

Proceedings of the  
3<sup>rd</sup> Regional Activity on  
Non-Revenue Water Management:  
Solutions for Drinking Water Loss  
Reduction

*Arab Countries*

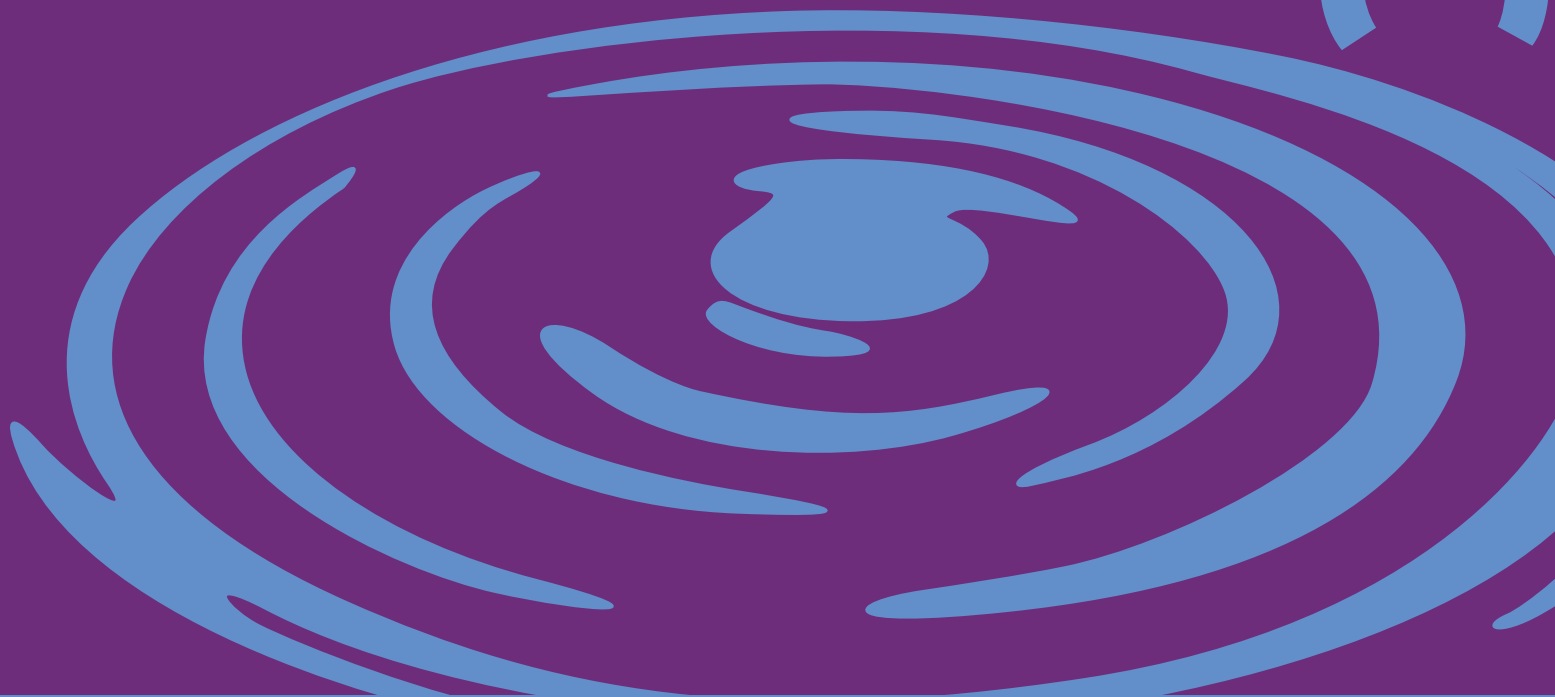
*3<sup>rd</sup> ACWUA Best Practices Conference*

*20-21 January 2010, Rabat, Morocco*

*Co-editors: Reza Ardakanian*

*José Luis Martin-Bordes*

UNW-DPC



Proceedings No. 5  
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# **CAPACITY DEVELOPMENT FOR IMPROVING WATER EFFICIENCY**

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## Forewords





# ACWUA



With support from ESCWA and the German Ministry of Economic Cooperation and Development through GTZ, the Arab stakeholders in the water sector founded the Arab Countries Water Utilities Association (ACWUA) in April 2007. The General Assembly of ACWUA decided in November 2008 to locate the ACWUA Secretariat in Amman, Hashemite Kingdom of Jordan, starting January 2009.

ACWUA's vision is to partner with water supply and wastewater utilities in Arab countries to provide best practice service delivery to their customers.

ACWUA members are the water utilities in most of the Arab countries, associations, individuals and honorary members.

In 2008, ACWUA held two "Best Practices" conferences dealing with the topics "Standards for Operation and Maintenance (SOMP's) at the Dead Sea, Jordan", and Capacity Building in Alexandria, Egypt. The third Best Practice Conference on Non-Revenue Water Management in the Arab Region - Solutions for Drinking Water Loss Reduction, on 20/21 January 2010 in Rabat, Morocco with the contribution of 16 Arab countries, 14 European

countries and the USA, was a great success. Around 300 participants - leading personnel, managers, and operational staff from water suppliers and from water authorities and ministries, water engineers, specialists and companies which offer products, consultancy and services in the field of Water Management - discussed the main aspects related to the Non-Revenue Water problem in the Arab region. The participants of the conference gathered applicable knowledge about possible strategies, techniques and applications, discussed regionally prepared case studies and useful tools, and collected clear concepts of the dimensions of integrated Non-Revenue Water Management.

As a significant outcome of this conference, a number of recommendations were developed which include key issues that serve the wider water sector community. All the efforts gathered jointly will facilitate application of the best available technical and managerial solutions and thus contribute to ACWUA's vision described above.

Eng. Khaldon Khashman

Secretary General of the Arab Countries

Water Utilities Association (ACWUA)

## ONEP-IEA



Water is undoubtedly a vital natural resource. In addition to being essential to life and to human health, water is also crucial for the socio-economic development of every country. In the Arab region, where the climate is primarily semi-arid, the scarcity of water resources is aggravated by an endemic drought that has lasted for nearly thirty years. Rainfall is erratic and variable in time and space.

In the face of this situation, water management is a major issue for water planners in the Arab region. Water resources are often overexploited and/or polluted as a consequence of population growth, tourism development, industry and irrigation.

If water losses are a serious issue for almost all the world's public water suppliers, the problem is particularly acute in areas where water is scarce. It requires immediate attention and appropriate measures to reduce pressures on rare and precious water resources. Economic losses due to lost water means that water suppliers need to deploy management strategies to respond adequately to the challenge.

In cities water loss is generally concentrated

around domestic connections, and reducing the level of losses calls for complementary technical, managerial and customer management solutions. Water valorization must be conducted in all areas of use. Reducing water loss is a key issue in enhancing water supplier performance and to ensure an adequate water supply to the population - even to those with sufficient drinking water.

Within this framework a conference on the management of unaccounted for water was held in Rabat on 20/21 January 2010, co-organized by the International Institute for Water and Sanitation (IEA), ACUWA, UNW-DPC and UN-HABITAT.

This conference was an opportunity for managers and operators to discuss in depth the main aspects related to the topic of water loss management. It brought together experts from all partners involved in the management of water losses, especially operators and professionals from Arab countries.

The aim of the conference was to review and assess current know-how in the field of water loss reduction, and in particular aspects such as:

- Possible strategies, techniques, and applications
- Learning from regional case studies
- Useful tools, and making better use of them
- Clear design of concepts in order to apply the best technical and managerial solutions to improving the control of water losses and reducing water loss for utilities in the Arab region.

The conference was a great success at all levels, being attended by 295 participants including 238 from 14 Arab countries (Morocco, Egypt, Jordan, Yemen, Lebanon, Syria, Tunisia, UAE, Algeria, Saudi Arabia, Mauritania, Bahrain and Oman) and 57 participants from other countries (Germany, France, Netherlands, Kenya, Burkina Faso, Turkey,

USA, Greece, India, Great Britain, Zambia, Albania, Belgium, Canada, Spain and Russia), and six international organizations (IWA, WWC, GTZ, INWENT, UNW-DPC, UN-HABITAT and UNESCWA).

The conference also succeeded in bringing together 36 companies operating in the area of water, with a high level of performance demonstrated by the presence of 20 company presidents and CEOs. On the scientific level, 30 studies were presented, including 19 case studies from the Arab region

Samir Bensaid

Director of IEA

ONEP, Morocco.

## UNW-DPC



I am pleased to present in these proceedings the outcomes of the 3rd Regional Activity on “Water Loss Reduction in Water & Sanitation Utilities” for countries in the Arab region that was jointly organized by UNW-DPC, UN-HABITAT, the Arab Countries Water Association (ACWUA) and ONEP-IEA as the 3rd ACWUA Best Practices Conference. The conference was held in the city of Rabat, Morocco, on 20-21 January 2010.

This conference represented another positive step towards implementing the original recommendations of the International Workshop on “Drinking Water Loss Reduction: Developing Capacity for Applying Solutions”, co-organized with UN-HABITAT and held on 3-5 September 2008 in Bonn, Germany. The setting up of regional workshops on improving urban water efficiency, such as this one in Rabat and the ones held in Latin American countries (November 2009, Leon, Mexico), and in the Southeast European countries (November 2009, Sofia, Bulgaria), is having the effect of creating an active regional and inter-regional network of practitioners and organizations that are able to disseminate their knowledge and experience in reducing water losses, across the world.

It is for this reason that UNW-DPC joined hands with UN-HABITAT, ACWUA and ONEP-IEA in this conference as a means of collecting data, documenting best practices and developing recommendations as to the most promising approaches for more efficient management in the field of water and sanitation, with a focus on water loss reduction. Lessons already learnt from previous workshops indicate that these approaches will most likely be those that incorporate the development of sound institutions and strong cooperation in order to apply the best available technical and managerial solutions.

More than 300 participants, including top and mid-level managers and professionals from water utilities, met in Rabat to share their experiences and best practices regarding their water loss reduction programmes. Representatives from water operators in cities from the following Arab countries and other European and African countries participated in the conference: Algeria, Egypt, Jordan, Lebanon, Morocco, Palestine, Syria, United Arab Emirates, Yemen, Greece, the Netherlands, United States of America and Zambia. They discussed the most promising approaches and the challenges and barriers that the water operators are facing in their daily efforts to increase water efficiency and reduce water losses in the water distribution systems.

With the results of this third regional activity, UNW-DPC hopes to advance in the search for applicable solutions and to encourage follow-up projects and help to establish communication between the policy makers, water managers and researchers in the region. The results of this conference will be largely disseminated and presented at international

fora such as the Stockholm World Water Week in September 2010.

My thanks go to the contributing experts, whose ideas and experiences are to be found in this publication. I would also like to thank both UN-HABITAT for what is becoming a fruitful, long-term collaboration in this field of urban water management, and our hosts ONEP-IEA for supporting the setting up of what I believe will mark another important milestone on the path towards improved urban water efficiency for all.

Dr Reza Ardakanian, Director

UN-Water Decade Programme on  
Capacity Development (UNW-DPC)

UN Campus, Bonn, Germany

# UN-HABITAT



There's a lot of weight on the shoulders of water operators these days. As always, we count on them to provide essential basic services, efficiently and affordably. But increasingly, they are being looked on as water stewards and principle actors within the water cycle who are counted on to minimize their impact on an increasingly sensitive and depleted environment. In light of growing demand and increasing scarcity (especially in the Arab Region), it has never been so important for water utilities to operate efficiently.

Water losses and non-revenue water in general within a utility's network are an enormous source of wastage. Water leakage notably accounts for a significant amount of non-revenue water in many cities of the world. Real losses add greatly to operating costs, and present a major barrier to the improvement or extension of services to the unserved. Water losses from the piped network also burden wastewater systems and energy consumption of utilities. Leaks can add great complication and expense to the sustainable management of waste-water systems, and the majority of utilities' energy expenditures – which commonly account for more than a full half of a utility's recurrent costs – can go to the inefficient

pumping of water through leaky networks.

Dilapidated, outdated networks present an enormous potential for efficiency enhancement. Though water loss reduction programmes are often costly, faced with growing demand for water, operators would be wise to recall that the cheapest source of new water is often recuperated losses. Because it saves water and energy resources and reduces pollution to freshwater systems, there is clearly no wiser choice from an environmental perspective than investing in reducing water losses. Water loss reduction can also be transformative, catalyzing an upward spiral of improvements within a water utility. The investments made in water loss reduction reap enormous savings, improve customer satisfaction, and avail the will and resources for more advanced management.

UN-HABITAT, the urban agency within the UN system, has long been concerned with helping urban water utilities provide sustainable, efficient and affordable access to burgeoning populations. Water Demand Management, and above all water loss reduction and non-revenue water management, is paramount to these goals. Piloting WDM projects that have attracted significant follow up investments, producing water loss manuals, and delivering training programmes for utility managers, UN-HABITAT has maintained water loss reduction as a pillar of its regional programmes in Africa, Asia and Latin America since 1999.

The Global Water Operators' Partnerships Alliance (GWOPA), an international network hosted by UN-HABITAT to increase utility capacity through mutual peer support, is glad to present



the proceedings of the “3rd ACWUA Best Practice Conference”, on “Non-Revenue Water Management in the Arab Region: Solutions for Drinking Water Loss Reduction” held on 20-21 January 2010 in Rabat, Morocco. This successful event, which was collaboratively co-organized by the Arab Countries Water Utilities Association (ACWUA), ONEP-IEA, UNW-DPC, and UN-HABITAT, provided an opportunity for water operators from the Region to learn, in a systematic and impactful way, from one another and from mentor operators – coming from outside the Region – who have been successful not only in water loss reduction, but also in comprehensive non-revenue water management.

Faraj El-Awar, PhD

Programme Manager

Global Water Operators Partnerships Alliance

UN-Habitat, Nairobi, Kenya



Background, objectives and  
partners





# BACKGROUND AND OBJECTIVES

Non-Revenue Water (NRW) and Water Loss Reduction (WLR) are a problem for almost all water supply utilities around the world. It is a particularly serious issue in areas where water is scarce. It requires immediate attention and appropriate action to reduce avoidable pressures on scarce and valuable water resources. Economic losses due to unpaid consumption require managerial strategies by the water suppliers to react adequately to that challenge. In many cities losses in water supply build up in the vicinity of domestic connections. Here technical, managerial and customer related solutions should be implemented. Water efficiency must be improved in all areas of usage.

The reduction of WLR is a key issue for increasing the performance of water utilities and supplying the population with sufficient clean drinking water.

Several big utilities have already started programmes to reduce WLR step-by-step. It is well known that many institutions and water suppliers have developed and implemented strategies and technologies to control leakage and administrative losses. These strategies have turned out to be highly efficient and have received worldwide recognition.

The Conference was an opportunity for leading personnel to delve deeply into the main aspects related to WLR. It brought together experts from all stakeholders involved in WLR, especially operators and operational staff from the Arab Region.

The objective of the conference was to gather together applicable knowledge of:

- Possible strategies, techniques and applications,
- Regionally approved case studies,
- Useful tools as well as
- Clear concepts of the dimensions of integrated WLR management in order to apply the best available technical and managerial solutions in improving the control of WLR usage and in reducing water losses for utilities in Arab countries.

This Conference was co-organized by ACWUA and IEA-ONEP. The event was realized in joint cooperation with UNW-DPC and UN-HABITAT as their Regional Activity on Capacity Development for Water Efficiency as follow-up of the recommendations of the International Workshop on „Drinking Water Loss Reduction: Developing Capacity for Applying Solutions“, held on 3-5 September 2008 in Bonn, Germany.

In order to address this problem at the regional level, UNW-DPC and UN-HABITAT are jointly organizing a series of regional workshops. This was the first regional activity in the Arab region and ensured a programme which will go beyond purely regional experiences.

# PARTNERS

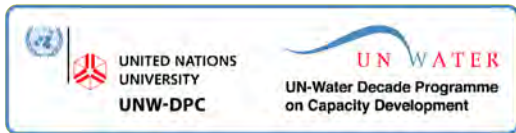
## ORGANIZED BY:



Arab Countries Water Utilities Association



Office National de l'Eau Potable International  
Institute for Water and Sanitation



UN-Water Decade Programme  
on Capacity Development



United Nations Human Settlements Programme

## SUPPORTED BY:



Deutsche Gesellschaft für  
Technische Zusammenarbeit



International Water Association



United States Agency International Development



United Nations Economic and Social Commission  
for Western Asia



World Water Council



German Association for Water, Wastewater and  
Waste

Conference papers







# Map of participating countries





**Arab countries**



# Algeria

## The management by the skills factor of performance and development in water companies

*Hocine Zaier, Directeur des Etudes et de Synthèse, Algérienne des Eaux*

### SUMMARY:

The management by the skills constitutes one of the major manager constituents of the economic and social prosperity of a public service water and purification company.

It plays a fundamental role in the process of continuous improvement of the public water utility, in particular by an approach of adaptation of the human resources to the new modes of technical and administrative management of the production and distribution of water.

To ensure this role, we present an approach based on a widened conception exceeding the only dimension administration of the staff, and assuring the necessary balance between the imperatives of the public water utility and the will to continuously develop the skills of companies.

The human dimension dominates in the evaluation of the causes of the registered failures in physical and commercial losses; they are essentially related to problems of organization and human resources, being:

- too stiff organization
- absence of versatility among the agents
- objectives insufficiently well defined
- individual merit not rewarded
- deficits in staff training
- absence of staff empowerment
- insufficient or non-existent reporting

The consequences of all these deficiencies translate externally into unsatisfactory quality of service for the customers and an absence of motivation and interest in the work for the internal customers.

Human resources management has to work through various control levers to ensure a strong will of membership of the staff actions of progress.

This conception of the human resources management articulates on four big families as follows:

- The administrative management of the staff which obviously constitutes the support and the base of the human resources management
- The framework of social, occupational and social relationships
- The development of management by skills, i.e. everything related to the evaluation,

orientation and management, functional and geographical mobility, training, valuation, empowerment and thus the motivation

- The organization of the work.

The implementation of these concerns, which must be gradually programmed, must necessarily be accompanied by the programming of an important training effort directed mainly at management and supervisors in the shape of an overall policy of ambitious training.

We also develop the mechanisms of management of the required change which can only be progressive. The improvement of the public water service should be conceived within the framework of a global strategy joining over time and articulating modernization of the technical means, valuing human resources, motivation as well as the improvement of working conditions.

## RÉSUMÉ :

La gestion par les compétences constitue aujourd'hui une des composantes managériales majeures de la prospérité économique et sociale d'une société de service public d'eau et d'assainissement. Elle joue un rôle fondamental dans le processus d'amélioration continue du service public de l'eau notamment par une démarche d'adaptation des ressources humaines aux nouveaux modes de gestion technique et administrative de la production et de la distribution de l'eau.

Pour assurer ce rôle, nous présentons une approche basée sur une conception élargie dépassant la seule dimension "administration du personnel", et assurant le nécessaire équilibre entre les impératifs du service public de l'eau et la volonté de développement continu des compétences de la sociétés.

La dimension humaine est prépondérante dans les évaluations des causes des défaillances enregistrées en matière de pertes physiques et commerciales; elles sont essentiellement relatives à des problèmes d'organisation et de moyens humains :

- Organisation trop rigide
- Absence de polyvalence des agents
- Objectifs insuffisamment bien définis
- Mérite individuel non récompensé
- Déficit de formation du personnel
- Absence de responsabilisation du personnel
- Reporting insuffisant voire inexistant

Les conséquences de l'ensemble de ces déficiences se traduisent par une qualité du service non satisfaisante pour les clients externes et une absence de motivation et d'intérêt dans le travail pour les clients internes (personnel de l'Établissement).

La gestion des ressources humaines doit œuvrer à travers différents leviers pour assurer une forte volonté d'adhésion du personnel à des actions de progrès.

Cette conception de la gestion des ressources humaines s'articule sur les quatre grandes familles de préoccupations suivantes :

- La gestion administrative du personnel qui constitue à l'évidence le support et la base de la gestion des Ressources Humaines,
- Le cadre socioprofessionnel et les relations sociales,
- Le développement de la gestion par les compétences, c'est-à-dire tout ce qui touche à l'évaluation, à l'orientation et à la gestion des carrières, à la mobilité fonctionnelle et géographique, à la formation, à la valorisation, à la responsabilisation et donc à la motivation,
- l'organisation du travail.

La mise en œuvre de ces préoccupations qui doivent être programmées graduellement, doit impérativement s'accompagner par la programmation d'un effort important de formation en direction principalement, des cadres et agents de maîtrise sous la forme d'une politique globale de formation ambitieuse et exigeante.

Nous développons aussi les mécanismes de gestion du changement qui ne pourra être que progressif et que l'amélioration du service public de l'eau devrait se concevoir dans le cadre d'une stratégie globale s'inscrivant dans la durée et s'articulant autour de la modernisation des moyens techniques, de la valorisation des ressources humaines, de la motivation et enfin de l'amélioration des conditions de travail.

## INTRODUCTION :

Le contexte algérien est assisté de plus en plus par des mutations profondes liées à la libéralisation de l'économie, l'ouverture sur l'extérieur et l'évolution des progrès technologiques. Cette nouvelle conjoncture, a poussé l'Algérie à opter pour un programme de mise à niveau visant l'amélioration de la compétitivité des entreprises algériennes notamment par le développement des ressources humaines.

Dans ce contexte, d'importantes mesures ont été prises en vue de revaloriser la fonction gestion des ressources humaines.

Compte tenu de cette nouvelle conjoncture, l'EP Algérienne des Eaux, assurant un service public stratégique et donc en contact permanent avec ces clients et la population, doit plus que jamais disposer d'un management qualifié maîtrisant les nouvelles technologies et capable d'améliorer la qualité de ses services en vue de satisfaire les besoins et les exigences de sa clientèle.

À travers notre contribution, nous allons essayer d'apporter des éléments de réponse à la problématique suivante :

Comment l'EP Algérienne Des Eaux a amorcé un processus de formation tendant vers le développement des compétences managériales?

## LES COMPÉTENCES :

Etymologiquement, le terme compétence vient du mot latin " competens " : ce qui va avec, ce qui est adapté à. Patrick Gilbert et Michel Parlier (1992) , définissent, quant à eux, la compétence comme " un ensemble de connaissances, de capacités d'action et de comportements structurés en fonction d'un but et dans un type de situations données ".

Plus simplement, nous pourrions dire que les compétences sont les moyens personnels dont dispose chaque individu pour agir : connaissances, expérience, technicité, aptitudes et qualités.

Il faut savoir que les compétences exigées à un manager sont généralement relatives à une situation donnée et résultent d'une interaction dynamique entre plusieurs types de savoirs : le savoir-faire, le savoir-être et le faire-savoir. Ses compétences sont par conséquent inévitablement liées au contexte de la situation professionnelle dans laquelle il se trouve.

## LA FORMATION :

La formation est un élément central dans l'organisation des ressources humaines, elle est un des principaux leviers pour augmenter les compétences générales du groupe, faire face aux changements et répondre aux problématiques d'adaptation. Elle est considérée comme la clé qui doit apporter une réponse pratique et appropriée aux besoins de développements de l'entreprise et de ses salariés.

La formation est destinée aux employés lorsque leur rendement est déficient et que cette situation peut être attribuée à des lacunes observées sur le plan des connaissances, s'ils possèdent des connaissances nécessaires pour faire le travail, des habilités s'ils sont en mesure d'accomplir les tâches qu'on leur demande de faire, et des attitudes s'ils sont motivés par leur travail où désirent-ils l'accomplir efficacement.

La formation tend à paraître aujourd'hui comme un « Atout Stratégique » (A. MEIGNANT 1986), ou comme un « Investissement » (G HAUSSER 1986) même si on continue d'observer les différences persistantes quant à l'importance des moyens engagés et à l'approche même de la formation.

*Selon l'Encyclopédie de la Gestion et Développement:*

*La Formation est le moyen de produire des compétences. Dans ce sens, elle peut être considérée comme une fonction de production. L'approche économique de la Formation s'exprime principalement par la notion d'Investissement Formation.*

On distingue généralement deux types de formation :

- La formation initiale qui englobe l'ensemble des connaissances acquises, en principe avant l'entrée dans la vie active, en tant qu'élève, étudiant ou apprenti. Elle se caractérise par trois composants :

a) - La Formation de Base :

- La Formation de type Scolaire Traditionnelle : C'est une formation type universitaire dite « classique ». Elle permet à un universitaire d'accéder généralement sur concours à un poste de travail.
- La formation de base Professionnelle : C'est une formation dispensée par les écoles spécialisées, qui aide le candidat à entrer dans le vie active après avoir eue un diplôme dit professionnel, comme un CAP par exemple.

b) - La Formation Initiale Complémentaire :

Concerne toute personne ayant une formation initiale, soit type scolaire traditionnelle, ou de base professionnelle pour s'adapter au besoin de l'entreprise.

c) - La Formation Post Recrutement :

- C'est une formation qui accompagne



l'entrée en fonction des agents ayant réussi un concours, ou un examen professionnel. La formation continue ou de perfectionnement est destinée aux employés en cours de leurs carrières professionnelles tout en continuant à occuper son emploi. Elle est dispensée dans le cadre du budget formation et s'adresse aux salariés de celle-ci.

Elle est nécessaire pour suivre l'évolution technologique d'une profession.

Cette formation comprend trois types :

a) Formation au Poste de Travail : Elle est centrée sur le savoir faire

b) Formation au Savoir Etre : Elle a pour but de faire acquérir les éléments de professionnalisme liés généralement aux comportements, aux relations humaines, et à la faculté d'adaptation pour atteindre les objectifs fixés.

c) Formation Promotion : le Savoir : Formation promotion est axée sur le savoir et les connaissances qui permettent à l'agent de passer avec succès les examens professionnels ou concours, pour accéder aux postes de travail supérieurs.

Le développement des compétences par le processus de formation continue demeure une des activités centrales de la gestion des ressources humaines, ceci pour les raisons suivantes:

- les nouveaux obstacles rencontrés par les organisations et la difficulté avec lesquelles se posent les nouvelles exigences et qui peuvent être réduites grâce à la formation.
- En favorisant l'intégration des employés, la formation peut remédier aux difficultés de communication interpersonnelles et inter organisationnelles que produit la croissance rapide des organisations.

L'objectif général d'un processus de développement

des compétences est formulé en verbes d'action et centré sur le stagiaire (et non sur ce que le formateur prévoit de faire). par exemple:

- être capable de conduire un processus,
- être capable d'utiliser un logiciel,
- être capable de développer un argumentaire de vente,
- être capable de faire une synthèse, ....etc.

Les objectifs opérationnels explicitent l'ensemble des compétences que les stagiaires doivent acquérir pour pouvoir atteindre l'objectif final. Ils se réfèrent aux contenus, aux comportements, aux niveaux de savoir à atteindre.

## LE MANAGEMENT :

Le terme management, comme le note G. Pédraglio, signifie étymologiquement, "*tenir en main*", "*avoir bien en main*" ou "*mener de main ferme*" ... ce qui laisse sous-entendre toute une idée de maîtrise et de contrôle de l'action. Certains désignent le management comme "*l'ensemble des disciplines, méthodes et techniques, qui englobe les tâches de direction, de gestion, administration, organisation des entreprises*"

En conséquence, la **formation au management**, consiste à **développer les compétences des managers** pour les aider à analyser un environnement et imaginer les réponses les plus pertinentes face aux situations les plus complexes.

Les exigences des Entreprises en terme de compétences :

A partir de l'année 2000, beaucoup d'entreprises ont bien changé : les pyramides hiérarchiques s'aplatissent de plus en plus, les frontières de l'autorité s'estompent, les définitions de fonctions deviennent plus souples et au fonctionnement

pyramidal se substitue un fonctionnement en réseau ... Les décisions sont prises sur le terrain; la perspective de chacun est globale et chacun intègre à la fois dans son travail : missions, objectifs et stratégies de l'entreprise

Ces vingt dernières années, le manager " type " en entreprise a lui aussi bien changé. On ne parlait d'ailleurs pas de " manager " à cette époque, mais de gestionnaire. Auparavant, le gestionnaire était celui qui dirigeait par son savoir et qui appliquait les directives et circulaires émanant de l'administration centrale.

L'entreprise qui privilégiait, il y'a une vingtaine d'années, les qualités de type (planification, action, maîtrise des évènements et des problèmes), est, depuis une dizaine d'années, ouverte au management " participatif ". C'est-à-dire qu'il n'est plus seulement question de dicter ses décisions : il faut aussi savoir écouter ses collaborateurs, se pencher sur leurs problèmes et établir le consensus ; sans oublier qu'aujourd'hui la performance d'une entreprise dépend aussi surtout de sa " compétence collective ", à savoir : la capacité de ses équipes à travailler ensemble.

## CONCLUSION

La société évolue de telle manière que dans le monde professionnel, par rapport aux connaissances techniques, les éléments de compétences notamment, comportementales vont prendre de plus en plus d'importance. Puisque le système éducatif algérien est basé assez largement sur des critères de sélection, de capacités d'ordre intellectuel et de formation où la dimension comportementale est peu prise en compte, il est important que le monde professionnel contribue encore plus au développement des compétences de ses employés en les poussant à se remettre en cause et en les aidant à prendre conscience de leurs

propres qualités et capacités

Ces capacités ne deviendront quant à elles de réelles compétences professionnelles que lorsqu'elles seront correctement mises en œuvre dans le cadre de situations réelles.

Pour autant, au-delà de l'extrême diversité des métiers concernés, les entreprises algériennes partagent des impératifs liés à la satisfaction des exigences sans cesse plus élevées de leurs clients. Ainsi, réactivité, adaptabilité et anticipation des besoins des clients représentent les conditions sine qua non de leurs existences.

Face à ces obligations, la question du développement des compétences est devenue une composante primordiale : dans les entreprises, la qualité des compétences humaines constitue l'avantage concurrentiel absolu. Pour les entreprises, il s'agit de réussir à nommer, formaliser et développer des compétences enracinées dans des valeurs beaucoup plus culturelles que techniques : la capacité à travailler en équipe, la notion de qualité du service rendu, l'écoute du client, l'autonomie et la responsabilité, etc.

Ce travail est d'autant plus essentiel que les métiers des opérateurs d'eau et d'assainissement demeurent peu valorisés socialement et peu pris en compte dans l'enseignement.

L'EP Algérienne des Eaux a suppléé à la faiblesse des formations initiales par de la formation interne, dans un contexte législatif, social et fiscal peu adapté.

# Algeria: city of Souk Ahras

## Optimization of water losses in the city of Souk Ahras

*Ali Sid, Director, Souk-Ahras*

### INTRODUCTION

Water resources are limited and unevenly distributed in space and time, which requires taking into account the needs and management style. Algerian politics of water has three main parts: water conservation, water management, and protection of water resources. The economics of water implies the need to end waste, through reduction of losses.

### ISSUES AND OBJECTIVES

The distribution network of the town of Souk-Ahras operates under atypical conditions, its main problem being the large losses that may represent 50% of the amount available for distribution in certain areas. This is related to poor restructuring of the network with distribution pressures exceeding 10 bars over a large part of the network of pipes, materials etc.

The water losses are divided into two main categories: commercial losses (plus park meter gets, the more risks of under counting are important and also the water-flies-illegal connections) and

physical losses (leaks). It is therefore a shortfall for the local unit of the Algerian waters.

