provide the required flood protection it is necessary to make the hydraulic capacity of the streams compatible with the predicted peak flows. The increase in the hydraulic capacity of the streams was achieved through the:
- Increased geometric section of flow passage
- Improved water flow by decreasing the bed roughness (removal of fallen trees and bushes, concrete cover or land, weed cutting, removal of the micro surface roughness, grinding plot etc.)

Given the conditions in Libreville, two different types of channel sections were considered:
- Simple rectangular or trapezoidal, concrete-lined sections
- Complex sections consisting of a rectangular main channel, referred to as the minor streambed section, and a floodplain part, which encompasses the minor section and is referred to as the major streambed section as shown in Figure 5.

Figure 5 - Two types of channel cross sections used as part of streambed improvement for flood protection



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During small rain events, only the minor streambed section is flowing, while during heavy rainfall the flow extends over the entire major sterambed section. Part of the major section in the floodplain can be occupied by recreational and light commercial facilities, but not with hard buildings, which would decrease the expected conveyance and create flood risk to people and property.

It was decided to give preference to complex sections wherever possible, because this form limits significantly the required concrete volume, softens the channel integration in the landscape, and allows easier crossing.

Figure 6 shows the simulated extent of flooding in two parts of Libreville during the 100-year rainfall event. Figure 7 shows the simulation results for the 100-year rainfall at the downstream end of the watershed Nzeng Ayong / New Land. As can be seen Figure 7, the channelization of the stream increases the peak flow from 100 m³/s under present conditions to 650 m³/s, and the peak flow arrives more than 2 hours earlier after channelization of the stream.

A complete channel management of the Libreville river system would lead to extremely high flows in the downstream parts of the watersheds, which in most cases are highly urbanized and do not allow a major expansion of the channels. Overflow areas, for storing a part of flood volumes, thereby reducing peak flows downstream, were therefore considered to compensate for the effect of channelization.
A study comparing different options showed that the slowdown of the flows by partial temporary storage in designated areas leads to 35% in cost savings compared to the option of complete channelization of the entire length of the streams. Temporary storage along parts of the streams to dynamically slow down the flow, is achieved by creating submersible frontal low-rise (and mechanically stable) banks allowing free overflow when the water surface in the stream exceeds a certain level.
These areas do not create permanent lakes, but only temporary flooding in controlled zones during periods of very heavy rain. Therefore they do not pose any risk of mosquito proliferation. Creating areas of temporary floodwater storage helps lower the overall cost of stormwater management in Libreville. Moreover, these areas are used to limit the role of the downstream channels and facilitate their integration in the urban environment.

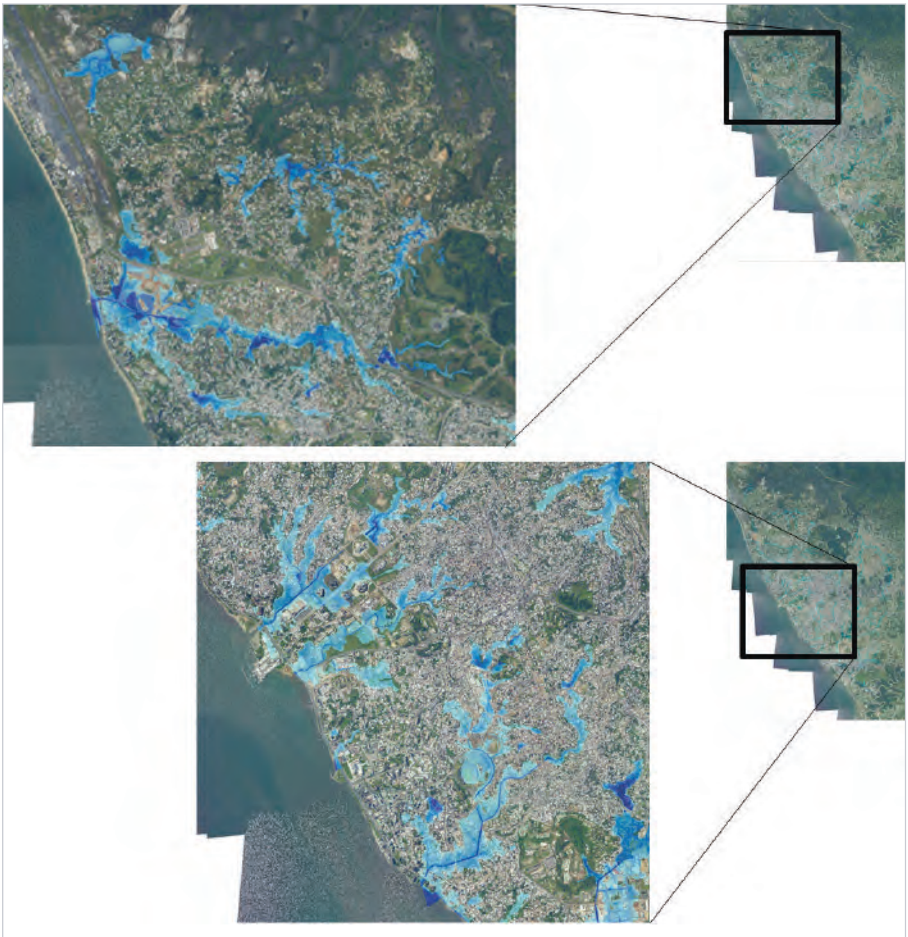

Figure 6 - Simulated extent of flooding in two parts of Libreville during the 100-year rainfall event

By slowing down the flows, they allow better flood control and a reduction of the hazard posed by these streams.

In total the stormwater management plan for Libreville includes the design of:

- 15 zones of temporary floodwater storage with a total storage capacity of 775 000 m³
- 70 km of open canals (15 km with complex sections, 55 km with simple rectangular sections)
- The reconstruction of 55 major river and stream crossings

It is estimated that the planned developments will lead to the relocation of around 2,000 households. The cost of the protection program against floods was estimated at 350 million euros.

The information and data presented in this article are part of the master plan for wastewater and stormwater management for Libreville prepared by the Cabinet Merlin between 2012 and 2013 on behalf of the National Agency for Major Works, the Ministry of Public Works and the Ministry of Water Resources of Gabon. ■

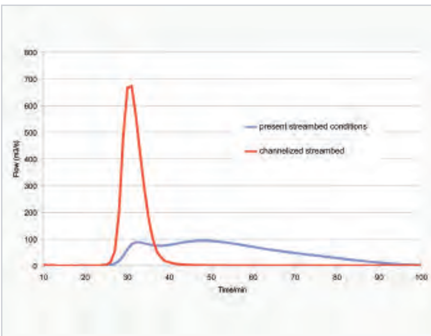

Figure 7 - Impact of channelization on the flow from the Nzeng Ayong and New Land watershed

Figure 8 - Example of temporary floodwater storage area

THE KALÉTA HYDROELECTRIC AN ACHIEVEMENT OF SINO-AF

BY CHEN XIANMING & ZHANG RUJUN

The total installed Capacity of Kaléta Hydroelectric Station in Guinea is 240 MW, which has tripled the existing capacity of this country. The total investment, 25% by the government of Guinea, and 75% by the Exim Bank of China in terms of loans, adds up to 446 million USD. China Three Gorges Corporation (CTG) was contracted this project in EPC form, and its subsidiary company China International Water & Electric Corporation (CWE) was responsible for its execution. Construction of the project started in April 2012, and all three power generator units came into service in the national electrical grid at the end of August 2015, which benefitted the Capital region Conakry and eleven other provinces and territories with a total population of 4 million. Kaléta supplies electricity to tens of thousands of families and it is viewed as a new engine for the socio-economic development of Guinea

The Kaléta project is part of a long cooperation between China and African countries in the development of hydroelectricity in the continent. In the 1960s, China Water & Electric Corporation (CWE) under CTG built the Kinkon Hydroelectric Power Plant as part of economic assistance from China, and in the 1970s, the Tinkisso Project, both in Guinea.

The Kaléta Hydroelectric Station is located in the Konkoure river basin in Guinea, and is the biggest hydroelectric project in the country. CTG, the builder, operator and manager of the Three Gorges Project in China, has been the principal executor of Kaléta. CTG is a model enterprise in the Chinese hydroelectric industry, and a leader in the hydropower industry worldwide. The Kaléta Hydroelectric Station and its facilities adopted Chinese hydropower standards in design and construction. All permanent electric machinery was supplied by Chinese equipment manufacturers.

Kaléta is a run-off-river hydropower project, with total installed capacity of 240 MW. The normal water level is 110 m, the minimum operation level is 109 m, and the regulating capacity of the reservoir is 6.5 million m^3 providing daily regulation.

The project includes a roller compacted concrete gravity dam of total length 1 150 m, of which, the water retaining section is 661 m, the spillway is 360 m, and the intake section is 66 m; the crest elevation of the dam is at elevation 114 m, and its maximum height is 31 m.
A free overflow spillway without sluice gates is located on the right bank. Its crest is 110 m, 4 m lower than the crest of the retaining dam. Its design transverse section of its weir is formed by two circular-arcs, and its downstream surface is made up of steps for energy dissipation. The intake is composed of three sections (each section 22 m long, with the total length of the intake sections 66 m), respectively connecting to the penstocks of three units. Along the direction of water flow in each section, are in order, the trash rack, the maintenance gate and the

Panoramic view of KALETA Hydropower station, whose 3 generator sets were connected to the grid

Transmission Lines reach Conakry, capital of Guinea. More than 4 million people benefited from it directly.

