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Integrating Visioning, RIDA and DSS activities in Alexandria

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Abstract

An integrated approach for linking the Alexandria LA activities and the application of a first prototype Decision Support System is presented. The objective is to exploit the synergies and to develop a collaboration scheme that, working with the local stakeholders, could map, model as well as test potential future scenarios for the city of Alexandria. To this end a methodology is introduced which includes a Visioning process, a Resource-Infrastructure-Demand-Access (RIDA) analysis and a stepwise development of the Decision Support System (DSS).

The Visioning process and RIDA analysis are practical methodologies that can be used both to promote stakeholder dialogue and to define the interrelations and dependencies within the urban water management system. Outputs from using these methodologies can be used as a starting point for scenario building and the development of a DSS. The DSS, which in the current stage makes use of the Aquacycle model will be used to evaluate strategies and to develop an IUWM plan aimed at achieving the shared Vision of the Alexandria Learning Alliance.

Keywords: Participatory processes, Visioning, RIDA analysis, DSS, Aquacycle, Scenarios

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1 Introduction

A framework of synergies between research processes and tools is developed to facilitate the LA activities in the Demo Cities, and to provide specific proposals for strategy implementation as well as indicators towards reaching the SWITCH objectives. To achieve this, three types of analysis and processes are proposed. The first, Visioning, will facilitate the development of a shared vision for the city, the second (RIDA) will provide a detailed mapping of the urban water system and the interdependencies in it, and along with visioning will develop scenarios and strategies. The third process entails the DSS application for modeling the urban water systems and for testing the alternative technology or governance options that, if implemented can contribute to achievement of the shared vision.
It is proposed that this methodology be applied in the Demo city of Alexandria with the ultimate aim of formulating a comprehensive and implementable IUWM plan for the city.

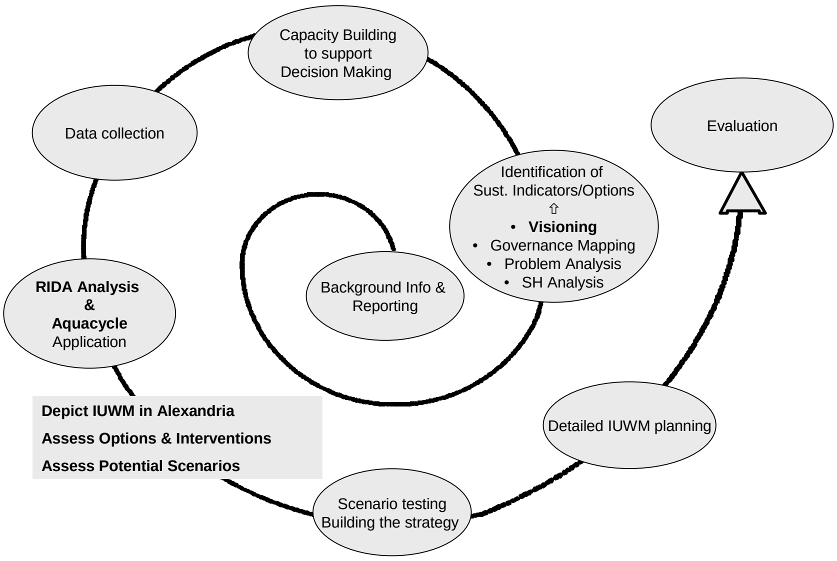

Figure 1 Methodological pathway of forming an IUWM for Alexandria

The methodological pathway of Figure 1 links processes and activities within SWITCH. Each step described in the pathway addresses a specific research aim:

Step 1. To find ways of sharing information among the SWITCH consortium and to obtain a good common level of knowledge and understanding of the main issues in the Demo City of Alexandria;

Step 2. To assess the urban water system, create a vision for the city also shared by local actors, and to develop a set of indicators to address the vision;

Step 3. To maintain a high level of consensus amongst LA members and SWITCH researchers on key information and problems faced in the area, and to establish a framework of cooperation and decision making;

Step 4. To undertake a water resource assessment aimed at supporting RIDA analysis and DSS modeling;

Step 5. To assess and simulate the urban water system;

Step 6. To develop and test future scenarios and related strategies;

Step 7. To adjust the vision and the scenario testing results towards developing a comprehensive IUWM plan;

Step 8. To evaluate the IUWM plan by the Alexandria LA with specialist support from relevant SWITCH partners.