### PRESENTATION OF THE STUDY AREA

The wilaya of Souk Ahras a border with Tunisia, and bounded by four wilayas (North wilaya of El-Tarf in north-west Guelma, east Oum El Bouaghi and south in Tébessa).



It covers an area of 4,358 km<sup>2</sup>. The wilaya has 26 municipalities and 10 Dairates.

## TREATMENT OF DRINKING WATER

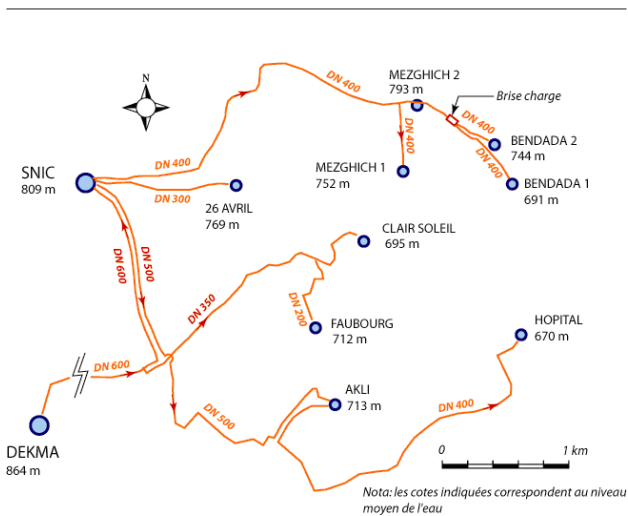
The characteristics of the treatment plant Ain Dalia are:

- Process conventional coagulation, sedimentation and filtration: sodium thiosulfate + aluminum sulfate for coagulation battery 4 filters with 2 pools.
- Maximum flow:
  - 78 000 m<sup>3</sup> / d, and De
  - Average flow: 60 000 m<sup>3</sup> / d;
  - Average daily operating time 20h / d.

Supply networks once the water collected and treated, it must be circulated in pipes supply (Water is then stored, and piped distribution in dwellings Distribution networks.

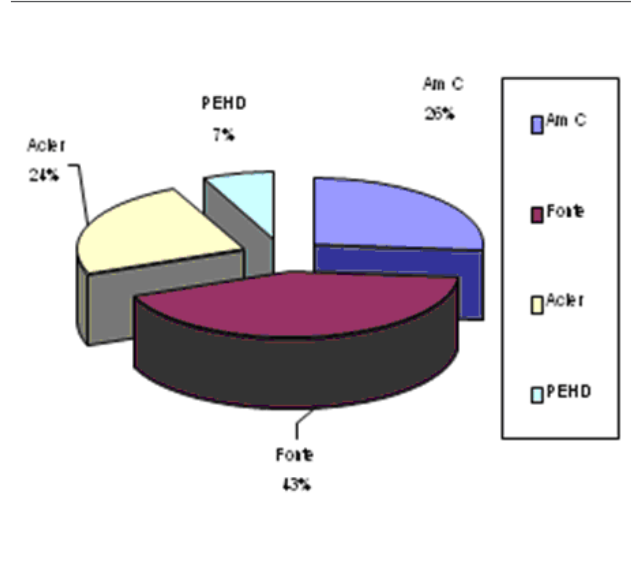
The network consists of Souk Ahras to 63% of PVC pipe over a length of 169 km. The asbestos cement pipes represent a rate of 11% which represents a length of 31 km. For cons, the replacement program conducted with HDPE is 11% or 30 km.

## SUPPLY NETWORKS

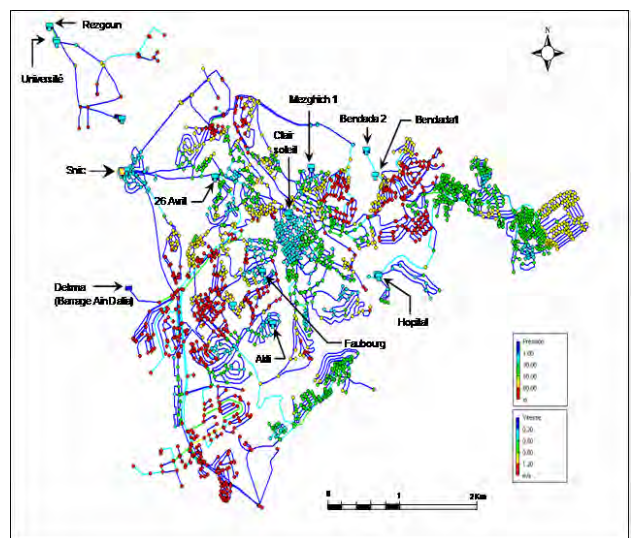


Once the water collected and treated, it must be circulated in pipes supply (Water is then stored and piped distribution in dwellings).

## DISTRIBUTION OF LENGTHS OF THE INTAKE PIPES ACCORDING TO THEIR NATURE



## DISTRIBUTION NETWORKS



The network consists of Souk Ahras to 63% of PVC pipe over a length of 169 km. The asbestos cement pipes represent a rate of 11% which represents a length of 31 km. For cons, the replacement program conducted with HDPE is 11% or 30 km.

## LOSSES

### Degradation of Infrastructure System EPA city Souk Ahras

The situation of the heritage of the distribution unit of the town of Souk-Ahras is critical. Efforts should then be made to rehabilitate and renew the heritage of the system supply drinking water to the town of Souk-Ahras. Leaks generate losses that can be of two types:



- The loss of supply that occurs in the case of very large transfers of water between the production and circulated.
- The distribution losses are the difference between the amount available for distribution and the volume of water consumed.

The causes of the poor condition of the network are many. Include:

- The pressure
  - The poor quality materials (PVC, galvanized steel)

### Loss Techniques

Losses Adduction: Diagnosis supply systems showed levels of road losses significant, made by both leakage and sampling more or less well controlled.

Samples way do not really losses; there is supply of small communities, villages and settlements close to the supply lines.

Losses in Distribution: The distribution losses are a component of the application as well as the needs of users. It is indeed water it was necessary to produce and thus represents a cost to the operator (both in investment operations).

The goal for all water service is to reduce losses to levels technically and economically acceptable.

It is generally considered a loss rate of 20% to 25% is an objective characteristic of a good network in good condition.

The rate of loss to which it refers is defined as the following report:

$$\text{Loss Rate} = (V \text{ set Distribution} - V \text{ delivered to users})$$

It is therefore a rate loss. At this rate of loss is

associated with the technical performance is expressed as a percentage:

*Technical Performance = 100 - rate of technical losses*

These indicators have the merit of clarity and simplicity and can make an assessment on the status of a network.

Trade losses

The commercial success of the town of Souk Ahras (V charged / V distributed) varies between 45% and 47%, representing a loss rate of 55%. These losses are due to faults occurring on hydraulic structures (broken pipes, joints and organs in defective plumbing, etc. ...): are the physical losses. But also there, and especially among users: the loss of business. These losses virtual (business), representing very high volumes, consistent with the fact amounts to be paid by users but not recognized, and this for the following reasons:



At the level of Counting:

a / or: because valuations are low when the meter is missing (the town of Souk Ahras over 2,000 defective meters).

b / Where: grounds of under counting due to poorly calibrated meters, indicating consumption of very distant from reality (the study identified over 8000 meters to replace in this direction).

At the User Level:

There are drinks that are:

a / or outright ignored because the user is not identified and thus the consumption of water is not charged.

b / or fraud:

Fraud counters: Cracking, tees before meters, illegal connections.

## OBJECTIVES

In view of these problems and given the fact that these losses are on one side at the level of distribution networks, and another side at the user level, it is necessary to modernize the management of the customer to ensure recovery of these volumes "lost"

With this in mind that the volume charged for 2010 will increase from 3 million m<sup>3</sup> to 4 million m<sup>3</sup> with a yield of 60% of the volume distribution. Achieving this goal will inevitably depend on the implementation of the following:

- A complete enumeration of all water users.
- A total elimination of the billing package.
- Improved network yields by reducing physical

losses.

- A precision in counting.

## CONCLUSION AND OUTLOOK

Given the current high level of losses in distribution networks of drinking water in Algeria, the reduction of losses is currently a priority for the units ADE. The reduction of losses requires, among other things, investments in networks, for many and varied interventions. We can consider 4 types of programs of measures for improvement:

I. Upgrade Program From Distribution Networks A program of short term actions for reducing the most significant losses, including:

1. Diagnoses

2. An emergency program consists of:

- Operations detection and reduction of leakage;
- Replacement of a series of counters;
- Replacement of some pipes and accessories.

II. Setup Meters

III. Maintenance Program

IV. Rehabilitation Program

# Egypt: city of Alexandria

## Reducing losses and detecting leaks in water pipeline networks in the Alexandria Water Company

*Faten El Kholy, General Manager for Technical Support Administration, Alexandria Water Company*

### AWCO PROFILE

Our company was originally two water supply companies, one French and the other a multinational Egyptian company.

- In 1879 – transformed into an English company
- In 1954 – became an Egyptian company
- In 1961 – the company was nationalized
- In 1968 – AWCO became a General Authority under the Ministry of Housing and Utilities
- In 2004 – a presidential decree was issued to transfer 14 companies to follow the holding company for water and waste water and become 24 subsidiary companies.

### AWCO POLICY

- Reduction of operation and maintenance costs and minimizing operating network pressure, thus leading to: -
  - increased pump efficiency
  - minimization of electric power consumption
  - decreased pipe bursts
  - increased water supply network investment

- water conservation
- service continuity
- customer satisfaction

### DEFINING WATER LOSSES AND LEAKAGE

Water loss = 'real' losses + 'apparent' losses

Water Loss = water produced – revenue water

Water produced = water loss + authorized consumption



Water produced	Authorised consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Billed Metered Consumption	Non-revenue water
			Billed Unmetered Consumption	
	Water losses	Apparent losses	Unauthorised consumption	
			Customer Meter Inaccuracies	
		Real Losses	Leakage on Transmission and Distribution Mains	
			Leakage and Overflows at Storage Tanks	
Leakage on Service Connections up to point Customer Meter				

Fig. (1) showing the IWA Standard Water Balance

**OUR ACTIVITY IN THIS FIELD**

1. The start was at the beginning of 1992 (receipt of German grant), and the area of Maamoura was chosen as Pilot Area 1 for reducing apparent losses study (block mapping).
2. In 1995 the pilot area of HADARA was chosen as Pilot Area 2, an urban area with all types of activities, successfully reducing the apparent loss rate from 50% to approx. 36%.
3. Block mapping activities have been continuous during this entire period and covering all branches.
4. The area of Toson–Abu kir was chosen by Dutch donors to study commercial and physical leaks, successfully reducing the apparent losses from 35% to 15%.
5. The district of Faisal–Mandara was chosen by Italian donors (Life Project), and is still in progress.

**THE TOSON PILOT STUDY AREA**

- The area consists of 16 five-storey buildings, a Mosque, a school and a number of commercial stores
- Total number of master meters = 26 master meters
- Number of gardens = 1 garden
- Number of fire hydrants = 2 hydrants
- Total length of network = 2.45 km

Average pressure = 2.4 bars

- Population = 1,920 capita
- Area = 0.05 km<sup>2</sup> (200 m × 250 m)

The area is fed from three sources, two of which were closed. An ultrasonic flow meter was installed on the main entrance (8" pipe), with a pressure gauge.

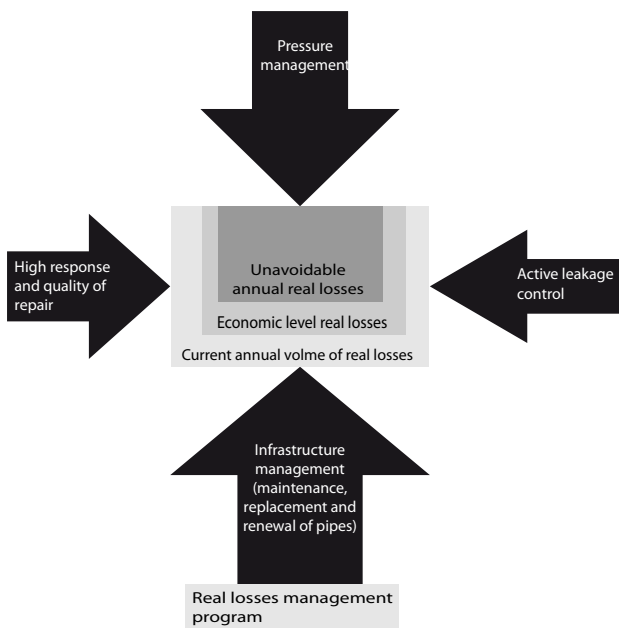


Fig. (2) showing the Real Losses Management Program Scheme

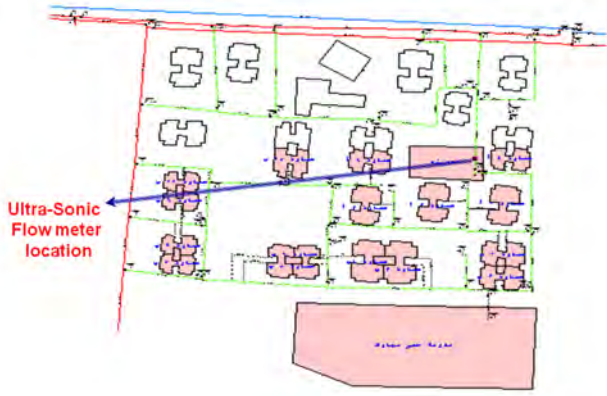


Fig. (3) showing the Toson area and location of flow meter

### WATER LOSS REDUCTION STUDY IN THE TOSON AREA

1. Prepare GIS map for pilot area and correcting by survey team.
2. Area valves: exposing and repairing, and replacing faulty valves
3. On-site field survey to locate main distribution pipe lines, sub-main distribution pipe lines and house connections
4. Implementing zero-pressure test
5. Field survey of the existing buildings and number of flats in each building (16 buildings and one school)
6. Registering data of sub and master meters in the area at the MMS sheets
7. Building a concrete chamber for main inlet and replacing a six-meter section of the 8” diameter main pipeline
8. Installing an ultrasonic flow meter as the main meter for the area
9. Reading the ultrasonic flow meter weekly and all master meters to calculate the commercial loss

1ST Step: Reducing Leaks From 35% to 21% by replacing five faulty meters

Date	Un accounted for water %	Sum of master meters M3	Inlet meter flowmeter M3	week
9-16/6/2007	35 %	1575	2400	1
16-23/6/2007	33 %	1561	2313	2
23-30/6/2007	21 %	846	1057	3

2nd Step: Reducing Leaks From 21% to 15% by replacing three faulty meters

Date	Un accounted for water%	Sum of master meters M3	Inlet flowmeter M3	week
17-24/5/2008	21 %	1359	1722	1
24-30/5/2008	21 %	1420	1798	2
30-11/6/2008	15 %	2464	2884	3
11-21/6/2008	15 %	2424	2864	4

"Our target is the reduction of NRW from 36 % to 15% in ten years"

### CURRENT AND FUTURE ACTIVITIES

Is currently activated and in progress to include the following.

- Forming and training additional crew, interested in leakage observation , analyzing observed data and planning to keep leakage level at min-point.

- Site survey for the existing network.
- Pinpointing weak and strong points of the network through the hydraulic modelling of network.
- Calibrating the hydraulic model regularly to be similar to the actual one.
- Importing high-tech leak detection devices.
- Pipe replacement, and rehabilitation of pipes and meters
- Creating a data base for all parts of the network and assets (customers, meters, pipeline, valves).
- Increasing the response speed for pipeline repairs, leaks etc. (hotline 125).
- Implementing SCADA system in water pumping stations and transmission pipeline network to create the pressure management in the whole network.

#### **BY APPLYING ALL THE ABOVE**

we will reach to optimal situation for leakage management earlier.

## Egypt: region of Sharkia

# The management of UFW in Egypt: Sharkia Potable Water & Sanitation Company

*Salah Bayoumi, Manager, SHAPWASCO, Project for UFW and SOP*

### ABSTRACT

Without a doubt, global water demand is growing while water resources are diminishing. For instance, water losses from distribution networks have long been a reality even in well-developed facilities and/or infrastructures that operate properly.

In the framework of technical cooperation between Egypt and Japan, a project for Improvement of Management Capacity of Operation and Maintenance of Sharkia Potable Water and Sanitation Company (SHAPWASCO) has been implemented at Sharkia Governorate starting in 2006 and it is planned to continue for three years. The project focuses on three main fields, among which is decreasing the losses and unbilled water using modern techniques. As a result, water pipe fractures can be detected and repair work or replacement of the pipe may take place.

The project activities were implemented in pilot areas in one of them the percentage of water leakage from the total water fed to this area was decreased from 26.5% to 9.3%. In other words, the saved volume of water reached 323 cubic meters per day. It is believed that if such activities are extended

through the whole Governorate, it is possible to save water which is equivalent to the production of a whole water treatment facility.

In addition, human resource development on the basis of «capacity development (CD)» is too important to be included as part of this Project. At the early stage of the project capacity assessments (CA) of the organization and each level of the personnel of SHAPWASCO has been conducted to identify the current conditions. At the same time, because of the necessity of training a fairly large number of staff members, workshops and seminars have been held simultaneously, and attention has been paid to the necessity of On Job Training (OJT) throughout the work procedures pertaining to the project activities.

## Jordan: city of Madaba

# Using local private sector to reduce NRW by improving billing and collection: the case of the Micro-PSP in Madaba, Jordan

*Dieter Rothenberger, Programme Manager, German-Jordanian TC Water Programme, GTZ*

### EXECUTIVE SUMMARY

The Non Revenue Water (NRW) rates throughout Jordan have not been reduced significantly within the last decade, despite major investments. This is partly due to the fact that apparent or administrative losses make up a big share of the NRW. It is assumed that approximately 50 per cent of the total NRW is due to incorrect meter reading, billing and cash collection, illegal consumption and faulty water meters. These problems will not be addressed if investments concentrate only on the rehabilitation of the network. Therefore it is essential to improve the customer management process with regard to these issues. One way to do this is to involve local companies in these processes.

Hence, the Micro-PSP approach has been introduced in Jordan as part of the Operation and Management Support project (OMS) within the framework of the German-Jordanian TC Water Programme, funded by the German Federal Ministry for Economic Cooperation and Development (BMZ). OMS is being implemented by the German Technical Cooperation (GTZ) and the Water Authority of Jordan (WAJ), with support from Dorsch Consult Water and Environment. Micro-PSP means the

outsourcing of clearly identified business processes in operation and maintenance of water supply and wastewater disposal to support commercialisation and efficiency of service delivery in WAJ by local private companies. An initial pilot was started in Madaba, with the clear objective (in addition to improving efficiency) of testing the concept and creating a market for local private companies to support the reform process in the water sector.

After an initial period of three years the Micro-PSP in Madaba proved to have been very successful. On the basis of this success, the contract in Madaba has been extended, and WAJ intends to award various new Micro-PSPs contracts in the country. This up-scaling includes the replication of the Madaba Micro-PSP in other Governorates, but also seeks to broaden the tasks for which Micro-PSP is used, and include fields like the refurbishment and operation of pumping stations or the improvement of household connection and leakage repair services. Interestingly, the autonomous Public Water Company in charge of the water and wastewater services in Amman (Miyahuna) also shows great interest in using Micro-PSP to improve its performance in some fields. As a result of its success the Micro-PSP contract in Madaba will not only be extended in terms of duration, but also

expanded in terms of outsourced tasks. Finally, the up-scaling might also take place regionally: already some water sector authorities of other countries in the Middle East and the Gulf States are investigating the Micro-PSP pilot study in Madaba to learn from it for their own reform processes.

## MICRO-PSP/OUTSOURCING

### Definition

The term “Micro-PSP” was introduced in Jordan by the Operation and Management Support Project (OMS 2003a: 7), implemented by GTZ with support from Dorsch Consult Water and Environment on behalf of the German Federal Ministry of Economic Cooperation and Development (BMZ). OMS uses the following definition for Micro-PSP:

*“Private Sector Participation in operation, maintenance and management of selected business activities and smaller business units of WAJ, enabling local private companies to support commercialisation and efficiency of service delivery in WAJ... It includes outsourcing of clearly identified functions/business processes in operation and maintenance of water supply and wastewater disposal...” (Abu Shams and Kachel 2003).*

The concept of Micro-PSP should provide rapid improvements and deliver better data on which the development of a large, long-term PSP can be based. As can be seen from the definition, Micro-PSP also covers outsourcing or contracting out. The main difference is that the remuneration for the private company in a Micro-PSP is normally performance-related, and depends on the achievement of specified targets, while outsourcing is rather fixed-fee based. In its other aspects outsourcing is very similar to Micro-PSP.

### Utilisation of Micro-PSP

Micro-PSP is increasingly being used by infrastructure utilities, since it can be used for the optimisation of many different processes within a water utility, for example billing and revenue collection; sewerage connection or water service connection replacements; leak repair service etc., IT and customer management, customer surveys and GIS services; operation of special plants and equipment; vehicle repairs and maintenance

#### Box 1: Outsourcing in industrialised countries

Chartwell (2005) found that in industrialised countries the percentage of utilities that now outsource certain business processes, e.g. in Customer Information Systems (CIS) and billing has surpassed the percentage of utilities which do not involve external private companies. The biggest growth in outsourcing has been in bill presentment and payment, where 70% of utilities now outsource some portion of their billing and payment cycle (Chartwell 2005: 7). The main motive for these outsourcing activities is cost reduction and the need for expertise not found in-house (Chartwell 2005: 4). However, utilities outsource certain processes where it makes sense, but most often keep the bulk of customer care activity in-house.

In Chile, a middle-income country, the utility companies have sub-contracted a very wide variety of activities, including the operation, management and capital investment of whole systems, as well as maintenance of all aspects of the networks, meter reading and billing. Contracting out has reduced the numbers of workers per connection. The public water utility in Santiago, EMOS, uses outsourcing in meter reading and other functions, and had with 2.04 employees per 1,000 connections in 1993 a labour productivity about three times the regional average’ (Lee, 1998). However, obviously, there are also risks of underperformance of the external service providers which need to be taken into account.

## Benefits and challenges

Keefe (1998) points out that outsourcing or Micro-PSP can lead not only to lower costs due to reduced inefficiencies, but also to higher quality and greater innovation. New opportunities for the local, often smaller-scale private sector can be achieved, and these have wider positive economic effects. However, there are also risks involved as in some cases these benefits may not be experienced. If poorly monitored and regulated, and with insufficient competition, quality may be reduced or the companies may be less innovative. Yet, he concludes the experiences in OECD countries show the huge cost saving potential (see also Box 1) and hence “justify serious consideration of contracting out across a wider range of government functions and settings” (Keefe 1998). The following Table 1 depicts some key benefits and challenges of outsourcing/Micro-PSP.

Can limit the authority's needs for new capital investment in maintenance and equipment.	May result in delays if procurement procedures are cumbersome.
Can develop useful benchmarks in terms of cost and performance of O&M tasks.	Increased vulnerability to non-completion of works due to contractors' financial problems, strikes etc.
May provide special skills and innovative methods of work and management.	Low bids may lead to inferior quality of work.
Supports the development of the local contracting industry, particularly small-scale entrepreneurs.	May lead to deterioration of in-house capabilities.

Source: Own table based on Sansom et al. (2003a: 22)

Other advantages and risks, as pointed out in Abu Shams and Kachel (2003) for the Jordanian water sector, are:

### Advantages

- The faster and cheaper implementation compared to large PSP approaches, which also brings short-term improvements;
- the familiarity of the target companies with the local conditions;
- the greater flexibility with a targeted contract, which is adaptable to available budgets, number and qualification of WAJ personnel, etc.;
- the applicability as a first step in a large-scale PSP approach as well as in a public company or a WAJ internal unit.

### Risks

- Lack of reliable business data and asymmetric information about hidden problems;
- depending on the type of service, the qualification of the local companies might be questionable, due to the lack of experience;

**Table 1: Possible benefits and disadvantages of Micro-PSP**

Advantages	Disadvantages
Cost effective if true competition, good procurement procedures and qualified supervision exist.	Requires qualified preparation of tender documents and close supervision.
Puts pressure on own labour organisation for efficiency improvements.	Risk of stimulating fraud and corruption in the procurement process and during supervision.
Increases flexibility to cope with seasonal variations and respond according to real needs instead of workforce and equipment at hand.	May lower quality of service to the public because contractors may tend to be less sensitive to the authority's objectives and public demands.
May reduce the authority's management burden, personnel administration and training.	May displease civil servants and consequently meet resistance from unions.

- the required delegation of power, e.g. concerning the collection of fees and taxes or the operation of facilities with high importance for the success of the contract, might be politically sensitive.

### Enabling environment for Micro-PSP processes

If private sector participation is to be developed on a substantial basis, it will be necessary for a government to develop an enabling environment that addresses key constraints. This also holds true for Micro PSP and outsourcing. The following paragraphs provide details on some key components of such an enabling environment.

#### *Contractor development*

One of the biggest challenges in Micro-PSP approaches is to encourage local companies to develop into effective and competitive operators, since in most cases originally all activities in the water sector have been undertaken by the public authorities. In order to do so, the following strategies might be considered (Sansom et al. 2003b: 73-74):

- a) Involve companies in the sector reform process through workshops, study tours and preparation of consultancy reports.
- b) Encourage the formation of consortia, particularly for larger contracts.
- c) Encourage former public sector staff to bid for new contracts as independent experts, with newly founded companies or with capable local private companies.
- d) Provide clear and comprehensive tender documents that will assist each bidder in understanding precisely what the client is

seeking in terms of the bidding process, and in the technical and financial proposals it must submit.

Once the local private sector sees a potential market in the provision of water and sanitation services, the companies are likely to be more proactive in the water sector. This can contribute to sector development, provided other aspects of the enabling environment are addressed.

#### *Commercial approaches*

There is a greater chance for successful Micro-PSP contract outcomes if an effective commercial orientation is established on both sides, within the water utility as well as with the contractor/operator. This includes in particular (see Sansom et al. 2003a: 70-73 for details):

- creating separate water and sewerage budgets, balancing expenditure with income and using management information (e.g. financial ratios);
- developing and implementing comprehensive training plans for all staff, based on detailed training needs analyses;
- increasing delegation of duties and staff authority, linked to new goal orientated job descriptions, and redeploying staff where necessary;
- implementing staff appraisals using agreed formats and linking this process to organisational objectives;
- developing staff incentives, including measures such as promotion on merit and bonus schemes;
- completing the decentralisation of responsibilities from state/central government and agencies to municipal corporations or utilities;
- establishing clear 'service provider' and 'enabling agency' or regulator roles for specific



organisations and providing support and resources to enable them to fulfil those roles;

- obtaining support from politicians and senior government officials for the changes and the transfer of selected powers to the water authority managers.

## MICRO-PSP EXPERIENCE OF WAJ MADABA, JORDAN<sup>1</sup>

### General introduction

Micro-PSP is a relatively new concept in Jordan. After some experience with the time consuming processes for Management Contracts in Amman and for the Northern Governorates (NGWA), the Micro-PSP approach was proposed as a fast-track option to achieve service improvements (OMS 2003b: 2). Yet, it was also clear that due to the limitations of the Micro-Scale PSP approach, this had to be seen rather as a complementary, preparatory stage for all kinds of PSP in the operation and management of water and wastewater systems in Jordan.

The objective of exploring the Micro-PSP concept is a goal in itself in Jordan: in addition to the objectives of cost reduction, management innovation and performance improvements, the creation of a market for local private companies to support the reform process in the water sector was perceived as a crucial economic issue (OMS 2003b: 3).

### The Madaba Micro-PSP

The Micro-PSP approach currently implemented in Madaba provides valuable information about the possibilities, but also the challenges of Micro-PSP in Jordan. The following paragraphs contain a

<sup>1</sup> The following information is based on information from reports and presentations of the Micro-PSP implementation, on interviews taken in 2006, and on the documentation of two workshops on Micro-PSP held in Jordan in 2003 and 2004.

summary of the process and the lessons learned.

### The situation before the Micro-PSP

The total number of water customers in the Madaba Governorate is 19,500, of which 94% were household customers. Large consumers play only a minor role in Madaba.

Before the implementation of the Micro-PSP, the situation of WAJ Madaba was dominated by severe problems in the customer management areas: customers were lost due to faulty application processes, the billing was often incorrect due to estimations, bills were not distributed due to poor information systems and the collection was ineffective. This led to very high Non-Revenue Water (NRW) ratios: In the 10 years before the Micro-PSP started, NRW ranged from 49-66%. It was estimated that there was a total revenue improvement potential of approx. 1.9 million JOD (WAJ 2005: 56).

Hence, the goals to be achieved are defined in WAJ (2005: 41) as:

- Improved water and wastewater revenue and reduced customer outstanding amounts;
- improved customer management efficiency;
- technical and administrative development of Madaba customer management organisation.

### The process of developing the Madaba Micro-PSP

In June 2003 the first Micro-PSP workshop took place in Jordan, organised by OMS and WAJ/PMU. Participants of this workshop mainly included senior staff from MWI, WAJ and PMU, NGWA, Amman Governorate, JVA, LEMA and various donors. The purpose of this workshop was to introduce Micro-PSP as a new and complementary approach to conventional PSPs with the objectives

of:

- accelerating/improving efficiency of WAJ service delivery within a short term horizon of less than two years;
- enabling the participation of Jordanian small/medium sized private sector companies in the operation of water/sewerage systems of WAJ.

This workshop supported the generation of general outlines and specific ideas about how Micro-PSP might be implemented in Jordan. In this workshop, the Madaba Governorate was presented as the area where the Micro-PSP pilot programme should start. Madaba was chosen as a pilot region for several reasons. These included but were not limited to:

- The improvement potential being seen as relatively large;
- the customer base being relatively small, so that task complexity is more easy to handle;
- the proximity to Amman, making cooperation with WAJ Headquarters and general transactions and logistics easier;
- a strong interest on the part of the local stakeholders in Madaba.

Nevertheless, it was obvious that it would be difficult to involve a competent private sector company because of the limited knowledge base in the tasks relevant to the contract. Therefore it was seen as absolutely essential to have a very detailed preparatory workshop in which interested and competent companies could participate to support the transfer of know-how and a better understanding of the expected activities:

*“As the Jordanian private sector does not have sufficient experience related to Micro PSP in customer services, the group confirmed that an orientation workshop is highly recommended....*

*the business fields which partially include this needed know-how have to be defined in order to identify local companies for pre-qualification process or workshops to build up the local know-how. In this respect, the Micro PSP project time horizon should consider the time needed to transfer the know-how up to the final pre-qualification” (OMS 2003b: 10).*

On 11 December 2003, WAJ advertised the intention to implement Micro-PSP for billing and revenue collection in Madaba in the local newspapers. Interested companies were invited to submit company profiles and information about their relevant experience. Based on this information, companies were invited for the preparatory workshop, which took place in February 2004. This two day workshop was attended by representatives from four companies. In total eleven very detailed and extensive presentations were given, and a substantial amount of time was allocated for discussion. It was hoped that this would assist in informing the companies about the contract, improve their understanding of WAJ water and wastewater customer business procedures, and reduce uncertainty and fears. In addition to providing information via this workshop, the companies were also invited to digest the topics discussed after the workshop and formulate questions that they could forward to the PMU Governorates Support Director.

The draft and the final Terms of Reference (ToR) were produced by the OMS project. The draft was the basis of the presentations given during the preparatory workshop in February 2004 and refined afterwards.

