

## Towards a paradigm SWITCH: Integrating urban water management in Belo Horizonte. Brazil

Vers un paradigme SWITCH : la gestion intégrée de ressources en eau à Belo Horizonte, Brésil

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### RESUME

L'objectif premier d'une telle approche holistique et intégrée pour la gestion de l'eau est celui d'assurer l'offre adéquate, durable et à faible risque des ressources en eau. Cela est au cœur de la mission du projet SWITCH (*Sustainable Water Management to Improve Tomorrow's Cities Health*) développé dans le cadre du 6<sup>e</sup> Projet Cadre Européen. Cette approche innovatrice de la gestion des eaux urbaines est centrée sur l'application sur le terrain des innovations proposées dans le cadre de SWITCH, à travers la formation d'Alliances stratégiques de Connaissances (LA : *Learning Alliances*). Les consortiums d'Alliances de Connaissances sont constitués par de groupes clés d'organisations et d'acteurs ayant un intérêt en commun sur la gestion intégrée de l'eau dans la ville, ainsi qu'une vision prospective de la mise en œuvre d'approches innovatrices alternatives. Le papier évalue la formation de l'Alliance de Connaissances à Belo Horizonte ainsi que les défis auxquels elle doit faire face au cours des processus de négociation, concernant non seulement les résultats envisagés, mais également les opportunités et les difficultés offertes par l'innovation dans ce contexte, surtout en rapport avec les conflits potentiels entre faisabilité et conformité avec les exigences du développement durable.

### ABSTRACT

A prime objective of an integrated, holistic approach is to deliver more effective provision of water resource services carrying minimum risks and improved sustainability. This is the core mission of the 6<sup>th</sup> EU Framework project, "Sustainable Water Management to Improve Tomorrow's Cities' Health" (SWITCH). The focus of the innovative management approach will be centred in demonstration cities such as Belo Horizonte in Brazil, through the formation of strategic Learning Alliances (LAs) comprising organisations having a shared interest in and vision of future urban water management. The paper explores both the LA formation and the challenges to be faced in the negotiating process which will be concerned with expected issues and "pay-offs", as well as opportunities and difficulties especially related to feasibility as opposed to sustainability.

### KEYWORDS

Integrated urban water management; knowledge transfer; learning alliances; scale-up

## 1. INTRODUCTION

Developing countries are at different stages in terms of addressing issues of integrated urban drainage management. In Brazil, whilst still experiencing high population growth in specific districts within urban areas, the major problems relate to infrastructure management and planning rather than to basic service provision. Nevertheless, in most developing countries, the main reasons for the high increase in water demand are typically associated with:

- Industrialisation which may change the characteristics of water demand, and reuse as well as with regulatory actions and costing regimes;
- Domestic water consumption standards which are also evolving, following improvements in drinking water connections as well as socio-economic and cultural changes;
- Deficiencies in water supply system operation and maintenance usually leading to high levels of water loss. Typical figures reported for Brazilian cities are about 15 to 20% of physical losses of water in respect to the treated volumes.

This situation is clearly not sustainable, and it is within this context that the need for an integrated urban water management (IUWM) approach, in which water supply, wastewater, stormwater and inter-related environments are managed holistically at the city-scale, is not only apparent but vital. The Brazilian city of Belo Horizonte (BH), is one example of a city taking significant steps towards addressing this issue. This forward-looking approach is most recently exemplified by BH's commitment to develop a collaborative stakeholder consultation approach (or Learning Alliance) as part of its role within the EU 6<sup>th</sup> Framework urban water management project SWITCH ([www.switchurbanwater.eu](http://www.switchurbanwater.eu)). This paper describes the philosophy behind the SWITCH Learning Alliance (LA) approach, the formation of the BH LA and its mode of operation and discusses some of the key challenges this new approach faces as it begins to deliver more sustainable solutions.

## 2. SUSTAINABLE WATER MANAGEMENT IMPROVES TOMORROW'S CITIES' HEALTH (SWITCH)

The integration of the urban water cycle is a major challenge requiring engagement with a diverse array of stakeholders with a variety of administrative, political, institutional, social, economic and cultural levels, issues and priorities (Ellis, 1995; Chocat *et al.*, 2004). A prime objective of this integration is the delivery of a more effective provision of water services that are more sustainable, equitable and carries minimal risks. It is this ambitious target which is the core mission of the SWITCH consortium. A major issue for the project will be that of feasibility versus sustainability in urban water management approaches (Starkl and Brunner, 2004). There is no "best" solution but a choice of feasible legal and socio-financial alternatives. In developing countries, the situation may be even more complex given overlapping, conflicting and semi-autonomous institutions, with decisions being frequently expressed in one way but at the local/district level, the potential solution being managed in a very different way.