Powerhouse of KALETA，whose annual generating capacity is 965 GWh

STATION:
RICAN COOPERATION

emergency gate, which line up to the penstock downstream at the back of the dam.

As part of the project design hydraulic model tests were performed to:

- Study the effect of the general layout on the flow patterns at the hydropower station intake and bottom outlet;
- Verify the flow coefficient and discharge capacity of the spillway for the selected weir surface curve;
- Observe and study the water level and flow velocity distribution in the reservoir;
- Study scouring and silting of the bottom outlet under different water levels, and intake flow patterns and sediment deposition caused by flood discharge.

It was found through these tests that whirls would be produced at the upstream side of the intake side. To eliminate these swirls, two anti-swhirl beams were added to the original design at the upstream side of each intakes, which effectively reduce whirl formation.

The powerhouse is behind the dam, and the rated water head is 48.3 m, varying between 42.43 m and 50.3 m . Each individual unit is designed to have a passing water volume of 180m3/s. Turbines with axial flow and rotating blades were selected, which can handle a larger range of water heads and provide running stability, meeting the requirements of the Kaléta Power Plant.

During the construction of Kaléta, CTG assigned technical and managerial professionals, who applied the Chinese Standards on quality, safety and environmental protection. Over ten thousand Chinese technical and managerial professionals were involved in this project, covering multiple aspects such as survey, design, construction, equipment manufacturing, installation, and tests, etc. At the same time, Guinea mobilized all its resources into the project. Workers from the two countries were working hard at the site day and night.

Because of the lack of electricity generation and distribution infrastructure and related technology in Guinea, a significant portion of the project involved technology transfer for the construction of a modern hydro power dam and electrical grid, the optimization of the operation of the system, and the development of a highly efficient dispatching system. In addition the project offered training opportunities to thousands of local workers who acquired new skills through their participation in the construction of Kaleta. CTG also provided training to civil, mechanical and electric engineering and other fields to Guinean professionals.

The construction of the project coincided with the outbreak of the most severe epidemic of Ebola in West-African history in the beginning of 2014. The Guinean government and CTG worked together to develop and implement measures for the prevention of the spread of the disease among the workforce involved in the construction of the project. The program proved to be effective as no Ebola incidents were reported among the workers and the schedule of the project was not affected.

In early October 2015, the first generator unit of the Kaléta Hydroelectric Station completed 100 days of safe operation, and the total power production of the three units reached 300 GWh. The operation of Kaléta put an end to the many daily blackouts in Conakry which were common before the commissioning of the project. The Kaléta project made possible the uninterrupted supply of electricity 24 hours a day to Conakry and 11 neighboring provinces. The lack of reliable, affordable electricity has long been viewed as a major obstacle to the development of Guinea, raising the cost of doing business, limiting the opportunities of economic growth and investment and affecting all aspects of daily life in the country. The completion of the Kaleta project was hailed as a major national accomplishment, memorialized by printing an image of the dam on the newly issued 20.000 Guinean Franc banknotes. ■

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ZHANG Rujun, **from CTG, the general manager of KALETA Hydroelectric Project in Guinea, who is 38 years old, has devoted to the development of Africa hydropower industry for 14 years in his 15-year-career. He is proficient in Hydropower technology, Management of hydro-project and Management on international contracts. For years, he has been one of the Practitioners of Sino-African cooperation on hydropower.**

GREAT ETHIOPIAN RENAISSAN NILE RIVER MANAGEMENT

BY YILMA SELESHI

The Grand Ethiopian Renaissance Dam (GERD) project is located 700 km northeast of the capital city Addis Ababa along the Blue Nile River at Guba locality, about 40 km upstream of the Sudanese Roseires dam. GERD main features are the Main Dam, a roller compacted concrete (RCC) structure that is 1 870 m long and 145 m high, concrete volume of 10.2 million m^3; and a Saddle Dam, a concrete faced rock fill dam (CFRD) structure, 5 200 m long and 45 m high, with embankment volume of 17 million m^3. GERD and its hydropower plant have been under construction since 2011 financed by the Government of Ethiopia to supply the sharply increasing energy demand of the country and its neighbors. The estimated cost of GERD is USD 4.7 Billion. At this time more than 46% of the dam has been completed and construction is going on at full swing under the engineering procurement & construction (EPC) mode of contract. The Ethiopian Electric Power is the employer. The joint venture Coyne et Bellier of France & ELC Electroconsult of Italy, a consulting firm, is the employer's representative. The EPC contractor (Salini Impregilo of Italy and Studio Pietrangeli) and the EPC plant contractor (Metal and Engineering Corporation of Ethiopia) are the two main contractors involved.

The reservoir area will cover 1 874 km^2 at full supply level (FSL) at 640 meters above sea level. The total storage volume is 74 billion cubic meters with an active storage volume of 59 billion cubic meters. A system of three spillways safeguards the project against the Probable Maximum Flood, estimated at 30 200 m^3/s peak discharge.

Two powerhouses located at the toe of the Main Dam will house 16 Francis units at 375 MW each, totaling 6 000 MW in capacity, for an expected annual generation of 15 600 GWh. The Project also includes 500 kV substations and switchyard and load dispatching center.

GERD will feature the largest hydropower dam in Africa and the 8th in the world in terms of power generation and will add to the energy generation

Rendered view of the Great Ethiopia Renaissance Dam

The Great Ethiopian Renaissance Dam project main dam view from the right abutment with the roller compacted concrete dam under construction, October 2014

CE DAM AND


The panoramic view of GERDP site from left bank side October 2014

capacity of Ethiopia, in addition to the recently completed dams and hydropower plants Gibe II (420-MW), Beles Multipurpose project (460-MW) and Gibe III (1870-MW).

The International Panel of Experts (IPOE) on the GERD was established in May 2012 at the initiative of Ethiopia to address the concerns of Sudan and Egypt regarding dam safety and downstream impacts. In May 2013 the IPOE issued a final report which confirmed that both the main RCC dam and the Concrete Faced Rock fill saddle dam design and construction follow International Standards, Codes and Guidelines including ICOLD and USACE, and stated that the construction is being executed following the highest standards and technology known to date with great professional care, responsibility and detail.
In terms of the benefit of GERD, with its 59 billion m^3 active storage capacity, the GERD reservoir will play an important role in attenuating large flood peaks with remarkable benefits for the hydrological safety of downstream countries and securing in particular Sudan from the threat of the Nile River flooding.

> **"the GERD reservoir will play an important role in attenuating large flood peaks"**

The evaporation loss from the GERD reservoir (1.4 billion m^3/year) is about 7% of the combined evaporative loss from the Sudan and Egypt reservoirs which are located in arid areas (about 19 billion m^3/year) for the same order of annual hydropower energy generation.

Yilma Seleshi **is an Associate Professor in Water Resources Engineering at Addis Ababa University, Ethiopia and he was a member of International Panel of Experts on the Great Ethiopian Renaissance Dam.**

Reservoir sedimentation rate is estimated at 127 million m^3/year (830 ton/km^2/year that is 143 million ton/year) with hundred year sediment reaching about 13 billion m^3 taking into account sediment density at 1.12 ton/m^3. When other upstream dams in the Blue Nile including Mandaya and Beko Abo come into the system and systematic soil and water conservation measures take root, the GERD dam's useful life will be significantly extended into centuries.
In March 2015, the heads of state of Ethiopia, Sudan and Egypt declared the principles for the coordination of water management in the Eastern Nile to the benefit of the three countries. Presently, Tripartite National Committee (TNC) comprising of four experts from each country are working together to maximize the benefits to the three countries from the Eastern Nile River system including GERD.
Ethiopia firmly believes that GERD will contribute to the economic development of the country, the promotion of transboundary cooperation, and the regional integration through generation of sustainable and reliable clean energy supply. ■

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THE NILE BASIN DECISION SUP

BY HENRIK REFSTRUP SØRENSEN, MEKURIA BEYENE AND HANS CHRISTIAN AMMENTORP

The Nile Basin Initiative (NBI) managed to successfully develop a shared and accepted set of water management tools to be used by 10 Nile Basin countries – the Nile Basin Decision Support System (NB DSS). The NB DSS was developed by DHI in close cooperation with the NBI, and it was funded a World Bank grant. The NB DSS also became the starting point for a generalized DSS, which was later commercialised by DHI and which is now used to improve water management in many other countries in Africa and elsewhere in the world.

Figure 1 - The Nile River is a vital water source for the Nile Riparians not least Egypt which rely almost entirely on the Nile River Water. The image shows city lights along the Nile River in Egypt (NASA)

The Nile basin with an area of 3 million km^2 covers about 10% of the area of Africa. More than 190 million people live in the basin itself and the population in the 11 basin countries exceeds 400 million. The average annual flow of the Nile is approximately 85 billion m^3, which makes the Nile basin, compared to many big rivers, a water stressed region. Livelihoods and ecosystems as well as economic activities in the region depend significantly on the Nile water. Most of the water comes from the Lake Victoria region and the Ethiopian highlands.