The contract

The contract was awarded to Engicon on 9 November 2005, and the contract started on 1 January 2006 - more than two years after the first

announcement in the local newspapers.

Detailed activities foreseen in the contract included:

- digital mapping and base data surveys (preparatory measures);
- water meter reading, billing and collection;
- leak detection and repair;
- procurement and installation of required equipment;
- business re-engineering of the customer services;
- training of staff.

The contract is divided into two phases. Phase 1 (preparatory phase) was seen as the basis for the re-engineering of the business processes. In Phase 1 the necessary systems and equipment were put in place, the databases were refined and staff were trained. The remuneration for Phase 1 is in effect a fixed fee. Phase 2 is called the Performance Management Period during which the private company takes over the performance based operations, i.e. meter reading, billing, collecting, handling bill objections, technical and financial inspections and follow-up, service disconnection and prevention of illegal use (WAJ 2005: 46).

There is an incentive scheme build into the contract by which the private operator receives a percentage of the additional revenue collected compared to the base year. This percentage was a figure specified by the bidders in their bids, and was part of the award criteria. The minimum percentage that had to be given was 10%. The winning bidder, Engicon, offered a relatively high percentage of 14%, and total costs for the contract of approx. 900,000 JOD. This amount includes the costs for the procurement of equipment, software etc., which constitute more than 500,000 JOD.

Since the contract is a service contract for billing and revenue collection, the contractor brings in only a small number of its own staff. 42 employees, mainly subscriber staff, are seconded by WAJ to the company, but remaining on the payroll of WAJ. However, the contract also foresees bonus payments for the seconded staff, and these bonus payments were part of the bidding variables.

Results after three years

The private contractor has successfully completed the preparation and the performance period, put new customer service structures in place and undertaken a number of actions:

- The surveying and mapping of the subscribers and the digitalising of all surveyed routes has been completed.
- Necessary technical (plotter, server & computer) and electromechanical (air-compressors, welding machines, hand-held test meter) equipment was supplied and training of the staff conducted.
- A new IT-based customer management system has been introduced. The private company transferred for the first time the issuing of the water bills from central WAJ in Amman to the Madaba Water Administration, thus supporting the decentralisation of services.
- A bonus scheme for the seconded staff of WAJ has been developed and remuneration procedures made transparent by publishing monthly a list of payments and bonuses received.
- Training activities for the staff, including customer care, data entries, and appraisal course for the management have been conducted.
- Rehabilitation works of the subscriber department offices and the file-storage rooms have been completed.

- A Sewage Database System has been installed and the transfer of sewerage customers' data from the files to the system has begun.

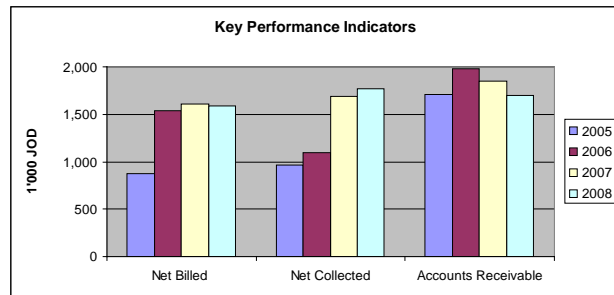
From the outset, the political will to make this pilot project a success was present, especially since the project was developed deliberately by WAJ and not linked with a donor-funded investment project. The monitoring of the performance is undertaken by the Programme Management Unit (PMU) of the Ministry for Water and Irrigation (MWI). There are regular formal and informal meetings between Engicon, WAJ/PMU and OMS to discuss progress.

At the beginning, the performance risks of the Micro-PSP were considered to be in the capability of the company itself, since the necessary framework conditions, with regard to the institutional settings, were in place.

- Nonetheless, the outcomes of the contract were very positive:
- Introduction of an efficient, transparent and reliable billing and collection procedure by digitalising of routes has been introduced;
- Establishment of more professional processes through enhancement of equipment and training of staff, securing the sustainability of results;
- Increased responsibility and accountability of local staff towards their customers through the new computer-aided billing system and decentralisation of part of the responsibilities from the central WAJ to the Water Administration in Madaba;
- Improved staff motivation due to the incentive system and capacity development activities;
- Better customer care and customer satisfaction as a result of professionalized services;
- Enhancement of a reliable customer base by increasing customer numbers and reducing illegal users;

- Reduction of accounts receivable by strict measures against illegal water use;
- Improvement of the reputation of the Water Authority in Madaba.

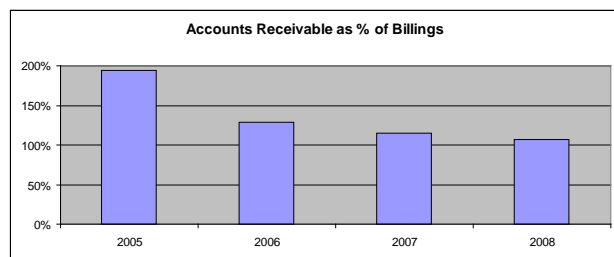
**Graph 1: Key Performance Indicators for the Micro-PSP in Madaba**



Source: own graph based on WAJ data.

The private partner managed to decrease considerably the high NRW and, by collecting additional cash, to significantly improve the financial situation of WAJ. As Graph 1 indicates, both the amounts net billed and net collected have increased remarkably: the billed amount increased by almost 80% between 2005 and 2008, while the amount collected increased by 84%. The outstanding invoices (or accounts receivable) as a percentage of the billed amount were cut by almost half, see Graph 2.

**Graph 2: Accounts receivables as percentage of billings in WAJ Madaba**



Source: own graph based on WAJ data.

These financial performance indicators clearly indicate impressive improvements. However, from

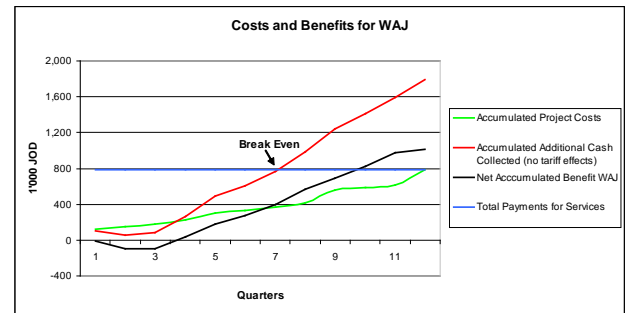
WAJ's financial perspective: was it worth testing the Micro-PSP approach in Madaba, considering the costs WAJ has to pay for Engicon's support?

Graph 3 shows the costs in terms of payments to Engicon for their services, the additional cash collected during the implementation of the Micro-PSP (compared to the base year 2005) and the accumulated benefit for WAJ, which is the additional cash minus the payments to Engicon.

In 2005, WAJ had collected revenue of less than 1 million JOD. In 2006 about 1.1 million JOD, in 2007 almost 1.7 million JOD and in 2008 more than 1.75 million JOD were collected. These figures do not include the additional collection due to tariff increases or new customers. Hence, the accumulated additional cash for WAJ after three years is almost 1.7 million JOD. This creates a stronger financial position for WAJ and costs the government less in subsidies to WAJ Madaba.

Graph 3 also shows that after only one year the accumulated additional cash was higher than the accumulated cost, i.e. the contract "paid for itself". If the full costs for the services over the three year contract are considered and compared with the accumulated additional cash for WAJ, the break-even point for the full contractual costs was in the seventh quarter. The cash collection almost doubled over the three years, and the net benefit for WAJ, after deduction of all service payments to Engicon, is almost 1 million JOD. Hence, the Micro-PSP proved to be a financial win-win partnership both for the company and for WAJ, and logically was extended for another three years.

**Graph 3: Costs and benefits for WAJ in the Micro-PSP Madaba**



Source: own graph based on WAJ data.

### Lessons learnt

The first Micro-PSP pilot project in Jordan can be described as a great success. The Micro-PSP project provided opportunities for the local private firms to participate and contribute to the water and wastewater services and operation and considerably improved cash flow in the sector. Compared to large-scale PSP models, the amount of funding required is much lower and the preparatory phase shorter.

Still not all expectations have been met: the start-up period of more than two years was longer than anticipated; dependency on external funding requirements could be reduced but remained important, especially for the preparation time and the back up for both partners. A critical issue is also the availability of competent local private companies to take over the tasks WAJ intends to outsource via a Micro-PSP. Hence, strong capacity development efforts are required to establish the long-term success of the Micro-PSP concept and to create a competitive market within Jordan.

This can be done in various ways, as the following Table 2 indicates.

**Table 2: Advantages/disadvantages of approaches to develop capacity**

Capacity Development Approach	Advantages	Disadvantages
Involvement in preparatory workshops	Clear focus, project oriented	Danger of being too abstract
General training irrespective of project implementation	create a broader market already before projects are developed	Selection of target group lack of focus (companies/content)
Coaching by OMS during project implementation	Clear focus, immediate impact;  Know-how transfer within Jordan	“supporting the strong” might create monopolies, Might be expensive
Recruitment of WAJ staff	Clear market driven approach  use of WAJ know-how	Planning time might be too short  risk of weakening WAJ
Staff from regional/international operators as support staff.	Benefit from international experience  less risk for WAJ/less support required  on the job training with clear focus, which could be linked to bonus.	Might be expensive  needs clear phasing-out planning  might be more complicated

Source: Own table.

While a mix of the different options would be a good way forward, some of the measures might happen as normal market reactions. This holds true especially for the recruitment of WAJ staff, which can currently be seen on such a scale that it already

negatively affects WAJ's capacity. There is the threat of an adverse selection from WAJ's point of view. Well trained, flexible WAJ staff that might also perform well within WAJ will be tempted by higher salaries in the private sector. They are targeted by private companies and can better handle the risk associated with private sector employment. While in general the staff reduction at WAJ might be helpful in increasing efficiency, an unbalanced reduction of high performers is a risk for WAJ.

There is another market reaction: the joint ventures with experienced companies inside and outside Jordan. While making use of regional or international operators is a very good strategy to overcome capacity gaps quickly, it would contradict the philosophy of employing local companies only. However, clear rules might be set, for example about the roles of the international staff mainly as trainers and backstoppers, the definition of training requirements as part of the contract, or the exit strategy for the international provider. Hence, this might only be a temporary and limited deviation from the objective to foster local private sector participation. Another possibility is to promote the formation of joint ventures with specialised companies in Jordan or the region, which contribute particularly relevant experience, e.g. in IT or customer management. Finally, also companies from other infrastructure sectors, for example JEPSCO, could contribute their experience in customer management. Since this is done within a Micro-PSP approach with very limited tasks, the risk of “being taken over” by other sectors is relatively small, compared to the potential benefits, as briefly outlined in Rudolph and Wilkes (2003, p.13). In addition, worldwide experience shows that both providers and customers benefit from shared experience and common responsibility.

## CONCLUSIONS AND OUTLOOK

### General

The results of the study by Sansom et al. show that a wide variety of activities and business processes are being outsourced in the water and sanitation sector in a wide range of countries. Even in countries where there is strong political resistance to more complex PSPs, contracting out is seen as relatively acceptable.

Overall, the studies demonstrate that Micro-PSP generally delivers better quality services at a lower cost, with competition for the market being a vital driver to reduce costs. Many authors support the importance of a sound relationship to make outsourcing a success:

*'Establishing a trust relationship requires structuring the right risks, rewards, benefits and opportunities in the early stages of the contract negotiation stage.'* (Eggers, 1998)

*'The real difficulties in managing successful outsourcing arrangements lie elsewhere: in specifying the relationship, creating the mutual trust which alone makes it workable, and coping with unexpected shocks.'* (Martin, 2001)

However, Sansom et al. also highlight the importance of not having too high expectations of the impact of Micro-PSP and contracting out on sector reforms:

*"Successful contracting out requires, like all management techniques, good clients and good, value-adding contractors. It can be a vital tool, but it is not a short cut. Contracting out is likely to be of most value as water companies become more efficient, effective and sophisticated in their management - i.e. after the process has*

*started, after some momentum for change has been achieved. Contracting out is not, as a single reform activity, delivering significant institutional change. Successful contracting out is a function of being a successful enterprise, not a direct route to becoming one."* (Sansom et al. 2003b, pp.33-34).

### Conclusions for Jordan

As the results in Madaba show, Micro-PSP can help to improve the performance of public operators because of the more flexible procedures of private companies, e.g. concerning procurement, staffing and salaries. However, the major bottleneck is the availability of competent local private companies to undertake the task. Considerable capacity development has to be undertaken to change this. This holds especially true for more complex Micro-PSP approaches, involving some expert operational knowledge.

Of the various options outlined above, the setting up of joint ventures with regional or supporting international operators, if a clear schedule for on-the-job training service delivery and for the phasing-out of the international support exists, could help to close the gap quickly. In addition, companies specialised in certain processes or from other infrastructure sectors with more experience and better performance in customer management or billing and collection can contribute to the solution. In addition to the capacity building issue, the need to conduct additional institutional reforms and improve the environment for the utilities (tariffs, flexibility, etc.) is apparent, due to the conceptual limitations of Micro-PSP.

## Outlook

Based on the success of the first Micro-PSP in Madaba, WAJ is currently in the process of awarding various new Micro-PSPs contracts in the country. This up-scaling includes the replication of the Madaba Micro-PSP in other Governorates, but also to broaden the tasks for which Micro-PSP is used, e.g. for fields such as the refurbishment and operation of pumping stations or the improvement of household connection and leakage repair services. As a result of its success, the Micro-PSP contract in Madaba will not only be extended in terms of duration, but also expanded in terms of outsourced tasks. And ultimately, the up-scaling might also take place in a regional context - already some water sector authorities of other countries in the Middle East and the Gulf States are investigating the Micro-PSP pilot study in Madaba to learn from it for their own reform processes.

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In addition, many thanks should go to all the people interviewed at the beginning of the pilot case in 2006. Your opinions shaped large parts of the process analysis for the Madaba case.

## Jordan

# Comprehensive, performance-based NRW approaches - from theory to real reduction

*Udo Kachel, Director, Dorsch Consult Water and Environment*

### ABSTRACT

Over the last 15 years, huge investments have been made in the Arab region to reduce NRW, ranging between 35 -50% in most utility companies.

Despite spending billions of Euros, little progress has been achieved.

Obviously, there is no simple and simultaneously sustainable solution to reduce NRW, since just providing the needed funds will not be sufficient.

Addressing NRW comprises a wide spectrum of partly interrelated activities like

- Network operations (intermittent supply regime, pressure management)
- Customer management (illegal connections, lost customers, billing & revenue collection)
- Maintenance & repair
- Hydraulic modeling
- Quality control and specification of materials used and workmanship
- Leakage control
- GIS usage for monitoring and control of NRW

Required is a paradigm change in NRW reduction, strictly output oriented, performance-based and bottom-up (house connections and tertiary networks must be the focus of activities).

Principles to be applied are:

1. NRW has to be addressed with a comprehensive approach, as the impact assessment of only partial elements is virtually impossible.
2. Any new NRW or WLRP project must be strictly performance-based and the output measurable, guided by the IWA definitions and mechanisms for transparent measurement of agreed performance indicators.
3. Performance-based EPC contracts for NRW reduction should be applied to create maximum flexibility and promote innovative solutions, the overarching objective is the cost effective reduction of NRW.

The responsibility for operation and management of a clearly defined project or service area during the contract period must be guaranteed and given to the EPC contractor.

## Jordan

# Effect of social factors and attitudes on non revenue water conservation experienced by Jordanian women

*Lina Ahmad Hiyari, Engineer, Jordan Valley Authority*

### ABSTRACT

Water or the lack of it has become an important issue in Jordan in recent years. Hundreds of thousands of people in suffered untold hardships of water cuts and water rationing. Gone are the days when water was abundant and no one had to conserve this vital resource. Increasingly, as water becomes scarce, increasing demand, high non-revenue water (NRW), and severe weather conditions, water will become an increasingly important factor in many peoples' lives. Hence, there is an urgent need for the public to play a more active role in helping to conserve water resources, viz. to reduce water demand. Awareness is growing of the importance of a gender approach to water management issues and this is where the role of women becomes vitally important. Currently, domestic water users consume roughly more than two thirds of the country's total water demand. Because of this huge volume, any reduction in consumption can save the country a lot of water. This is where women can play a vital role as they are the "managers" at home. Women are usually the ones who manage the family's water budget. They are considered vitally important in water conservation. Finally, women themselves need to cut down on water

use via substitution of water-saving methods and other personal adjustments. These paper studies women's reproductive and productive roles as they relate to using and managing water. The effects of Jordanian women's attitudes and their expected values towards saving water, usage habits for use by the family ,water saving methods and tools in households, and demographics were examined in this exploratory research. Data from 350 Jordanian women in households , aged 26 or above, indicate that, when it comes to attitudes towards the saving of water for family use, expected factors (such as age, education, income), significant predictors for good water management experienced by women.

## Lebanon: Saida area

# Non-revenue water reduction potential in the Saida, South Lebanon

*Ahmed Nizam, General Director of South Lebanon Water Establishment*

### ABSTRACT

Triggered by occasional shortfall during summer, water demand investigations were initiated recently in Saida (20,000 customers, 45,000 m<sup>3</sup>/day, 24/24 supply pattern). The town is serviced by a distribution network with a total length of approximately 200 km (including service connections) at an average pressure of 4.5 bar in two pressure zones. The system shows a number of critical indicators. One of them is the non-revenue water (NRW) which, due to the absence of customer metering data, can only be estimated (52%). Consequently, a considerable reduction potential of non-revenue water is associated to physical losses. Commercial (apparent) losses are regarded as equally important and are recommended to be targeted.

If addressed properly, long-term water demand for the City of Saida can be secured sustainably with moderate investments. The reduction of commercial losses includes a fully fledged customer survey and house water metering. Pressure management is the most cost-effective method to reduce physical losses and is advised to be adopted as a short/mid term solution. Network rehabilitation based on the recommendations of a loss reduction strategy is

advised as an integral part of a long-term approach to reduce NRW.

### INTRODUCTION

South Lebanon Water Establishment (SLWE) provides water supply and limited wastewater management services to approx. 563,000 people (of total 655,000) in the area served by the four former water authorities known as Saida, Tyr, Jabel El Aamel, and Naba El Tasseh. These services are provided, to various degrees, throughout the geographic service areas of each of these former authorities. SLWE is based in Saida, 40 km south of Beirut.

The creation of the SLWE was authorized under Law No. 221, which was approved by Parliament in May 2000, and its amendments (Laws 377 and 241). Law 221 and its amendments intend to introduce the common concept of Integrated Water Resources Management (IWRM) with a focus on centralization of management and decentralization of services.

The SLWE serves a geographic area of 2130 square

kilometres that is organized, for service and management purposes, into seven water supply “Departments” of the Establishment. The table below provides summary profile statistics relative to SLWE.

Geographic Service Area of Establishment (km <sup>2</sup> )	2,130
Estimated Total Population in Service Area	655,000
Estimated Served Population in Service Area	563,000
% Service Coverage of Household Population	85,9%

Table 1

The water supply sources for the SLWE are a combination of natural springs occurring in the mountainous areas and some artesian springs near the coast, as well as drilled well supply sources throughout the service area.

Forecasts presented in this paper are based on various published documents. In this regard please refer to the references at the end of this paper. Concrete NRW targets are addressed in the SLWE Business Plan (11/2008, supported by USAID funded LWPP). The Business Plan covers the period 2009 to 2013 and includes strategic goals of the Establishment.

This paper summarizes NRW-related activities envisaged to sustainably manage Saida water sources. Starting point of the discussion was a comparison of water demand projection and available water sources. The gap between both projections has shown that potential water demand management activities will effectively reduce the high levels of non-revenue water.

A short description of the water supply system of Saida is followed by an outline of available options to manage future demand.

## SAIDA WATER SUPPLY SYSTEM

### Water Sources

Saida is supplied by a number of sources which deliver a generally good quality of water. Currently these sources are sufficient to provide continuous (24 hour) water supply to the customers in Saida for most of the year. However, during summer there are occasional shortages leading to intermitted supply over short periods. In addition, occasional water shortages have been reported due to power cuts which affect the operation of pumping stations.

Current sources of the water supply system are summarised in the table below:

Yield (m <sup>3</sup> /d)	winter	summer
Wells (12)	45,550	41,150
Kfaroueh Spring	6,000	2,700
T O T A L	51,550	43,850

Table 2

As shown in the table above water sources of Saida vary between the dry season and winter. This is typical for groundwater sources and springs in Lebanon. However, the variation in Saida is probably less significant than in other regions.

Five of the wells are located in the urban area of Saida and are therefore exposed to a higher risk of contamination.

### Water Distribution

The primary distribution network of Saida is well documented. Lateral pipes and service connections however are not documented.

The primary network is composed of the following materials:

	length (km)	%
steel	50.2	69
asbestos cement	8.9	12
ductile iron	11.8	16
polyethylene (PE)	2.1	3
TOTAL	73.0	100

Table 3

Asbestos cement pipes account for 12% of the documented pipes. Major pipe bursts are reportedly related to this part of the network. (see Figure 1 below).

**Saida - Network Layout**  
 --- Asbestos Cement Pipes

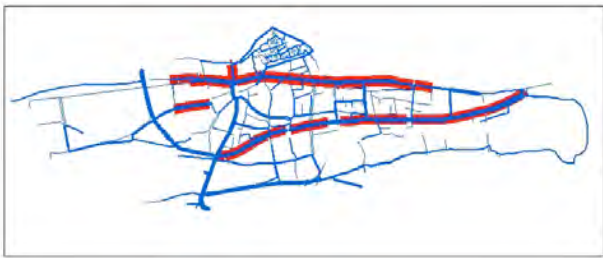


Figure 1: Saida Network - Network Layout

The network of Saida has to cope with high pressure conditions during the night. Pipe bursts are more likely in these areas. In addition, losses are expected to be high in the primary and secondary network including house connections due to constantly high pressure levels. In addition, private pipes and in-house plumbing will be affected.

The approximate pressure regime of the distribution

network in Saida during the night is shown in Figure 2.

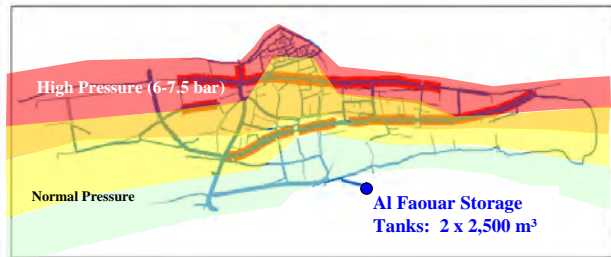


Figure 2: Saida Network - Pressure Regime

Typically the night flow constitutes an indirect indication of the levels of losses in a water supply system. Under typical conditions the area concerned with an estimated 15,000 subscribers would show a pronounced drop in water flow over night. Recently conducted flow measurements on the principal inlet pipe into the Saida network however revealed high levels of night flow. The water lost is shown in Figure 3 below (shaded area), representing the water that could potentially be used to safeguard future water demand.

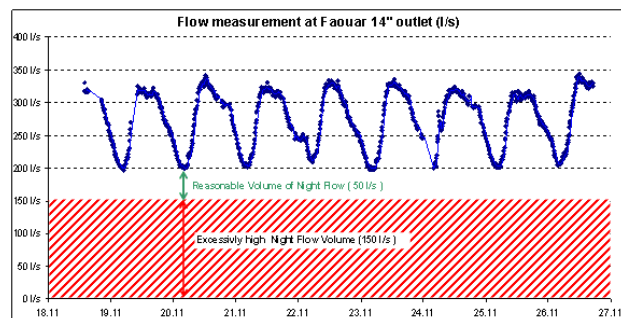


Figure 3: Flow at the principal inlet into Saida Network - showing high levels of Night Flow

Population and Subscribers

Urban water supply services address first and foremost the population. Reliable information about the number and distribution of the population is therefore essential. Several studies on population growth and population development for South Lebanon are available. Whereas the Investment Planning Programme adopted low growth rates (1.7% in 2005, decreasing to 1.5% in 2035, see low growth rate scenario in Figure 4 below), the wastewater master plan conducted within LWPP adopted higher growth rates (2.0% to 2.35% depending on the size of towns, see high growth rate scenario in the figure below). The moderate growth rate assumes a decrease from 2% in 2010 to 1.6% in 2040 (Figure 4).

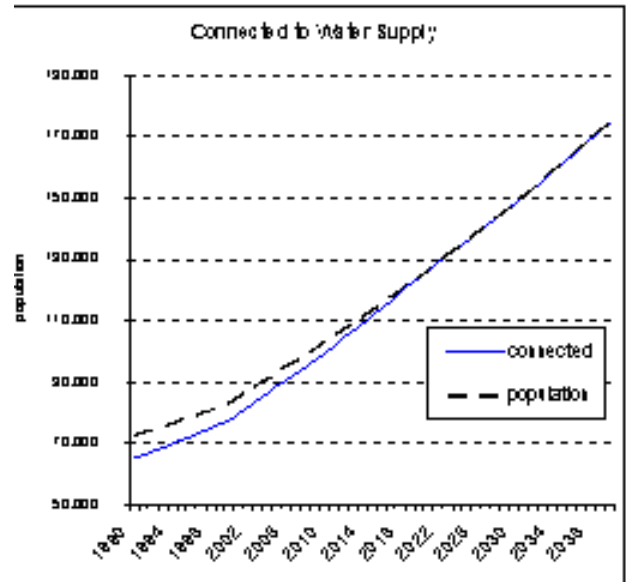
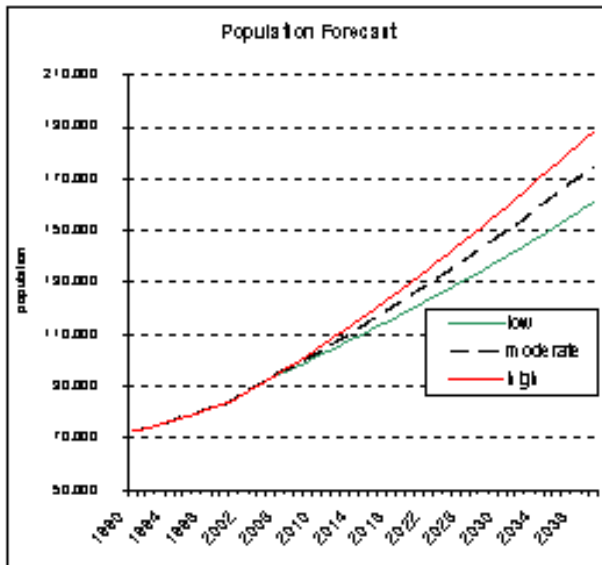


Figure 4: Saida – Population Forecast

Based on the number of residential units, the current population of the Caza (district) of Saida is estimated at 170,000. The current population located within the supply area of Saida is estimated at 100,000 and will increase (applying the moderate growth rate) to 175,000 in 2040 (see Figure 4 above).

The number of subscribers connected today to the water supply system is about 19,750 (year 2009). Assuming that the current connection rate is 95% this would be equivalent to 5 persons per connection which is considered realistic.

Subscribers in Lebanon commonly subscribe to a certain daily quantity of water and are billed accordingly on an annual basis. Customers receive their water through a “gauge” which is a calibrated orifice and theoretically allows only for the subscribed volume of water to be delivered. The current subscriptions add up to 20,600 m<sup>3</sup>/day (year 2009) and the actual amount of water for domestic consumption is estimated at 25,000 m<sup>3</sup>/day. This indicates that there are a considerable number of water users without a subscription.

## WATER DEMAND PROJECTION

### Specific Water Demand

Water demand forecasts depend primarily on the assumptions regarding the specific domestic demand for water. CDR suggests adopting a demand of 200 litres per capita and day (lcd) which would increase to 250 lcd after 2010 (the figures for Beirut are 50 lcd higher). The wastewater master plan for the South suggests a domestic consumption of 145 lcd in addition to a non-domestic consumption of around 50 lcd the total consumption is about 195 lcd. The Business Plan (which is the most recent document) considers 150-190 lcd.

Based on today's water demand data the specific daily water demand per person is about 217 lcd. However, this value includes water used also for non-domestic purposes (commercial, industrial, public, irrigation). In urban areas, where little or no water is used for irrigation, consumption is likely to be considerably lower.

Furthermore, the specific water demand varies according to the living standard, cost of water, awareness on water saving and habits related to water use. Typical water demand categories in an urban context are explained in the table below:

Scenario	Average daily demand per capita per day, including non-domestic water (lcd)	Description
High	250	High average demand expected in a system that provides sufficient quantities of inexpensive water (i.e. without consumption based tariffs). Occasional limitations and supply interruptions may occur.
Moderate	150	A moderate consumption is expected in a system where demand management is in place. If customers are continuously supplied with water and charged according to consumption, the water demand can be reduced significantly.

Table 4

### Future Water demand

#### Introduction

Water demand usually includes water used by the subscribers and water lost in the network. The loss is generally referred to as "unaccounted-for water"<sup>1</sup> or "non-revenue water" thus describing water as a commodity that has a commercial value. While saying this, it is generally assumed that the water lost could be provided to customers. Any demand forecast must therefore anticipate the role of water losses in its future water balance. Therefore any water service provider should primarily reduce the water losses as fast and cost efficiently as possible.

<sup>1</sup> According to the IWA water balance the UfW represents the "Water Losses". NRW additionally contains the unbilled but authorized consumption.



Commercial figures generated by Saida Branch Office indicate that close to half the water produced is not sold (i.e. is lost) due to physical (i.e. real) losses and administrative (i.e. unaccounted-for) losses. Today both types of losses add up to about 52% with an increasing tendency.

	2006	2007	2008
Subscribers	18.422	18.325	18.789
Contracted volumes (m <sup>3</sup> /day)	18.785	19.052	19.436
Billing LBP (Mio)	3.180	3.708	4.059
Distribution (1000 m <sup>3</sup> /year)	13.396	13.709	14.791
Billed volume (1000 m <sup>3</sup> /year)	6.857	6.954	7.094
Non-revenue water (1000 m <sup>3</sup> /year)	6.540	6.755	7.697
non-revenue water ( % )	48,8%	49,3%	52,0%

Table 5

#### Physical Losses (Real Losses)

Physical losses are assumed to be in the order of 50m<sup>3</sup> per kilometre of pipe per day (a detailed water balance would be required to verify this assumption). This volume corresponds to 25% of the water produced daily in Saida. Physical water losses cannot be avoided entirely, but should be controlled and reduced. However, the long-term target for physical losses should not exceed 5 m<sup>3</sup> per kilometre of pipe per day.

#### Administrative Losses (Apparent Losses)

Water that is being used without authorization of the operator is considered an administrative loss. It generates no income and increases the burden on the operator who provides water at a certain cost. Unauthorized use of water, such as false

declaration of the residential unit, water used by illegal customers, unauthorised connections and manipulation of gauges and water meters are the most common types of administrative losses in Saida.

Administrative losses are best addressed by appropriate monitoring mechanisms for customers and within the Water Establishment. Administrative losses are particularly high in an environment where lump sum tariffs are applied because the customer has no incentive to save water (such repair of leaking taps and flush toilets). Customers may also reduce payments by using one legal connection to serve several households. Means to reduce administrative losses should always include the installation of customer meters together with the introduction of consumption based tariffs. This report assumes that the current administrative losses are in the order of 27% of the water produced. The long term target for administrative losses should be well below 5%.