SWITCH calls for a paradigm shift in urban water management in which the current "*ad-hoc*" actions (primarily problem/incident driven) are transformed into a coherent and consolidated, integrated urban water cycle approach which is forward looking and sustainability driven. The focus of SWITCH is centred around the development of Learning Alliances (LAs) in nine demonstration cities around the world, selected to reflect a variety of climatic, income and water sector development conditions. An LA

is a group of individuals and/or organisations with a shared aim of applying innovation in an area of mutual interest (in the case of SWITCH this refers to IUWM). The role of the demonstration cities is to support the scaled-up implementation of SWITCH research activities into real socially relevant demonstration activities delivered within a complex infrastructure and policy framework subject to a variety of stakeholder interests. Hence the innovative aspects of SWITCH are not the implementation of new research activities *per se* but rather the mobilisation, integration and delivery of current tools, technologies and approaches within and across different sectors of the urban water management cycle. The work of LAs is seen as the central mechanism for effecting such holistic integrated change with its emphasis being firmly based on capacity building networks.

### 3. LEARNING ALLIANCES

Central to the development of the concept of LAs is the recognition that many research tools and methodologies fail to 'make the leap' from research to practice, together with an appreciation that the introduction of new products and processes into widespread use requires the integrated response of a wide range of stakeholders from a variety of organisations. The development of LAs aims to address both these issues by bringing together relevant representatives and organisations from a range of public, private and civil sectors to foster and facilitate integration and the scale-up of new and innovative approaches (Moriarty *et al.*, 2005). LAs typically consist of a series of structured platforms, at different institutional levels (e.g. national, regional/river basin, metropolitan, district, local community) designed to break-down barriers to both horizontal and vertical information sharing and facilitate strategic policy decisions (Gulati, 1998).

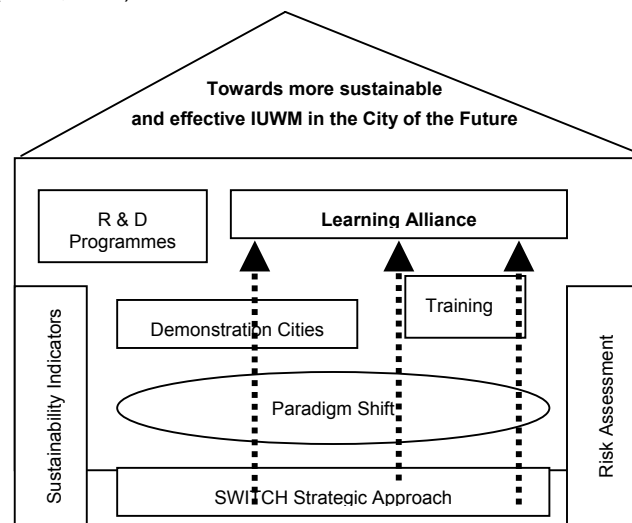


Figure 1. Schematic Representation of SWITCH and the LA Context.

Such innovation must take place within the prevailing framework of national and local conditions and norms to help ensure that what is implemented is relevant and appropriate. The building blocks and components underpinning the LA approach are schematically illustrated in Figure 1. To date the BH LA has representatives from a

range of organisations which operate at a various institutional levels, from national (federal) organisations to local action groups (see Figure 2). The Prefeitura Municipal de Belo Horizonte (PBH) is the executive municipal power and shares with the municipal parliament all sectors of urban management covering housing, health, education as well as roads, transport, environment, water supply and sanitation, urban development and land use planning regulation. PBH is the responsible body for the four environmental sanitation ("saneamento") sectors of water supply, wastewater, stormwater and solid waste.