The Visioning process and the RIDA analysis (Theme 6) utilise participatory processes for scenario building and strategic planning. Theme 1 provides the modeling tools for the simulation of the urban water system and for the testing of alternative technologies/options that form the scenarios and the strategies. A DSS tool, based on Aquacycle, is currently developed stepwise and applied in the Demo City of Alexandria, taking into account data availability, specific needs and involvement of Stakeholders.

2 Overview of Methodological Components

The synergies among the three approaches lie on the on-going collaboration in data collection, on the creation of an information-exchange platform among SWITCH researchers and local actors, and on the development and testing of scenarios and strategies.

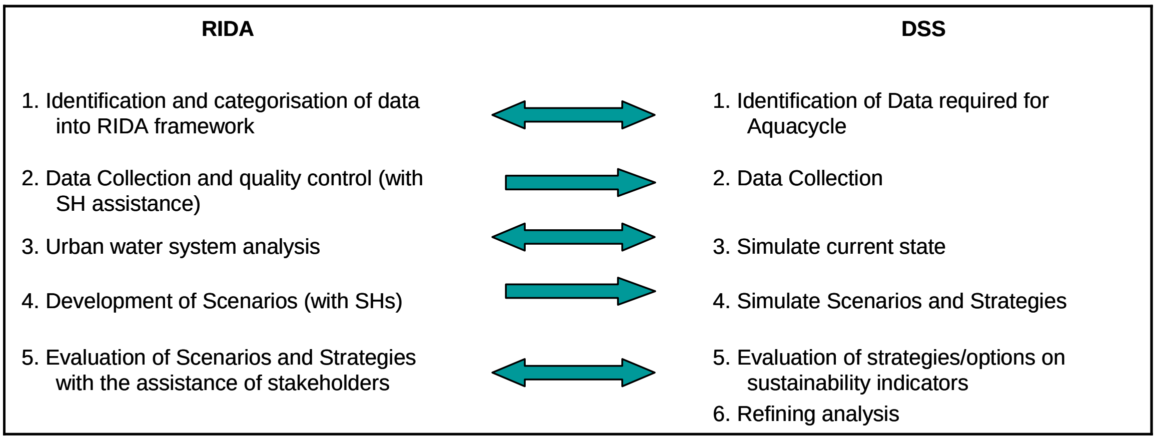

Figure 2 Synergies and interdependencies between RIDA analysis and the DSS application

Both quantitative and qualitative data are collected, comprising both societal and technical information. Information to be collected and quality-controlled will include: meteorological data; spatial and temporal water supply and demand information; wastewater and stormwater information, as well as information relating to social inclusion, administrative and institutional issues. The data required will overall be used a) in mapping (RIDA) and simulating (DSS based on Aquacycle) the current condition of the urban water system, b) in evaluating the extent to which current and future demands are met; c) in creating a vision for the city and in developing future scenarios and related strategies (Visioning & RIDA), and d) in evaluating the formed scenarios and strategies using sustainability indicators (DSS).

2.1 The Visioning process

The dual objective of Visioning is to:

- Reach consensus among a group of stakeholders on their vision of the status of water resources and water services in set a future timeframe;
- Produce a vision that can provide a common focus and target for strategies and plans aimed at managing and improving water services.

A vision represents a desired situation at a certain point in the future. As such, the gap between the current situation and the vision defines the gap or deficiency that the stakeholders would like to overcome (EMPOWERS Project, 2005).