Non-revenue water (NRW) combines both the physical and the administrative losses<sup>2</sup> and is today in the order of 52%. A reduction to 42% in 2015 can be realistically achieved and would result in daily savings of 14,500 m<sup>3</sup>. This should be further reduced to 20% within 15 years (by 2025) which corresponds to daily savings of 21,400 m<sup>3</sup>. Finally total losses (physical losses plus administrative losses = non-revenue water) should be reduced to about 10% by 2040 as shown in Figure 5 below.

<sup>2</sup> NRW and Total Losses (sum of physical and administrative losses) are equal, according to IWA definitions, in case the Unbilled Authorized Consumption remains insignificant.

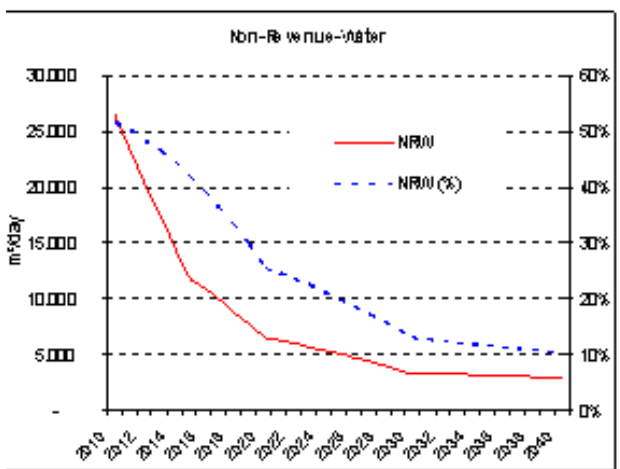
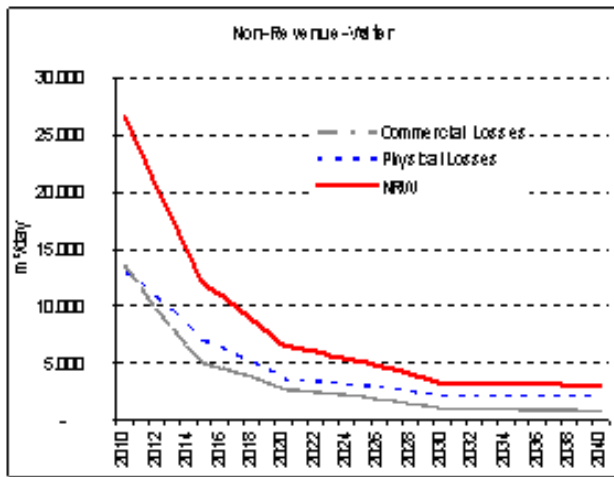


Figure 5: Water Losses and Non-Revenue Water

As shown in the above figures, the reduction of administrative losses is assumed to be more efficient than the reduction of physical losses. The reasons are given in the following section.

### NRW REDUCTION ACTIVITIES

#### Customer Metering

Although customer metres have been installed between 2000 and 2001, no meter readings took place. In addition, the metres installed are of poor quality and broken. According to the business plan 50% of the customer meters should be replaced before 2013. Based on recent subscriber questionnaires, resistance against

individual household metering is widespread. The introduction of water meters must therefore be supported with awareness campaigns to inform customers about the advantages of customer meters. Additionally, the installation of customer metres must be combined with the introduction of consumption-based (volumetric) tariffs. It is assumed that the specific water consumption can be reduced by 40% (from 250 litres per capita per day to 150 lcd).

Assuming full metering at the end of this decade would result in daily savings as follows:

		2010	2015	2020	2030	2040
Water metering savings:	m <sup>3</sup> /day	-	9.100	12.300	14.700	17.300

Table 6

Investment costs for replacing the water meters in Saida3 are assumed to be in the order of USD 3.5 million (considering about USD 150 per unit). It is estimated that customer metering will allow saving (on average) of about 10,500 m<sup>3</sup> of water per day (see details in table above). This is equivalent to investment costs of about 330 USD per cubic meter of water saved.

#### Customer Survey

The current customer database of Saida included around 19,750 customers. Despite major demographic changes the customer registry is based on data from the late seventies which have not been updated since then. It is therefore considered likely that:

<sup>3</sup> For estimated 23,000 customers by 2010.

- The number of illegal connections and customers without subscriptions is very high.
- Billing and collection systems do not provide accurate data about subscribers and receivables.
- Statistics about residential and administrative customers are incomplete and unreliable.

Based on the experience of the customer survey conducted in Beirut between 2003 and 2004, it is considered realistic that the customer survey will increase the number of registered customers considerably. In Saida it is estimated that a customer survey would increase the registry by at least 10%, which is equivalent to 2,000 additional subscribers.

New “legalized” subscribers will be paying for their consumption in the future whereas today these quantities of water are written off as administrative losses. It is estimated that this will allow for reducing administrative water losses by 2,000 m<sup>3</sup> per day.

Costs related to the customer survey in Saida are estimated at USD 60,000. This is equivalent to investment costs of only 25 USD per cubic metre of water saved.<sup>4</sup>

### Network Rehabilitation

The condition of the water distribution network in Saida varies according to the type and age of water supply pipes and connections. Network or physical losses are estimated to be about 50 m<sup>3</sup>/km/day. As already discussed in Section 4.3.3 above, this should be reduced to less than 5 m<sup>3</sup>/km/d.

Most of the physical losses are expected in areas where pipes are old and the water pressure is high. As discussed in Section 3.3 (Figure 1) above, pipe replacement should focus on asbestos-cement pipes. Considering the replacement of nine

kilometres of AC pipes with various diameters (ranging from DN 150 to DN 300) this may allow for reducing losses by an estimated 1,300 m<sup>3</sup> per day. Costs for the replacement are estimated at USD 3.3 million. This is equivalent to 2,500 USD per cubic meter of water saved and therefore considerably higher than other measures discussed in this report.

Another important activity would be the development of a network restructuring plan which allows for the zoning of supply areas. Ideally each of the zones should include between 1,000 and 3,000 customers. This would facilitate network management and systematic leak reduction significantly. As a first step SLWE should complete the network documentation which currently covers only about half of the network in Saida.

### Pressure Management

As shown earlier in Figure 2 the network of Saida has to cope with high pressure conditions in its lower areas during the night. This is leading to high water losses in the network. The distribution network of Saida consists of two main pressure zones. Pressure management should focus on the lower area which supplies most of Saida. The average pressure in this zone could be reduced to between 1.5 and 2.0 bar during the night hours (i.e. 1 a.m. to 5 a.m.). It is estimated that this would allow for reducing water losses by about 2,300 m<sup>3</sup> per day (on average). However, it should be mentioned that pressure management should be regarded as an intermediate solution until old and poor sections of the network are permanently replaced.

<sup>4</sup> The customer survey for Saida is currently prepared (joint effort of SLWE and GTZ).

		2010	2015	2020	2030	2040
Average daily water savings through Pressure Management	m <sup>3</sup> /day	1.800	2.000	2.200	2.600	3.100

Table 7

The costs related to pressure management in Saida involve the implementation of a manhole downstream of AlFaouar storage tank on the DN 300 galvanized iron pipe, the installation of a combined flow and pressure gauge (already available at the Water Establishment), a pressure reduction valve (plunger valve), dismantling joints, an air valve and two butterfly valves. The overall cost is estimated at only 100,000 US\$ which is equivalent to 44 USD per cubic metre of water saved and therefore very cost effective.

**CONCLUSIONS**

The water supply of Saida is increasingly facing supply problems in summer. Instead of following the supply management approach by drilling new wells, the long-term demand can be satisfied by adopting a number of activities which reduce the high non-revenue water levels registered in Saida.

Following the assumptions made earlier the water demand of approx. 50,000 m<sup>3</sup> (maximum daily demand in summer) can be effectively met by reducing physical and administrative losses as shown in the graph below.

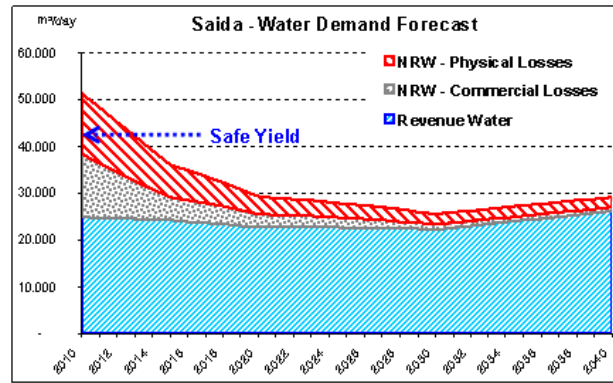


Figure 6: Saida - Water Demand Forecast

Balancing the water quantities produced with the water consumed and lost shows that the long-term demand of Saida can be met (projection until 2040) by initiating a number of measures thus avoiding major investments in large scale supply schemes. This, however, will require SLWE to apply demand management techniques. Two types of water losses have to be addressed in Saida: Administrative losses (i.e. non-payment for water) which according to current knowledge account for losses of the same magnitude as the physical losses (i.e. leakage through the network).

Further to strategic goals of the Business Plan for SLWE (November 2008) related to demand management, a number of additional options are discussed in this report. Based on these options, recommended measures are summarised below:

Recommended NRW reduction measures for Saida (ranked according to cost efficiency) <sup>1)</sup>	Estimated Water Saving (m <sup>3</sup> /day]	Estimated Costs (US\$)
Customer Survey: The customer data base for Saida is based on registries from the late seventies. Many households are not registered and do not pay for the water consumed. <sup>2)</sup>	2,000	60,000
Pressure Management: Reducing the high night pressure in the supply system of Saida would only require a moderate investment to reduce losses considerably.	2,300	100,000
Customer Metering: Introducing customer water meters combined with appropriate tariffs would have the largest potential to save water. This water would be available to satisfy increasing future demand.	10,500	3,500,000
Network rehabilitation: Replacement of 9 km of asbestos cement pipes with diameters up to 300 mm in the urban area of Saida would allow to reduce water leakage significantly.	1,300	3,300,000

Table 8

- SLWE, 2009 Commercial records, water production records (not published)
- USAID, 2007 South Lebanon Wastewater Master Plan, USAID, January 2007
- USAID, 2008 South Lebanon Water Establishment, Business Plan 2009-2013, LWPP, November 2008
- WB, 2009 WATER SECTOR: PUBLIC EXPENDITURE REVIEW, Draft, June 2009 Document of the World Bank

<sup>1</sup> Ranked according to the investment required per cubic metre of water saved.

<sup>2</sup> The customer survey is currently prepared (joint effort of SLWE and GTZ).

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## Lebanon: Hamat-Batroun area

# Development of a water balance for the distribution network in Hamat–Batroun area in North Lebanon

*Katia Fakhry, Agriculture Engineer, M.S. Water Resources Management, University of Jordan*

### INTRODUCTION

Compared to other countries in the Middle East, Lebanon has a relatively favorable position with regard to rainfall and water resources; however Lebanon is poised to face chronic water shortages by 2020 unless actions are taken to reform the sector (Comair 2008).

As a country which is still recovering from two decades of civil war, Lebanon faces deficiencies in the water supply sector. A key problem in the water sector in Lebanon is the weak performance of the Regional Water Establishments which together with the lack of storage capacity and growing demand leads to a demand-supply imbalance. Because of a lack of metering, households in general and low income households in particular cannot adapt their water consumption in line with demand and affordability level (World Bank 2009). Installing customer water meters in Lebanon is still in the early stages; people generally pay an annual fixed fee per household based on a contractual volume of water of 1m<sup>3</sup>/day. Due to the lack of metering, the development of a water balance is still not applied in Lebanon.

By conducting a water balance, the different components of water losses can be determined. The water balance calculation provides a guide to know how much water is lost as leakage from the network (real losses) and how much is due to apparent or non physical losses, for instance due to illegal connections or deficient metering practices.

This research was conducted in cooperation with the German Technical Agency for Technical Cooperation (GTZ) which is supporting the Water Establishments in order to strengthen the Lebanese water sector. It describes the International Water Association (IWA) approach to develop a Non Revenue Water (NRW) strategy for a region situated in North Lebanon called “Hamat” and it describes the perceptions of people towards the new water supply system and the current metering technology.

### CASE STUDY

Hamat, with a surface area around 10 km<sup>2</sup>, is located in the district of Batroun in North Lebanon, 60 km from Beirut at an altitude of 300 meters above sea level and has about 4800 inhabitants.

The average rainfall in Hamat-Batroun is 786 mm per year and varies between 138 mm in April and 60 mm in October.

The following table describes the annual subscription for 1 m<sup>3</sup> per day registered in the four Governorates of Lebanon including the region of Hamat. The annual charges per household range between 160,000 LBP/m<sup>3</sup>/year in Bekaa and 210,000 LBP/m<sup>3</sup>/year in Beirut & Mount Lebanon without the Value Added Tax (VAT = 10%). Figures are in Lebanese Pounds, 1USD = 1,507.5 LBP (fixed rate).

**Table 1: Annual subscription for domestic water**

Water Authority	Annual subscription for 1m <sup>3</sup> /day registered	Maintenance cost	Total Cost
Hamat - Batroun	180,000 LBP	20,000 LBP	200,000 LBP + 500 LBP per additional m <sup>3</sup>
North Lebanon	180,000 LBP	20,000 LBP	200,000 LBP
Beirut & Mount Lebanon	200,000 LBP	10,000 LBP	210,000 LBP
South Lebanon	175,000 LBP	25,000 LBP	200,000 LBP
Bekaa	140,000 LBP	20,000 LBP	160,000 LBP

Source: Water Establishments of Lebanon 2009  
LBP = Lebanese Pound

Hamat is the first area where a water balance has been established. The total number of registered customers is around 253; all of them are equipped with water meters (which is an exception in Lebanon). The water for this area comes from two wells and is pumped uphill into two reservoirs that supply two different zones in Hamat. Bulk meters are installed on distribution pipes at the

reservoirs. Customers are continuously supplied with water (24 hours per day) and the customers in Hamat pay a lump sum according to the basic quantity of subscription, for example 1 m<sup>3</sup> per day for 210,000 LBP (including VAT) per year, plus 500 LBP for each additional consumed 1m<sup>3</sup>, which is exceptional in Hamat.

## METHODOLOGY

Two water balances for the high and low region in Hamat-Batroun was calculated according to the IWA standards, for the period of 45 days from 24/09/09 until 08/11/09. The tool WB – Easy Calc, the free water balance software, version 3.00 was used in this study in order to calculate the Non Revenue Water (NRW). WB-Easy Calc is the first free multilingual water balance software. It was developed to help water utilities and consultants properly apply the IWA Water Loss Task Force Methodology (Liemberger & Partners July 2009).

Moreover, a survey was carried out in the study region on a small sample of 50 respondents. The questionnaire covered information about the households, the water use and the water service in the Hamat region. The objectives of this survey are based on interviewing customers in Hamat in the North about their level of awareness with regard to the water sector in Lebanon and the changes that they would like to make in order to improve this sector.

## RESULTS AND DISCUSSION

The water balance showed 17% of NRW in the distribution networks of the high region and 12% of NRW in the distribution networks of the low region of Hamat-Batroun. According to the World Bank (2009), the average level of unaccounted losses in

the distribution networks in Lebanon is estimated at about 40 percent. So compared with many other areas of Lebanon the level of NRW in both zones is very low. This can be explained by the installation of the new distribution networks (since 1999), the adapted pressure condition and the low number of pipe breaks.

According to the water meter readings and customer's consumption, the average water consumption per customer per day varies from 1.0 m<sup>3</sup> in the low region to 1.2 m<sup>3</sup> in the high region. Moreover, the water consumption increases during the dry periods (May-August), then decreases again from September. The values are high since the water supplied is used for domestic purposes in addition to irrigating the green landscaping areas surrounding the houses. Furthermore, the high consumption reflects the high living standard of the customers in Hamat, the permanent availability of water (24/24) and the absence of an incentive to save water.

It was significant that the consumption varies dramatically in the high and low region and the reasons are the irrigation period; the increasing number of persons per household and the fact that some of the people live in the area only during the summer.

The survey revealed that the majority of customers were satisfied with the annual tariff structure; however many people think that they do not have to save water since their water supply is based on a contractual volume of 1 m<sup>3</sup>/day. On the other hand, as Hamat is considered to be an area of high household income, the majority of residents have no problem with the additional charge for the extra consumed 1m<sup>3</sup> at the end of the year. This is considered to be an enabling environment for implementing meters and thus enforcing meter collection rates. However, it is not easy to transfer this issue to all regions in Lebanon since

a pricing system which recovers full operation and maintenance costs may not be feasible in poor areas.

## CONCLUSIONS AND RECOMMENDATIONS

- Every water utility should measure or meter all water taken into its system and all water distributed from its system at its customers' point of service. This can be done by dividing the regions into zones, thus allowing production, distribution and individual metering to be implemented.
- Greater attention should be given to assessing the impact of metering and pricing on consumption patterns in Lebanon. Investments are required to achieve continuous water supply. Solutions to increase continuity of water supply include the rehabilitation of old networks (i.e. fixing leaks in old pipes and service connections), execution of new projects or the extension of existing networks (i.e. improving a network layout), and significantly improving distribution and system management.
- A pressure management scheme should be conducted as it is one of the methods to control the pressure and supply in networks in relation to supply and demand.
- It is recommended that Water Establishments should conduct more awareness-raising campaigns all over Lebanon about the benefits of installing water meters and to encourage customers to save water.
- Hamat-Batroun should be a real example in the Lebanese sector to reduce NRW in the distribution networks by installing meters at dwelling level and carrying out the water balance model. It should, however, be borne in mind that the Hamat model cannot easily be transferred to other regions in Lebanon due to the difference in surface area,



population density, income and economy. But it is very important to transfer the concept of a water balance through the continuous implementation of awareness in order to reduce water losses.

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## Morocco

# Principes de management de la réduction des pertes d'eau potable au Maroc: Approche de l'ONEP

*Driss Bahaj, Directeur de la Direction Commerciale et Marketing, ONEP, Abdellah Harriz, Chef de la division Amélioration des Performances, ONEP*

### PRÉAMBULE :

La politique du secteur de l'eau adoptée par le Maroc depuis longtemps à travers la réalisation d'une infrastructure hydraulique considérable (plus de 128 barrages pour une capacité de retenue totale de près de 17 milliards m<sup>3</sup>), lui a permis de se doter d'une bonne maîtrise de ses ressources en eau, assurer une meilleure valorisation de l'eau et de satisfaire les besoins en eau potable et d'irrigation. Cependant, le secteur de l'eau doit faire face à plusieurs contraintes et défis, en l'occurrence :

- Le contexte climatique et hydrologique du Maroc caractérisé par une pluviométrie irrégulière et une succession des périodes de sécheresse ;
- La croissance démographique, urbanistique et touristique exerce une pression sur les ressources en eau conventionnelles limitées.
- la surexploitation des nappes souterraines se répercute par une nette diminution des réserves d'eau, le tarissement des sources, des khéttaras ou/et une dégradation significative de la qualité de l'eau par intrusion marine.

Face à ces contraintes liées à la raréfaction des ressources en eau et aux changements climatiques, des efforts sont nécessaires pour préserver et gérer de façon rationnelle et durable les ressources en eau disponibles. L'efficacité dans l'utilisation de l'eau potable est un axe prioritaire de la pérennisation des ressources en eau et constitue actuellement un défi majeur du secteur de l'approvisionnement en eau potable urbain et rural pour l'ONEP.

### INTERVENANTS DANS LA GESTION DE L'EAU

#### POTABLE:

Au Maroc, plusieurs opérateurs interviennent dans la gestion des services de distribution d'eau potable notamment :

- L'office National de l'Eau potable (ONEP);
- les régions autonomes qui sont actuellement au nombre de 12 ;
- les opérateurs privés qui sont au nombre de 4 ;
- Les communes elles-mêmes ;
- les associations d'usagers et les coopératives qui interviennent principalement en milieu rural.

L'ONEP, est un établissement public à caractère industriel et commercial créé par le Dahir n°1.72.103 du 3 avril 1972 tel qu'il a été modifié et complété, sous la tutelle du Ministère de l'Energie, des Mines, de l'Eau et de l'Environnement. Il assure la production d'eau potable au niveau National pour les régies de distribution Municipales, les opérateurs privés de la distribution d'eau potable et pour 532 petites et moyennes villes dont il a la charge de gestion directe, ou en gérance au profit des communes ayant délibéré pour confier la gestion de la distribution de l'eau à l'ONEP conformément à la loi n° 78-00 portant charte communale (article 39).

## QUELQUES DONNÉES SUR L'ONEP

Le volume d'eau potable produite par l'ONEP pour l'année 2008 est de 828 Millions de m<sup>3</sup>. Pour assurer cette production l'ONEP gère environ 1065 captages, 56 stations de traitements et 1425 stations de pompage avec un débit de production total équipé de 48 m<sup>3</sup>/s. Le transport et la distribution d'eau produite se fait via un linéaire de réseau constitué de 8300 Kms d'adductions et 26 300 Kms de réseau de distribution de différents diamètres et matériaux. Le nombre d'abonnés de l'ONEP s'élève à environ 1,3 millions d'abonnés.

## ACTIONS TECHNIQUES POUR LA RÉDUCTION DES PERTES D'EAU POTABLE :

### Origine des pertes d'eau

Les pertes en eau au niveau des installations de production et distribution d'eau potable peuvent avoir plusieurs origines:

- Pertes techniques : dues au Rinçage, désinfection des conduites et lavage des

réservoirs ;

- Fuites apparentes et non apparentes sur conduites et branchements ;
- Pertes commerciales : dues aux consommations non comptabilisées suite à un sous comptage, blocage de compteurs, manque de compteurs au niveau des bouches d'incendies ou branchements illicites.

### Actions pour réduire les pertes d'eau (Amélioration de rendements des réseaux)

Dans le cadre de la stratégie de l'office concernant la pérennisation des installations, et afin d'augmenter l'efficacité des systèmes de production, de transport, et de distribution, l'ONEP entreprend plusieurs actions d'amélioration des rendements hydrauliques. Ces actions se manifestent à différents niveaux:

Au niveau de la conception et réalisation des projets par:

- Le choix de procédés de traitement adapté à la qualité d'eau brute avec recyclage des eaux de lavage;
- L'application des normes nécessaires pour le choix des matériaux adéquats, et les essais de réception à l'usine et sur les chantiers.
- La réalisation des études spécifiques d'amélioration des rendements et le suivi rigoureux des travaux qui en découlent.

Au niveau de l'exploitation par :

- La mise à niveau des réseaux de transport et de distribution des nouvelles gérances : En effet, chaque année l'ONEP prend en charge environ une trentaine de nouvelles gérances caractérisées par un réseau vétuste ;
- La sectorisation des réseaux avec équipement

des secteurs par des débitmètres pour le suivi des débits nocturnes, et la maîtrise de l'équilibre de la pression et de la protection des réseaux ;

- La réalisation de campagnes de détection et réparation de fuites par les moyens de l'ONEP et le privé. A cet effet, l'ONEP dispose actuellement de 17 équipes de RDF opérationnelles qui ont réalisé 100 centres en 2008 en balayant 2800km (les opérations de sous-traitance ont permis de balayer 3400km). L'ONEP compte ramener le nombre de ses équipes à 35 vers l'horizon 2012.
- La réhabilitation des installations des adductions vétustes et des réseaux de distribution fuyards via des programmes d'amélioration des performances financés par des bailleurs de fond internationaux avec des objectifs à atteindre après mis en service des projets ;
- L'amélioration des articles des branchements et guide technique pour leur mise en œuvre ;
- L'amélioration du comptage hydraulique gros et petit calibre :
- Au niveau comptage petit calibre :
  - Choix stratégique pour l'acquisition, depuis 2004, des compteurs petits calibres de classe C, caractérisés par une forte précision même à débits faibles ;
  - Réalisation de tests de sensibilité et des essais d'endurance.
  - Equipements de bancs d'essais par du matériel performant pour étalonnage des compteurs petits calibres.
  - Changement d'environ 1/3 du parc de compteurs âgés pour réduire l'âge de la réforme des compteurs petits calibres à 10 ans en 2010 et programmation de changement de 100000 compteurs environ par an pour réduire l'âge du parc

de comptage à 8 ans à l'horizon 2015 ;

- Acquisition de compteurs étalons portables pour les centres de distribution.
- Au niveau comptage Gros calibre:
  - Réhabilitation et pose d'environ 350 débitmètres électromécaniques depuis 2004, et il est prévu la pose d'environ 1700 compteurs de ce type durant la période 2010-2015. Ce type de compteurs est caractérisé par une grande précision ;
  - Généralisation de la pose des compteurs au niveau des piquages pour l'AEP du monde rural ;
  - Instaurer la télé relève au niveau des gros consommateurs, et en tête de secteur pour suivre les débits nocturnes instantanés du réseau de distribution.
- La mise en place des procédures pour l'exploitation et la mise à jour en continu des plans des réseaux ;
- L'entretien et la maintenance des réseaux par les moyens de l'ONEP et par le privé (Marchés cadres; micro entreprise)
- La sensibilisation et la formation du personnel de l'ONEP, et des micros entreprises assurant la gestion et l'exploitation des installations de production et de distribution.
- La mise en place en 2010 d'un système SIG et GMAO

## ACTIONS COMMERCIALES

Pour le volet commercial, les principales actions menées pour la réduction des pertes d'eau et une rationalisation de sa consommation peuvent être classées essentiellement en trois catégories :

- Les actions qui ont trait à la fiabilisation des volumes facturés ;
- Les actions visant la réduction des pertes dans les installations internes ;

- Les actions de rationalisation de la consommation, notamment celles des administrations et bâtiments publics.

L'ensemble de ces actions est soutenu par les mesures d'ordre tarifaire qui ont contribué à la réduction de la consommation spécifiques des différents usages.

La fiabilisation des volumes facturés :

La fiabilisation des volumes facturés passe à travers la sécurisation de l'opération de la relève en utilisant les outils et les pratiques ci -après :

L'utilisation des TSP (terminaux de saisie portable) au lieu des bordereaux manuel de relève, cet outil a permis de relever les index avec une meilleure exactitude, constat confirmé par le taux de relevés erronés qui a été revu à la baisse ;

La systématisation de l'opération des contres – relèves qui a incité les releveurs à exécuter cette tâche avec une attention particulière.

Par ailleurs, le renforcement des actions d'assistance et de contrôle commercial vise notamment :

- l'identification et la suppression de tout prélèvement clandestin éventuel (piquage direct sur adduction d'eau potable, prise directe sur le réseau non munie de compteur,...), les quels prélèvement constitue une source non négligeable des pertes d'eau ;
- La généralisation du comptage pour la totalité des volumes distribués dans le réseau.

La réduction des pertes dans les installations internes :

Cette action passe par l'assistance apportée aux différents utilisateurs pour :

- Le suivi régulier de la consommation d'eau potable pour les gros consommateurs, accompagné de message d'alerte en cas de constatation de consommation anormale ;
- L'installation et l'utilisation d'ouvrages et de sanitaires économes d'eau ;
- La recherche et la réparation des fuites internes, cette action est couplée à l'application de tarifs dissuasifs pour toute consommation jugée excessive d'eau potable ( on entend par consommation excessive toute consommation supérieur à quatre fois la consommation moyenne historique enregistrée sur une période de deux ans) .

La rationalisation de la consommation d'eau potable pour les administrations :

La rationalisation de la consommation d'eau potable pour les administrations et les bâtiments publics est passé par :

- La conclusion d'accord et de convention avec plusieurs départements administratifs pour la réhabilitation et la mise à niveau des réseaux et des installations internes et ;
- L'instauration d'un système de paiement des consommations d'eau, d'électricité et de téléphone par des vignettes. Ce système à été mis en place suite à l'accumulation des arriérés de paiement des factures d'eau et d'électricité ayant engendré de graves problèmes financiers et de trésorerie des organismes producteurs et distributeurs d'eau et d'électricité conjugués à des tensions avec les bailleurs de fonds ; ainsi

et pour mettre un terme à la reconstitution des arriérées et après plusieurs tentatives de solutions entre 1984 et 1992, les Pouvoirs Publics avaient décidé de mettre en place, à compter du 1er Janvier 1993, un système de paiement des consommations d'eau et d'électricité par vignettes (circulaire du Premier Ministre n° 69/CAB du 13/11/92).

*Brève description du système :*

4. L'Administration formule une demande à l'ONEP relative à l'établissement de conventions pour l'acquisition des vignettes Eau-Electricité. Les conventions établies sont signées par l'ONEP et transmises à l'Administration concernée aux fins d'approbation et de virement au compte vignettes ouvert à la Trésorerie Générale au nom de l'ONEP. L'ONEP remet les vignettes à l'Administration après virement du montant de la convention au compte vignettes sur la base d'un avis de crédit établi par la Trésorerie Générale.
5. Le distributeur remet les factures à ses abonnés Administratifs à la fin de chaque trimestre : au plus tard fin Avril, fin Juillet, fin Octobre, fin Janvier. L'Administration valorise les bons vignettes au vu des factures reçues et les remet au distributeur dans un délai maximum de deux (2) mois.
6. Les bons valorisés reçus par les distributeurs sont remis à l'ONEP aux fins de paiement sur le compte vignettes. Après contrôle des bons valorisés émis, l'ONEP établit des lettres de virement au profit des organismes de distribution concernés et les transmet à la Trésorerie Générale dans un délai ne dépassant pas un (1) mois.

*Objectifs assignés à ce système :*

L'ONEP, en tant que gestionnaire de ce système s'est fixé comme objectif non seulement d'assurer le travail matériel pour le paiement mais d'apporter sa collaboration à toutes les parties concernées pour permettre un fonctionnement pérenne du système et une amélioration dans la gestion des budgets d'eau et d'électricité afin d'éviter les coupures.

L'Office a mis en place toute une structure tant au niveau central que régional, provincial que local pour rapprocher le gestionnaire du système des entités décentralisées (Collectivités Locales, Administrations, Distributeurs, etc).

*Evaluation des résultats du système :*

Le système a permis une augmentation de manière significative, pour l'ensemble des distributeurs d'eau et d'électricité, du taux de recouvrement de la facturation Eau et Electricité des Administrations et des Collectivités Locales

Au delà de l'amélioration du taux de recouvrement, une réduction de la consommation d'eau et d'électricité a été observée suite à la responsabilisation des consommateurs directs et ce, en dépit des augmentations tarifaires eau – électricité appliquées entre 1993 et 2000 ainsi que des extensions des établissements ou des constructions nouvelles.

La facturation d'eau et d'électricité n'a augmenté en moyenne annuelle entre 1993 & 2000 que de 5 % pour les administrations et de 7 % pour les collectivités locales. Ces résultats ont été atteints suite à la suppression des branchements illicites et à la mise en place des compteurs individuels aux habitants privés dans les enceintes administratives, au contrôle de la consommation, au contrôle de l'état des installations internes, etc.

La Tarification à tranches progressives comme outil de gestion de la demande en eau

Contexte général :

La création de l'ONEP en 1972, constitue la fin d'une époque marquée par une gestion de l'eau tournée vers l'offre et les premiers pas en faveur d'une stratégie intégrée en matière de l'économie d'eau ; en effet les ressources à proximité immédiat des agglomérations humaines, facilement mobilisables sont surexploitées et polluées. Les ressources en eau additionnelles, quand elles existent, comportent des risques sécuritaires et reviennent plus cher en investissement alors que l'eau de mer, bien qu'accessible, reste coûteuse à dessaler et inabordable pour le pays où le coût de l'énergie reste élevé.