Water supply in most downstream countries in the basin, not least Egypt, relies almost entirely on the Nile water. It is expected that the growing population and climate change will further strain the available water resources in the region.

The main challenges in the basin include droughts, environmental degradation, floods, poor coverage of water supply, food insecurity and power shortages. On the other hand, the region offers opportunities because of the still untapped potential for energy and food production. In appreciation of this, the Nile riparian countries have expressed their political will for cooperation and there has been international readiness for support.

In the last decades, the Nile riparians have been in the process of working towards cooperatively developing and managing their shared water resources. This required identifying mutually beneficial development and management options as this is the key to sustainable use of the shared water resources. Consequently, the Nile riparians have recognized that accurate information and shared water management tools would provide a sound technical basis for joint decision-making.

This was the rationale behind the NBI's decision to develop the NB DSS – a common, computer-based platform for communication, information management, and analysis of Nile basin water resources.

Coupled with human resources development and institutional strengthening, the NB DSS would provide a framework for sharing knowledge, understanding river system behaviour, evaluating alternative development and management schemes. It will also support informed decision-making from a regional perspective with the shared objective of developing the water resources in a cooperative manner, sharing socio-economic benefits, and promoting regional peace and stability.

The NB-DSS was developed between 2006 and 2012. The needs assessment was based on a comprehensive consultative processes with relevant stakeholders and led to the conceptual design of the system and the identification of the functionality required to address the key areas of concerns. This process resulted in a number of requirements related to the software development process (process requirements), the functionality of the system (functional requirements), the software architecture and deployment options (non-functional requirements).

The functional requirements were derived based on additional stakeholder consultations focused on identifying the key challenges in the Nile Basin. These were identified as the water resources development (infrastructure, e.g. new dams), optimal utilization of the water resources (e.g. reservoir operation rules), energy (hydropower) development, irrigated and rain fed agriculture, coping with droughts, coping with floods, navigation, and watershed management (soil erosion and sediment loads). In addition and across the eight areas of concern come climate change and water quality.

The non-functional requirements were related to ease of use, expandability options, openness and transparency and included a long-term commitment for maintenance and support. Hence, largely the non-functional requirements focused on ensuring long-term sustainability of the system, for instance, by requiring a software architecture that allows developers other than DHI's to extend the system with new functionality.

PORT SYSTEM

With these prerequisites, it was apparent that developing a generalized DSS rather than a very specific Nile Basin system would be the most efficient option. Such a system would fulfil the requirements for the NB DSS and it would be an opportunity to adapt and customize the system easily to other river basins in Africa and elsewhere. Both parties recognized a mutual interest in DHI's commercialization of the system. For DHI, the commercial scalability was the driver while for NBI the driver was sustainability of the product, as DHI would commit to maintain and further develop the system.

The NB DSS is an integrated solution with four main components:

1) An information management system that comprises (a) a relational database management system to store all information in one repository
2) A geographic information system (GIS) to process all geo-referenced information
3) A time series management toolkit to process and analyse time-series data
4) A set of analytical and modelling tools including:

- a water resources modelling platform that allows plugging-in and linking of water balance and allocation, rainfall-runoff and hydrodynamic models (an open modelling framework)
- scenario management including key performance indicator (KPI) calculations for scenario comparison
- ensemble generator for probabilistic analyses
- climate downscaling tools based on global circulation models
- multi-objective optimization and trade-off analysis
- economic cost-benefit-analyses, and multi-criteria-analysis to support a structured stakeholder involvement and decision-making process

Today, the commercialized products are marketed under names MIKE INFO, MIKE PLANNING and MIKE OPERATIONS (http://www.mikepoweredbydhi.com/areas-of-application/data-management-decision-support-and-operational-forecasting). The NB DSS was the predecessor of MIKE INFO and MIKE PLANNING, while MIKE OPERATIONS has added capabilities to work with online data, forecasting and operational control. These products are integrated with DHI's MIKE modelling systems, but they are also open to non-DHI models, which was one of the key features of the NB DSS. During the past few years, they have been applied to a large number of projects both in Africa and elsewhere. The two applications presented next demonstrate the use of MIKE INFO for data management in the Lake Victoria basin and MIKE OPERATIONS for forecasting floods and droughts in the Shire river basin in Malawi.

Figure 3 - The Functionality of the Nile Basin DSS is now embedded in MIKE INFO, MIKE PLANNING and MIKE OPERATIONS

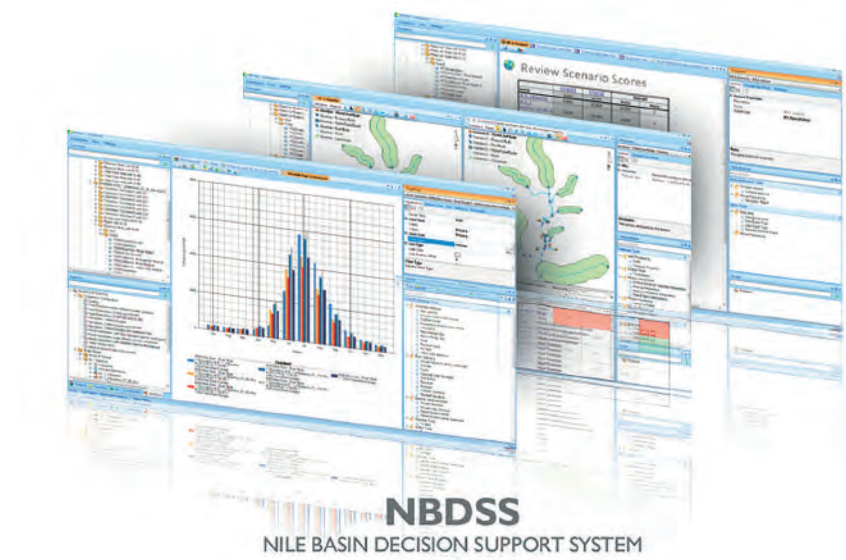

Figure 2 - The NB DSS provides a suite of tools for time-series analysis, scenario management and Multi-Criteria-Analysis

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Mekuria Beyene **is a water resources systems specialist. He is on assignment for DHI as team leader for the ODSS project. Mekuria was the Regional Water Resources Modeler at NBI where he contributed to the development, implementation and piloting of the NBDSS. Mekuria's activities also focused on scenario analyses for development interventions in the Nile basin. Mekuria has a Doctorate of Engineering from the University of Technology (RWTH) in Aachen, Germany.**

Hans Christian Ammentorp **is a senior hydrologist at DHI with more than 30 years of professional experience. He has held several Team Leader positions and has been in charge of establishing multiple forecasting- and decision support systems addressing issues of drought and floods in many different pats of the world. He has worked Head of the Water Resources Department of DHI Malaysia during 2013 and 2014. Hans Christian holds a M.Sc. from the Danish Technical University.**

Application 1: Lake Victoria Water Resources Information System (WRIS)

Several East African countries depend on Lake Victoria – the world's second largest freshwater body – for transportation, hydropower generation, food, and water. Environmental changes in recent years have highlighted the need to coordinate various water resources and environmental initiatives in the basin. Working with the Lake Victoria Basin Commission (LVBC), DHI developed a Water Resources Information System (WRIS) based on MIKE INFO.

The 68 800 km^2 Lake Victoria is the second largest freshwater body in the world. The lake's basin is a vital trans-boundary resource shared by the East African Community (EAC) – Kenya, Tanzania, Uganda, Rwanda, and Burundi. Part of the upper Nile River Basin system, the Lake Victoria Basin (LVB) and the lake itself support a wide diversity of habitats, flora and fauna, making it ecologically significant. It is also economically important for the EAC, as the basin:

- supports a large fishing industry – both for export and local consumption
- is an important source of water
- provides a means of transportation
- is vital for hydropower generation

In 2001, the EAC established the Lake Victoria Basin Commission (LVBC) to serve as a mechanism for coordinating various water resources and environmental initiatives in the basin. Today, it is a centre for the promotion of studies, investments, and information sharing among the various stakeholders.

Well-documented environmental changes have occurred in Lake Victoria's and the basin's ecosystems over the past several decades. Increased strain on the basin's water resources has led to water quantity and quality issues. This could potentially affect the natural flora and fauna habitats in Lake Victoria and its basin.

Concerns about these changes led to the creation of the large-scale Lake Victoria Environmental Management Project (LVEMP), supported by the Global Environment Facility (GEF) and the Government of Sweden. With the goal of improving the livelihood of the communities that depend on the natural resources of the Lake Victoria Basin, the long-term, trans-boundary LVEMP is designed to:

- improve the collaborative management of natural resources
- identify and reduce environmental stress in hotspots and selected degraded sub-catchments
- better utilise water resources

LVEMP is now focused on developing a Water Resources Information System (WRIS) to monitor surface water, groundwater and water quality, and making this key information available. It includes a GIS-based database for land-use, hydrology, and biodiversity in the Lake Victoria Basin.