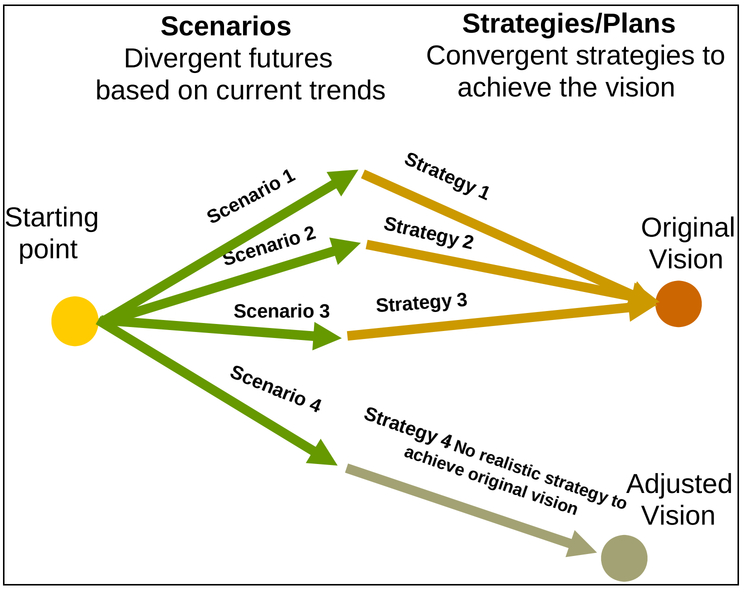

Figure 3 The Visioning process

The developed common vision is used as a basis for further formulation in collaboration with stakeholders, of future scenarios – consistent descriptions of possible future situations - and related strategies that take account of inherent uncertainties, constraints and risks.

2.2 The RIDA analysis

The overall objectives of the RIDA framework are to:

- Establish a high level of consensus and understanding amongst LA members and SWITCH researchers in water supply and service delivery systems;
- Provide background information for problem analysis, IUWM modeling studies and solution identification;
- Identify possible information gaps and/or quality control challenges.

The first step in the RIDA analysis framework is to identify and categorise existing data according to the Resource-Infrastructure-Demand-Access scheme (Batchelor et al., 2005). This categorization enables the collection of quantitative and qualitative information, such as social and administrative issues and patterns, with the assistance of local stakeholders (Table 1).

Table 1. Key information categorized according to RIDA analysis approach

Resources **(water resources in space and time)**	**Infrastructure** **(Supply and treatment capacity)**	**Demand** **(Entitlement, right or need)**	**Access** **(Actual use)**
What are the main water sources and their volumetric contribution in space/time to meeting demand? What is the scale of competition for water between urban and peri-urban/rural areas? Who is affected by this competition? What is the quality in space/time? Who manages water resources and on what basis? What are the existing human and financial resources? What is the water harvesting potential? What are the desalination costs? What are the irrigation and wastewater return flows? What percentage is treated?	What infrastructure exists? What is the extent of infrastructure systems? Do these systems supply water to users outside the urban areas? What is the infrastructure capacity in space and time (nominal and actual)? What is the condition of infrastructure? Who is responsible for Operation & Maintenance? What are the losses and unaccounted water volumes? Who controls different parts of the infrastructure system? What are the levels of water treatment and what are the costs? What is the storage capacity in space and time? Who is responsible for monitoring water quality?	What is the extent of the urban area? What are the demands of different sectors in space/time? Are peri-urban users included? How many domestic users in space/time? What are the systems of governance? What are the institutional structures? Are demand management policies in place and enforced? Is there legislation to support entitlements? Who pays and how much? Is there an independent regulator?	Are demands of all sectors and users met in space and time? If not, who loses out when and where? What are the coping strategies of users who lose out? What is the level of access to safe water (within government norms)? Are there access issues that are related to women, the poor and the marginalized? Is account taken of ecological flows and maritime eco-systems? Is access maintained to users who have difficulty paying for services?

The RIDA analysis consolidates the information gathered and provides mapping of the current urban water condition in tabular, schematic and descriptive form. It also provides an assessment of the main urban water problems in the area of interest, management gaps and areas of interventions.
As a second step, RIDA, is used in collaboration with Visioning in developing future scenarios and in identifying technology options to form the related strategies, all targeting the achievement of the overall vision.