Dès 1975, les premiers axes développés en termes de recouvrement des coûts, dénote la volonté des pouvoirs publics à asseoir une gestion de la demande par l'économie de l'eau et la rationalisation de son usage, Un des instruments privilégié utilisé est certainement la tarification et sa progressivité conjuguée avec des campagnes de sensibilisation et d'information ;

Descriptif flash du système tarifaire marocain :

Les tarifs sont fixés :

- par référence au coût économique de développement, ce qui permet de faire ressentir à l'usager la rareté de l'eau et de l'amener ainsi à éviter le gaspillage et à préserver la ressource, en assurant l'efficacité économique.
- En permettant une meilleure viabilité du secteur de l'eau par la couverture des charges d'exploitation et le financement partiel des coûts compte tenu des possibilités de l'Etat et des opportunités que peut offrir le recours au

financement extérieur ;

- En acceptant de redistribuer les subventions croisées entre les abonnés au profit de la tranche sociale avec une participation accrue des tranches intermédiaires et une diminution de la pression sur les gros consommateurs notamment ceux des secteurs économiques productifs comme les industriels ou à caractère hygiénique ou préférentiel ;
- En prévoyant des mécanismes d'évolution régulière et progressive des tarifs ;

Ses objectifs d'ordre théorique et conceptuel se sont traduits sur le plan pratique par :

- Une tarification différenciée entre production et distribution pour les grandes villes et une tarification uniforme pour les petits centres gérés par ONEP,
- Une tarification différenciée entre villes visant à refléter la rareté relative de la ressource et la disparité des coûts de production et de distribution,
- Une tarification différenciée par catégorie d'abonnés (progressive par tranches de consommation pour l'usage domestique et uniforme pour les usages préférentiel et industriel).

Réaménagements tarifaires successifs:

Ces réaménagements tarifaires ont été accompagnés de mesures visant essentiellement la rationalisation de la demande en eau à travers :

- L'accentuation de la tarification progressive par la limitation de la 2ème tranche à 60 m<sup>3</sup>/trimestre et l'institution d'une troisième tranche au delà de ce seuil.
- La création d'un tarif préférentiel unique

en faveur des bains publics et des bornes-fontaines.

- La révision du seuil de la première tranche (de 8 à 6 m<sup>3</sup>/mois)
- la mise à niveau de la redevance fixe restée figée depuis 1977
- La réalisation de campagnes de sensibilisation de la population relatives à l'économie de l'eau ;
- Le lancement de programmes d'amélioration des rendements des adductions et réseaux de distribution afin d'éviter le gaspillage des ressources et de maintenir les nouveaux investissements à un niveau acceptable;
- La suppression du gaspillage induit par les bornes-fontaines : dans ce but, diverses formules de gestion rationnelle ont été adoptées (gardien gérant, amicale).
- L'encouragement des branchements particuliers pour les ménages à faibles revenus. Une politique dite de "branchements sociaux" a été adoptée en vue de favoriser le raccordement aux réseaux d'eau potable par l'octroi de facilités de paiement.

Les résultats sont probants en matière d'économie d'eau potable:

Les mesures tarifaires ont permis d'infléchir considérablement la demande, l'on peut constater :

- L'infléchissement de la dotation spécifique qui est passée de 130 l/hab/j en 1982 à environ 70 l/hab/j en 2010 sous l'effet des révisions tarifaires de l'eau potable doublée par l'introduction de la facture assainissement liquide depuis 2000 et qui est assise sur la consommation facturée en eau potable
- le nombre des abonnés qui migre vers les tranches inférieures (effet accordéon) ;
- l'atomisation et la nucléarisation des ménages a permis de développer dans certaines

mesures un comportement économe envers la ressource en eau (versus compteur collectif et son corolaire consommation abusive)

Ces constats bien que révélateurs restent en deçà des attentes dans la mesure où :

- Le secteur de l'eau potable intervient dans une faible mesure dans la consommation globale des ressources en eau du pays (moins de 10%) ;
- Le caractère non suffisamment dissuasif des tarifs actuels ; la quatrième tranche ne joue pas le rôle pour lequel il a été institué ;
- La convergence tarifaire, bien qu'entérinée en principe par les pouvoirs publics en faisant même l'objet d'une circulaire trouve d'énorme difficulté pour sa mise en œuvre.



## Morocco

# Non-revenue water management in the Arab Region: solutions for drinking water loss reduction - capacity building approach -

*Mostafa Biad, Head of Planning Division, DAE, ONEP*

### BACKGROUND

Water resources must be protected, conserved, developed, managed, used, and controlled in way that ensures efficient, sustainable and beneficial use in the public interest. In this context, “water demand management within the framework of integrated water resources management” is a key to securing and safeguarding water supplies for sustainable development.

Indeed, utilities pay particular interest to NRW and to performance improvement with a double objective: (1) to improve their financial situation by reducing costs and increasing revenues, postponing investments (avoiding early water resources saturation), and (2) to improve water service delivery mainly in areas experiencing shortages.

It is commonly recognized in the water sector that capacity building activities are one of the most important elements of a comprehensive and integrated water loss control programme. These activities are both intra-utility and inter-utility, with the involvement of private sector.

### WHAT IS CAPACITY BUILDING?

In literature and within specialized agencies it is generally recognized that capacity building involves three different levels:

1. Human resource development: skills, knowledge and training to ensure effective performance
2. Organizational development: management structures, processes and procedures, management of relationships between different organizations and sectors (public, private and community)
3. Institutional development and legal framework: enhancing capacities at legal and regulatory level, and helping institutions and agencies at all levels in the sectors

### CAPACITY BUILDING APPROACH FOR NRW

Capacity building in companies and institutions in charge of water production/distribution should be multi dimensional and articulated primarily according to different axes, i.e.

1. Axis: Institutional and Organizational
2. Axis: Exchange and Networking
3. Axis: Training, Competences and Communication
4. Axis: Private Sector Participation
5. Axis: R&D

### Capacity building approach for NRW



### AXIS: INSTITUTIONAL AND ORGANIZATIONAL DEVELOPMENT

- Institutional aspect :  
NRW strategy should be on the agenda of the topmost institutions in the water sector, and translated into real measures among the utilities. This involves the establishment of law texts and bylaws, special programmes, incentives (targeted subsidies) etc.
- Organizational aspect :
  - Coaching for identification and implementation of NRW integrated global action plan. (supporting utilities in leading NRW diagnosis, identifying all forms of losses and then designing a logical and prioritized modus operandi to redress the situation in a sustainable manner)
  - Choosing the best structure for "NRW function" and organization development (job descriptions, procedures etc.)
  - Setting up performance indicators,

measurement systems, monitoring and reporting systems (both within the utility and within the sector, sector newsletter)

- Best management practices (incentives, management by results, etc.)

### AXIS: TRAINING

Identifying needs in terms of capacity building, setting up and implementing training and multi-year action plans involving all NRW competences.

- Package of training modules (certification modules)
- Training plan for different levels of staff (top and middle management, technical, commercial and financial staff etc.)
- Permanent modules
- Training of Trainers programme

### AXIS: EXCHANGE AND NETWORKING

The challenge is to identify partners among (1) local or regional institutions, (2) NGOs and (3) business associations (local/regional/international) with an interest in water issues, performance improvement, and in human, organizational and institutional development in the water sector. The objectives can be summarized as follows:

- Promoting experience exchange between institutions/regions, sharing difficulties
- Encouraging networking and creating a platform for exchange and dissemination of good practices (capitalizing on others' experiences, knowledge society)
- Sectorial and regional reporting for performance indicators, benchmarking among utilities, countries, regions (regional, sectorial newsletter), competition climate

## AXIS: PRIVATE SECTOR PARTICIPATION

Decisions on private sector involvement depend on numerous considerations relating to the utility environment such as technical needs, economic motivation, managerial aspects, and sometimes political orientations.

The combination of these considerations will help in deciding on the level of private sector participation in NRW activities.

From the point of view of a capacity building approach, concrete actions are multiple and more or less complementary, and include mainly:

- Information and awareness raising among leaders and decision makers about the importance of involving the private sector
- Supporting utilities in conducting analysis and diagnosis (SWOT) for private sector participation. Specific cases of successful experiences and examples of failure can be used as a guide to good practices to follow and mistakes to avoid
- Accompanying the modus operandi for PPP (drawing up specifications, possible arrangements, results-based contacts, etc.
- Supporting the private sector in meeting the utilities' expectations

## AXIS: R&D

Promoting R&D in the field of NRW involves promoting technical solutions (processes, equipment, etc.) and methodologies (procedures, modus operandi, organization) that have a positive impact on the efficient use of water resources.

Examples include the following:

- Strategic watch for methodologies and best practices related to loss reduction

- Technological watch for equipment, software, hardware etc. to improve performance (efficiency) in reducing NRW
- Research for leak detection optimization, efficient use of different equipment, more precise and more selective campaigns
- Technological-industrial watch for metrological equipment, software, hardware (metering, recording etc.) to improve billing accuracy (increasing revenue) and management (decision support for optimization of equipment and facilities, etc.)

In terms of capacity building, R&D actions required are the following:

- Skills development
- Contribution to capacity building in utilities
- Setting up networks of internal and external experts, researchers, etc.
- Partnership with research centers, laboratories, universities, etc.

## Morocco - Mauritania

# Le partenariat public public au service de la généralisation de l'accès à l'eau potable et à l'assainissement: Cas du Partenariat ONEP (Maroc) et SNDE (Mauritanie)

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### LE CONTEXTE À L'ÉCHELLE MONDIALE ET RÉGIONALE:

La communauté internationale s'était fixée des Objectifs de Développement pour le Millénaire en cours (ODM). Parmi ces ODMs visant la lutte contre la pauvreté dans le monde, figurent deux objectifs directement liés à l'amélioration du taux d'accès à l'eau potable et à l'assainissement (Réduction de moitié du taux de non accès à ses 2 services à l'horizon 2015).

Les différents rapports (en particulier le dernier rapport sur le développement humain 2006 réalisé par le PNUD) montrent très bien, chiffre à l'appui que les pays du Sud sont, non seulement loin d'atteindre les ODMs relatifs à l'Eau potable et à l'assainissement (EPA), mais ne sont même pas, pour la plupart, sur la bonne voie pour espérer d'y arriver un jour. Ceci est le cas en particulier des pays de l'Afrique Subsaharienne.

Afin de soutenir les pays du Sud, dont les ressources aussi bien financières que humaines et techniques sont très limitées comme chacun le sait, dans leurs efforts pour redresser la courbe d'évolution en direction des ODMs relatifs à l'EPA, des solutions

ont été préconisées et expérimentées.

Parmi celles-ci, la solution consistant à faire participer le privé (communément appelé Partenariat Public Privé PPP ou PSP) en lui déléguant la mission du service public d'assurer les services d'eau potable et d'assainissement en l'occurrence, a été présentée longtemps, et presque d'une manière dogmatique, comme LA solution miracle qui allait résoudre tous les maux.

Le constat qui est fait aujourd'hui, même par la Banque Mondiale, est que le grand privé international n'était pas au rendez-vous faute de taux de rentabilité et de garantie suffisants, les effets d'échelle d'économie ainsi que les risques politiques et économiques ne sont pas de nature à rassurer ses actionnaires. L'ouverture d'autres marchés plus juteux, notamment en Chine et en Europe de l'Est, a découragé enfin les plus téméraires des multinationales du secteur.

Le privé local étant par ailleurs relativement faible et pas suffisamment structuré et/ou intéressé pour relever les grands défis du secteur.

Une autre solution fut proposée, en tirant justement

les leçons de la déficience de la solution du PPP, par le Conseil consultatif du SG de l'ONU pour l'eau et l'assainissement (UNSGAB), et présentée lors du 4ème Forum Mondial de l'Eau à Mexico en mars 2006 (Plan Hashimoto).

Cette solution préconise en gros la mise en place d'un mécanisme partenariat Public-Public entre les opérateurs du secteur (mécanisme appelé WOP (Water Operators Partnership), basé sur le principe du non profit, en vue d'aider les opérateurs des pays du sud à mener à bien leur mission de garantir l'accès à l'EPA à leurs usagers dans le cadre des ODMs.

Force de constater, malheureusement, que le processus de mise en œuvre du WOP a connu et connaît beaucoup de difficultés et d'aliénation par rapport même à ces principes fondateurs du moins pour ce qui concerne le processus lancé en Afrique.

Face à cette situation, il apparaît nécessaire d'agir pour contribuer à soutenir les pays africains, en l'occurrence, dans leurs efforts pour atteindre les ODMs, et particulièrement ceux relatifs à l'accès à l'eau potable et à l'assainissement.

## **LES LEÇONS DES EXPÉRIENCES DE PARTENARIAT ENTRE OPÉRATEURS PUBLICS :**

Pour agir le plus efficacement possible il y a lieu bien évidemment de tirer les leçons des expériences passées ou en cours en matière de partenariat et capitaliser les avancées enregistrées dans ce domaine, tout en gardant en vue une ligne de conduite claire et nette consistant à rechercher des solutions adaptées à chaque situation spécifique en évitant les recettes toutes faites et les dogmes prédominants.

En effet le bilan des actions de partenariat (Sud-Sud) de l'ONEP en Afrique sous ses différentes

formes (multilatérales, bilatérales ou tripartites) depuis les années 90 montre bien que les actions réalisées à ce jour, bien qu'elles soient bénéfiques, restent ponctuelles et globalement insuffisantes au regard des énormes défis que doivent relever les sociétés partenaires d'eau et d'assainissement. Ceci est en partie dû à :

l'absence de stratégie de long terme des projets de développement du secteur dans bon nombre de pays africains

l'indisponibilité de ressources techniques et financières durables au niveau des opérateurs publics d'eau et d'assainissement dans ces pays.

L'insuffisance également de ressources financières (voire technique dans certains cas) consacrées par la coopération des pays du Sud, relativement développés dans le secteur de l'eau, au profit de ceux moins développés.

Quant au partenariat Nord-Sud, dont l'essentiel des réalisations s'est également traduit par des actions ponctuelles sous forme de formations, d'expertises ou d'ateliers et de séminaires, celui-ci reste limité par son coût, relativement élevé comparé aux ressources disponibles d'une part mais aussi aux résultats délivrés, ainsi que par les difficultés d'adaptation des solutions pratiquées dans les pays du nord à la réalité des pays africains.

## **PROPOSITION D'UN NOUVEAU MODÈLE DE PARTENARIAT SUD-NORD-SUD**

A cet effet, il serait intéressant de s'inspirer à la fois de l'initiative initiale du WOP ainsi que l'expérience réussie « Twinning » ou jumelage qui, à titre d'exemple, fut mise en place dans les années 90 entre la société d'eau et d'assainissement de la ville de Stockholm VATTEN et deux sociétés similaires des villes de Kaunas (Lituanie) et Riga (Lettonie). La

société VATTEN a accompagné les deux sociétés partenaires sur une période de 5 à 10 ans pour les amener à un niveau de performance similaire au sien. Ce partenariat était basé sur le recouvrement des coûts d'intervention de VATTEN sans bénéfices. Le coût des ressources humaines impliquées dans le projet a été couvert par l'Agence Suédoise de Développement de la Coopération Internationale (SIDA). Le programme d'investissement a été réalisé par les deux sociétés avec l'assistance de VATTEN. Ce programme a bénéficié de fonds de la Banque Européenne pour la Reconstruction et le Développement (BERD) et de la Banque Européenne d'Investissement (BEI), et a également été financé en partie par les gouvernements des deux pays. Les Institutions Financières Internationales ont supporté le programme de jumelage en fixant des objectifs liés à la protection de l'environnement à travers l'amélioration de la qualité des services d'eau et la restructuration des opérateurs. L'intervention de VATTEN a permis d'augmenter les performances des deux sociétés grâce à l'amélioration du management, l'efficacité opérationnelle, le recouvrement total des coûts et le développement institutionnel. Le jumelage a surtout permis aux deux opérateurs lettons et lituaniens d'être autonomes sur le plan financier et sur le plan managérial.

Au vu de ce qui précède, il apparaît nécessaire, voire urgent, de réfléchir de nouveaux modèles de partenariat en évitant toute sorte de dogmatisme en la matière.

A cet effet, le modèle de partenariat proposé aura à viser les objectifs suivants :

- Objectif stratégique : Assurer l'accès à l'eau potable et à l'assainissement pour tous les citoyens. Les ODMs constituent une étape importante et un levier dans ce sens.
- Objectif opérationnel : Le renforcement des capacités des sociétés publiques d'eau

et d'assainissement dans les pays du Sud (en Afrique subsaharienne en l'occurrence) pour leur mise à niveau afin qu'elles puissent à terme (moyen terme : 3 à 5 ans) assumer pleinement leur mission de service public pour la réalisation de l'objectif stratégique précité.

Pour ce faire, Le modèle de partenariat proposé devra être guidé par les principes suivants :

- La durabilité: par l'adoption d'une approche intégrée aux niveaux Institutionnel, Organisationnel, Technique & Financier dans le cadre d'une vision stratégique de long terme (objectif stratégique rappelé ci-haut).
- La rationalisation des ressources de financement disponibles par la mise en cohérence des diverses actions et programmes de partenariat d'un côté et par une meilleure utilisation du potentiel d'expertise des opérateurs du sud relativement avancés au service des moins avancés..
- La mutualisation des ressources d'expertise aussi bien des sociétés d'eau du Nord que celles du Sud par la mise en place d'un réseau d'experts.
- Le non-profit.

## PROJET DE RENFORCEMENT DES CAPACITÉ DE LA SOCIÉTÉ NATIONALE DES EAUX (SNDE) EN MAURITANIE

### Objet et objectif généraux :

La Mauritanie a adhéré aux objectifs du Millénaire qui vise notamment à réduire de moitié d'ici 2015 le nombre de personnes n'ayant pas accès aux services d'eau potable et d'assainissement. La politique mauritanienne en matière d'hydraulique

et d'assainissement s'est ainsi fixée comme objectif principal : « Améliorer l'accès à l'eau et à l'assainissement en quantité et qualité à des prix abordables pour tous de façon durable ».

Les objectifs poursuivis à l'horizon 2010 concernent entre autres, (1) le renforcement et l'extension de la production de l'eau potable pour atteindre un niveau de consommation de 60 litres par jour et par personne en milieu urbain et une consommation supérieure à 20l/j/h en milieu rural et semi urbain, (2) le renforcement et l'extension des systèmes de distribution de l'eau potable en vue d'atteindre un niveau de desserte en eau de 48% en milieu urbain et un niveau de couverture de 60% pour le milieu rural et semi urbain.

La réalisation de ces ambitieux objectifs nécessite les moyens humains et organisationnels appropriés.

Dans le cadre de la convention signée entre l'ONEP et la SNDE d'une part, et des conventions de partenariat entre l'ONEP et des opérateurs publics d'eau et d'assainissement du Nord, d'autre part, il est proposé de mettre en place un programme global de renforcement des capacités de la SNDE. Il s'agit ainsi de mutualiser les ressources d'expertise aussi bien des sociétés d'eau du Nord que celles du Sud par la mise en place d'un réseau d'experts au profit du programme.

Toute l'expérience et le savoir faire de l'ONEP et de ses partenaires en matière d'Alimentation en Eau Potable seront mis à la disposition de la SNDE. Des experts seront ainsi mobilisés sur de courtes et longues périodes pour réaliser les programmes de transfert de savoir faire et de formation en Mauritanie et dans les pays partenaires du programme.

La confiance mutuelle, le respect des engagements ainsi que la compréhension des environnements professionnels respectifs sont les caractéristiques

de base de cette collaboration.

#### Phase préparatoire du programme de renforcement des capacités :

Une table ronde regroupant les différents partenaires du Nord et du Sud ainsi que les bailleurs de fonds a été organisée le 24 mars 2008 à Rabat afin de valider la démarche globale de ce partenariat. Le comité d'organisation fut conjointement composé de responsables de La SNDE et de l'ONEP.

La table ronde a connu la présence de hauts responsables des différents opérateurs partenaires ainsi que les représentants régionaux des divers organismes de coopération techniques (GTZ, Coopération technique belge, espagnole, JICA, ...) et bailleurs de fond (KFW, BAD, AFD, Banque Mondiale...).

Il en est résulté une importante Déclaration de Principe (cf. Annexe1) qui signifie le démarrage du processus de ce Partenariat et du Projet de renforcement des capacités de la SNDE en vue de contribuer à la réalisation des OMDs relatifs à l'eau et l'assainissement en Mauritanie.

La première étape du processus a consisté à l'élaboration des TdR pour la réalisation d'un diagnostic global de la SNDE ayant pour objectif l'élaboration d'un plan d'action pluriannuel et multidisciplinaire pour la mise à niveau de la SNDE aux niveaux techniques, organisationnel et institutionnel et en faire un outil performant capable de prendre en charge la réalisation de ces missions de service public.

La suivante étape découlant du diagnostic général sera la mise en œuvre u programme de renforcement de capacités qui devra être mis en œuvre sur une période de 4 à 5 ans.

### Mise en œuvre du programme:

Cette seconde phase du programme consiste à réaliser le plan d'actions de renforcement de capacités de la SNDE dans toutes ses composantes.

Encadré

### DÉCLARATION DE PRINCIPES

Partant du retard inadmissible que connaît l'Afrique, en particulier sa région subsaharienne, dans la réalisation des objectifs de développement du millénaire (ODM) relatifs à l'eau potable et à l'assainissement, les opérateurs publics d'eau potable et d'assainissement, réunis à Rabat le 24 mars 2008 :

- Expriment leur volonté à œuvrer en réseau pour mettre en commun leurs expertises et leurs savoir-faire, partager leurs expériences et s'engager dans des actions concrètes d'appui aux opérateurs publics d'eau et d'assainissement de l'Afrique et sa région subsaharienne en particulier.
- Affirment leur volonté de créer une nouvelle dynamique de partenariat dépassant les formes classiques de l'aide internationale orientées exclusivement « Nord-Sud » en faveur d'un partenariat axé d'avantage sur le « Sud-Sud » mais ouverte sur le Nord.
- Confirment leur attachement aux principes fondateurs du Partenariat Public Public (PuP) sous ces différentes formes, basés essentiellement sur le non-profit, la transparence, la mise en commun du savoir-faire, la gestion rationnelle des ressources et la gestion durable des services de l'eau potable et de l'assainissement.
- Déclarent, dans le cadre de cette collaboration, porter l'essentiel de leurs efforts aux domaines

de la formation et du renforcement des capacités (Formation, assistance technique, coaching...) des opérateurs publics bénéficiaires, sur la base de plans d'action pluriannuels intégrés couvrant les aspects institutionnel, organisationnel, technique, financier...etc.

- S'engagent, dans ce sens, à soutenir le projet de renforcement de la Société Nationale des Eaux de Mauritanie sur la base d'un plan d'action de 4 à 5 ans à préparer et à présenter lors d'une prochaine rencontre à organiser à Nouakchott dans les mois à venir (fin 2008). A cette occasion, le gouvernement mauritanien est appelé à manifester d'une manière expresse sa volonté d'appui au projet de renforcement de la SNDE en tant que société publique.
- Invitent les autres partenaires publics, opérateurs, agences de coopération technique et banques de développement..., en particulier ceux intervenant dans cette région du monde, à participer à cette nouvelle démarche de partenariat, sur la base de projets concrets (en l'occurrence celui de la SNDE) dans un souci de mise en cohérence des programmes et de rationalisation des ressources.

Rabat le 24 Mars 2008

Signée par les opérateurs publics suivants :

Eau de Paris, SIAAP (France), Vivaqua, SWDE (Belgique), ONEA (Burkina Faso), ONEP (Maroc), SNDE (Mauritanie)...

Soutenue par :

AECI (Agence de coopération Espagnole), BID (Banque Islamique de développement), ...





Photo des participants à la tale ronde de Rabat du 24 Mars 2008.

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Photo de la signature de la convention de jumelage entre l'ONEP et la SNDE en présence du représentant du GWOPA / UN-Habitat le 21 janvier 2010

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# Palestine: city of Nablus

## Experiences of the city of Nablus/Palestine in NRW

*Mohamed Imad Farouq El-masari, Manager, Nablus Water Supply & Sanitation Department*

### ABSTRACT

The Water Supply and Sanitation Department has a total staff of 290 persons and serves (WSSD) Nablus city and the surrounding areas which have about 250,000 inhabitants. WSSD is responsible for planning and managing the operation and maintenance of the water and sewage services. Nablus relies on two main water resources. Firstly, five main springs started in 1934. And secondly five deep wells, bearing in mind that the Israeli water company suspended water to Nablus in 1994. In our region, water holds privileged place in our life. In addition, the scarcity of water in our region leave us with no choice but to have a comprehensive Non- Revenue water management, In 1994 water losses were about 60%. Following major investment in house connections it dropped to about 40%.

### Non-Revenue Water Management: Leak Detection Unit

The Action plan for the Non Revenue Water Management started in 2007 by establishing the (leak detection unit) responsible for:

1. Collecting all the data needed from main bulk meters.
2. Collecting the total consumption from water meters.
3. Helping to detect the leakage of the pipe network.
4. Monitoring the new developed area to ensure that the water losses are not above average.
5. Isolating the zero or low consumption water meters and following up with their records to assure fair recording.
6. Detecting the leakage after the water meter, especially in multi story buildings.

## Syria: city of Aleppo

# Water loss reduction unit pilot project: Jamaieah Al Muhandesien subdivision

*Mostafa Abdel-Wahab, Joachim Hengge, Jamaieah Al Muhandesien Pilot Project (GEWSSA), Water Loss Reduction Unit Aleppo*

### INTRODUCTION

The pilot project was started in June 2007 by the General Establishment of Water Supply and Sewerage in Aleppo (GEWSSA) with the support of the Gesellschaft für Technische Zusammenarbeit (GTZ). The purpose of the project was to assess the condition of the water distribution system and quantify water losses in a small area of the water network under defined boundary conditions. The main objectives of the project were to quantify water losses in a pilot area, reduce the amount of “Non Revenue Water” (NRW) in the area and apply the information gained from the pilot area to the water network as a whole. To contribute to the prosperity of the city, the GEWSSA developed strategies to provide a safe, reliable, and efficient water supply system and preserve valuable resources. The reduction and control of water losses in the water network is becoming more important as the city of Aleppo is growing annually in population and economical activities, and the water demand in the city is increasing constantly. At present the NRW in the water network is estimated at approximately 40%.

All other components of water demand generate revenue for the Water Establishment, whereas

NRW reduces that revenue. The benefits to the water utility of reducing the NRW rate include:

- Savings in the production costs of the water
- Increased revenues through sale of the water saved
- Deferment of network expansion and other capital expenditure by capturing lost water
- Stable utility rates and generally better consumer relations.

The components of water demand in the water network are generally divided into:

- Residential water use,
- Commercial and industrial water use,
- Institutional or public water use, and
- Unaccounted network losses or non revenue water (NRW).

Unaccounted network losses (NRW) are generally divided into:

- Physical losses (leakage in the water network and the reservoirs), and

- Administrative losses (faulty water meters, illegal water connections, incorrect meter readings, incorrect billing, unpaid water bills).

To get a better understanding of the problems in the water network and to reduce the amount of NRW, the GEWSSA with the technical support of the GTZ started a pilot project. At the start a suitable area in the city network division had to be identified. After reviewing the water network, the Jamaieah Al Muhandesien (Engineering Association Subdivision) in New Aleppo was chosen as the pilot area because:

1. The area is relatively easy to isolate,
2. The water supply into the area is limited to two inlets,
3. The area includes residential, commercial, and municipal customers,
4. The customer information required was available for the area.

Below is a list of the different types of customers in the pilot area:

	Customer Type	Description	Number of Water Meters
1	Residential	Residential	548
2	Municipal	Public Park	4
		Mosque	1
		School	1
		Kindergarten	1
3	Commercial	Restaurant	1
		Shopping Centre	1
Total Number of Water Meters in the Pilot Area			557

Table 1

Below is a plan of the Jamaieah Al Muhandesien area showing in green the buildings included in the pilot project:



### THE WATER LOSS REDUCTION TEAM

To initiate the pilot project a Water Loss Reduction Team was established by the GEWSSA. Eng. Mostafa Abdul Wahab from the Network Division of the GEWSSA was chosen as project leader and team coordinator. Eng. Waleed Sukker, a specialist in water loss reduction from Jordan, assisted the Water Loss Reduction Team on technical questions. The following GEWSSA staff members were involved in the pilot project:

#	Name	Position
1	Eng. Mostafa Abdul-Wahab	Engineer
2	Tech. Jamal Al Achmed	Technician
3	Tech. Azaad Hassan	Technician
4	Alaa Shremow	Meter Reader
5	Hasan Tatrie	Meter Reader
6	Abdul Assis Bable	Mechanic

Table 2

Eng. Joachim Hengge from the German Development Service (DED) joined the team recently to provide technical support with data collection, data evaluation and preparation of the report.

The Table below shows technical data about the pilot area:

#	Category	Number
1	Estimated Number of People per Family	5
2	Total Number of House Connections	105
3	Meter of Water Network in the Pilot Area	2350 Meter

Table 3

At the start of the pilot project the physical conditions of the water network in the pilot area had to be evaluated from existing plans; and information from the plans had to be verified in the field. It was determined that the pilot area is supplied by two inlets from the water network. In order to isolate the area from the water network and determine the amount of water consumed in the pilot area, a 150 mm Magnetic Meter and a 100mm propeller bulk water meter with isolation valves were installed in an underground vault chamber. An ultrasonic water meter with a data logger was installed on the 100 mm diameter water inlet to record the continuous flow into the area for two weeks.

Below is a table with the different bulk water meters installed to record the water inflow into the pilot area:

Inlet	Bulk Water Meter Type	Dimension
1	Propeller Meter	100 mm
	Ultrasonic Meter	100 mm
2	Magnetic Meter	150 mm

Table 4

The 105 residential buildings in the pilot area have typically between 4 and 8 water meters in each apartment building. To facilitate the recording of the date from the water meters in each building the form shown below was developed:

Pilot Project Muhandesien Subdivision		
House Number		
Location of Meter	Meter Reading	Comments
First Top Right		
Second Top Right		
Second Bottom Right		
First Bottom Right		
First Bottom Left		
Second Bottom Left		
Second Top Left		
First Top Left		

Table 5

## DATA COLLECTION AND ANALYSIS PHASE I:

The first phase of data collection in the pilot area was started on 6 June 2008. An information pamphlet was developed by the Water Loss Reduction Unit and with support from the Director of Investment and Maintenance of GEWSSA. The pamphlet, delivered to each customer affected by the project, included information about the objectives of the

project, the dates when the water meters would be read, and what inconvenience the people in the area might experience as a result of the project. A special phone number allowed customer's to contact the team leader of the pilot project in case of additional questions or problems.

On the day of the water meter readings (always Tuesdays), the main valves supplying the pilot area were closed. Then the water meter readers from the GEWSSA recorded all the water meter data in the pilot area on the forms described above, using one sheet for each building. When reading was complete, the readings of the two bulk water meter were recorded, and the main valves reopened.