As part of the LVEMP, DHI has developed and operationalized the WRIS for use by multiple stakeholders, including technical and managerial personnel and selected information is available to the public. The project will also

Figure 4 - Local Fishermen on Lake Victoria (photo by Jens Kristian Loerup, DHI)

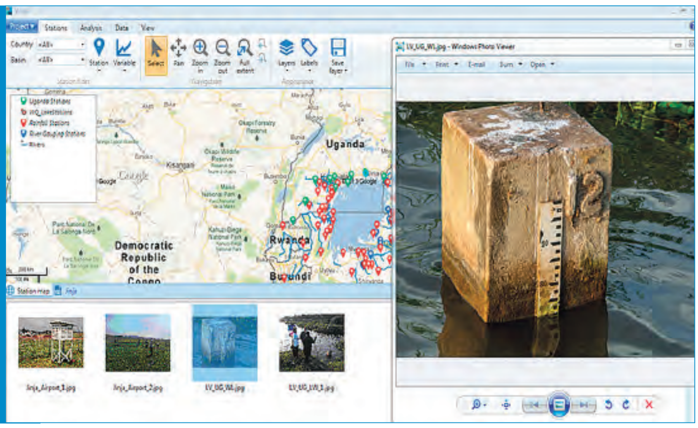


Figure 5 - The WRIS gives easy access to data for water managers within the Lake Victoria Basin (graphics by DHI)

contribute to the development of guidelines and methods for data exchange between stakeholders.

Application 2: Operational Decision Support System, Malawi

The Shire River is the largest river in Malawi and is the only outlet of Lake Malawi. From the lake, it flows around 400 kilometres before entering the Zambezi River in Mozambique. The river is an important water source for local water supply, irrigation and hydropower. Malawi relies almost entirely relies almost entirely on hydropower on the Shire Riverf or its power production, which depends primarily on a stable and sufficient outflow from Lake Malawi. Consequently sustainable use of water in the Lake Malawi basin is essential. The sustainable use of the water resources is a key element of the Shire River Basin Management Program (SRBMP, World Bank) which is currently being implemented in Malawi to increase social, economic and environmental benefits by effectively and collaboratively planning, developing and managing the Shire River Basin's natural resources.
Another central component of the SRBMP is the development of an Operational Decision Support System (ODSS) to provide short- and long-term forecasts of river flow and water levels along with a range of drought indicators to support operational decisions in the Shire River basin. The ODSS builds on MIKE INFO for data management, MIKE PLANNING for scenario analysis and MIKE OPERATIONS for long- and short-term forecasting.

The ODSS implementation is carried out in close cooperation with the Malawian authorities, particularly the Department for Climate Change and Meteorological Services and the Department of Water Resources, to ensure its applicability in reducing the adverse impacts of future climate extremes.

The ODSS automatically imports the latest spatial and temporal data, performs the required analyses and forecast calculations, and extracts key results and information for dissemination to stakeholders. It also includes a range of tools for the operators to monitor, process, and analyse the imported data and results of the ODSS.
Using satellite information as a data source is an important element of the project. Figure 7 shows the soil water index from 17th November 2014 through 1st January 2015 a period during which a drought was developing.

Shortly after 1st January 2015 (the last satellite image in Figure 7) the country was hit by heavy rainfall – more than 400 mm/day - causing severe floods, loss of life and damage to property, crops and infrastructure (see Figure 7). Thus, within few days the country went from dealing with drought to dealing with severe floods. This illustrates the relevance of the ODSS in helping water managers understanding, forecasting and managing these extremes and reducing their impacts.

Key results are kept up-to-date on a web site accessible by all stakeholders in the river basin as well as by the general public. Personnel with responsibilities for emergency actions automatically receive notifications (SMS or email messages) whenever the risk of flooding increases in their area. Figure 8 shows MIKE OPERATIONS giving water managers quick and simple access to key information during extreme events such as floods.

Conclusions

The Nile Basin DSS was the starting point for the development of a generalised software platform for data management, water resources planning and forecasting. The NB DSS is today a shared and accepted water management tool used by the Nile Basin countries. Today NB DSS is driven by the commercialised version of the software platform - MIKE PLANNING - which is used by many other countries in Africa. The system has further developed into a data and information management system and for operational forecasting, as exemplified by the Lake Victoria Water Resources Information System (WRIS) and the Operational Decision Support System (ODSS) in Malawi. MIKE INFO, MIKE PLANNING and MIKE OPERATIONS are today used globally and are continuously being further developed by DHI. Many of these new developments are made available to the NBI as part of their long-term service and maintenance agreement. What started with the NB DSS in 2009 has proven its usefulness at a global scale and is now moving into other water domains. For instance, MIKE OPERATIONS now helps cities reducing combined sewer overflows by controlling and optimising their collection systems in real-time and soon MIKE OPERATIONS will provide marine water forecast services – for instance during oil spill accidents or dredging activities. ■

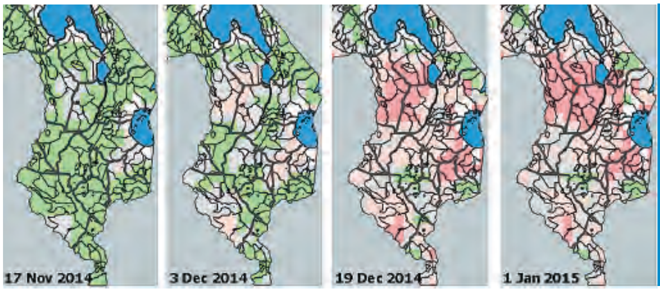


Figure 6 - Satellite-based soil water index illustrating the unusually dry conditions prevailing in December 2014 and early January 2015. These very dry conditions were followed by floods in January and February (graphics by DHI)

Figure 7 - The recent floods caused severe damage to important infrastructure in Malawi

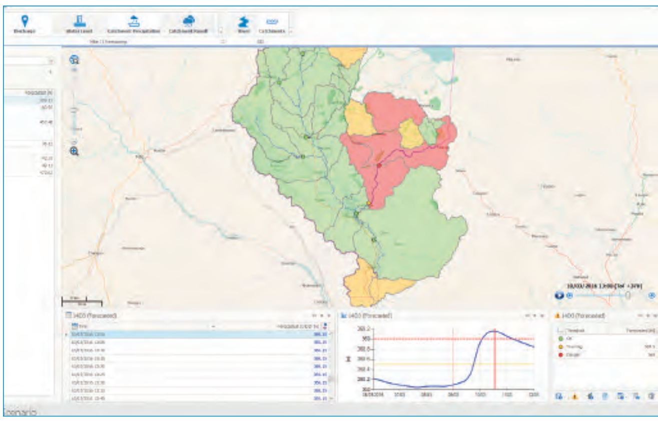


Figure 8 - A Real-Time Flood Forecasting System is being established with MIKE OPERATIONS, which gives water managers access to rainfall forecasts from meteorological models and forecasted flows and water levels at key locations along the rivers (graphics by DHI)

SOUTHERN AFRICA: WILL IT BE ACHIEVE INTERNATIONAL WAT

BY DAVID STEPHENSON

Southern Africa is the most dynamic zone on the African continent and sharing of resources is one of the aims of Southern African Development Community (SADC). Most countries in southern Africa share common major rivers i.e. the Zambezi, the Limpopo and the Orange. There is enough water to go around but country interests could interfere with sharing for equitable use.

Most interest is at present focused on the Orange River, which rises in Lesotho where it is called the Senqu River. The mean annual runoff of the Orange River is 12 000 Mm^3/yr (million cubic meters by year). Although guides as to sharing were originally related to the Helsinki/Berlin rules, a new set of guides was developed under the auspices of SADC. Agreements were signed between countries in some cases and protocols established. International agencies including EU, GTZ and the World Bank have maintained interest in setting up management guidelines.

SOUTH AFRICA (SA) has the highest demands for water in the region, for urban, mining and agricultural uses. It has rights to use of water from international rivers, especially the Orange River. It has plans to draw 1 400 Mm^3/yr from Lesotho and a further 7 000 Mm^3/yr for irrigation from the Orange River. A treaty between the two countries exists enabling SA to use this amount of water, but with other countries clambering for water this may have to be re-looked at.

LESOTHO has surplus water from its Highlands. The runoff from Lesotho including the Senqu river is 5 000 Mm^3/yr. South Africa draws water from the Katse and Mohale Dams in the mountain kingdom of Lesotho at an elevation 2 000 meters above sea level (masl). It is now planning another dam, the Polihali, to supplement those dams. South Africa will finance further developments to a large extent, whereas previous developments were funded by international organizations like World Bank.

South Africa also utilizes runoff from Lesotho to the Orange River. The bulk of that flow is used for irrigation. There are huge “losses” from the irrigation system, and environmental releases are proposed to improve the river eco system. South Africa already claims there is a shortfall of water for its purposes if environmental releases are increased in line with an upgrade of the river status.