#### **4. CHARACTERISTICS OF THE URBAN WATER CYCLE IN BELO HORIZONTE, BRAZIL**

Belo Horizonte (BH) is the 330 km<sup>2</sup> planned capital of the State of Minas Gerais, Brazil. The city was founded in 1898 and has a population of 2.2 million with an average population density of 6,900 inhabitants/km<sup>2</sup>. It is sited within a basin which is located in a mountainous region in the South East of Brazil with an average yearly rainfall of 1500 mm and an average yearly temperature of 23°C. The rainy season lasts from October to March when 90% of the total yearly rainfall occurs. The typical rainfall intensity for a 10-year return period event with a 5 minute duration is 200 mm/h. The water supply is primarily from four surface water sources with the drinking water system connecting 99.7% of BH residents with an average supply of 286 L/inhabitant/day. Approximately 92% of the population are connected to the wastewater sewerage system but mainly due to a lack of interceptor lines, currently only 38% of wastewater is treated. BH has a separated sewerage system but misconnections are common resulting in highly polluted receiving water bodies both within and downstream of urban areas. Approximately 200,000 inhabitants, many of whom live in the favelas, have no sewage collection facilities.

#### **5. PROBLEMS AND RESEARCH NEEDS IDENTIFIED AT LAUNCH OF THE BH LEARNING ALLIANCE**

The agreement to form an LA in BH occurred at an opportune time, as in 2004 PBH-SUDECAP established a special committee to consider more integrated urban water and wastewater policies at the municipal level and to develop a masterplan (Plano Municipal de Saneamento) for future implementation. The role of this municipal committee is to address priority policies for water supply, sanitation, urban flooding and stormwater control, receiving water pollution, upstream pollution of water supplies and river restoration, solid waste management as well as to consider more sustainable approaches to secondary water use. Hence the municipality of BH had already demonstrated a clear commitment to integrating its approach to urban water management. The established committee structure and membership represents an appropriate focus to attract the wider range of participants and organisations required to develop a relevant LA. An LA awareness-raising (or scoping) meeting, hosted by SUDECAP and UFMG, was held in June 2006 at which the organisations shown in Figure 2 were present. During these discussions, the individuals present identified from round-table discussions what they considered to be the most pressing issues related to urban water management in BH.

The cited problems included :

- frequent flash floods (particular problems occurring in favelas where unsuitable land has been illegally developed)

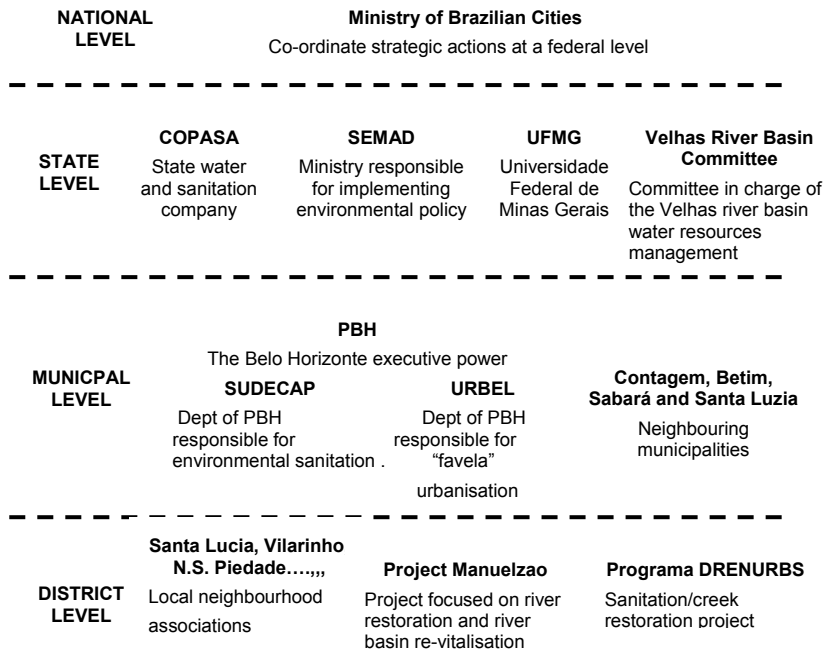


Figure 2. The Belo Horizonte LA: Connected Stakeholder Platforms.

- blockage of drains with solid waste
- high level of pollution in receiving waters due to diffuse pollution (e.g. misconnections, lack of interceptor pipes, urban runoff, solid waste and intensive erosion)
- upstream pollution of water supplies due to urbanisation, mining and agricultural activities at the metropolitan scale (RMBH).
- illegal occupation of "risk-prone" areas mainly by low-income people – risk of flooding, landslide and health risk due to poor sanitation conditions.
- lack of social inclusion
- high costs of urban stormwater management
- lack of integrated strategic planning
- lack of linkages between theory (i.e. governance) and practice
- need for institutional developments for enhancing decision making, budget planning and technology update (e.g. knowledge on system functioning, data collection and analysis, use of non-structural measures in storm water management).
- need to develop inter-municipal cooperation.
- need to increase public participation in decision making concerning UWM, including flood and diffuse pollution control, stream restoration in urban areas, scenic enhancement of landscape including water bodies ...