2.3 A DSS for evaluating alternative options and strategies towards developing an IUWM plan for Alexandria

A DSS based on the Aquacycle modeling tool (Mitchell, 2001), is currently under adaptation for use in the Alexandria Demo City. Aquacycle is a decision support system that allows the simulation of urban water systems and scenario modeling of alternative urban water management schemes, through the use of relevant indicators.
The main objectives of the DSS are:

- To use existing data, in this case collected collaboratively with RIDA, to simulate the urban water cycle, in an integrated way, through:
    - determining the demand criteria of the various urban water uses in terms of quantity and temporal and spatial pattern;

- characterizing the supply of urban stormwater and wastewater in terms of quantity and temporal and spatial distribution;

- To provide a tool for assessing the performance of alternative schemes/scenarios, i.e. changes in water supply and demand, stormwater and wastewater reuse.

Aquacycle can, therefore, be considered a powerful tool not only in simulating the existing water cycle but also in improving efficiency of water use through the optimization of stormwater and wastewater reuse (Mitchell et al. 2001).

The Aquacycle modeling approach accounts for all stages of the urban water system, starting with inflows, in the form of precipitation and imported freshwater, passing through the supply-wastewater system, and exiting in the form of evapotranspiration, stormwater and wastewater.

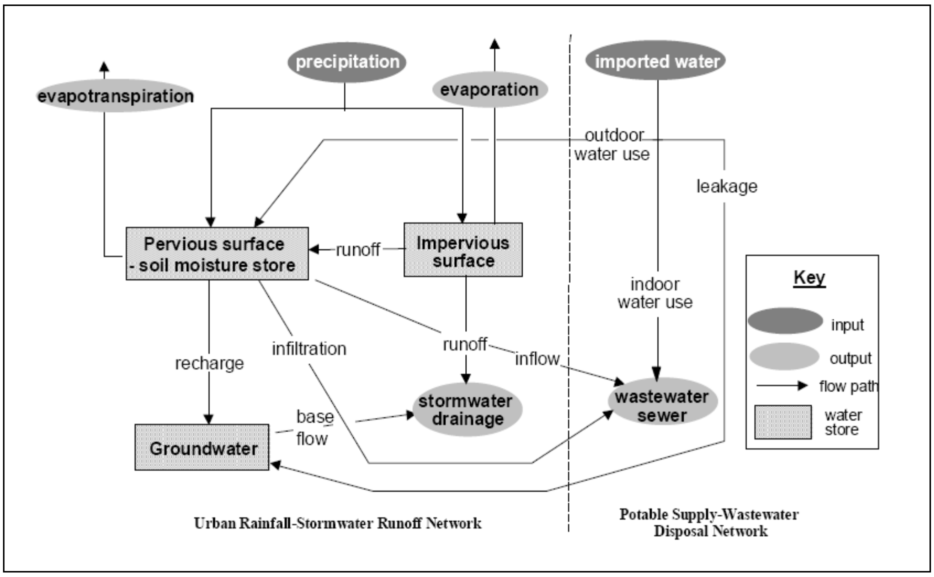

Figure 4 The urban water system as represented by Aquacycle

The model operates on a temporal scale (daily time step) and on three spatial scales (unit block, cluster, and catchment), which enable the modeling of alternative system configurations and the evaluation of alternative recycling and reuse schemes.