BOTSWANA is the most desperate to get water. It shares the Zambezi, the Limpopo and Orange Rivers. But agreements have to be reached as to how much water it is entitled to from those international rivers. It is experiencing

Katse dam in Lesotho at an altitude of 2000 masl.

Zambezi river at Victoria Falls

POSSIBLE TO ER SHARING?

a drought at present, and as shown in the photograph, the main supply dam is empty. Botswana, strangely, realizes that water directly from Lesotho would be more economic than from the Chobe/Zambezi River confluence on its northern border, and indeed from its own dams 400 km to the north of the capital city of Gaborone. A scheme to dam water in rivers on the west of Lesotho and pump into rivers flowing north-west through the Freestate in SA is being considered. Initially water may be taken from the Highlands scheme. This idea will cause consternation amongst the countries involved. Existing treaties are threatened and usage in SA will be affected.

NAMIBIA is the most arid of the countries. It could theoretically tap the Okovango River which brings water from Angola's highlands to the Okovango delta in Botswana. That water flows into an environmentally sensitive site, and it is 700 km from the Capital city of Windhoek. The alternative is the Orange River to the south. Negotiations with South Africa to construct a dam on the Orange at Vioolsdrift are proceeding.

ZIMBABWE has access to the biggest river in the region, the Zambezi. But the river is to the north of these countries and 1 000 km of pipe is needed to reach Gaborone, the economic centre of Botswana.

MOZAMBIQUE suffers floods and droughts more severely than its geographic setting warrants. When there is a flood in the Zambezi, or Limpopo or other rives crossing borders into the country, its low lying plains suffer the most. And when there is drought in the region, waters are held back in dams in the countries to the west.

SADC - has established River Basin Commissions in attempt to reconcile management of the communal rivers.

Water infrastructure

The series of dams in Lesotho, intended to supply South Africa, includes Katse, Mohale, Muela and soon Polihali. An extensive series of tunnels over 100 km in length leads from the Highlands to South Africa, in particular Johannesburg and Gauteng province.

The biggest water pipelines are in Botswana.

Table with existing dams in Lesotho (Phase 1), and proposed (Phase 2).

Indicator	Phase IA	Phase IB	Phase II
Name	Katse Dam	Mohale Dam	Polihali Dam
Dam height (m)	185	145	182
Power generation (MW)	110 at 'Muela	N/A	Yes separate
Water transfer capacity (m^3/s)	17	10	
Transfer tunnels	Yes to 'Muela	Yes to Katse	Yes to Katse

David Stephenson **is a civil engineer based in Botswana. He is a consultant to Governments and industry on water supply and hydraulic structures. He was the lead consultant on the Lesotho Botswana Water Transfer Study. He conducted the hydraulic design for the North South Carrier pipeline. He was a professor at the University of Witwatersrand, and visiting professor in Tokyo, Stuttgart and McMaster. He is the author of 11 books and over 200 technical papers. He represents Africa on the IAHR Council.**

The North South Carrier I is 360 km long and up to 1.4 m diameter. It is made of GRP in places and steel in other places with higher pressures. There are 4 pumping stations along the line. The pipeline brings water from Letsibogo dam and Dikgathlong dam on the Shashe River north of Gaborone. North South Carrier II is at present under construction, also to supply Gaborone and towns and mines along the way. North South Carrier III has been mooted, but is likely to be supplanted by the LHBWT (Lesotho Highlands Botswana Water Transfer) comprising pipeline and rivers.

Botswana's expenditure on water infrastructure is the highest per capita in the region. With a population of 2 million people it relies heavily on diamond mining for its wealth. The resulting high cost of water is borne largely by the State. ■

Gaborone dam empty

NSC Pipeline to convey water to Gaborone

WATER GOVERNANCE IN MOROCCO

BY DALILA LOUDYI & MOHAMED OUBALKACE

Since its independence in 1956, Morocco has put in place a governance model of its water resources designed to satisfy its needs. First, a fairly structured centralized institutional framework was established along with a set of instruments for integrated water resources management. This governance model enabled undeniable achievements, yet it resulted in important shortcomings in managing the water resources across the country and the need for a new law for water resources management in a decentralized and participatory manner became urgent.

Legislative and regulatory framework

Water Law 10/95

At the legislative level, and in order to consolidate various laws on water and adapt these texts to new conditions of water resources use, the Moroccan government in 1995 promulgated the Law 10/95 on water. This law is based on the following principles:

- Water is public domain;
- Decentralized and participatory management with the creation of basin agencies;
- The regulation of activities that pollute water resources;
- The creation of a water police to suppress any illegal use of water or any act likely to impair (affect) its quality.

Other laws

This law is not the only one to govern the water sector. Indeed, given its importance and close relationship with the environment, the water sector is also ruled by a number of provisions scattered in other laws. These are primarily:

- The framework Law No. 99-12 to establish the National Charter for Environment and Sustainable Development, which sets out the rights and duties inherent to the environment and sustainable development, strengthening the legal protection of resources and ecosystems, defines responsibilities and commitments of all stakeholders, and expects the institutional, economic and financial measures to establish a efficient environmental governance system;
- Law No. 11-03 on the protection and enhancement of the environment which seeks to lay down basic rules and general principles of national policy in the field of environmental protection;
- The Act on environmental impact studies that submits all projects studies mentioned in the list annexed to this law to an environmental impact study and which links the authorization of any submitted project to an environmental acceptability decision;
- Agricultural Investment Code enacted in 1969 to specify the scope of intervention of the Regional Offices for Agricultural Development (ORMVAs)[1] relations and regulatory mechanisms between the state and farmers in particular the pricing of irrigation water;
- Communal Charter which gives broad competences to communal councils. In the area of

Oued al makhazine dam

Ouzoude waterfall

Bin El Ouidane dam

ORMVA is the acronym for the french name of the Regional Offices for Agricultural Development in Morocco.

water, these competences range from the drinking water distribution and sanitation to the preservation of the environment;

Other laws contain also stipulations to water use such as the Renewable Energy Act; the Delegated Management Act; the Public-Private Partnership Act; the Law on unhealthy uncomfortable or dangerous establishments; the Protected Areas Act; the Coast Act; the law on urban planning and the law on housing estates.

Institutional Framework

Given the multiplicity and variety of water users, the management of this resource involves several national stakeholders resulting in a shared responsibility not only at regional level but also at the institutional level. Indeed, water management responsibilities are shared among:

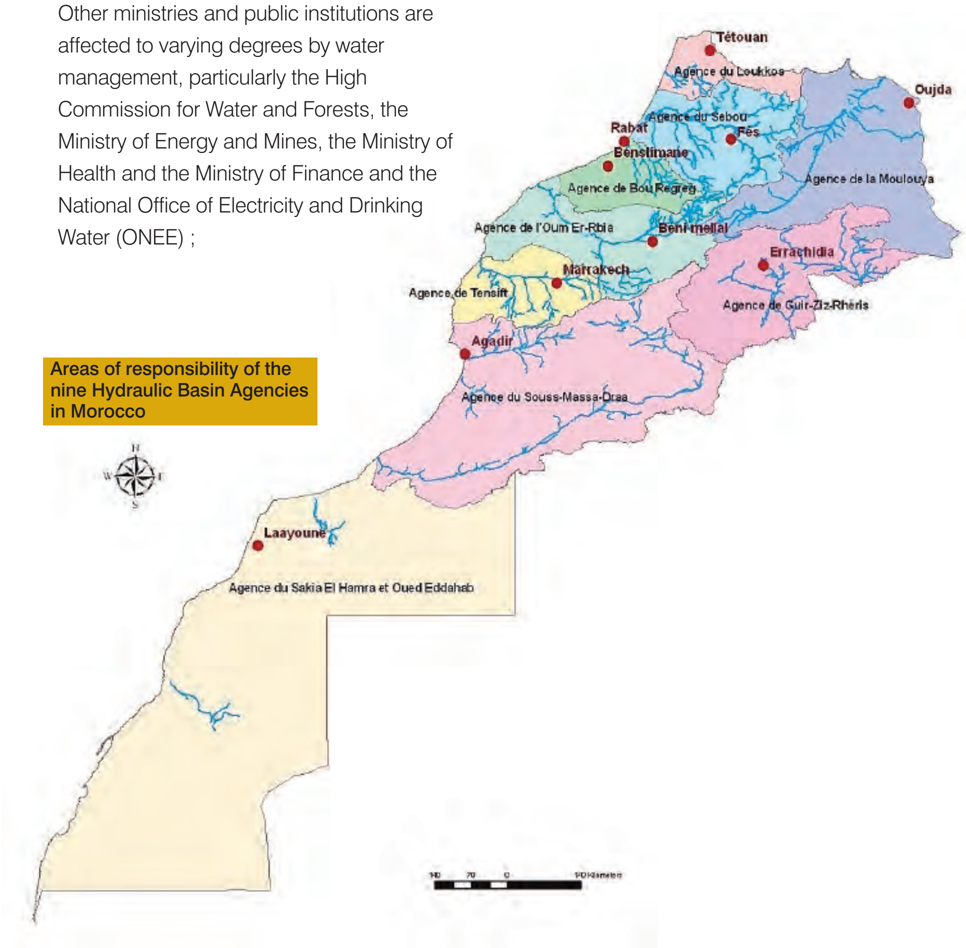
- Consultation bodies on national water policy, in particular the High Council for Water and Climate established by Law 10-95 on water,
- Coordinating bodies such as the Interministerial Water Commission, established by decree 2-14-500.
- The regulatory and planning institutions at national level, namely the ministries in charge of Water, Agriculture, Environment and Interior. Other ministries and public institutions are affected to varying degrees by water management, particularly the High Commission for Water and Forests, the Ministry of Energy and Mines, the Ministry of Health and the Ministry of Finance and the National Office of Electricity and Drinking Water (ONEE) ;
- Control and management institutions at regional and local levels, in particular the Hydraulic Basin Agencies (ABH), ORMVAs, municipalities, provincial services of the ministries in charge of water and agriculture;
- Operators: the ONEE, water distribution utilities, concession operators in the area of water and hydroelectric energy, drinking water distribution and sanitation, individual users and associations of water users;

This notwithstanding, the specialized services of the Ministry in Charge of Water, and hydraulic basin agencies placed under its supervision are the main administrative tool for water governance in Morocco.

