Improvement of water supply through a GIS-based monitoring and control system for water loss reduction

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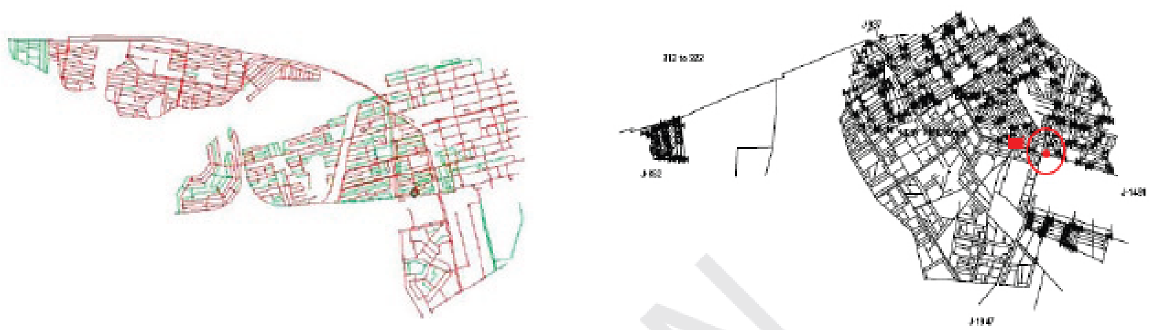
Type of tool: technology for efficient water use (specifically: GIS-supported dynamic pressure control, automated valves and leak detection systems)

Location: Africa (Ouagadougou, Burkina Faso) with the municipal water utility operated by ONEA, Office National de l'Eau et de l'Assainissement

The relevance of the challenge and objectives

In many countries of the developing world, including regions with water scarcity, water losses (technical leakage and water theft) are very high, mostly exceeding 40% and often even exceeding 60%. To improve water supply and serve more consumers (preferably from low income areas, which often remain unserved), the capacities of water supply systems must be increased. Very often, the necessary increase can be achieved through water loss reduction (WLR). WLR may be much more feasible (in economic and ecological terms) than the expansion of water production, i.e. through new river dams, desalination plants, underground well fields or else.

In Ouagadougou, a pilot project has been implemented, to reduce water losses within the distribution system of the municipal utility. The technical components of the process are leak detection devices, pressure and flow control sensors with real-time and online data transmission, automated pressure valves and an intelligent GIS-based computerised system to steer the whole process. The figure below shows the GIS (Geographical Information System) file of the distribution zone (left), with the most critical point of pressure and water losses to be controlled through pressure reduction (right part of the figure below), as simulated with the hydraulic modelling tool EPANET.



Représentation SIG du secteur de distribution R7 (gauche) et identification du point critique par EPANET dans le secteur de distribution RE (droite)

The drivers of technological change

There has been tremendous progress in the use of computer-based control, both for pump efficiency (accompanied by energy efficient pumps) and for network management, especially dynamic pressure control. This provided the opportunity to introduce the water loss reduction programme. The driver of change to develop these technologies was, of course, water scarcity and the water losses being too high in the utility. Anyhow, the basic technological development has already taken place in other sectors from industry, dealing with higher financial volumes than in the public water sector (e.g. pump efficiency established at a very high technological level in the chemical industry, pressure control of gas pipeline networks, or oil pipeline networks in industrialised countries).

Barriers to technological development, adaptation and adoption

The strongest barrier slowing down technological development, adaption and adoption is the subsidisation of water tariffs. Full cost-recovery of water services provision cannot be achieved in many developing countries, due to political restraints and the need to support the poor with subsidies. The greatest barriers are the lack of willingness to charge and the lack of willingness to pay for water. In order to overcome these barriers, the implementation of the project was supported by an extensive capacity development programme to secure the necessary change process.

Lessons learnt from implementation

Implementation was successful for a limited zone within the city and service area of the utility. Due to the unstable political situation in the country and due to other issues being prioritised over water loss reduction (politically as well as financially), full implementation has not yet been achieved.

Scaling up

Regretfully, the Water Loss Reduction Programme has not yet been extended throughout the region, even though the profitability of the water loss reduction programme has been verified (taking the "low-hanging foods" first, in a priority of actions).

With support of UN-Water DPC, the scaling up of such water loss reduction technologies and programmes in other developing and transition countries could be done. One very helpful activity was a workshop with the African Water Association in Ouagadougou, where the success of the project was presented to other utilities, lessons learnt were shared and training activities were undertaken with participants from all over Africa. Furthermore, UN-Water DPC has disseminated the technologies and overall management concepts, including economic and financing aspects in other regions such as Latin-America and Asia.

Evaluation: economic, environmental and social benefits

The programme has generated positive benefits for the local economy. Local jobs have been created through the investment in and continuous operations of the water loss reduction programme. More importantly, the project has leveraged job creation due to the fact that economic development, public health and a comfortable environment are based on the quality of water and sanitation onsite – which has improved significantly since water efficiency had been increased through WLR.

The figure below indicates the direct monetary profit of the water loss reduction programme, accompanied by improvements of general maintenance and operations. Once the water losses are reduced from approx. 45% to 6%, and the technical failure from 30% to 6%, the water service costs would be reduced from 4 EUR/m^3 to 1.33 EUR/m^3 (see calculation in the slide below).