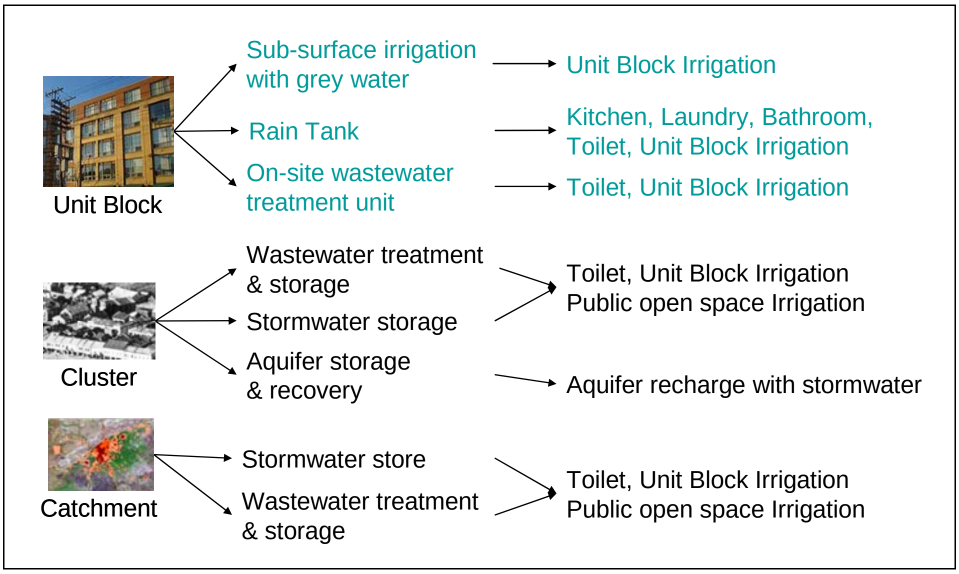

Figure 5 Alternative recycling and reuse schemes at Unit Block, Cluster and Catchment scale levels

Within Aquacycle the urban water ‘cycle’ categorizes the water pathways in two main subsystems; rainfall-runoff (i.e. the urban drainage system), and water supply and wastewater system. The interactions of the two subsystems are taken into account in the simulation of the water balance. The processes of interception, storage, infiltration, inflow, and drainage are modeled using conceptual stores with parameters that can either be measured, or calibrated by the user.

3 Test application in Alexandria Demo City

3.1 Background information

The city of Alexandria is located on the north western border of the Nile Delta and has a population of 3.864.000 million. The city has a warm dry climate with maximum average temperature ranging between 19^{o}C in January and 30.5^{o}C in August. The monthly mean relative humidity averages 68.4%, varying between a minimum of 64.7% in April and a maximum of 71.3% in July. The wind speed does not fluctuate significantly during the year, and averages 13km/hr. The average annual rainfall ranges between 170 – 190 mm in coastal areas (according to the Dekheila and Alexandria meteorological stations respectively), with the highest rainfall in one day being about 64.4 mm.
Alexandria receives freshwater from the River Nile through the Mahmoudia Canal. Freshwater is treated at 7 water treatment plants of 2.3 million m^3/day total capacity. A large proportion of households, almost 50% in some parts of the city, are not connected to the drinking water system.
Similarly not all households in Alexandria are connected to the sewage system. Wastewater in Alexandria is collected in combined sewers that receive domestic waste, stormwater, and partially treated industrial effluents. Wastewater is conveyed into four wastewater treatment plants of a total capacity of about 835,000 m^3/day; the treated wastewater is discharged to Lake Mariout and is later pumped out to the Mediterranean Sea or discharged to drains ending up in the sea. A fraction of the collected wastewater is directly discharged into the sea without receiving any treatment. Moreover, about 47000m^3/day of industrial wastewater is directly discharged into Lake Mariout (UNESCO-IHE, 2007).

The most important water issues identified for Alexandria during the SWITCH Kick-off meeting are:

1. Surface water pollution in Lake Mariout;
2. Lack of sanitation services (peri-urban slum areas);
3. Industrial waste receives only primary treatment;
4. Storm water is not collected or reused for productive / environmental purposes;
5. Water resources availability to cover future demand is a present and future challenge;
6. Institutional bottlenecks to effective coordination & management;
7. Weak law enforcement;
8. Financial constraints in resolving water related problems.