Decentralized and collaborative management

The Hydraulic basin agencies

Regionally, water management is entrusted to nine Hydraulic BASIN AGENCIES (ABH) nationwide. They are autonomous public bodies established under the Law 10/95 on water that states the tasks entrusted to these regional institutions.
Their missions are extensive and diverse in nature and cover the public service (resource monitoring, water control, etc.), planning and regulation, operational and project management.



Areas of responsibility of the nine Hydraulic Basin Agencies in Morocco

Control and Water Police

Water control is one of the ABH missions. Indeed, according to the water Law 10-95, the ABH is responsible for managing and controlling the use of mobilized water resources. This Law states that, besides the officers of the judicial police, sworn agents commissioned for this purpose by the administration and basin agency are responsible for monitoring any violations of legal provisions on water and their related implementation texts.

This decentralized model has the advantage of unifying within the same organization, and basin-wide, all components of integrated water management. However, it may have, in the absence of regulatory mechanisms at higher level, conflicts of interest and in some cases financing problems of the ABH missions.

Allocation of resources in water-PDAIRE

The allocation of water resources between different competing, and most often conflicting, uses is done at the global level through the Master Plan of Integrated Water Resources Management (PDAIRE) and the National Water Plan (PNE) that are developed and adopted after a long consultation process.

When water rights are not applicable, in practice and on a larger scale, the distribution between same category users follows the rule of "first come, first served", particularly for groundwater. Despite the regime of water allocation and the obligation to respect the requirements of the PDAIREs, and in the absence of strict control, this practice leads to reducing the responsibility / accountability of water users who prefer to serve their immediate individual interests over the collective and long-term interests of their community. This also causes the over-exploitation of groundwater and widens the gap between traditional uses of poor peasants and modern uses of rich farmers.

The undergoing discussion on a new water law project (36-15) plans to remedy the shortcomings of this rule by involving end users in the management of groundwater within a contractual framework (aquifer contract).

Demand management is planned in an integrated manner along with supply management to ensure better development of water resources, and to adapt water demand to available water resources. It is now an essential component of water planning documents (PDAIREs and PNE) that have set efficiency targets for irrigation and drinking water distribution. Indeed, an important irrigation water saving program was launched in 2006, to provide for the conversion to localized irrigation of more than 550 000 ha by 2020. Financial mechanisms for promoting water savings and encouraging localized irrigation conversion have also been put in place. They provide, among others subsidies that can reach 100% for farms of less than 5 ha.

In addition to regular awareness campaigns for users, tariff readjustments in irrigation and drinking water services are also made occasionally aiming at full recovery of the distribution network operating costs. These adjustments encourage users to more rational water use and improve the funding of maintenance, and therefore reduce losses in the water distribution networks.

This approach will be strengthened in the future with the enactment of the new law on water which requires urban planning documents to take into consideration the guidelines and requirements of the PDAIREs and PNE.

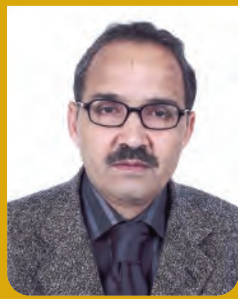
Participation of users and different stakeholders in water management

The participation of water users and the various water stakeholders comes at different levels such as:

- At the outline of the national water policy through the High Council for Water and Climate, where half the members are representatives of water users, prefectural or provincial assemblies, higher education and scientific research, and professional and scientific associations (NGOs);
- At the development and review of the master plans for integrated water resources management (PDAIRE) and the National Water Plan (PNE);
- At the level of exploitation and distribution of water through user associations (NGOs) of agricultural water and associations operating in rural areas.

Recently, several meetings of the hydraulic basin agencies boards of directors highlighted the lack of user involvement is basin management. To address this failure, basin councils were introduced by the draft law project 36-15. The chairpersons of these councils will be elected among the elected representatives and the civil society.

Dalila Loudyi **is a Professor at the Department of Water and Environmental Engineering at the Faculty of Sciences and Techniques at Mohammedia – University Hassan II of Casablanca. Since 1996, she is lecturing and supervising many courses for engineers in water and environment. In 1995, she graduated from Mohammedia School of engineers, in Rabat, Morocco. In 2005, she got her PhD in Environmental Water Management at Cardiff School of Engineering in the United Kingdom.**
Prof. Loudyi was selected by the Moroccan Ministry of Higher Education as a national contact point in environment, in 2010, to promote the use of the Seventh European Framework Program (FP7) for research and development at a national level. She is leading a research team working on water resources management, numerical modelling, hydro-informatics, urban water and climate change adaptation and mitigation measures, collaborating with different public and private water stakeholders. Since 2011, she is a member of the Leadership Team of the IAHR-MENA Collaboration Committee.



Mohamed Oubalkace **is Project Officer at the Department of Water Research and Planning at the Moroccan Ministry in Charge of Water. After graduating as an engineer specialized in hydrology from the Hassan II Agronomy and Veterinary Institute in Rabat, Mr. Mohamed Oubalkace joined the Directorate of Water Research and Planning at the Ministry of Public Works in December 1983. He was first assigned to the Hydrology Service as a planning engineer before joining the Service of Master Plans as a senior in charge of general, economic and environmental impact studies of hydraulic projects. Five years later he was appointed Head of the Master Plans Service before being promoted Head of Water Quality Division three years later. In 1997, he became Special Advisor of the General Director of Water, then, in 2003, the Special Advisor of the Secretary General of the Ministry of Land-use Planning, Water and Environment. In 2011, he regained the leadership of Water Research and Planning as a Special Advisor to the Director.**

Public-private partnership in the field of water

The use of public-private partnerships (PPP) in the water field is a very old practice in Morocco. The first concession for the production and distribution of drinking water was established in 1914.

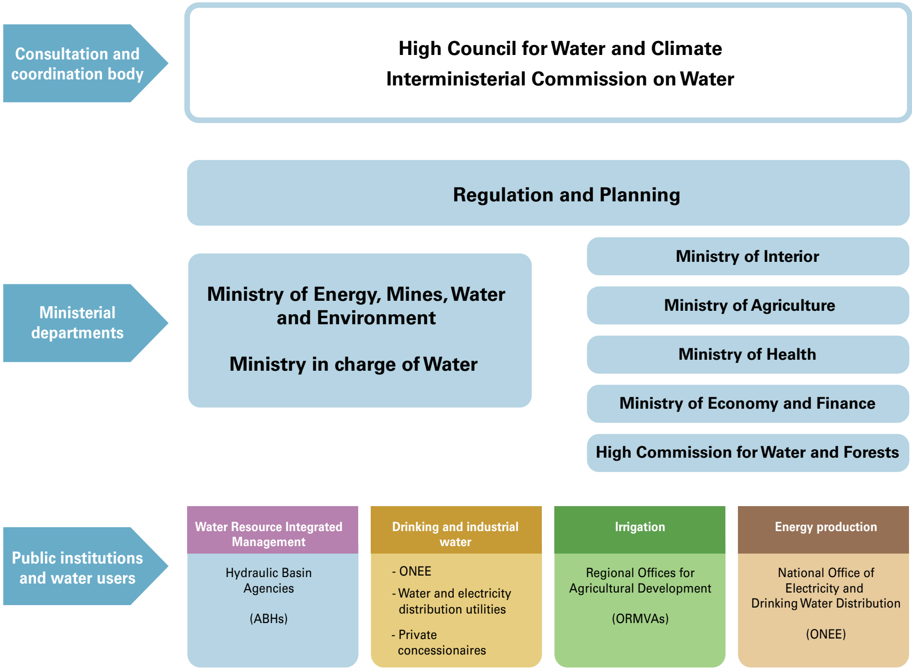
Today, and because of the institutional and regulatory business-friendly environment, concessions in the water sector have expanded also to the production and distribution of drinking and agricultural waters and production of hydro-electric power. Recently, a public-private partnership was established for the desalination of sea water.

Although the performance of these PPPs still falls short of their expected results, these partnerships have brought a certain knowledge that has also inspired local operators through a kind of competition between different private partners. This acquired know-how is now exported to countries in sub-Saharan Africa.