In addition, the discussions also included a review of how SUDECAP and UFMG as the SWITCH project co-ordinating representatives of the LA would materially contribute to the development of USWM innovation outside of the BH territory. This outreach capability is essential to the achievement of appropriate and proper regional basin level action and can only be realised through pro-active involvement of state and national level participation in the LA activities (Figure 2).

## **6. KEY CHALLENGES FACING THE BH LEARNING ALLIANCE**

At this preliminary stage of the establishment of the LA grouping and activities, a number of initial challenges in the LA formation and in the negotiating process have been identified and will be addressed within the on-going LA agenda. These issues include:

- the identification of optimum and achievable institutional frameworks to deal with new approaches as viewed in terms of the current organisations, institutional actors and their mandates
- the need for gradual “take-up” of innovation to be conceptualised by IUWM at the basin level
- the historical isolation and internal “autonomous-efficiency”, as well as the lack of an interdisciplinary culture and inter-sector relations, which characterise the current institutions linked to urban water management at the basin scale
- the institutional conflicts between the federative levels in Brazil (state, metropolitan, municipal) regarding water supply and sanitation management, as exemplified within a “metropolitan” basin such as the Rio das Velhas basin that essentially comprises the Belo Horizonte territory
- opportunities for new and innovative institutional alternatives for IUWM, that might be brought about following new national legislation for public consortia and inspired by discussions on a new national legislation to create a “National Environmental Sanitation Policy”.

## **7. OUTCOMES OF THE BH LEARNING ALLIANCE LAUNCH**

Following discussions on problems and research needs, a series of research issues have been identified as possible areas for scaled-up demonstration activities under the SWITCH action research programme:

- Identification, adaptation and uptake of new technological and alternative innovative approaches to IUWM with focus on the use of BMPs and source control within stormwater and wastewater domains. An assessment of the feasibility of retrofitting of BMPs within existing drainage infrastructure will take place within the LA
- Identification and development of flood control alternatives in urban areas which have their focus on non-structural measures adapted to flash flood occurrences. This will include the development and application of a decision-support tool to predict and manage flooding and flood risks
- Identification, use and evaluation of alternatives for the modelling of stormwater systems; the identification of more appropriate hydrological models for the BH catchment.
- Development of indicators of sustainability for IUWM or more specifically the development of integrated urban or environmental sanitation quality indicators. However this will need to consider the relative effect of feasibility and sustainability in the decision-making process as well as a review of the application of indicators in the context of practical and feasible costing and planning requirements.

- Identification of more optimal and achievable institutional frameworks as well as legal bases and financing models to deal with new approaches as viewed in terms of the current organizations, institutional actors and their mandates.

## 8. NEXT STEPS FOR THE BH LA

The next steps for the BH LA include finalisation of the draft LA research plan and the subsequent design of research and demonstration activities with the objective of:

- Enhancing the identification of major problems associated with the introduction and implementation of IUWM and the principal causal factors which impede their operation at differing territorial scales, including neighbourhoods, city, metropolitan, and river basin scales;
- Anticipation of UWM potential future problems within the Belo Horizonte municipality and Belo Horizonte metropolitan area (RMBH) based on: demographic projections, major urban development projects according to current land use zoning law; the assessment of urban threats and uncertainties etc.
  - Identification of the main difficulties and reasons for current issues and problems in implementing IUWM at differing spatial and temporal scales.
  - Identification, adaptation and uptake of new technology and alternative innovative approaches to IUWM and their appropriateness at varying scales as well as capability to operate in conjunction with conventional systems.
  - Identification of optimal and achievable institutional frameworks, legal bases and financing models to deal with new approaches as viewed in terms of the current organizations, institutional actors and their mandates. This may include the assessment of alternatives for implementing a sustainable and integrated management of urban waters at different territorial scales (district, city, metropolitan, river basin), at different water domains (water supply, wastewater, stormwater) and at different sectors of urban policy formulation and development.
  - Promoting and assessing a more effective and intense public participation in the urban water management decision making process.