3.2 The Visioning

A Visioning workshop was held in Alexandria during 24-25 July 2007. A range of stakeholders, including decision makers and representatives from the government departments and NGOs participated in this workshop. Selection and invitation of stakeholders was made on the basis of a stakeholder analysis conducted for the Alexandria LA. Participants were invited to share ideas and experiences, to learn through the Learning alliances processes, and to commit themselves to participating in future SWITCH activities. The main aim of this Workshop was to create a platform of collaboration between SWITCH researchers and local stakeholders through:

- Getting an insight on the urban water issues in Alexandria based on the experiences of stakeholders;
- Presenting the SWITCH objectives for Alexandria to stakeholders;
- Identifying management gaps and investigating potential opportunities in water management;
- Raising awareness and advocacy to generate ownership of the vision and commitment to change;
- Providing the framework for dealing with uncertainty and global change in assistance to the Visioning and Scenario Building activities.

The Visioning process resulted in developing a common vision for Alexandria shared by local actors and SWITCH partners:

"We envision a prosperous city where all communities have access to sustainable and affordable water services (supply, sanitation), a clean environment, a secure food supply and recreation. Citizens are proud of the cities water management that ensures innovation and integration and makes Alexandria a leading City in IUWM. "

3.3 Data collection and RIDA analysis in Alexandria

A preliminary assessment of the urban water situation in Alexandria was undertaken based on a list of key information gathered to-date. A schematic depiction of the Alexandria water systems and their interlinkages and interdependencies are described in Figure 6.

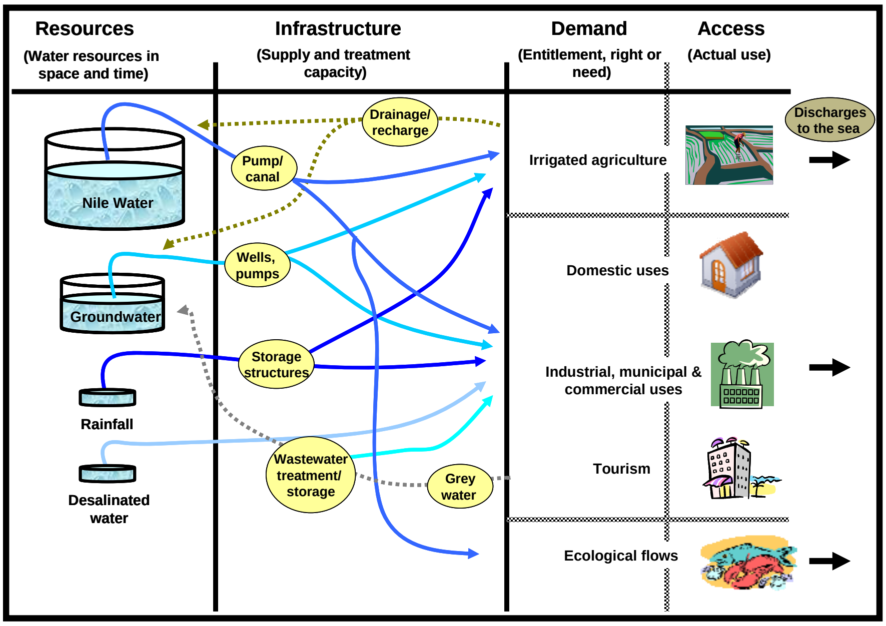

Figure 6 An example of RIDA analysis

This schematic analysis illustrates the high dependency of the domestic sector on the water from River Nile, and the sea water pollution issue due to uncontrolled discharges.

3.4 Data processing and modeling of urban water use

The preliminary application of Aquacycle in Alexandria made use of three groups of parameters/data: (a) the household water usage profile, used in the estimation of domestic water use, (b) meteorological data, comprising daily precipitation and daily evapotranspiration and (c) the physical catchment characteristics.