UNW-DPC

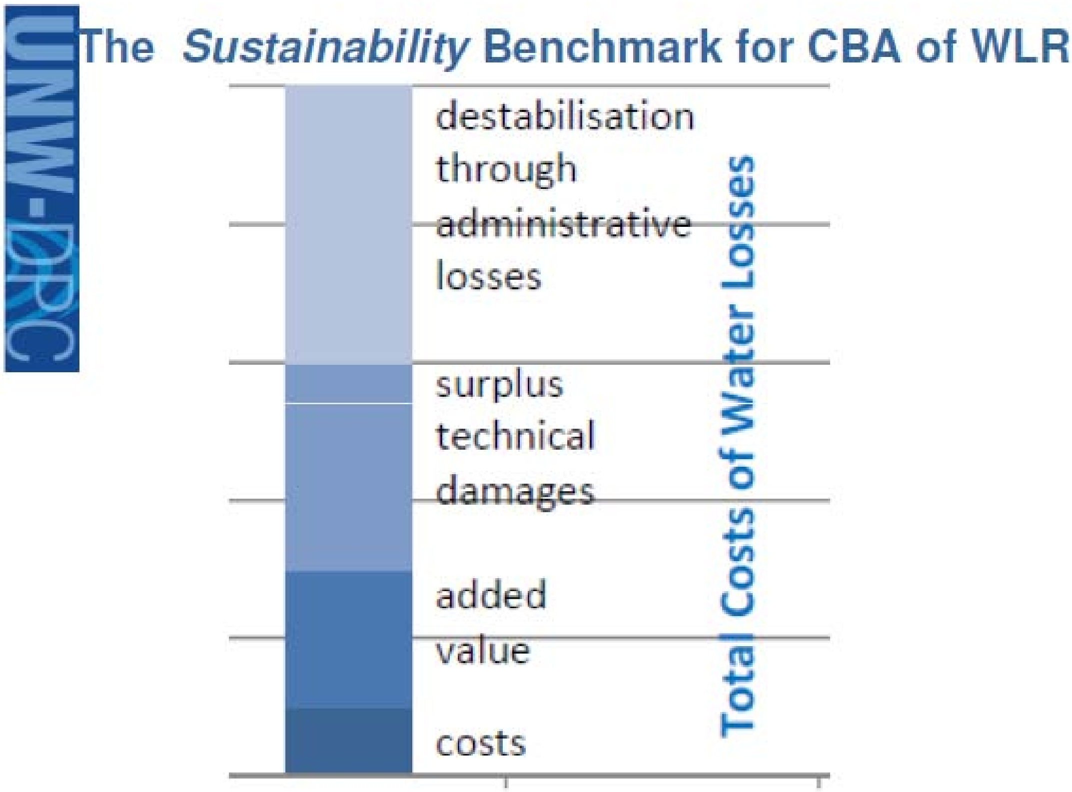
Water Losses and Technical Failures cause High Surplus Production Costs

a)	Theoretical CAPEX	=	1 €/m³ $\hat{=}$ 1 €/1 000 l
	Leakage rate 45 %	$\hat{=}$	450 l lost
	Technical failure 30 %	$\hat{=}$	300 l lost
			750 l lost
	Real CAPEX	=	1 € per 250 l
		$\hat{=}$	**4 €/m³** **plus Surplus Damages !!!**
b)	Theoretical CAPEX	=	1.15 €/m³ $\hat{=}$ 1.15 €/1 000 l
	Technical failure 6 %	$\hat{=}$	60 l lost
	Leakage rate 8 %	$\hat{=}$	80 l lost
			140 l lost
	Real CAPEX	=	1.15 € per 860 l
		$\hat{=}$	**1.33 €/m³**

Additional economic gains are expected through the reduction of damages which accompany water loss ("surplus damages") in technical terms (especially reduced lifetime of the pipe network, caused by mechanical stress with non-continuous supply generating hydraulic shocks) and in administrative terms (reduced willingness to pay from customers facing high water losses that see other consumers who are not charged or do not need to pay).

For the case of Ouagadougou, the direct savings of the water loss programme has been estimated to be around 0.8 EUR/m³. With the surplus costs on top, the total economic profit might well exceed 2.0 EUR/m³ (not yet calculating the external profits for public health and the gross national economic product.

The figure below indicates the factors that should be considered when defining a "sustainability benchmark" for cost-benefit calculations of water-loss reduction programmes and target values, site-specific standards of water losses (set as % percentage of raw water abstraction, or as m³ per day, or as m³ per pipe km).



Along with the improvements in water efficiency, the environmental situation will improve step by step, provided that the development of sanitation will follow the development of supply water efficiency.

Social benefits are derived from the enhanced performance of the utility and water services provision. The situation before project implementation was characterised by poor or no water supply in certain town areas and at certain times, water theft and a lack of concern about taking care of resources and public water properties. Since improving water efficiency, the water utility has been empowered to introduce transparent structures, cut water theft and raise awareness among the public and its customers of the need to take care of water properties.

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