The first set of water meter readings was taken to establish a base line. Two more readings were taken on a weekly basis, to allow the data to be analyzed and eliminate mistakes from the date recording. The data from the three sets of water meter recordings was entered into an EXCEL work sheet and analyzed. A summary of the results of the first phase of the project is shown below:

Date of Reading	Total Amount of Water Supplied (Bulk Meters) (m3)	Total Amount of Water Metered (m3)	NRW (m3)
17/06 to 24/06 (first and second reading)	4,787	2,980	1,807
24/06 to 01/07 (second and third reading)	4,565	3,053	1,512
Total for two weeks	9,352	6,033	3,319
Daily water use	668	431	237

Hourly water use	28	18	10
NRW in %	35%		

Table 6

The analysis of the data also showed that a number of water meters were not functioning and that some apartments were supplied by illegal water connections. For a summary of the broken water meters and illegal connections see the Table below:

#	Type of Water Meter		Number of Meter
1	Broken Water Meter	Residential Meter	106
		Municipal Bulk Meter	4
2	Illegal Connections		17

Table 7

After the presentation of the results from Phase I of the project, immediate action was taken by the GEWSSA Subscriber Department to replace the broken meters and disconnect illegal water supplies. After the implementation of these actions Phase II was started.

**DATA COLLECTION AND ANALYSIS - PHASE II**

For the second phase of the pilot project the same procedures were used as for the first phase. For a summary of the results for the second Phase of the project see the Table below:

Date of Reading	Total Amount of Water Supplied (m3)	Total Amount of Water Metered (m3)	NRW (m3)
12/08 to 19/08 (first week)	4,579	4,105	474
19/08 to 26/08 (second week)	4,717	4,304	413
Total for two weeks	9,296	8,409	887
Daily water use	664	601	63
Hourly water use	28	25	3
NRW in %	10%		

Table 8

An analysis of the data showed that the water use especially in the municipal parks with the broken meters was considerable (about 20% of the total water use), compared to the total water use in the area. The daily water use of the replaced bulk water meters is shown below:

#	Location of Water Meter	Average Daily Water Meter Reading Phase I (m3/day)	Average Daily Water Meter Reading Phase II (m3/day)
1	(1) Municipal Park	0	9
2	(3) Municipal Park	0	46
3	(4) Municipal Park	0	35
4	School	0	3

Table 9

It was also noticed that some water meters that had

been working well during Phase I were showing unrealistic reading results in Phase II, as shown in the table below.

#	Location of Water Meter	Average Daily Water Meter Reading Phase I (m3)	Average Daily Water Meter Reading Phase II (m3)
1	Kindergarten	12	4
2	Mosque	12	2
3	(2) Municipal Park	5	0

Table 10

An analysis of the data recorded by the water meter readers indicated that human error occurred (i.e. an incorrect figure was recorded) in about 2% of the records. These incorrect recordings were adjusted on the basis of the overall data recorded.

The graph below summarizes the results of Phase I and Phase II of the pilot study:

It should be noted that following the installation of three new water meters in the parks, the NRW in the pilot area was reduced from about 35% to approximately 16%.

### RECOMMENDATION PHASE III

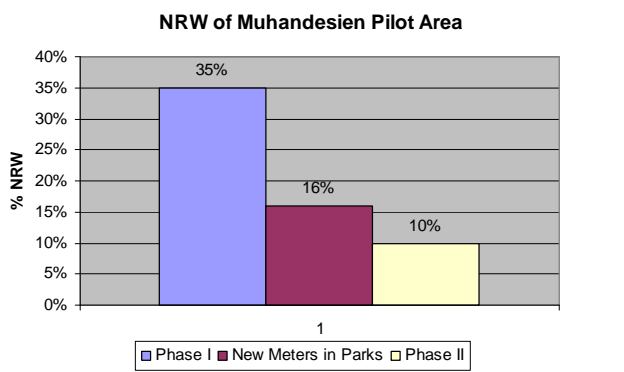
Through the dedication of the members of the Water Loss Reduction Unit and excellent cooperation between the different departments of

the GEWSSA, it was possible to reduce the NRW in the pilot area by 25% - from an initial 35% to about 10%. Considering this success, the Water Loss Reduction Unit hopes to continue the work in the pilot area with the cooperation of the GEWSSA's Customer Department by using the bi-monthly water meter recordings from the water meter reader register for the area.

**CONCLUSION AND RECOMMENDATIONS**

The reduction and control of water losses in the water network is becoming increasingly important as the population of the City of Aleppo is growing annually and economic activities and water demand are constantly increasing. The pilot project in the Jamaieah Al Muhandesien subdivision of New Aleppo, enabled GEWSSA to reduce the NRW from initially 35% to about 10% within a short time frame and with a minimal investment. Additional steps should be considered in order to reduce the NRW further:

- As shown in the attached pictures, most of the water meters in the area are installed inclined (not horizontal). Depending on the brand of water meter and the installation angle, the



meter may record up to 10% less than the actual water flow through the meter.

- More and more customers of the Water Establishment use water pumps after the water meter to increase the pressure in the system or to fill roof tanks (see attached pictures). If the

pumps are installed at the wrong location the water meter may record up to 15% less than the actual water flow through the meter.

- Minimum standards for the installation of water meters and pressure booster pumps in house installations should be developed by the GEWSSA and implemented.
- As shown in the analysis of the water meter data, some water meters working properly during the first phase of the project had low or zero readings in the second phase. To maintain constant revenues to the GEWSSA the water meter of all large consumers like schools, mosques, public parks, including large commercial and industrial water users, should be assessed and checked for accuracy on a regular basis.
- Almost 20% of the total water demand in the pilot area was used to irrigate public parks. It is important to provide green spaces in form of public parks for the people; however, the water amount used for the irrigation of these parks appears out of proportion. Especially since most of the water used to irrigate parks is expensive treated drinking water and there is a desperate shortage of water drinking water in the hot summer months.
- For the irrigation of the public parks new irrigation systems using less water should be assessed and installed.
- Drinking water is a limited resource, especially in Aleppo where there is only a limited annual amount of rainfall with typically no rain during the hot summer months. Increased public awareness is required to sensitize the population about the water situation in the city and encourage people to conserve water. This is especially important for large water users in the municipal, commercial, and industrial areas.
- To further reduce the NRW in the water network, it is important to establish and



support a strong Water Loss Reduction Unit in GEWSSA. With the reduction of NRW in the water network the GEWSSA can:

- Make savings in the production costs of water,
- Increase revenues through sales of water saved,
- Defer network expansion and other capital expenditure through the capture of lost water,
- Maintain stable utility rates, establish better consumer relations, and maintain the prosperity of the city.

## WATER LOSS REDUCTION UNIT: MUHANDESIIEN PILOT PROJECT

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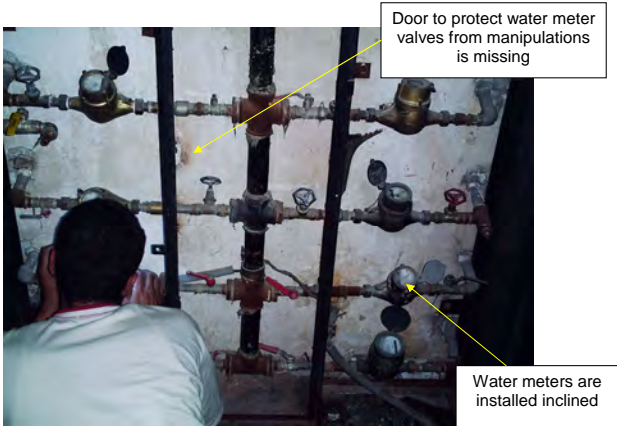
Pilot Area Muhandesien Subdivision, Municipal Park

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Pilot Area Muhandesien Subdivision, Typical Practiced Park Irrigation

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Pilot Area Muhandesien Subdivision, Typical Water Meter Tree



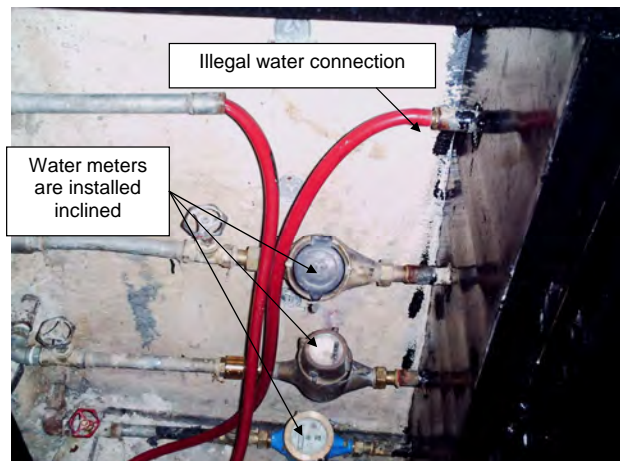
Pilot Area Muhandesien Subdivision, Meter Replaced in the Parks and Scholl



Pilot Area Muhandesien Subdivision, Typical Water Meter Tree



Pilot Area Muhandesien Subdivision, Bulk Water Meter 100mm Inlet



Pilot Area Muhandesien Subdivision, Water Meter Tree with Illegal Connection



Pilot Area Muhandesien Subdivision, Bulk Water Meter 150mm Inlet

# United Arab Emirates

## Al Ain Distribution Co. NRW reduction strategies

*Mohammed Obaid, Manager, Water Networks Al Ain*

### ABSTRACT

- AADC wish to achieve a water network management system that is equal to the best in the world.
- We set this objective because in the Gulf Region, water, (especially high quality potable water) is an expensive and scarce resource.
- The economic cost of 1,000 gallons of water in Al Ain is AED 37 several times the equivalent cost in Regions with more abundant raw water resources. Note: Customers pay say AED10per 1,000 gallons – subsidy, say AED27 per 1,000 gallons.
- Historically there has always been constrained supply of water to Al Ain and this is unlikely to change in the long term.
- All forms of water loss reduction are essential to this objective.
- Monitoring of each gallon of water received at our network.
- Monitoring of pressure and quality delivered.
- Allow us to quickly identify where any losses are occurring.
- Provide accurate, historical data on demand and consumption.
- Facilitate the planning of network expansion and modification.
- Permit accurate demand projections
- Provide a basis for asset maintenance and replacement planning.
- 

The concept:

We will build a centrally controlled network management system that will allow:

## Yemen: city of Aden

# Customer management is the key for controlling the administrative NRW

*Arwa Ahmed Ali Humadi, Project Manager, Local Corporation for Water Supply and Sanitation*

### ABSTRACT

Our past understanding of the NRW included leaks in house connections, leaks in the distribution network or even before, on the way from the source to the distribution network, called the physical losses. Controlling these problems will reduce NRW and improve service. But now we know the problem isn't limited on that: a Comprehensive Subscriber Survey (CSS) in the Local Water and Sanitation Corporation - Aden (LWSCA) pointed out that the business processes and work flow in the Customer Department cause administrative losses, and showed an urgent need to study and redesign these disordered processes.

These business processes are extremely important in any water utility. They are the pillar of the organizations and as such controlling the subscriber and all the related data flow are the key to a control of the administrative losses.

The Customer Management is benefitting from the introduction of specialized IT and GIS tools if applied comprehensively to be able to compare the production with consumption.

The preconditions for reduction of the administrative losses are:

- Comprehensive Subscriber Survey (CSS), creates the nucleus of the future customer database (run in the Customer Information System, CIS). The CSS has been carried out first of all to obtain the geographical address (code) of the customer and to clean the original data history, otherwise the principle of garbage in, garbage out applies. Here are some figures out of CSS in Pilot Area in Aden
- Link the water network delivery point to the customer's real location
- Redesign the business processes and work flows linking the Customer Dept. to all other departments, sections and divisions (CSS, GIS, HRIS, ACS, MMS, MIS etc).
- Introduce redesigned subscriber business processes based on GIS support and create efficient daily routines, controlling the customer services and the efficiency of the LC organization.

## Yemen

# Maintenance management software (DCMMS) for physical NRW reduction

*Abdul Raqeeb Al Sharmani, Technical Manager, LWSC-Ibb*

### ABSTRACT

The Maintenance Management Software (DCMMS) installed in Ibb/Yemen in July 2004 is used to store, manage and analyze customer complaints for water and wastewater networks. Each complaint reported to the LC is printed on a work order (WO) containing a map of the described area. The maintenance teams take the WO to plan repair and maintenance work. The action taken by the team (repair, exchange of material, cleaning, etc.) and additional data of the repaired network (diameter, location, material, etc) are collected and stored by the DCMMS. The updated information compared to earlier stages, in general shows the improved pipe or network section with significantly fewer complaints. All WO information is analyzed by the DCMMS operators and is reported on a regular base to the LC Management.

The analysis of the DCMMS results is the key figure for the NRW reduction. Repeated reports of problems on specific pipes or in certain sections of the network become visible when displayed on maps. The resulting action (usually pipe replacement) focuses on weak parts of the network and thereby reduces quantity of water losses more efficient.

The example of the LC Ibb shows, that a two month on the job training for the pipe fitters and maintenance crews is suitable to implement the DCMMS tool to the establishment.

This GIS based open source application is also used to collect data for “type of complaint”, “response time of the maintenance teams” and also collects landmarks of the city to improve the overall orientation for the maintenance team. By combining this information, a reliable operation structure is now adopted and quick reaction on network problems additionally reduces NRW.



**Other countries**





## Greece

# Implementing a high-accuracy water meter strategy to reduce client-side leakages

*Panagiotis Georgiadis, Technical Consultant, Oxide Ltd*

### ABSTRACT

In the past recent years, water is becoming a scarce commodity. This has given rise to other means of obtaining water, such as desalination, water re-use, etc. The cost of implementing such methodologies to increase water resources is increasingly high, both from a financial and an ecological point of view. Instead, it is widely accepted that reducing the needs for water is cheaper and can sometimes be easier.

One of the most underestimated sources of water loss is Client-Side Leakages. This is mainly due to the fact that such leakages involve very low flow rates and, as such, are wrongly considered insignificant.

In this paper the writer refers to the importance of this misunderstood global issue, the risks it involves, the reasons why it is so important, and finally a way to prevent the phenomenon of Client-Side Leakages.

Of course, as all strategies and methodologies, implementing a prevention strategy for Client-Side Leakages can also entail a certain amount

of difficulties or problems. This is why the writer has intended to describe a complete guideline of implementing a high-accuracy water meter strategy for water authorities, while also describing most common problems that will be encountered and solutions to the problems or ways of dealing with them.

# The Netherlands: city of Amsterdam

## Maintenance of water mains with Amsterdam water supply: for non-systematic control of loss due to leakage

*Kees van der Drift, Manager Research & Development Water Distribution, Amsterdam Water Supply*

### SYNOPSIS

Amsterdam has a relatively low rate of losses due to leakage of 3 to 4 percent. This is due to the low pressure maintained in the water distribution network. By including losses due to leakage as an item in the regular maintenance schedule, the rate of loss due to leakage can be limited, although a gradual increase cannot be avoided.

### INTRODUCTION

Gemeentewaterleidingen Amsterdam (GWA, Amsterdam Water Supply) is a drinking-water supply company with a production of 90 million m<sup>3</sup> a year. The company supplies drinking water for 750,000 inhabitants and also delivers drinking water to adjacent drinking water companies. For this purpose the company uses a distribution network with a total length of 2200 km. The water is produced at two production locations and distributed by means of five pumping stations, three of which maintain potable water reservoirs.



The total distribution area is geographically flat; the elevation varies between minus 2 meters NAP (Normal Amsterdam Level) and plus 2 meters NAP. It is, therefore, not necessary to create pressure zones in the distribution network. This means an uninterrupted distribution network. Water pressure in the distribution network ranges between 230 kPa and 300 kPa relative to NAP. The reasons for the low pressure are the size of the service area and the high volume capacity needed by the distribution network for fire-fighting purposes.

There is a long-standing agreement with the fire department that every fire hydrant must be able

to deliver 90 m<sup>3</sup>/hour. This means the distribution network has been dimensioned for this capacity and not for drinking water consumption. An advantage of the over-sizing is a low level of pressure loss in the distribution network.

The GWA distribution network makes use of three materials. Gray cast iron has been in use since 1953. PVC was introduced in 1960 and, starting in 1975, the gray cast iron is being replaced by granular cast iron. In addition, concrete is used for transport mains, as well as copper and PE for smaller distribution lines. The total length of AC used is 6 km and is of minor importance. The total lengths and the average ages of the water mains are shown in the table.

material	total length	average age
pvc	531	22
gray cast iron	738	52
granular cast iron	361	11
various	570	-

Table 1

It can be seen from the table that granular cast iron is still an important material for GWA. This has to do with soil contamination, the water supply company's obligation to provide electrical grounding, and the heavy traffic loads in the inner city of Amsterdam. The average age of the entire distribution network is about 30 years. On average, 30 km of water mains are replaced each year, which means the average age of the distribution network increases every year.

Amsterdam began metering household use in 1999. That means installing 440,000 water meters. So far 25,000 meters have been installed in two years. The entire program will take 30 years to complete.

Household consumption in Amsterdam is not known; business consumption is metered, however. Calculations show a consumption of 156 litres per person per day. This figure is high in relation to the national consumption level of 138 litres. Measurements within the distribution network confirm the relatively high consumption levels.

## EXPLANATORY FACTORS

The annual consumption figures for every user cannot be used to determine the losses due to leakage in the distribution network.

The following calculation determines losses due to leakage:

production	93.3 106 m3	
business consumption	20.7 106 m3	
collective distribution	27.3 106 m3	
household consumption	43.0 106 m3	
draining, own use, losses due to leakage	2.3 106 m3	(3.6 %)
household use		
individual water use	154.5 l/day	
inhabitants	762348	

Table 2

Hence the losses due to leakage are 3.6 %. The critical assumed figure used in the calculation is individual water consumption. Individual water consumption is, however, measured at the neighbourhood or dwelling level on a project basis. These measurements show that water consumption does indeed lie between 150 and 160 litres per person per day. The basic assumption for the

calculation is correct.

Water consumption during night hours is an indication of loss due to leakage. Measurements over the past 10 years show night consumption to be constant. This is an indication that there has been no increase in the loss due to leakage over the years. The lines are also worked on regularly. As part of the activities, the lines are inspected for leaks. Data from these inspections show that no large quantities of water are being lost from the lines, including the old granular cast iron ones. It can be concluded from this that loss due to leakage is indeed low.

Past experience shows that inhabitants of Amsterdam report any possible leak immediately to the trouble service, which can be reached 24 hours per day and 7 days a week. A leak is spotted quickly in the city due to the high groundwater level and because the pavement above the leak is most often loose paving. These two factors mean that a leak can cause a large hole in the road surface or the sidewalk.

Water pressure in the lines is not high (on average 250 kPa). It is known that there is a direct correlation between water pressure and losses due to leakage. The relatively low pressure also means a low loss due to leakage. Leak loss figures from water supply companies in comparable situations are also known. Their figures all lie around the same values as those of the GWA. This also confirms that the figures for loss due to leakage in Amsterdam are correct.

Water mains maintenance is often based on other maintenance activities in the city, and not on the age or the condition of the lines. By specifying line replacement more precisely and thereby taking losses due to leakage into account, losses due to leakage can be reduced. The information needed for this is already available, but is not yet formulated in a form that can be used for decision-making. It

concerns data pertaining to:

- water quality;
- water mains registration;
- water mains field information;
- breakdowns and complaints.

## CONCLUSIONS

A case can be made that Amsterdam has low losses due to leakage. The most important reason is low water pressure in the distribution network as a result of the requirement for a high volume capacity for fire-fighting purposes.

By employing new designs and specifications and by lowering the volume capacity for fire fighting in consultation with the fire department, the water pressure in the distribution network will need to be raised. That will have a negative influence on losses due to leakage.

The age of the distribution network will become greater over the years because the replacement program (30 km per year out of a 2200 km network means replacement every 70 years) does not keep pace with the average age of the distribution network.

# United States of America

## Application of a financial model for determining optimal management of non revenue water in developing countries

*Alan.S. Wyatt\*, Kyle J. Romeo\*\*\* Senior Water Supply and Sanitation Specialist, \*\* Engineering Intern, RTI International, from Engineering Dept., University of North Carolina at Asheville*

### ABSTRACT

Non Revenue Water (NRW) includes 1) physical losses (pipe bursts and leaks) and 2) commercial losses (illegal connections, un-metered public use, meter error, and data recording errors). NRW levels are high in many developing countries, and can be expensive to reduce. Various authors (Lambert, Farley, McKenzie, Trow, and others in the International Water Association [IWA]) developed a framework — the Economic Level of Leakage (ELL) — which outlines the optimum level of physical losses based on the costs of water production, physical loss control costs, and other engineering inputs. However, the ELL approach is less useful in developing countries, as it ignores 1) commercial losses, 2) the annualized cost of water supply capacity expansion, and 3) situations where production capacity does not meet demand. Also, the computerized ELL requires data which are not readily available in many countries. A new model which addresses these issues would allow individual, regional, or national utility managers and regulators to establish NRW targets and to optimally allocate resources to NRW management.

This paper presents a financial model which

addresses the limitations noted above and provides acceptably accurate values of optimal steady-state NRW. The model uses an NRW framework consistent with the IWA water balance and solves the algebraic optimality conditions for commercial and physical losses. The spreadsheet form of the model computes optimal NRW from a modest, commonly known set of inputs. The paper examines the sensitivity of the model to the accuracy of input data. Next, the paper presents both generic results for optimal NRW and specific results for ten countries in Asia, Africa, and Latin America. Input data come mostly from secondary sources. Key results and their implications are reviewed. The paper closes with conclusions and recommendations for further research and model application.

### BACKGROUND

NRW is a very large issue in developing countries. The World Bank estimates that developing countries lose about \$5.8 billion USD per year. Whether measured as a percentage of production, per length of distribution line, by connection, or using the infrastructure leakage index (ILI),

the losses are generally high compared to many other parts of the world. But reducing leakage and commercial losses costs money, especially if large sections of piping need replacement. Nevertheless, studies have shown that efforts on conservation and NRW reduction cost about one third of water production from new plants. The fact that NRW reduction costs increase as losses are reduced more and more is of critical importance. Depending on site conditions, any location has an “optimal” point where cost and benefits are equal.

Many policymakers tackling this problem have adopted very simplistic targets for multiple utilities, such as “cut the losses (% of production) in half”, or “<20% = Good, 20–25% = Acceptable, and >25% = Unacceptable.” These targets do not use the correct indicator, nor are they based on local costs and conditions. Most importantly, the best target depends on the location, taking into account the influence of local costs, benefits, engineering parameters, etc.

A number of authors, including Lambert, Farley, McKenzie, Trow, and others have developed a conceptual framework known as the Economic Level of Leakage ELL which outlines the economically optimum level of physical losses based on pressure/burst relationships, marginal cost of water production, the cost of physical loss control programs, engineering parameters, and other inputs.

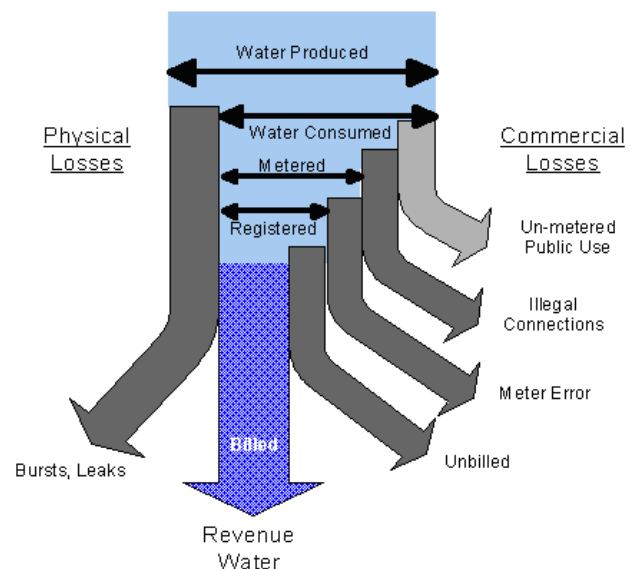
However, the ELL approach is somewhat inappropriate for many developing countries, for a variety of reasons. First of all, ELL ignores the financial optimality of commercial losses, which can be a very large part of NRW in developing countries. Second, the ELL model does not account for the annualized cost of future water production capacity expansions (which is affected by loss reduction policies). This consideration is commonly used in other economic analyses. Third, the ELL

approach does not address situations where water production capacity does not meet water demand. These considerations are of high importance in developing countries. In addition, detailed computation of the full ELL model requires data which are not readily available in many developing countries. A new model which addresses these issues would be a step forward. A revised model would allow managers of municipal, regional or national utilities to assess their performance in relation to optimum and to allocate resources optimally.

## CONCEPTUAL FRAMEWORK

Terms and Definitions. The model depends on a clear set of terms and definitions, which are outlined in the water flow diagram in Exhibit 1. This layout is fully consistent with the IWA water balance.

Exhibit 1

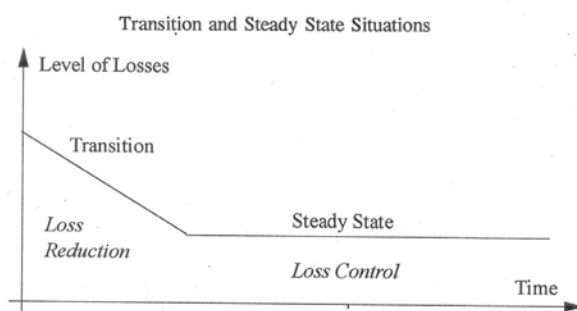


Another critical point, which Exhibit 1 illustrates, is that representing the losses in terms of percentage of production can be misleading. Imagine a situation where the volume of the losses (shaded in

gray) are constant over time. If consumption rises, production will also rise. Therefore the ratio of losses to production will decrease, even though the actual amount of losses has not changed. IWA has abandoned the indicator of NRW as a percentage of production in favor of representing NRW in terms of liters/connection per hour (or per day).

**Key Concepts.** First, the model must show the distinction between transition situations and steady-state situations, as shown in Exhibit 2. This model does not focus on the transition from a high level of losses to a lower level or how to achieve such a transition. Instead, it focuses on what the target for steady-state losses should be, after transition. As illustrated in Exhibit 3, a low, steady-state level of losses will require aggressive pressure management and a rapid Active Leak Control program. A relaxed approach will yield a higher steady-state level of losses. An aggressive program will cost more than a relaxed one, so a tradeoff is established between the cost of the losses and the cost of loss control.

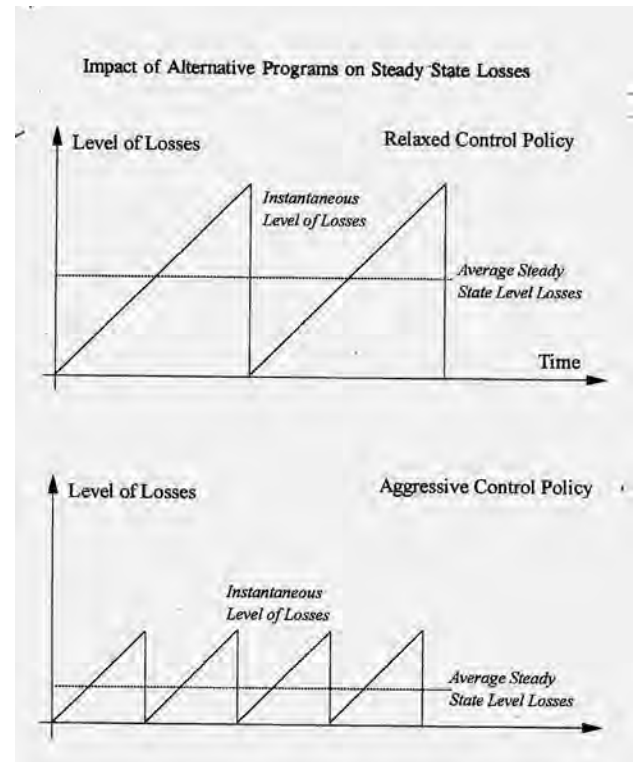
**Exhibit 2**



Second, the model has to distinguish between situations where 1) water production capacity is ample (capacity surplus), or 2) where serviceable demand exceeds water supply production capacity (capacity deficit). In the first case, the benefit of reducing leakage will mainly be savings of variable water production costs (electricity and chemicals).

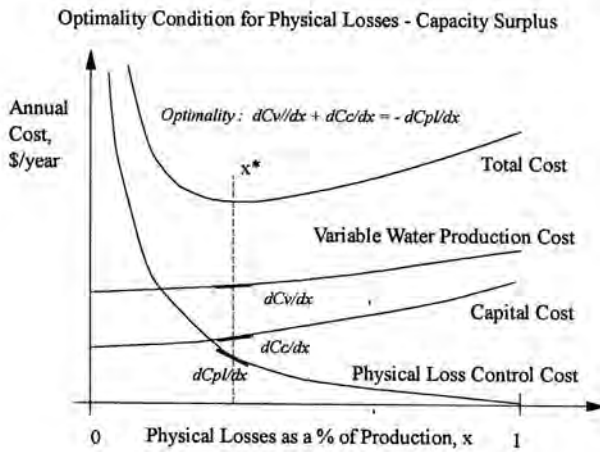
In the second case, the benefit will be the revenue that can be collected from the sale of the recovered water. In this second case, if the tariff or collection rate is low, as is common in developing countries, the benefits will be low.

**Exhibit 3**



Third, the model must take into account the diminishing return from an increasingly stringent loss-control policy. As shown in Exhibit 4, the proportion of steady-state losses ( $x$ ) increases, the cost of loss control falls, but other factors increase: the cost of water production and the cost of future capacity expansion (because expansion must happen sooner). Adding the costs will yield a total cost, which will have a minimum. Simple calculus shows that the optimum physical loss is reached when the marginal cost of physical loss control has the same magnitude as the sum of the marginal cost of water production and the marginal cost of future capital expansion.

Exhibit 4



The optimal commercial loss is reached when the marginal cost of commercial loss control is the same as the marginal revenue, as illustrated in Exhibit 5 below.

Note: the diagrams shown here are only the optimality conditions which apply to the Capacity Surplus conditions. This paper only deals with the Capacity Surplus scenario, but the model has been fully developed for Capacity Deficit conditions.

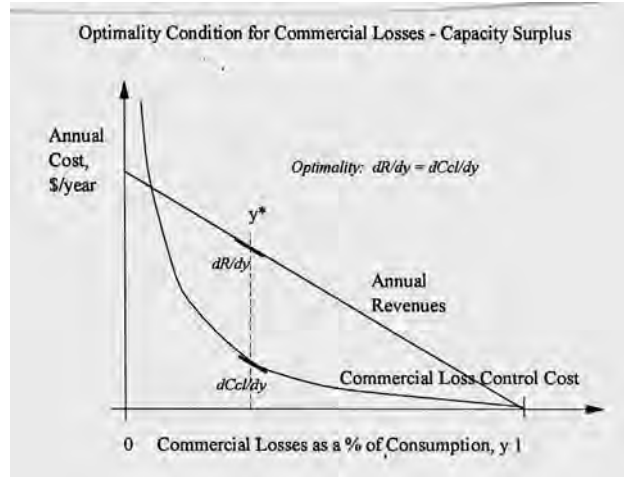
**MODEL DEVELOPMENT**

Next, algebraic expressions were developed for the costs and revenues associated with both commercial and physical losses. The brevity of this paper does not allow a full elaboration of all the formulae, but a detailed write-up is available from the authors. This paper will present a few of the highlights.

Note: only those cost elements which are affected by the degree of “stringency” of the steady-state loss control program are considered. Thus the cost of excavating and repairing a leak is not included, because that cost will be incurred at one time or another whether the control policy is relaxed or

stringent. It is possible that the excavation cost would grow over time, but this consideration has been ignored for now.