The average per capita consumption for Egypt is based on the estimate of 210 lt/cap/day – (Aquastat FAO, 2003). The meteorogical data comprised daily precipitation measurements and average daily values for evaporation deriving from monthly measurements, as those were provided by the Alexandria LA. The definition of measured parameters describing the three spatial scales (unit block, cluster and catchment) of the Aquacycle package entailed the collection of relevant information from various data sources, including digitized maps and satellite images. It was also assumed that the majority of buildings pertain to residential blocks of flats, each one containing 24 flats on average, with average unit block occupancy being 5 persons. For modeling purposes the relative share of commercial, public buildings and tourism installations is negligible. On the basis of satellite images, the catchment area was divided into 8 clusters (Figure 7), according to spatial and building characteristics.

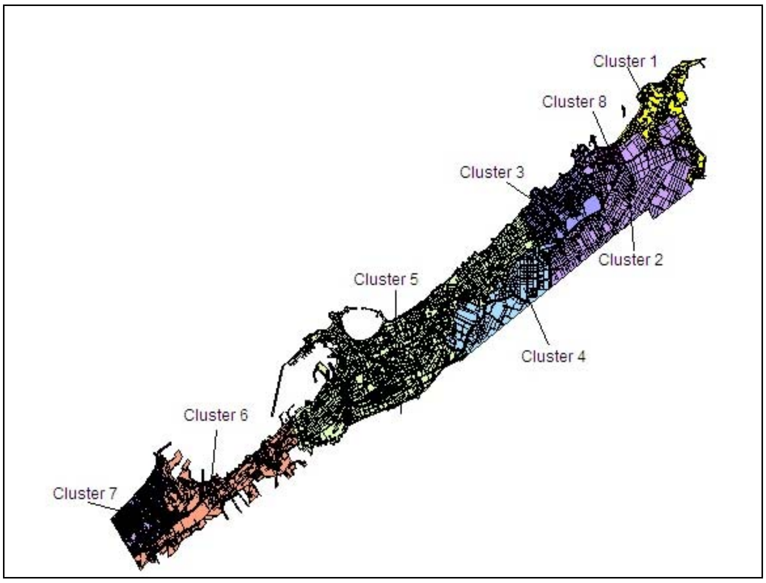

Figure 7 GIS map of Alexandria and the Clusters identified and parameterized during the pilot application of Aquacycle

The interaction of flows within and among clusters was identified and represented (Figure 8) to describe the flow of the water imported in the urban water system, and the wastewater and stormwater flows through the study area.