To encourage the establishment of PPPs, while ensuring effective regulation, the law on public-private partnership was enacted in 2013. The law on renewable energy also has been amended to increase the installed capacity of renewable energy plants that can be granted to private parties, to 30 MW from the current 12 MW.

Financing of the water sector

The government fully supports investments of surface water mobilization using dams and partially those relating to hydro-agricultural developments in public areas. It is also granting aid or subsidies for desalination of sea water, wastewater reuse, hydro-agricultural farm equipment, sanitation and works and equipment for using water more efficiently.



Operating Institutions in the Water Sector in Morocco

The ABHs finance totally or partially the construction of flood protection infrastructure, participate in the maintenance costs of the hydraulic infrastructure for the development of water resources and provide funds for water efficiency and water pollution protection projects. These operations are therefore partly financed by fees charged by the agencies for the use of water and public water infrastructure.

Local authorities are also involved in some cases in the construction or rehabilitation of hydraulic water works to the benefit of rural populations.

Private and public operators carry the costs of production and distribution of drinking and agricultural water as well as those related to sanitation. These costs are fully reflected in water pricing.

To improve the water sector financing terms, the draft water law project 36-15 stipulates sharing of costs and expenses incurred by the reuse of wastewater, between operators discharging wastewater and users of these waters.

Experts in irrigation with local farmers in Doukkala region

In conclusion, the water sector is financed in different ways depending on the level of water use without an overall fixed, strict and formal set of rules which would not allow streamlining developer decisions and user behavior.

Information and communication

Hydrologic data are published and distributed by the different administrative entities and semi-public and private operators. However, despite the large amount of water information circulating, the information systems of the water sector remains fragmented and not consolidated. The available data are disparate, sparse, incomplete and not updated on a systematic basis, and therefore difficult to use.
These weaknesses do not allow effective regulation of the water sector and directing water management decisions and behavior towards efficiency, rationality and sustainability. For this reason, the water law project 36-15 includes provisions requiring the administration and public institutions to set up an efficient water information system at the basin level and nationwide.

Conclusions

Analysis of the governance of the water sector in Morocco shows that significant progress has been made since 1995, following the promulgation of the Water Law 10-95. The organization of the water sector is thus characterized by the distribution of water management responsibilities among different institutions. Although this has advantages, it also shows some problems in the sharing of responsibility, control and coordination. Weaknesses and shortcomings still exist, particularly in terms of the regulation of the water sector as a whole, as it is still sketchy and incomplete, in addition to the lack of accessibility to reliable physical and financial information on the water sector.

To overcome these difficulties the draft water law project 36-15, which is now being discussed within the government, includes provisions and improvements in the regulatory and institutional framework. It aims to fill a large part of these weaknesses by:

- the creation of basin councils to strengthen consultation at regional level;
- the regulation of sewerage;
- the regulation of desalination of sea water to clarify responsibilities in the matter. ■

WE ARE GETTING CLOSER TO CONGRESS OF HYDRAULICS IN

BY THE LOCAL ORGANISING COMMITTEE

1

Time has gone by fast since the last 26th Congress in Santiago de Chile in 2014, and now it is Peru's turn to prepare to host the 27th Congress. Arrangements are well under way! This is our chance to welcome you, help you get to know Peru and Latin America, and have you enjoy some intense and productive days filled with experience sharing and new opportunities.

Peruvian IAHR members have been making efforts for some years to make Peru the venue of the Congress, like in the congresses of Punta del Este, Uruguay, and San Jose, Costa Rica where Lima was finally elected! For various reasons –that are now happily overcome – Peru has not been able to hold the Latin American Congress of Hydraulics since 1972.

In the last five years Peru has experienced one of the highest growth levels in Latin America with an average annual GDP increase of 5.4% (2010-2014), mostly driven by the mining sector and non-traditional exports which develop engineering-intensive activities in terms of consulting and construction.

The Conference could not be held at a better time. By the end of September, the misty days of July and August are over and the sun starts to shine making the city of Lima feel intensely alive. The conference venue is located between the modern and residential districts of Miraflores, San Isidro and San Borja where our participants will find a range of suitable accommodation and, of course, outstanding restaurants serving Peruvian cuisine in today's gastronomic capital of South America.

The local organising committee has been working on the reception of extended abstracts for the nine areas of specialization and expects to exceed the number of papers presented in

THE NEXT LATIN AMERICAN LIMA, PERU!

Deadline for abstracts extended until January 15th

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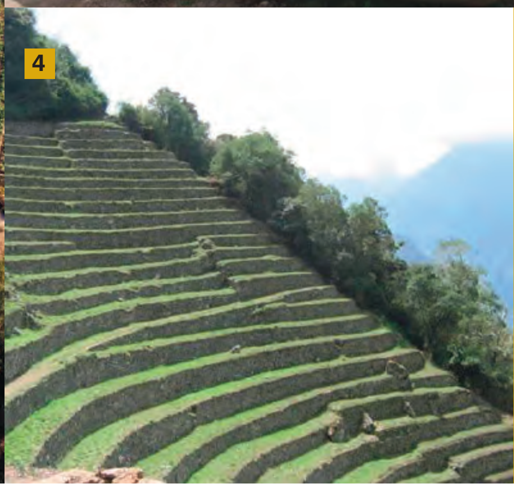


1. The Basilica Cathedral located in the Plaza Mayor of downtown Lima, Peru.

2. Nazca aqueducts, irrigation and drainage system in an extremely arid coastal plain, Pre-Inca waterworks. Location: Ica, Nazca, Peru

3. View of the Sayhuite stone, and Inca deity representing the hydraulic model of an Andean irrigation system. Location: Apurimac, Peru. Source: Promperu

4. Inca terraces at Machu Picchu, a true example of drainage and erosion control engineering. Location: Cuzco, Peru. Source: Promperu

5. Tiphon is a sacred ceremonial site dedicated to water that displays waterworks with exquisite designs and water management techniques. Location: Cusco, Peru

earlier events. Leading researchers from the United States, Europe and Latin America are expected to participate as keynote conference speakers, for example, Prof. Marcelo Garcia from the University of Illinois; Prof. Pierre Julien from Colorado State University; Prof. Wolfgang Kinzelbach from ETH, Zurich; Prof. Bárdozzy from Stuttgart University, Germany; and other renowned researchers. Furthermore, the committee is organizing up to six pre-congress courses on different trending topics, such as: physical modelling of flows, 2D and 3D numerical modelling, hydrological uncertainty and climate change, river hydraulics, optimization of hydraulic models.

After the conference, participants will have the opportunity to go and visit the fabulous city of Cusco (the navel of the world) and, of course, Machu Picchu one of the new seven wonders of the modern world, which is only 1 hr. and 30 mins away from Lima by plane. For those who do not want to travel far, the Nazca lines are also a good choice. These majestic pre-Inca shapes are located in the coast of Ica (south of Lima) with its aqueducts and irrigation systems can be visited.

This congress with its slogan "Ancient and Modern Peru: from ancestral hydraulic wisdom to state-of-the art technology at the service of sustainable development" seeks to become a continental reference for the coming years in the fields of hydraulics and the environment. Thanks to the support of Peru's four largest universities – namely *the Universidad Nacional de Ingeniería, Universidad Nacional Agraria, Universidad Nacional Mayor de San Marcos and Pontificia Universidad Católica – plus three institutions – Autoridad Nacional del Agua (National Water Authority), Colegio de Ingenieros del Perú (Board of Engineers of Peru), and CREAR: Center for Research and Education of the Amazonian Rainforest* (Univ. of Pittsburg) – as well as with the support of IAHR and its Latin American committee, ***Lima is waiting for you from September 26 to 30, 2016!!!***

Point of Contact: Julio Kuroiwa Z, PhD.
E-mail: secretaria@ladhi2016.org
Website: http://ladhi2016.org

CONNECTING THE COUNTRY, IMPROVING HYDRO-ENVIRONMENTAL RESEARCH – THE START OF A NATIONAL YOUNG PROFESSIONALS NETWORK: IAHR PORTUGAL YPN

BY TIAGO FERRADOSA, VANESSA RAMOS, GUILHERME PAREDES, PEDRO LOPES AND RUI LIMA

Tiago Ferradosa *Vanessa Ramos* *Guilherme Paredes* *Pedro Lopes* *Rui Lima*

Gathering and mobilizing a country's community of young engineers and researchers in a full national scale might seem a herculean task. However, this challenge was taken on by several Portuguese institutions at the 3rd Europe Congress of IAHR, held in Porto, 2014.

The idea was to create an IAHR-YPN nucleus that could contribute for the knowledge and professional experiences sharing and improvement for Portuguese young professionals in the field of hydro-environmental engineering.
IAHR-YPN Portugal was also born as a continuity project of the Students' Chapter, already existent in Coimbra. Founded at the beginning of 2015, IAHR-YPN Portugal is now gaining strength and projection, being committed to several activities that are already being organized. This group of young members has a remarkable will to increase the links between academia and companies. Several events are now being planned as part of the annual contribution that this nucleus wants to provide in order to increase the dynamism of young engineers.