Exhibit 5



Commercial Losses. Based on the optimality conditions in Exhibit 5, we derived formulae for the cost of a commercial loss control program by extrapolating from the costs of a meter replacement program. The result was a formula of the following form:

$$C_c = M N s / 2 y, \text{ where:}$$

M = unit cost of a meter replacement program inflated to account for activities associated with other commercial losses

N = the number of connections

s = the slope of the meter accuracy line (accuracy decline/year)

This algebraic expression is consistent with the cost curve in Exhibit 5. Next we developed an expression for the revenues based on the collected tariff, number of connections, consumption per connection, and the specific commercial losses (y). By taking the derivatives of each expression with



respect to  $y$  and equating them, we arrived at a simple formula for the optimal commercial losses:

$$NRW_c = (M s q / K T)^{1/2} \dots \text{where:}$$

$q$  = consumption per connection,  $m^3/yr$

$K$  = a constant for conversion of units for algebraic consistency

$T$  = collected tariff,  $\$/m^3$

Note: this formula for optimal commercial loss does depend on the costs of the loss control program, the consumption, meter accuracy, and tariff, but it does *not* depend on the *number of connections*, *the population of the city*, the length of distribution line, variable water production cost, or any other factors. Also note that the formula includes a square root, so the optimal commercial loss is not highly sensitive to the inputs.

Physical Losses. The derivation of optimal physical losses is much more complex than commercial losses, due to the multiple costs, illustrated in Exhibit 4. However, the basic process is the same. We derived formulas for each cost element, found the derivatives with respect to  $x$ , and using numerical methods in a spreadsheet, solved for the optimum point. Key factors are the cost of the Active Leakage Control Program, the distribution line per connection, leak flow, and the variable cost of water production. The formula includes a square root, so the results are not very sensitive to inputs.

Parameter Estimation. In applying the model, values for all the input parameters are needed. Some parameters are frequently reported, such as water production, number of connections, tariff, etc. However, some other parameters are not commonly found. In order to proceed on testing and evaluating the model, we derived default values for those parameters, based on reviewing dozens of

documents from many countries. Exhibit 6 shows important variables and our current default values. These parameters should be the subject of more detailed research and estimation on a country-level basis if the model is going to be used regularly for planning purposes.

Exhibit 6 Input Parameter Assumptions for Less Commonly Reported Parameters		
Parameter	Default Value	Notes
Capital Cost of Water Production Facility	$C = \$3000 * Capacity^{0.7}$	The exponent of 0.7 often reported
Capacity Utilization	67%	Often reported
Estimated Commercial Losses / Total Losses	40%	Sometimes reported.
Active Leakage Control Costs	$\$200 / km$ of line	Needs local research
Commercial Loss Control Cost Parameter	$\$150 / connection$	Needs local research
Burst Flow Rate	$20 / (leaks / km / year)$	More literature review needed

Sensitivity Analysis. Next we performed a sensitivity analysis, with results shown in Exhibit 7. For a typical, hypothetical situation, we systematically varied input parameters and noted variations in results. Exhibit 7 shows that the model is not sensitive to any important variables. However, there could be more sensitivity if there were considerable uncertainty in multiple inputs.

Exhibit 7 Model Sensitivity

Input Parameter	% change in Input	% change in NRW
1) Consumption	-20% to + 20%	+15.4% to -11.3%
2) Distribution Length	-20% to + 20%	-8.6% to + 7.5%
3) Average Tariff	-20% to + 20%	+5.8% to -4.3%
4) Production Capacity	-20% to + 20%	-5.4% to +3.8%
5) ALC Program Unit Cost	-20% to + 20%	-4.3% to +4.7%
6) Leak / Burst rates	-20% to + 20%	-4.3% to - 3.8%
7) Variable Operating Cost	-20% to + 20%	+2.7% to - 2.7%

**MODEL APPLICATION**

Generic Results. The model can be used to generate expected results for a hypothetical, typical city in a lesser-developed country (LDC). Such calculations illustrate fundamental relationships coming from the model optimality conditions. For example, Exhibit 8 shows that as distribution length per connection increases, the value of optimal NRW also increases linearly. In other words, as the population is less dense, the greater distance between connections requires more effort and cost for loss control, raising the optimal NRW. Exhibit 8 also shows that lower tariffs will lead to higher optimal NRWs and vice versa. In other words, if the tariff is low, there is little reason to spend too much money to reduce losses.

Exhibit 8

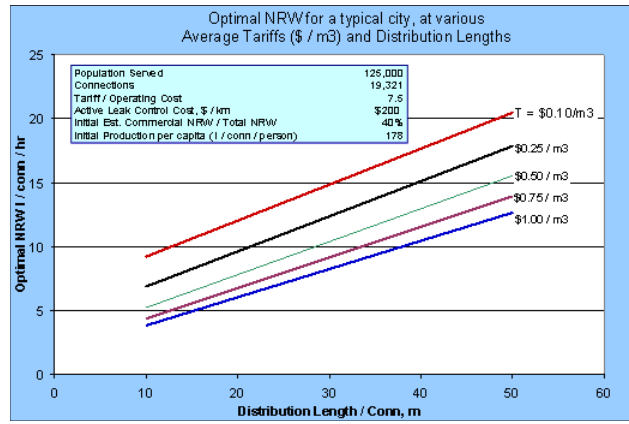
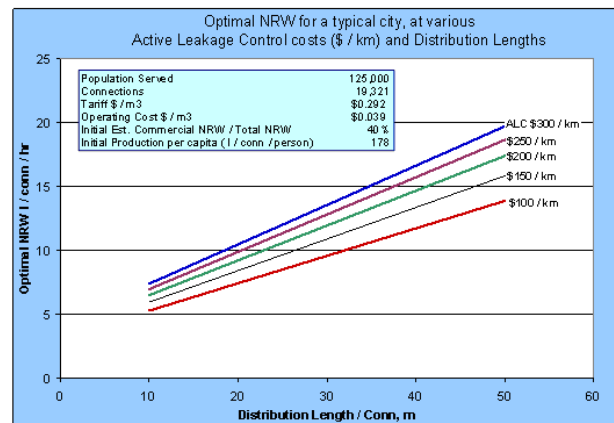


Exhibit 9 shows the impact of a range of costs for Active Leakage Control.

Exhibit 9



Similar “nomographs” can be produced for different sized cities, different levels of water consumption, etc. These charts can be handy to get a quick estimate of optimal NRW.

**Exhibit 10**

**Exhibit 10 High optimal losses occur when:**

- 11. 1) Water consumption is low, and not rising quickly
- 12. 2) Distribution length per connection is high (sparse population)
- 13. 3) Average tariff is low
- 14. 4) Active Leakage Control Program costs are high
- 15. 5) Water production capacity is ample
- 16. 6) Number of leaks or pipe breaks is high
- 17. 7) Variable water production costs (electricity & chemicals) are low

The conditions above are mostly true in developing countries indicating that losses can be expected to be higher in LDCs.

Exhibit 10 presents some basic conclusions from generic use of the model. It explains the conditions that would lead to high optimal losses and, by implication, those that would lead to low optimal losses.

Model Application in Ten Countries. We applied the model to 74 municipal, regional, and national utilities in Africa, Asia, and Latin America, mostly using basic data from secondary sources. In several cases, we used correspondence with local officials to fill gaps in the data. In most cases, we used the default parameters noted above, due to a lack of such data. We recognized that these results would be preliminary but would 1) provide a “reality check” on the model; 2) give approximate results which could be useful; and 3) would indicate if the model could provide information useful to local planners or regulators. If the third outcome proves to be true, more investigation could be carried out to estimate the default parameters more precisely and to produce more precise overall results.

The results, detailed in Annex 1, are summarized below. Exhibit 11 shows the overall optimal NRW (in L/connection/hr) for the ten countries, based on the average inputs and results in each country. This graph shows the expected linear trend with optimal NRW rising as the distribution length per connection rises. Ecuador has higher optimal values due to low tariffs. However, grouping all utilities in a country is not the best way to analyze the results. Annex 1 has a similar chart with all 74 utilities included. This full-page utility-level graph in the Annex is more accurate and useful.

**Exhibit 11**

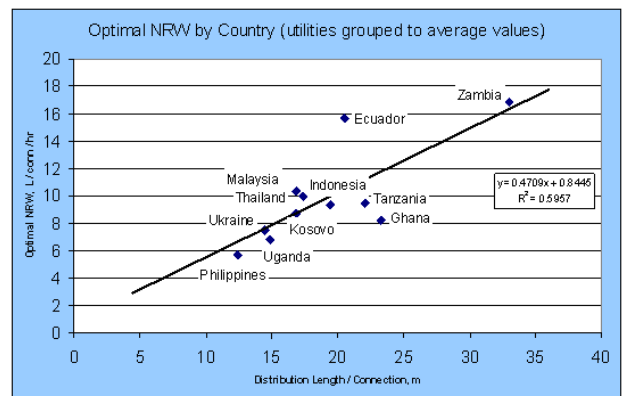
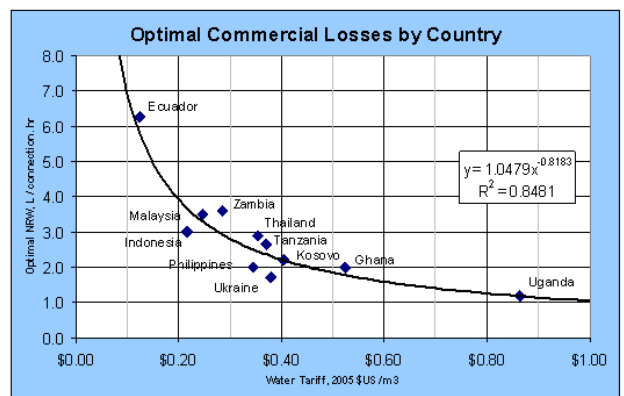


Exhibit 12 and Annex 1 show similar results for commercial losses.

**Exhibit 12**



As with the total optimal NRW, the utility-level information is more informative than the aggregated country-level information. Note that the shape of the curve, both here and in the Annex, is consistent with the square root relationship in the formula for optimal commercial losses on page 4.

One last note before turning to a detailed case study of Zambia. All the results reported so far have been optimal values of NRW; no actual values of existing NRW have been reviewed so far. The Zambia cases will explore this subject.

### EXTENDED ANALYSIS OF ZAMBIAN COMMERCIAL UTILITIES

We applied the model to ten commercial utilities, each associated with a province in Zambia. These regional utilities typically serve one or two large towns and a modest number of smaller towns in the same province. Some are highly urbanized, such as Lusaka and utilities in the Copperbelt region, while others serve more dispersed populations. They are regulated by and report performance data to the National Water Supply and Sanitation Council (NWASCO), which does an excellent job of analyzing and disseminating information. Annual reports from 2000–2008, covering all the commercial utilities, can be found on their web site. Supplemental information was obtained from the World Bank’s International Benchmarking Network Program, and from the dataset recently published by Water and Sanitation Program (WSP) and the Africa Water Operators Partnership (WOP). Exhibit 13 shows key input parameters and summary results for the Zambian utilities for FY 2006–2007.

Exhibit 13

Exhibit 13 Input Data and Results – Zambian Commercial Utilities 2006-7				
Parameter	Minimum	Average	Standard Dev	Maximum
Population Served,1000	42	329	351	1,042
Connections, 1000	6	24	23	75
Production, 1000 m3/day	7	87	103	311
Distribution length / conn, m	12.6	33.0	14.9	51.5
Average Tariff, \$/m3	\$0.164	\$0.295	\$0.142	\$0.578
Variable Production Cost, \$/m3	\$0.005	\$0.018	\$0.006	\$0.024
Reported Leaks / km/yr	1.3	3.8	1.3	5.2
Estim Consumption, m3/conn/day	1.0	1.8	0.8	3.0
Actual NRW, L/conn/day	380	1430	860	3100
Optimal NRW, L/conn/day	225	400	130	645

Exhibit 14

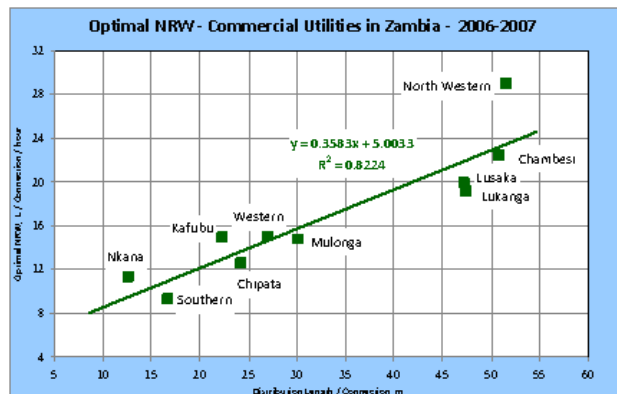
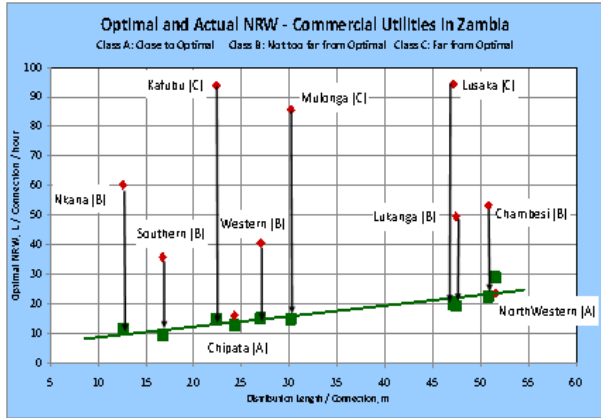


Exhibit 15



Exhibits 14, 15 and 16 present analyses of the data. The optimal NRW values follow the familiar linear pattern, with a good fit. Using the guidance in Exhibit 10, we can explain North Western’s high optimum NRW by low water consumption, infrequent pipe breaks, ample water production capacity, and low variable water production costs.

Exhibit 16

Actual NRW / Production: %	Actual NRW: L / conn / hr			Annual Savings: Production Savings – Loss Control Costs	Payback period (years) to recover transition costs of \$200 / m3 / day
	Actual	Optimal	Ratio		
<b>Lukanga (B)</b> 61%	<b>Lusaka (C)</b> 94.2	19.9		Lusaka (C) \$5.04m	Lusaka (C) 3.4
Kafubu (C) 58%	Kafubu (C) 93.9	14.9		Kafubu (C) \$2.96m	Kafubu (C) 4.5
Mulonga (C) 56%	Mulonga (C) 85.6	14.8		Nkana (C) \$2.09m	Southern (B) 4.5
Chambesi (B) 54%	<b>Nkana (C)</b> 60.2	11.3		Mulonga (C) \$0.75m	Mulonga (C) 4.8
<b>Lusaka (C)</b> 51%	Chambesi (B) 53.2	22.4		Southern (B) \$0.69m	Nkana (C) 8.5
Western (B) 47%	<b>Lukanga (B)</b> 49.4	19.1		Lukanga (B) \$0.14m	Lukanga (B) 11
Southern (B) 43%	Western (B) 40.6	15.1		Western (B) \$0.08m	Western (B) 22
North-Western (A) 36%	Southern (B) 35.7	9.3		Chambesi (B) \$0.02m	Chambesi (B) 77

<b>Nkana (C)</b>	<b>35%</b>	North-Western (A)	23.5	(29.0)	North-Western (A)	\$0	North-Western (A)
Chipata (A)	31%	Chipata (A)	16.0	12.6	Chipata (A)	\$0	Chipata (A)

We can now compare the actual NRW to the optimal to see how the utilities are actually doing. The results in Exhibit 15 show that there are two utilities operating close to the optimal NRW (Class A), five that are operating not too far from the optimal NRW (Class B), and three that are operating quite far from the optimal NRW (Class C). Clearly the Class C utilities merit more careful examination and effort on NRW reduction.

Exhibit 16 examines the ten commercial utilities using a variety of indicators. Considering NRW in terms of percentage of production, the utilities range from Lukanga at 61% down to Chipata at 31%. These are high values, even if this indicator is flawed. However, if we rank the utilities by Actual NRW, the ranking changes drastically. Lusaka, a Class C utility, rises to the top, and Lukanga falls far down the list. Next, Exhibit 16 shows the potential net annual savings from a transition from actual to optimal NRW and the “payback period,” assuming a cost of \$200 per m<sup>3</sup>/day reduction. In simple terms, it is the Class C utilities that have attractive payback periods for NRW reduction. Overall, we can see that the actual NRW in L/connection/hr and the “distance” to the optimal NRW are the key parameters in allocating resources to NRW reduction in Zambia (and elsewhere).

## DISCUSSION

Before turning to areas of further research and model development, we cover a few key perspectives and observations about the information presented so far and about the model itself.

7. The optimal NRW depends on the tariff, operations and maintenance (O&M) costs, number of connections, and other factors that change over the years — so the optimal values will shift somewhat from year to year. Optimality calculations should be recalculated accordingly.
8. There is no way to scientifically prove that the model accurately predicts the optimal NRW. There is no other method or benchmark to compare to. We can only see if more elaborate models, with higher data requirements, lead to more plausible results.
9. The current model is a financial one. The O&M costs or tariffs do not necessarily reflect “economic” values of water, energy, labor, commodities, or even political contexts. Adjustments may be needed in some cases, such as cases of severe water scarcity or drought. The model could be adjusted using “shadow” prices to define an economically optimal NRW rather than a financial one.
10. The model makes assumptions for default parameters where data is not available. This is a potential criticism of the current state of the model. However, if more research suggests a change in the default values, all is not lost. First, the model is relatively insensitive, and second, the basic concepts and relationships will not change. Lines may shift a little, but the key lessons of the model — that a site-specific optimal NRW can be derived (even if approximate) — will still be true.

## AREAS FOR ADDITIONAL RESEARCH AND MODEL APPLICATION

Our team and developing country collaborators have identified several areas for continued application, research, and improvement of the model. Those work areas include the following:

1. Application of the model in additional countries based on secondary data. More than 12 additional countries have already been identified with viable existing secondary data sets. It is likely that more countries, including those in the Arab world, would be able to provide secondary data and work with the model.
2. Refinement of the model based on additional literature review, especially the latest research on the effectiveness and costs of different control strategies.
3. Additional research on specific model parameters, especially the default parameters listed in Exhibit 6. These studies will have to be detailed programs in specific countries where interest in using the model is high.
4. Development of protocols for country-level parameter estimation and development of a handbook for model use.
5. Development and implementation of training programs on model use, where relevant.

## CONCLUSION

This paper indicates that a model can be developed which will allow utility managers or regulators to identify a good approximation of the financially optimal level of NRW in a given location. The field results to data show clear trend lines that are consistent with the model framework and theory.

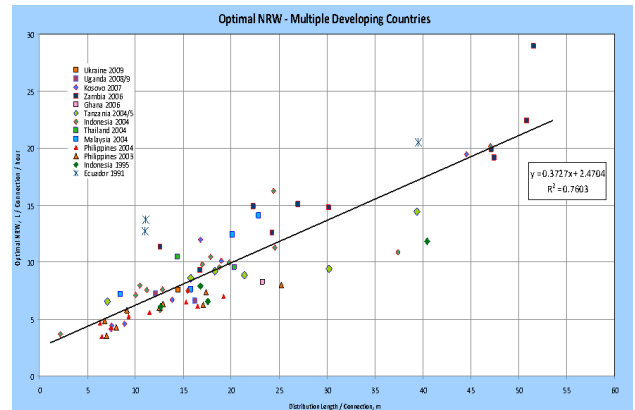
Analysis of a typical developing country case shows rather low model sensitivity to input parameters and also indicates that optimal NRW levels in developing countries will tend to be higher than in developed ones.

The Zambia case study illustrates how actual and optimal NRW values in L/connection/hr can allow managers or regulators to prioritize among different locations for investment in NRW reduction and steady-state maintenance.

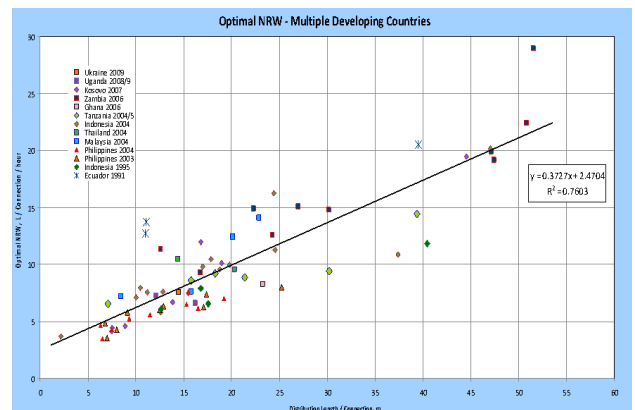
Additional work on the model would be advantageous and is ongoing. Plans include the refinement of the model based on additional literature review, development of protocols for country-level parameter estimation, and application of the model to more countries.

## ANNEX 1

### Detailed NRW Analysis Results



Optimal NRW - Multiple Developing Countries



Optimal NRW - Multiple Developing Countries

Would you like to collaborate on further testing, refinement, and application of this model? I am seeking utilities interested in collecting data and applying the model. I will provide the model spreadsheet if utilities gather, verify, and provide input data. Together, we can evaluate results, discuss the need for additional data, if any, and assess the potential use of the findings.

RTI International is a trade name of Research Triangle Institute.

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# Zambia: city of Lusaka

## NRW plans in practice: development, implementation and follow-up

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### ABSTRACT

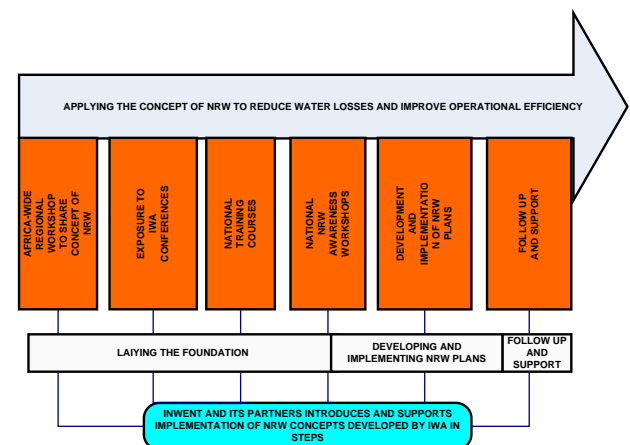
The paper outlines (i) a capacity building initiative to manage and control water losses, and (ii) the specific challenges encountered in Zambia to understand and address all components of NRW at utility level. The capacity building initiative follows a multiple step and multiple level approach. The NRW covers Southern Africa - consisting of Kenya, Uganda, Tanzania and Zambia. The paper first presents the process for the development of NRW plans and follows up with a case study from the Kafubu Water and Sewerage Company showing how NRW plans are developed and implemented, including their benefits.

### PROCESS OF NRW PLAN DEVELOPMENT

#### Approach and Organisation

Capacity Building is organised to follow a multiple step and multiple level approach shown in figure 2.1

Figure 2.1: Multiple step and level Approach



(a) Africa-wide regional workshop

These regional workshops targeted senior staff of water utilities with the objective of raising awareness and introducing the concept of NRW. This is the first step in sharing NRW concepts with water utilities Africa-wide, organised by AfWA, WBI and InWEnt.

(b) Exposure to IWA Conference

The Water Loss 2009 Conference in Cape Town from 26-30 April 2009 introduced senior decision makers

of utilities, regulators, water board members and water associations to the techniques, technologies etc. for water loss reduction being promoted by IWA and other experts around the world. Stakeholders from Southern Africa, comprising Zambia, Kenya, South Africa, AfWA, WASAZA etc. discussed and planned the development of pilot NRW plans, starting with Zambia and Kenya.

#### (c) National training courses

At the Southern Region level in Kenya, Uganda, Tanzania and Zambia, country group stakeholders and water experts, supported by the InWEnt WAVE CB programme, organised national training courses based on IWA and WBI material. This was done under the WAVE Programme 2007-2010. Under the WAVE Programme several courses were identified by the Southern Region, and NRW was a top priority. At least three NRW courses have been conducted in each country.

The objective of these courses is improving efficiency and effectiveness of water services in urban areas, targetting mid-level staff. The courses include managing commercial and physical water losses, cost recovery mechanisms, mechanisms to increase cash flow, network maintenance behaviour toward unaccounted-for water.

#### (d) Development and implementation of NRW plans in Zambia

The development of the NRW programme in Zambia promotes and implements the internationally agreed standards to reduce water losses in urban water supply systems by the application of standards that were developed by the International Water Association (IWA) and its Water Loss Task Force (WLTF). The reference material, procedures and tools of the WLTF are used and adapted to the situation in Zambia.

The approach followed two stages:

#### Development of NRW Programme in Zambia in Detail

##### National NRW awareness workshops

As a **first stage**, national awareness workshops were held from 24-25 June 2009 with senior decision makers from national institutions (ministry, boards, regulator) and senior management of all water companies in Zambia. The aim was to encourage them to accept the concept of NRW and its implications, and to get their commitment to the NRW initiative in Zambia. In addition, consultative meetings were held with representatives of the Zambian National Water and Sanitation Council (NWASCO), the Water and Sanitation Association of Zambia (WASAZA), Zambia WAVE Pool and water utilities. This ensured ownership, support and strengthening of partnerships in addressing NRW using internationally agreed standards. The IWA international experts Ronnie McKenzie and Willem Wegelin of WRP Consulting Engineers were engaged as facilitators of the national awareness workshops for the regulator and senior management to introduce the concept of NRW.

Attendance was as follows:

Commercial Utilities	Training Institute	InWEnt Partners	InWEnt/Organisers
All nine (9) managing directors of commercial utilities	Two (2) heads of department at local training institute	GTZ, Advisor to NWASCO	WASAZA/WAVE Zambia, Administrative Secretary/WAVE Pool Focal Person
Five (5) directors/managers of commercial departments		Chief Inspector, NWASCO	InWEnt Programme Manager
Eleven (11) directors/managers of engineering/technical departments		GTZ Administrative Secretary of WASAZA	National NRW Specialist
Six (6) directors/managers of finance and administration departments		Advisor to Eastern Water, GTZ	DED Water Coordinator
One (1) water production manager		DED Technical Advisor, Northwestern Water	Technical Officer, NWASCO
One (1) water audit engineer		Corporate Systems Specialist, NWASCO	Financial Inspector, NWASCO
		GTZ, Junior Expert	

As can be seen from the above, there was adequate representation of commercial utilities (all nine directors attended), training institutions, InWEnt partners and organising institutions.

Outcome and output of the national NRW awareness workshops

1. Government commitment to the NRW initiative was represented by the presence of the Director of DISS, representing the government. In his speech he stated that NRW is a big concern to Government as it affected cost recovery effort which is one the key sector principles.
2. Introduced the NRW concept to the regulator and discussed implications to implement. The concepts focused on development of NRW reduction plans and performance indicators. Importance of having more than indicator for NRW such as % explained. Indicators for monitoring physical (real) and commercial (apparent) losses were outlined.
3. NWASCO indicated that they are developing indicators for NRW and that they appreciated the workshop.
4. Introduced the NRW concept and implications to CU senior management. The participants appreciated and were supportive of the NRW concepts. The Chairman of WASZA expressed his appreciation of the facilitation of Ronnie Mckenzie and that he would be instrumental in building a strong cadre of water professionals in Zambia.

Development of NRW plans for two pilot water utilities

As the second stage, NRW plans were developed for two pilot water utilities. Coordination for development of NRW plans was done by the national NRW specialist and a CU representative. NRW teams were formed by each water utility together the international expert of the IWA Water Loss Task

Force developed NRW plans. Coordination and support continued in the implementation of pilot NRW plans in two selected commercial utilities (CUs). NRW plans for the implementation of WC/WDM were based on the best available information for the CUs. Willem Wegelin and Stuart Hamilton as international experts guided the development of NRW plans in the pilot commercial utilities. The case for Kafubu Water shows development of NRW Plans.

#### *Follow up on InWEnt shared workspace*

The follow up activities on the InWEnt shared workspace consisted of chat sessions organised to take place during the implementation of NRW plans by Kafubu and Northwestern Water with technical advisory missions by water experts.

The InWEnt shared workspace provided a tool for:

- Reporting progress update by the water companies on implementation of NRW plans.
- Sharing of experiences and knowledge in NRW during implementation between water companies and the international expert.

Organisation of use of InWEnt shared workspace  
The partners consisting of GTZ, DED, WASAZA, WAVE Pool members including the coaches were kept informed through circulation of progress updates as well as their being included on the InWEnt shared workspace. Water companies adopted the NRW plans developed with the IWA experts and prepared operational plans which prioritised interventions into short term, medium term and long term up to 2010 and formed the basis for progress update.

Output/outcomes of the follow up activities

1. The water companies are already implementing the interventions as presented.
2. The NRW plans have become part of strategic plans and budgets, including the regulation-by-incentive system
3. Noticeable improvements have been recorded, indicating that NRW has begun to be addressed systematically as per IWA standard. The case study for developing and implementing NRW plans by Kafubu Water is an example.
4. InWEnt capacity building initiatives have become part of the existing capacity building initiatives of the National Urban Water Supply and Sanitation Programme being developed in Zambia up to the year 2030.

Lessons learnt on follow ups

1. Follow up sessions are a useful tool for monitoring and encouraging water companies in implementing interventions. This tool can provide an additional cheaper means of achieving monitoring in addition to the planned annual physical inspections.
2. There is need to continue the follow ups using the InWEnt shared workspace. This ensures continued encouragement, which is so much required, sharing of experiences and knowledge among water companies.

Country-wide dissemination plan is under development and will be jointly implemented

A country-wide dissemination plan is under development and will be jointly implemented by the regulator, utilities and water associations with support from the German Development Cooperation (GTZ, InWEnt, DED, KfW) and others.

Work with other partners, GTZ, DED, etc. role out the development of NRW plans for the remaining 8 commercial utilities (Lusaka Water is being assisted by the World Bank). GTZ is already considering adopting the approach used in the pilot water companies.

*4.0 Recommended approach for promoting and adopting IWA standards in water loss reduction*

The approach recommended for promoting and adopting IWA standards in reducing water losses includes:

1. Identification of partner organisations in regions/countries. Organisations are actors in the water sector, e.g., the regulators where they exist, the water service providers where the pilot projects are planned to be done, etc.
2. Cooperation of supporting organisations, e.g., in Zambia, InWEnt worked with GTZ.
3. Identification of representative water utilities where pilot projects could be done. The selection of the water utilities is based on agreed criteria.
4. Formation of implementation team for coordination and facilitation of implementation. In Zambia it consisted of a national NRW specialist and NRW commercial utility representative.
5. Selection/placing of IWA experts for implementation of NRW initiative in these countries
6. Sharing of experiences in Zambia via email, InWEnt shared workspace, etc.
7. Mobilisation of resources for implementation, e.g. in Zambia, GTZ provided resources through the regulatory-by-incentive (RBI) and the Devolution Trust Fund for Utilities to procure meters and keep the motivation.
8. Galvanising the resolve to tackle NRW by encouraging twinning arrangements, partner organisations in pulling resources together, etc.

