Development of a Spatial Data Infrastructure for the water sector of Benin

J. van der Kwast¹, D. van den Bergh², D. Mama³, P. Hounkpe⁴, J. de Schutter¹

1. UNESCO-IHE Institute for Water Education, Delft, the Netherlands
2. Deltares, Delft, the Netherlands
3. Université d’Abomey-Calavi, Abomey-Calavi, Benin

Corresponding author: J. van der Kwast, e-mail: j.vanderkwast@unesco-ihe.org

1 Introduction
Benin has adequate water resources for food production, drinking water and nature conservation. Nevertheless, unsustainable agricultural and other land-use practices and water use, combined with the anticipated effects of climate change and population growth threaten the water resources. As more West African countries, Benin is already confronted with large environmental problems such as seasonal water shortages, (urban) pollution, salinization and increasing damage due to flooding. For this reason Benin adopted Integrated Water Resources Management (IWRM) as the key policy to manage its large problems with water resources in a sustainable way.

Since 2009 a water policy exists. In 2010 a new water act was adopted. Furthermore, there is a climate adaptation plan (Plan d'Action National d'Adaptation aux Changement Climatiques; PANA) and the national action plan for IWRM (Plan d'Action National pour la Gestion Intégrée des Ressources en Eau; PANGIRE).

IWRM, however, cannot be done without an in depth knowledge of water resources in both quantitative and qualitative terms. Both public and private stakeholders in the water sector of Benin, who are responsible for the operational strategies and policies, lack knowledge and data on, e.g. the amount of groundwater recharge, the network and discharge of river systems, the dynamics on catchment level, water quality and ecological status.

In order to develop capacity in the water sector, the Dutch funded Nuffic NICHE 167 project aims to establish a National Water Institute (Institute National de l'Eau; INE). The INE will organise short courses and develop a research agenda tailored to the needs of the water sector. Furthermore the INE will provide specialised consultancy services at the interface of science and policy for water management. A quick scan needs assessment done in Benin in May 2013 showed that the water sector urgently needs a Spatial Data Infrastructure (SDI) to improve the quality and the access to data collected by the different stakeholders. This study presents an approach for setting up and maintaining an SDI at the national level and the challenges that need to be tackled. An SDI is defined by the technology used, policies and standards applied, human resources and institutions participating, and activities necessary to acquire, process, distribute, use, maintain, and preserve geo-referenced data.

2 Current situation
From the interviews of the needs assessment it became clear that different organisations in the water sector (e.g. SONEB, DG Eau, ASECNA, MS, ANCB) have their own databases but they are not connected. Access to the existing datasets is limited and mostly off-line. Many datasets are only available as hardcopy, hampering (near) real-time monitoring and forecast. Digitization of hardcopy data can induce errors. The data are generally not validated and therefore the reliability of the data for each database cannot be guaranteed. Furthermore many data are missing, resulting in suboptimal solutions for environmental problems. Another issue is that only 3.5% of the population uses internet, while for example in Bangladesh this is 5% (http://www.internetworldstats.com, June 30 2012), hampering a wide distribution of data.
3 Approach

3.1 Standardisation

Standardisation of procedures for data collection, storage and sharing is the first step for establishing a national SDI. In addition, origin and ownership of the data needs to be clear. Internationally the Open Geospatial Consortium (OGC) develops and promotes open standards to ensure interoperability of content, services and exchanges in the fields of geomatics and geographic information. These standards promote cooperation between developers, data suppliers and end users. The use of these standards in Benin will also enable connection with regional and global SDI’s.

Standardisation requires collaboration at different scales (institutional, community, national, regional, and global). Furthermore, consensus to accept the standards applied is needed from the entire water sector. This often means that existing standards for collection, processing and storage of data need to be replaced within an organization. These standardised processes need to be repeatable and certified.

The most important standard to agree upon is the metadata standard. These are requirements which are intended to establish a common understanding of the meaning or semantics of the data, to ensure correct and proper use and interpretation of the data by its owners and users (ISO/IEC, 2003). To achieve this common understanding the metadata needs to be defined. For example, the European Union adopted the ISO 19115 standard in the INSPIRE directive. In this way the different data repositories can be easily connected to a pan-European SDI.

3.2 Connecting existing databases

Once the existing databases are adapted to the standards, they can be connected to a central portal that gives access to metadata and, depending on the user privileges, to the data in all databases connected to the SDI. Because of the low availability of internet in Benin, it is proposed not to use only one central server, but to establish a mirror of the central server at the INE at the largest data providers in Benin (e.g., SONEB, ANCB and DG Eau). These redundant servers not only increase the uptime of the SDI, but also increase the concept of a cooperating water community in Benin, without centralized power. For most users, however, data will be easily accessible through the INE, which is a national institute. Within the INE users can connect to the SDI web portal using the wifi intranet at the institute.

3.3 Challenges

The effective implementation of an SDI for the water sector of Benin has some important challenges. The data collection needs to be improved by using measurements that are digitized in a prescribed format or by using digital measurements that directly connect to the SDI via internet or GSM (telemetry, sms or internet via 3G/4G). Crowd sourcing is also a serious option, particularly in data poor rural communities. Implementation of data collection standards, such as the OGC sensorweb standard, is a prerequisite.

Investment in the availability of internet is needed to increase the accessibility of the SDI nationwide. A business plan needs to be developed, including a cost benefit analysis, to account for cost recovery and return on investment for the SDI. Furthermore, capacity development is needed for the installation and maintenance of the hardware and software, data collection and processing, and quality assurance.

An SDI policy needs to be developed taking into account the (metadata) standards and rights management (copyright, open access and restricted access). Besides the technical challenge an access policy including copy rights and payments needs to be established.

Undoubtedly, the most important factor for a successful implementation of an SDI is the commitment of different and well informed producers, integrators and users of data in the water and water related sectors.
4 Conclusion
This study presents an approach for the implementation of an SDI for the water and water related sectors of Benin. Only by improving the availability of data the water use and water user challenges of the future can be anticipated and appropriate mitigation actions implemented.

References

Acknowledgments
We sincerely thank all stakeholders in Benin that participated in the needs assessment.