The following milestones are being organised for the year of 2015/2016: the 1st National Meeting for Young Professionals and Researchers, the award "Best Publication of the Year", the cycle of keynote speeches "Let's talk about" and several other activities such as courses, field trips and newsletter.
IAHR-YPN Portugal is also very keen in providing strong contacts with members of the other nucleus across the world, within a perspective of internationalisation of the Portuguese achievements in the Hydro-environmental Engineering. ■

PEOPLE & PLACES

Please send us news and news of your colleagues to share with the IAHR community! (eg. a new appointment or promotion in your department or an award)

Jean-Paul Chabard Scientific Director of EDF

Jean-Paul Chabard has recently been appointed Scientific Director of EDF, the French Power Company. He was also been awarded IAHR Honorary Member at the recent IAHR World Congress in The Hague.

Left to right Arthur Mynett, IAHR VP and LOC Chair, Roger Falconer, IAHR President, Jean-Paul Chabard & Christopher George, IAHR Executive Director

Anton Schleiss President of ICOLD

Anton Schleiss has been elected as President of ICOLD - International Commission on Large Dams - for the term 2015 to 2018.
The mission of ICOLD is to lead the field in setting standards and guidelines, to ensure that dams are built and operated safely, efficiently, economically, and are environmentally sustainable and socially equitable. The election was held in Stavanger, Norway, during the organization's 83rd Annual Meeting followed by its 25th Congress. Schleiss is also an IAHR Council Member and Chair of the IAHR Europe Division.

IAHR Honorary Member Felipe Martinez Receives Award

IAHR Honorary Member and Former IAHR VP from 1994 to 1996 was recently presented with a special Life Achievement Award at the 13th Spanish National Ports and Coasts Conference.

Felipe Martínez second from left

New Institute Members

We welcome our latest Institute Members:

Action Modulers,
Consulting & Technology, Portugal
www.actionmodulers.pt

Water and Environmental
Engineering Group (GEAMA),
University of A Coruña, Spain
www.geama.org

INGETEC, Consulting Engineers,
Colombia
www.ingetec.com.co

Institute of Hydraulics,
Hydrology and Sanitary Engineering,
University of Piura, Peru
www.udep.edu.pe/ingenieria/ihhs

Young Professionals Networks News

The CIWEM - Chartered Institution of Water and Environmental Management - Micro-Presentations Evening organised and hosted by the Cardiff IAHR YPN was awarded with the Institution of Water & Environmental Management Welsh Branch Award for best presentation of the year.

Officers of the Cardiff IAHR Young Professionals Network

ERRATUM

In the article titled "Summary of recommendations for policymakers on adaption to climate change in water engineering" published in Hydrolink, 3, 93-95, 2015, the full list of authors is:
Ranzi R., G. Nalder, A.A. Abdalla, J. Ball, G.S. De Costa, C. Galvão, Y.Jia,Y.O. Kim, E. Kolokytha, S.I. Lee, E. Nakakita, V.T.V. Nguyen, A. Paquier, P.L. Patel, M.A. Peviani, R. Teegavarapu.
Maximo Aurelio Peviani was missing.

PEOPLE & PLACES

New IAHR Council completes its team with two Co-opted members

The IAHR Constitution provides for the new council to co-opt up to three additional members from members of the association who preferably have served on council. One of the co-opted members who has preferably served on the executive committee may in exceptional circumstances be appointed as a vice president.

The co-opting of additional council members provides a mechanism for the incoming council to fill any gaps in the competencies of the elected council body (whether regional or technical). Following internal discussions the new Council - elected in The Hague - has made the following appointments:

Dr Angelos Findikakis (Bechtel, USA) Council Member - is co-opted as a Vice-President

The development of our association to respond to the needs of "practice" is vital if we are to survive and prosper.

Angelos is very well known in IAHR. He was formerly Chair of the Groundwater Committee, and is already an elected Council Member. In addition to his specialist hydraulic engineering project role in Bechtel, he is a Bechtel Fellow. This is the highest honour bestowed on an employee of Bechtel. Bringing Angelos into the Executive Committee of the Council as a Vice president will enable us to benefit from his skills, industry experience and extensive connections to the private sector. By co-opting Angelos to the EC, we will also be able to support Angelos in his other new role as Editor of Hydrolink. The primary role of this Vice-President will be to expand our connections with industry and the private sector.

http://www.bechtel.com/services/engineering/fellows/angelos-findikakis-flow-transport-simulation/

Prof Rob Ettema (Colorado State University, USA) - is co-opted as a Council Member

Rob is well-known in IAHR and has served on council between 2011 and 2015; the outgoing council approved his proposals for IAHR to develop new approaches to revenue generation for IAHR. Rob has been heavily engaged in fund raising and revenue generation for universities and co-opting him will allow us to use these skills to explore innovative ways of improving the financial sustainability of IAHR. Furthermore he will complement the elected council through his links with ASCE and our ice engineering community, his experience in editing journals, and IAHR congress organisation.

https://www.engr.colostate.edu/ce/

IAHR Vice President Prof Mynett retired

Prof Arthur Mynett, IAHR Vice President, Professor of Hydraulic Engineering and Head of the Water Science & Engineering Department at UNESCO-IHE The Netherlands retired on 27 November 2015. His career at UNESCO-IHE started in 1985 as a guest lecturer, teaching physics and mathematics in the Hydraulic Engineering course. While leading the department for Strategic Research at Delft Hydraulics, he was appointed part-time Professor of Environmental Hydroinformatics at UNESCO-IHE in 1997. From 2011 onwards he was employed as full time Professor in Hydraulic Engineering and River Basin Development, and served as Head of the Department of Water Science & Engineering.

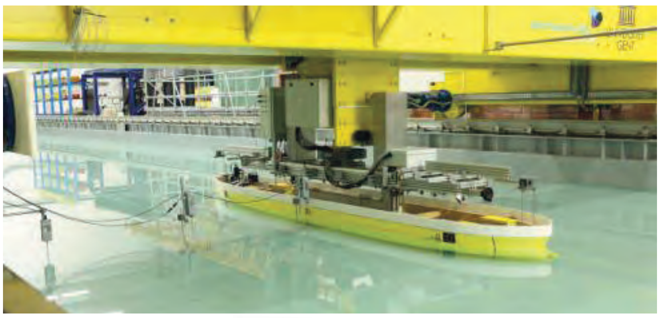
Prof Nigel Wright, Pro Vice-Chancellor and Dean of the Faculty of Technology, De Montfort University, Leicester, UK

Professor Niguel Wright, former Chair of the IAHR UK National Chapter, has been appointed as Pro Vice-Chancellor and Dean of Technology of the De Montfort University of Leicester, UK in September 2015.

http://www.dmu.ac.uk/about-dmu/university-governance/executive-board/nigel-wright.aspx

Flanders Hydraulics Research has recently published a Newsletter on behaviour of ships in shallow and confined water

http://www.flandershydraulicsresearch.be/22nd%20Newsletter%20KCMSCW



Please send us news and news of your colleagues to share with the IAHR community! (eg. a new appointment or promotion in your department or an award)

PEOPLE & PLACES

Interested in hosting the IAHR 2021 World Congress?

IAHR Members are cordially invited to submit expressions of interest to host the 39th IAHR World Congress which will be held in 2021. Expressions of Interest should be submitted to the IAHR Secretariat by January 31st 2016, and prospective applicants are strongly recommended to contact IAHR Executive Director, Dr Christopher George, for an informal discussion as a first step. The IAHR Council will select the Congress venue at its meeting in August 2016. The forthcoming World Congresses will be in Kuala Lumpur, Malaysia in 2017 and in Panama in 2019.

World Water Council President Braga to serve a second term

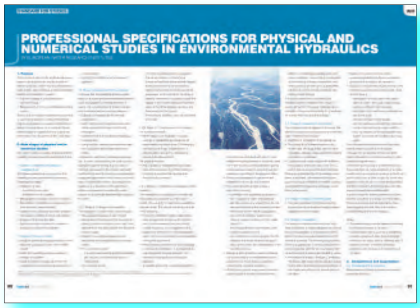
Benedito Braga has been elected to serve his second term as President of the World Water Council, on the occasion of the Council's triennial General Assembly, which is taking place in Marseille, France. IAHR council recently decided to rejoin the WWC.

Dr Bas Hofland appointed to faculty of TU Delft, The Netherlands

Bas has joined the Department of Hydraulic Engineering recently. He will be working with Henk Jan Verhagen on bed, bank and shoreline protections, and coastal structures, as part of both the Hydraulic Structures & Flood Safety and Coastal Engineering sections. He will be involved in both teaching and research.

Discuss the draft document

We welcome any comments on the article entitled "**Professional Specifications for Physical and Numerical Studies in Environmental Hydraulics**" published in Hydrolink issue 3, 2015. Our intention is to discuss the draft document prepared by the European Water Research Institutes with other members.


PROFESSIONAL SPECIFICATIONS FOR PHYSICAL AND NUMERICAL STUDIES IN ENVIRONMENTAL HYDRAULICS

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