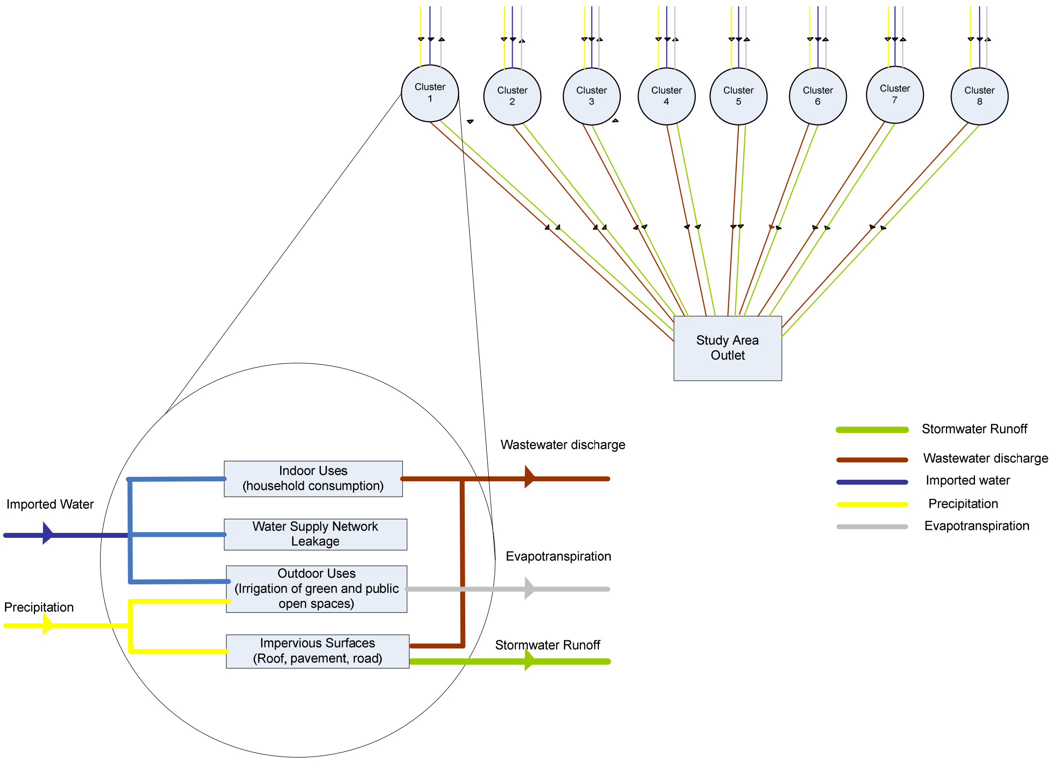

Figure 8 Conceptual representation of the urban water system

The mapping of the flows allows estimating the wastewater discharges and stormwater runoff for each cluster and for the catchment as a whole. It can also be used in the development of water management strategies at decentralised level, as it allows for estimating water savings at unit block and cluster level.
A preliminary application of the Aquacycle model based on the data currently available has provided with model simulation results on the water supply and on the wastewater produced, as portrayed in Figure 9 and Figure 10.

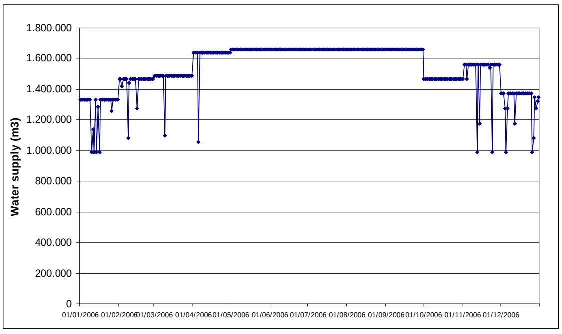

Figure 9 Preliminary simulation results for water supply

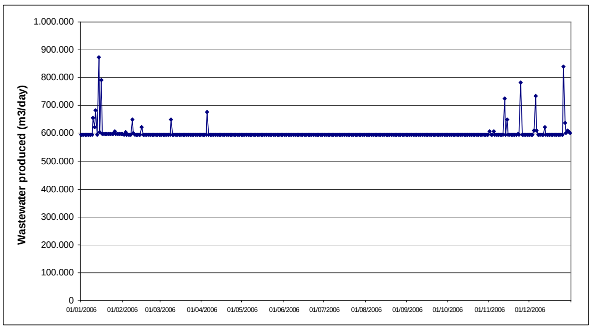

Figure 10 Preliminary simulation results for produced wastewater

Extended data collection, assisted by the collaborative RIDA-Aquacycle process, is required for refining this pilot application. Daily measurements on evapotraspiration should be provided, instead of the evaporation data used in the preliminary application. In addition, time series of imported water, of wastewater discharges, and of stormwater runoff are also needed for the validation process.
Aquacycle will be used for the evaluation of a) alternative options, such as water reuse at catchment scale and stormwater storage and recycling at cluster scale, b) scenarios affecting the urban water system, such as population growth. The specific technology options and parameters will be determined following the Visioning and RIDA activities and scenario building and strategy development.

4 Conclusions

Within SWITCH, Theme 1 aims to set the scene for the 'City of Tomorrow' through the development of drivers for change and the selection of sustainability indicators. The big question however, remains how to ensure that other SWITCH research activities are informed by this process and how to strengthen the links among the different Themes. The proposed synergies discussed in this paper, if capitalized upon, provide an opportunity for systematizing Theme 1 and Theme 6 collaborations into a tailored framework of strategically selected research activities, which can ensure that a broad spectrum of issues and needs of the Demo Cities are covered. The close collaboration of SWITCH partners with the cities LAs is the key to the successful implementation of such integrated approaches.

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