Planned experimental demonstrations involve the use of BMPs for stormwater control, focusing on requirements for their use within the Belo Horizonte municipality context e.g. developing criteria for the choice and the design of suitable BMPs, assessing maintenance requirements, costs, public acceptance and inherent risks of employing technical alternatives (covering probabilities of pollution, public health and operational failures ...). An assessment of flood control alternatives within urban areas with a focus on non-structural measures adapted to flash flood occurrences will also be undertaken, combining actions within monitoring, modelling and emergency planning; domains which currently are not well developed in Belo Horizonte.

Research on water governance will consist of an assessment of institutional, governmental and social organisations participating in the management of urban water at the national, state, metropolitan and local levels. At these various levels it is important to identify who actually participates in, and decides on, policy formulation and implementation; what is the degree of participation of social organisations as well as identifying possible difficulties in participation for some social sectors. In order to ensure an effective participation and the meeting of different stakeholders interests, the LA participants will be divided into thematic groups according to their interest in, and knowledge of, an evolving development of particular subjects such as governance, modelling, BMPs, decision-making etc. Nevertheless, an LA general assembly, composed of all the Learning Alliance members will be maintained,

allowing a shared experience in the different domains of demonstration and research activities and promoting a more effective integration in urban water management.

## 9. CONCLUDING REMARKS

The connected LA platforms bring together a wide range of partners with capabilities in IUWM implementation including water and wastewater service utility operations, policy and legislation, planning and urban land use development, local community and vested public interest groups, research and training, and in documentation and dissemination. There will be a need for an alignment of objectives, vision and values within the LA to maximise communication and trust as well as to agree shared goals and strategic directions. The role of LAs within the SWITCH project is to guide and support the implementation of appropriate research and evidence-based demonstration activities within the demonstration cities, which specifically tackle local problems and needs. A successful LA must monitor its efficiency, equity and adaptability, making adjustments to member relationships as they move away from initial conditions. The optimal decision for each partner will be a function of expected and realised “pay-offs”, with stakeholders identifying with incentives to invest in adaptation i.e a positive sum game. LAs will be driven by such expectations, even if they may only be realised at some future time. The aim of LA leadership will be to identify a more effective integration of activities at the city/district level and the scaled-up implementation of robust, viable IUWM options. This effective ground-level impact is the paradigm shift that the SWITCH LA structure is intended to achieve. The BH LA will follow an “openness” approach, in order to potentially receive innovative contributions for the improvement of urban water management and to increase the stakeholders’ engagement in the process.

A key point in the SWITCH philosophy is to recognise that the LAs are not pure “interest” groups or “talking-shops” but, ideally, comprise a cross-section or microcosm of the key stakeholders that can effect, control and support change in the urban water management system. A full database on current urban water management is therefore required so that it can be used to develop baseline and/or benchmark data against which the impact of SWITCH can be measured. Although the Initial steps in the LA formation have been well received, the momentum needs to be maintained with each consortium member being able to clearly identify their contribution to, and benefits to be gained from, the SWITCH project.

## REFERENCES

- Chocat, B., Ashley, R.M., Marsalek, J., Matos, M.R., Rauch, W., Schgilling, W and Urbonas, B. (2004). Urban drainage: Out-of-sight-out-of-mind. 1659 – 1690 in “Sustainable Techniques and Strategies in Urban Water Management”, Proc NOVATECH04, 5th Int.Conf., GRAIE, Lyon, France.
- Ellis, J.B (1995). Integrated approaches for achieving sustainable development of urban storm drainage. *Water Science Tech.*, 32(1), 1 – 6.
- Gulati, R. (1998). Alliances and Networks. *Strategic Managt. Journ.*, 19, 293 – 317.
- International Year of Water (2003) Water for our future: what are the trends? [www.wateryear2003.org/en/ev.php-URL\\_ID=3697&URL\\_DO=DO\\_TOPIC&URL\\_SECTION=201.html](http://www.wateryear2003.org/en/ev.php-URL_ID=3697&URL_DO=DO_TOPIC&URL_SECTION=201.html). Verified 30 November 2007.
- Moriarty, P., Fonseca, C., Smits, S and Schouten, T (2005). Learning Alliances for scaling-Up Sanitation Centre (IRC), Delft, The Netherlands.
- Starkl, M and Brunner, N. (2004). Feasibility versus sustainability in urban water management. *Journ.Envir.Managt.*, 71, 245 – 260.