## CASE STUDY: KAFUBU WATER AND SEWERAGE COMPANY

### General

**Project Title:** Development and Implementation of NRW Plans

### Project Objectives:

The project objectives were:

- Evaluate each water supply system in terms of operational performance and identify main water loss contributing factors based on IWA water balance and key performance indicators,
- Develop recommendations on possible WC/WDM interventions for each system with cost implications and potential benefit to reduce these losses, and
- Prioritise interventions with time scales to provide a short, medium and long term WC/WDM project implementation plan

### Project Organisation

NRW teams were established in each commercial utility as a first step. The NRW team for Kafubu Water comprised of Directors of Planning and Development, Project Manager, Water Audit Engineer, Water Production Manager, Operations Manager and Maintenance Engineer.

Draft plan document for developing and implementing a NRW plan were prepared with the international experts. The NRW plans were further discussed by the management and incorporated into the strategic plans, budgets and board approval was sought.

## Background

Kafubu Water and Sewage Company Limited was established in July 2000 as a joint venture by three local authorities of the City of Ndola, the Municipality of Luashya, and Masaiti District in accordance with the Water Supply and Sanitation Act No. 28 of 1997 of the laws of Zambia. The company now operates in the towns of Ndola, Luanshya and Masaiti.

Main activities in the area are mining and agriculture, and all consumers are supplied with potable water with 60% supplied with waterborne sanitation.

## Key Characteristics of the Water Supply and Waste Water Systems

Background information on water supply and waste water systems for the three towns is summarized in **Tables 2.3.1 and 2.3.2**

The total operational area is supplied from nine water treatment works (WTW) with a total capacity of 291 106 m<sup>3</sup>/day and nine waste water treatment works (WWTW) with a total capacity of 80 727m<sup>3</sup>/day. The WTWs are operating at 61% of their design capacity, whereas the WWTWs are operating at 92% of total capacity.

It was noted that all the WWTWs in Ndola are operating at 113% if Old Lubuto is included in the capacity or 192% if it is excluded. Ndola has a serious sewerage problem considering that only 46% of the input volume returns through the sewerage system but the WWTWs are already operating at double their capacity.

Luanshya has sufficient WTW and WWTW capacity but only 32% of the input volume return

through the sewerage system. In most systems the return flow is 60-70% of the input volume which indicates excessive garden watering or the return flow never reaches the WWTW and is discharged somewhere else.

**Tatable 2.3.1: summary of key characteristics**

Settlement	Number of connections	Estimated population @ 7 people / connection	Input volume m <sup>3</sup> /annum	l/c/d	m <sup>3</sup> / connection/ month
Ndola	29 387	205 709	48 801 000	650	138
Luan-shya	18 409	128 863	15 393 000	327	70
Masaiti	342	2 394	531 000	608	129
Total / average	48 138	336 966	64 725 000	526	112

**Table 2.3.2: summary of WTW and WWTW**

Location	WTW	Design m <sup>3</sup> /day	Actual m <sup>3</sup> /day	%	WWTW	Design m <sup>3</sup> /day	Actual m <sup>3</sup> /day	%
Ndola	Kafubu	81 000	55 000	68%	Old Kanini	11 400	15 000	132%
		27 000	23 700	88%	New Kanini	9 700	12 000	124%
		55 000	30 000	55%	Old Lubuto	22 700	0	0%
	Mis-undu II	45 000	25 000	56%	New Lubuto	10 300	34 000	330%
Sub-total	Ndola	208 000	133 700	64%		54 100	61 000	113%
Luanshya	Mikom-fwa	20 000	9 000	45%	LYA Ponds	4 691	3 283	70%
		57 000	31 000	54%	Mpata-matu	7 568	3 784	50%
		4 346	2 173	50%	Roan	6 882	3 441	50%
					Kami-renda	4 492	2 246	50%
					Mikom-fwa	2 995	898	30%
Sub-total	Luan-shya	81 346	42 173	52%		26 627	13 653	51%



Masaiti	Boma	1 250	1 010	81%	Septic tanks	N/A	N/A	N/A
	Council	510	446	87%				
Sub-total	Masaiti	1 760	1 456	83%				
Total		291 106	177 329	61%		80 727	74 653	92%

The first step is to establish the water balance for the system. A standard IWA water balance developed for the whole area is shown in Figure 2.1

Figure 2.1: KWSC Standard IWA water balance

*Water Demand Projections*

**Ndola demand projection**

The Ndola projection indicated that it was possible to supply Ndola from Itawa, Misundu 1 & 2 and replace Kafubu with Lake Isiku and also showed that between the five treatment works there is more than sufficient capacity to supply in the high demand.

**Luanshya demand projection**

The Luanshya projection shows that it will not be possible to supply the future high demand from the existing WTWs and that additional capacity would be required. Should it be possible to reduce the demand, the three existing works should be more than sufficient.

**Masaiti demand projection**

The Masaiti projection shows that the existing WTWs are already stressed and that if the future demand cannot be reduced, additional capacity would have to be developed.

Annual system input volume	Authorised consumption	Billed authorized consumption	Billed Metered Consumption	Revenue water	
		29 712 420 m3/year	7 024 140 m3/year		29 712 420 m3/year
	Error margin [+/-] 0.1%	Unbilled authorized consumption	Billed Unmetered Consumption	Unbilled Metered Consumption	Non-revenue water
			22 688 280 m3/year		
Error margin [+/-] 3.5%	Unbilled Unmetered Consumption	710 700 m3/year	710 700 m3/year	Error margin [+/-] 3.5%	
		565 750 m3/year	565 750 m3/year		
Error margin [+/-] 0.9%	Water losses	Commercial losses	Customer Meter Inaccuracies and data handling errors	Error margin [+/-] 5.3%	
		1 173 621 m3/year	1 173 621 m3/year		5.3%
Error margin [+/-] 1.9%	Physical losses	31 301 275 m3/year	31 301 275 m3/year	Error margin [+/-] 1.9%	
		31 301 275 m3/year	31 301 275 m3/year		1.9%

Based on the standard IWA water balance the non-revenue water in the system was 33.75million m3/annum or 53% of the system input volume. The high physical losses were because of the uncontrolled water use in the low cost areas and visible leaks.

Uncontrolled water usage: Excessive water usage was experienced in the low income areas mainly due to the uncontrolled (continuous) water use.

*Key Problems*

The main water loss contributing factors were identified and are presented in the following sections.

Non-Revenue Water

This is as a result of vandalized / stolen taps.

**Visible leakage:** There were several visible leaks observed. Some of these leaks are at the water treatment works and due to lack of general maintenance.

**Unmetered connections:** Only 30% of the consumers were metered, i.e. mainly the non-domestic and high income consumers are metered. The remaining consumers are billed on flat rate consumption.

**Concrete pipe supply mains:** The concrete pipe supply main from Nakaputa reservoirs was a major source of leakage. The joints on this line were leaking severely and were difficult and costly to repair.

**Lack of accurate information:** There was limited accurate information available on the supply system. The system input volume was based on the performance curves of the pumps. However, the metered and billed data was quite accurate.

**High average consumption:** The average litres/capita/day of 526 l/c/d and 112 m<sup>3</sup>/connection/month was very high compared to international standards and the level of service provided. Acceptable consumption would be 30-40 m<sup>3</sup>/connection/month for high income areas and 10-20m<sup>3</sup>/connection/month for low income areas.

**Flat rate billing:** The current flat rate billing system is not in line with the actual consumption.

**Inefficient use and wastage:** Consumers are not water wise and excessive watering of gardens and subsistence farming is evident.

#### Interventions

The list of activities summaries NRW plan

interventions adopted into strategic plans, budgets and approved by the Board are shown in table 2.3.3. Table 2.3.4 shows status of bulk meter installation. The senior management team, lead by the Managing Director, is at the centre of implementing the programme.

**Table 2.3.3: List of activities developed up to 2010**

Item No.	Activity	2009 Progress	2010
1	Immediate interventions integration into strategic plans, budgets and Regulation-by-Incentive (RBI)	100% done	
2	Seek funding to implement short, medium and long term interventions	50% done	Continued
3	Installation of bulk meters on all water production facilities, including reservoirs	50% done	
4	Carry out an inspection of all storage infrastructure to ascertain level of losses and scope of repair works required	0%	
5	Install 4000 meters in Lubuto township, low cost area in Ndola to reduce water wastage	100%	
6	Perform proper analysis of distribution network and obtain accurate water production & water loss data	40%	
7	Investigate and implement an effective metering and billing management system	25%	
8	Produce detailed BoQs for all storage facilities	Planned for 2010	
9	Procure repair materials and carry out repair works on all storage infrastructure	Planned for 2010	
10	Walk all the non-concrete mains for leak location	Planned for 2010	

11	Repair all the leaks on non-concrete mains, valves and associated fittings.	Planned for 2010	
12	Install 600 meters in unmetered parts of Towncentre, Northrise, Kansenshi and Kanini	Planned for 2010	
13	Split and meter 656 connections in Luanshya	Planned for 2010	
14	Audit all billed non domestic top consumers, identify anomalies and institute corrective measures	Planned for 2010	
15	Audit all authorised unbilled consumers and establish consumption levels	Planned for 2010	
16	Take corrective action to bring authorised unbilled consumption within acceptable levels	Planned for 2010	
17	Evaluation and re-planning		periodically

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Table 2.3.4 Status of Bulk Meter Installation

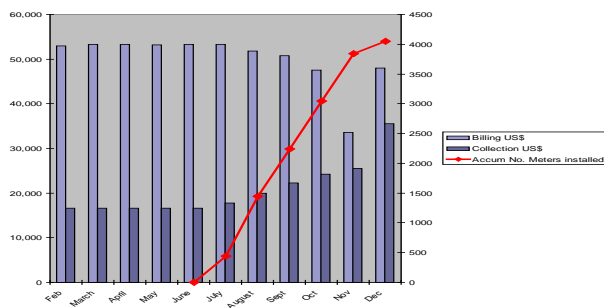
Location	Size of meter		Total Bulk meters required	Total meters installed and functional	Total meters installed and not functional	Total numbers of meters to be installed	Total cost installed (US\$)	Remarks
Misundu I Water Works (WW)	20"	Macroflow, electromagnetic	1	0	1	0	12,334	Instrumentation technician to be called to rectify the fault, stopped working two months ago
Misundu II WW	20"	Macroflow, electromagnetic	1	0	0	1	12,334	Meter and accessories purchased and awaits installation
Itawa WW	14" and 12"	Macroflow, electromagnetic	2	0	1	1	24,668	Instrumentation needs to be completed on the installed meter and the other fabrication works done and awaits installation.
Kafubu Dam WW	20"	Macroflow, electromagnetic	2	0	1	1	24,668	Instrumentation needs to be completed on the installed meter and the other fabrication works done and awaits installation.
Makoma WW	20" and 2 are 12"	Macroflow, electromagnetic	3	1	2	0		Meter cards replacement required
Luanshya Water Works	12"	Macroflow, electromagnetic	1	0	1	0		Recalibration or replacement
Masaiti Boma WW	6"	Mechanical	1	1	0	0		Old meter; needs checking
Masaiti Council WW	3"	Mechanical	1	0	0	1	660.00	Awaits installation
Fisenge WW	4"	Mechanical	1	1	0	0	660	
<b>Company Totals</b>			<b>13</b>	<b>3</b>	<b>6</b>	<b>4</b>		

*Benefits Obtained from Developing and Implementing NRW Plans in Lubuto Township*

Lubuto is a low cost township in the City of Ndola with 4,000 connections that was identified as one of the areas with high water wastage and selected among the immediate interventions during development of NRW Plans for Kafubu Water.

Installation of 4,000 domestic meters in Lubuto Township, representing 100% for the area, has been done, resulting in improved efficiencies. Tables 2.3.5 and 2.3.6 show improvements in collection after meter installation and repair of leaking fittings.

**Table 2.3.5: Effects of metering on Billing and Collection rates in Lubuto Township**



**Table 2.3.6: Metering, Billing and Collections in Lubuto Township**

	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Billing US\$	53,000	53,300	53,289	53,222	53,311	53,267	51,778	50,756	47,578	33,556	48,000
Accum No. Meters installed					0	445	1,445	2,245	3,045	3,845	4,050
Collection US\$	16,667	16,667	16,667	16,667	16,667	17,778	20,000	22,222	24,222	25,556	35,556
Collection efficiency	31%	31%	31%	31%	31%	33%	39%	44%	51%	76%	74%

Billing amount tended to drop slightly when meters were being installed. The reduction in billing was attributed to consumers being billed for the amounts consumed.

However, collections doubled from an average of US\$17,000 months before metering July and to US\$ 36,000 in December 2009.

Water supply has improved from 60% to almost 100% after NRW intervention through 100% metering and replacing leaking fittings.

The improved service provision in turn enhanced the willingness to pay by customers.

Extra water saved in Lubuto is now supplied to surrounding areas with no increase in input volume.

Due to the metering programme, there has been an increase in the general pressures in the low lying sections of the project area, the company intends to install at least two pressure valves (PVRs) to pressure manage.

Cost of metering 4,000 connections was US\$309,360.00. This intervention was financed by the Devolution Trust Fund (DTF) Donor Basket fund supported by GTZ, Danida and other donors.

The total cost of the intervention in Lubuto of US\$309,360 is equivalent to 16 months of extra amount of about US\$19,000 now being collected.

Kafubu Water has plans to replicate lessons learnt in Lubuto into other areas of water supply to improve the overall efficiency of the Company.

# Institutions





GTZ

# Water loss reduction through intelligent pressure management (IPM)-guidelines & implementation

*Dr. Dörte Ziegler, Planning Officer for water, GTZ*

## ABSTRACT

Intelligent Pressure Management (IPM) is a solution for water loss reduction which is still not common knowledge. Therefore GTZ and VAG want to improve information on and application of IPM. The idea is to reduce water losses through an improved management of existing water supply networks by local water utilities. Three areas of intervention are planned:

- Development of guidelines for Water Loss Reduction with a focus on Intelligent Pressure Management (IPM)
- Capacity building through dialogues, trainings and on-the-job instructions
- Demonstration of improved management measures in pilot areas

The Guidelines are addressed to decision makers and relevant stakeholders on national level, the management, the planning & design department and the operational level of local water utilities. Aims of the Guidelines are to raise awareness and understanding on the different types, reasons and impacts of water losses. The Guidelines will contain

comprehensive working materials on IPM. Also strategies for solving existing problems in water supply networks will be demonstrated. Methods and instruments for the analysis of the current state of the utility and for the development of action plans will be documented as well as basic requirements for a sustainable management of existing water supply networks. IPM will be explained including the installation of valves, additional components and remote control technology. The first draft will be ready by March 2010.

To allow the implementation of the Guidelines, target group-oriented workshops and trainings will be necessary. Based on a needs assessment of three target groups, training plans and materials will be developed on the management of water supply networks including valve design, maintenance and repair.

The implementation of the Guidelines will also require technical installations of modern valve technologies. Pilot areas will serve as practical examples for the discussion on best practices regarding design and management of water supply networks. Countries or Pilot zones where IPM has been or is being implemented include Jordan,

Yemen, Burkina Faso and Peru. The use and implementation of the developed guidelines will lead to a more sustainable network management, including a reduction of water losses and the guarantee of a constant and safe water supply. Additionally the guidelines will contribute to a more preventive operation and maintenance of the networks, which is less cost-intensive than the reparation of existing damages on the long term (rehabilitation).

The training of technicians, technical directors and representatives of governmental authorities will contribute to a more efficient maintenance and management of the networks and thus to water loss reduction. A comprehensive data base of the water supply network is a prerequisite for IPM. Such a database also contributes to better maintenance and financing decisions. With a good database and with IPM, management and maintenance of the water networks will improve. This will contribute to reducing the pollution of drinking water and thus to decreasing water-borne infections.

## UNW-DPC

# Economic aspects of drinking water loss reduction within integrated urban water management

*Prof. Dr Dr Karl-Ulrich Rudolph, Coordinator of UNW-DPC Working Group on Capacity Development for Water Efficiency*

It is obvious that in a water system with 50 % loss through leakages and from other causes a minimum of 2 m<sup>3</sup> of drinking water have to be produced if only 1 m<sup>3</sup> are to reach the consumer. In countries with scarce water resources many people will receive no water at all because of water losses, and in low-income countries it is the water customer and/or the tax payer who suffers, having to pay at least double costs. The journal WATER 21 (June 2008, page 48) estimates the benefits to be gained from a reduction of water losses in lower and middle income countries to just half of the current level:

- 11 billion m<sup>3</sup>/a would be available to water customers;
- 130 million more people could again access public water supply;
- water utilities would gain US\$ 4 billion in self-generated cash flow.

These figures illustrate the economic importance of water loss (WL) and the need for water loss reduction programmes (WLR-P). For decision making and design of WLR-P, costs and benefits have to be analysed and evaluated, using a cost-benefit-analysis (CBA). This paper explains that:

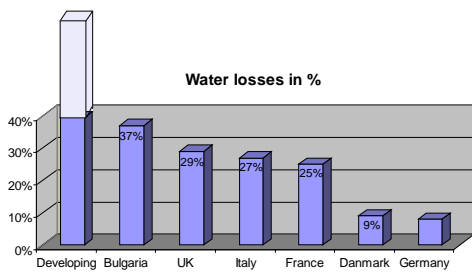
- CBA must be appropriate to regional conditions (OPEX, CAPEX) and include surplus technical and administrative WL-damages;
- the German guideline recommends WL below 20 m<sup>3</sup>/h·km, or below 7 %;
- design and implementation of WLR package solutions would support WL promotion, and local business should be developed through capacity building,

Financial arrangement through business models with know-how transfer, such as water franchise, can develop local business more than purely public operations or private concessions.

### FIGURES ABOUT WATER LOSSES IN DIFFERENT REGIONS

Due to different calculation methods and a not always reliable data basis, it is necessary to verify data about water losses case by case. Data published for different countries reflect averages and cannot be regarded as valid for individual cities or utilities. Figure 1 shows data published for developing European countries and developing countries. As

one might expect, water losses in most developing countries are quite high (up to 90 %), due to poor operation and maintenance of existing facilities. The low rate of water losses in Germany (less than 8 %, and for some utilities around 3 %) are the result of the high budgets available for utilities, and the fact that the German tariff system allows full cost recovery for structural maintenance, without any significant problems with tariff collection. Certainly this is a strong economic incentive for extensive WLR-P.



Source: BGW 2004 u.a.

Figure 1: Water Loss Figures from Different Countries

Years ago, an expert team from the World Bank made a tour through Germany and criticised that German water utilities have realised "uneconomically low water losses". The discussion at that time was that approx. 15% of water losses would seem economically feasible under the conditions of the region (where water is not scarce; the recommendation would probably have been lower for countries which need desalination to produce the water supply).

The German utilities, being criticised for overstressing their WLR-P to achieve non-economic low water loss rates, argued that low water losses are an indicator for good network maintenance, and that well-maintained networks have a longer lifetime and lower repair costs.

However, although a loss of 15 % may have been justified a decade ago, the present "assumed optimum" might well be around 4 %,

- because of increased costs for supplied water (production + distribution), especially power and regional water shortages,
- because of improved technologies for water loss reduction (WLR), e.g. for leak detection, trenchless rehabilitation, automated metering, asset management etc.

Figure 2 includes guide figures from German standards, for water losses in [m<sup>3</sup>/h · km] which may serve as a first orientation where no other economic considerations or data are available. These indicate that percentages below 7 % are reasonable.

Water loss category	Approximate spec. water losses $q_{VR}$ in m <sup>3</sup> /h·km		
	City	Town	Rural
Low water losses	< 0.10	< 0.07 <sup>2)</sup>	< 0.05 <sup>1)</sup>
Medium water losses	0.10 - 0.20	0.07 - 0.15 <sup>3)</sup>	0.05 - 0.10
High water losses	> 0.20 <sup>5)</sup>	> 0.15 <sup>4)</sup>	> 0.10

Remarks:

1. Hardly achievable
2. Very good maintenance, new systems
3. Achievable with technical/operational measures
4. Maintenance not efficiently performed
5. Maintenance and/or system in poor condition, if >30

Figure 2: "Reasonable" Level of Leakage

## A STANDARD APPROACH TO COST-BENEFIT-ANALYSES

The CBA method of "first choice" is usually a comparison of WLR costs with WLR benefits, measured as reduced costs for water production, according to reduced leakages. Figure 3 illustrates the results of a CBA for a city which would be able to avoid desalination if the water losses were reduced below 30 %. From this level, the cheaper water from a river dam in the mountains would be sufficient to meet the demand.

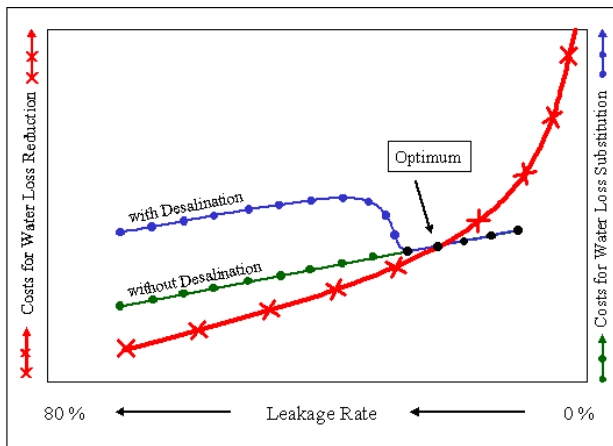


Figure 3: CBA (Cost-Benefit-Analysis) for WLR-P

Another CBA approach is to compare the specific supply costs for different levels of water loss reduction, which is usually accompanied by equally high levels of technical failure. Figure 4 shows a calculation of specific supply costs in two different networks (a) the current situation for a large Asian city and (b) a calculation for the technical stages equal to high quality equipment and maintenance, such as are often achieved by water companies and water utilities in Germany (e.g. Gelsenwasser, Huber, Remondis, Siemens), Europe and other countries. It is understandable that leakage and technical failures inflate the specific cost of the water delivered enormously. Although higher costs for equipment might lead to a higher overall CAPEX of an additional 15 % (note: civil constructions unchanged), the resulting costs per cubic meter are much lower ( $\text{€}/\text{m}^3$  1.33 for high quality, compared to  $\text{€}/\text{m}^3$  4 for poor quality).

a)	Theoretical CAPEX	=	$1 \text{ €}/\text{m}^3 \hat{=} 1 \text{ €}/1\,000 \text{ l}$
	Leakage rate 45 %	$\hat{=}$	450 l lost
	Technical failure 30 %	$\hat{=}$	300 l lost
			750 l lost
	<b>Real CAPEX</b>	=	1 € per 250 l
		$\hat{=}$	<b>4 €/<math>\text{m}^3</math></b>
b)	Theoretical CAPEX	=	$1.15 \text{ €}/\text{m}^3 \hat{=} 1.15 \text{ €}/1\,000 \text{ l}$
	Technical failure 6 %	$\hat{=}$	60 l lost
	Leakage rate 8 %	$\hat{=}$	80 l lost
			140 l lost
	<b>Real CAPEX</b>	=	1.15 € per 860 l
		$\hat{=}$	<b>1.33 €/<math>\text{m}^3</math></b>

Figure 4: WL and Cheap Technologies cause Surplus Costs

Furthermore, a CBA should not be limited to public expenditures. Whenever water supply services are not reliable in continuity and pressure, the private customers are bearing significant additional expenses, for example for booster pumps, roof storage tanks etc. These extra costs (in one case:  $\$/\text{m}^3$  0.50 water sold) are often much higher than the amount the (usually public) utility would have had to spend on appropriate water loss reduction programmes, structural maintenance and network rehabilitation.

## SPECIFIC REQUIREMENTS FOR CBA IN DRY AND DEVELOPING COUNTRIES

For developing and transformation countries, especially those that are dry and have scarce water resources, the definition of major cost components should reflect the specific situation onsite. This applies to labour costs (maybe near to zero for low-skilled labour in national economies with high unemployment), on electric power (in many countries power is still subsidised and does not reflect the real values, which should be considered in a CBA), on imports and foreign currency exchange rates (local products may be advantageous under certain national-economic conditions), on natural resources (like land used for plants to substitute

water loss reduction) and on the calculation focus (any CBA should clearly indicate what is considered to be OPEX and CAPEX, especially regarding the difference between operational and structural maintenance, and whether the focus is on micro-economic or macro-economic issues).

A review of about two dozen cost-benefit analyses (most of them donor-funded) in the framework of research projects funded by the World Bank, the EU and the German Federal Ministry of Education and Research, IEEM (the Institute of Environmental Engineering and Management, headed by the author) found that 17 were not appropriate in economic and methodology and/or regarding the input data. This may have led to unfair decisions regarding

- wastewater pond systems versus activated sludge technology,
- decentralised versus centralised systems,
- water loss reduction versus desalination plants.

### ADDITIONAL DAMAGE DUE TO TECHNICAL LOSSES

Figure 5 shows that the costs of failures from a leaking or even collapsing pipe network exceed the savings in expenditure for structural maintenance and rehabilitation(s). And emergency repair after failures have occurred will generate significant additional costs, especially as a result of accidents, destabilisation of foundations, road collapse, wetting of buildings, electrical equipment etc., damage to trees and open spaces as a result of flooding, hygienic risks or even disease, odour nuisance, for cleaning up flooded areas, additional emergency expenditure etc.

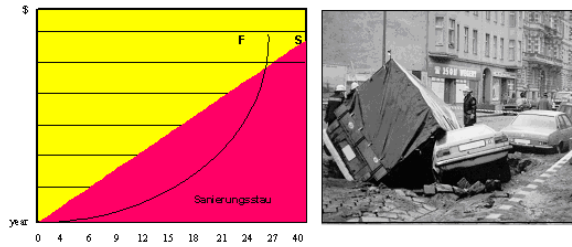


Figure 5: Damage Due to Technical Losses

### ADDITIONAL DAMAGE DUE TO ADMINISTRATIVE LOSSES

The administrative losses, e.g. water theft or non-payment of water supplied according to valid tariffs, is in no way limited to the loss of revenue for the water utility. The additional effects are much more severe, for example

- excessive consumption  
(A user who doesn't pay will not save water, this eventually leads to water shortage, usually hitting the poor and sub-urban population)
- illegal water trafficking  
(In many cases it was found that illegal water trafficking is more likely in supply areas where administrative losses are not dealt with. If the water utility does not fight for proper payment through the water customers, someone else will step in - leading to structures often described as a "local water mafia".)
- unwillingness to pay/charge  
(Where there is little revenue, there is little incentive for decision makers and managers to adopt appropriate water tariffs, and the search for appropriate billing and collection systems is hampered.)
- Finally, administrative water losses above a certain level will lead to financial destabilisation

of the water utilities and preclude the development of sustainable water services.

This may result in what can be described as a "vicious circle in water and sanitation" (see Figure 6).

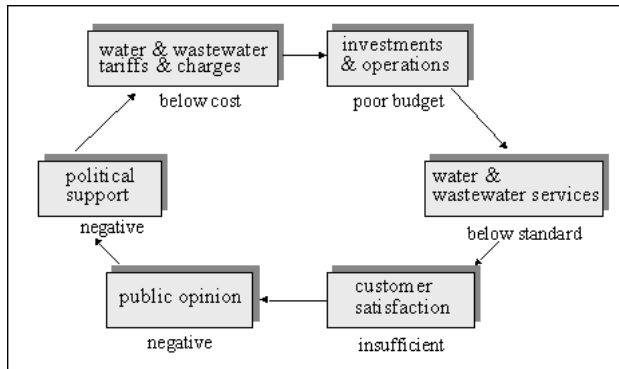


Figure 6: The Vicious Circle in Water and Sanitation

In many developing and transformation countries, water tariffs are below costs. The utilities are forced to work with insufficient budgets. But, with an insufficient budget, investments and operations are below needs, leading to poor water services, low customer satisfaction and a negative public image. In this situation, political support ("willingness to charge") for the introduction of cost-covering water tariffs is less likely. This vicious circle could be broken if all the water produced reached the paying customer.

In other words: A proper water loss reduction programme is an essential pre-condition for achieving sustainable water services.

## PUBLIC RELATIONS AND WATER LOSS REDUCTION

There are several reasons why water loss reduction-programmes are not attractive for public relations and decision makers who depend on public votes:

- Water loss reduction activities are either

invisible to the public, or disturbing.

- Today's politicians will be made responsible for the expense and inconvenience of a water loss reduction programme, whereas the benefits are for the future.
- No good "package solutions" for easy handling by the client are yet on the market (apart from some very new IT, GIS-based service products).
- Lobbying powers are focused rather on big investment (e.g. desalination, dams), than on water loss reduction programmes as a business target.

75 % of total expenditure is usually for distribution, and only 25 % for the production of water. Operations and maintenance, especially water loss reduction programmes, are often neglected when preparing budgets. Water loss reduction programmes usually receive only 10 % to 30 % of the calculated needs in budget expenditures (estimated average).

The question is, how can water loss reduction programmes be promoted better. Probably the following activities are necessary:

- Raise awareness, education, training;
- Eradicate intransparencies and populism;
- Promote the financial benefits of water loss reduction;
- Create reliable "package solutions";
- Enable local business.

The last issue is of outstanding importance. Franchise might be one option to change the acceptability. Of course, until now, only experienced, international players have been able to deliver an overall, reliable success-oriented package for water loss reduction in urban networks. Instead of hiring such large international companies (which are not always favoured by local decision-makers), it might seem better to hire local and smaller businesses, enabled through franchise contracts with the

professional international players. This approach is different from the conventional scheme, i.e. to choose the international player, who then sub-contracts local SMEs under whatever conditions and for whatever duration.

## **ACKNOWLEDGEMENTS**

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The author would like to thank these institutions for supporting the work on the important issue of water loss reduction.



# Waternet

## Presentation World Waternet

### WATER OPERATORS NETWORKING IN AFRICA

The City of Amsterdam has a public water operator, called Waternet. Waternet is a total water cycle water operator, responsible for the supply of drinking water, sewerage, waste water treatment, ground water and surface water management.

World Waternet is the working arm of this public utility for sharing the Waternet expertise on integrated water management in the world. This exchange of know-how and experience with other water operators takes place in partnerships on a solidarity basis. Amsterdam World Waternet has a long history and tradition of international cooperation. These cooperations are based on our principles on water.

Our principles on water are:

- Water is the first principle of life
- Access to drinking water and sanitation is a human right!!
- Water is related to thirst, hunger, poverty, health, social and economical growth and climate
- Water problems are integral problems, needing

an integral vision and integral solutions

Safe water is the carrier of all other Millennium Development Goals

- Safe water for the poor is just a matter of Good Governance
- Water is a source of conflict
- Working on water is working on fighting poverty and working on peace

As mentioned before, World Waternet maintains several Water Operators Partnerships (WOPs) in Suriname, Netherlands Antilles, Egypt, Morocco, Turkey and Indonesia.

Our principles on WOPs are:

- Exchange of knowledge based on solidarity
- Focus on capacity building
- Working together on water at operational, organisational, financial, legal, institutional and political level
- A longstanding process versus a short term project
- Slow wins versus quick wins
- Impact versus output
- Also the supporting partner will benefit (more attractive jobs and creating more responsible

global citizens)

In 2010 World Waternet has implemented some new developments:

- The integrated approach to the total water cycle will be expanded with solid waste
- management and concepts of waste to energy.
- The global focus of World Waternet will be expanded with water operators on the African continent. The major challenges to achieving MDGs are faced on this continent.

In this context World Waternet has implemented a cooperation agreement with the Amsterdam Waste to Energy utility. Cooperation agreements with Egypt and Morocco have been signed on assisting neighbouring water operators on the African continent. The plan is to achieve the same with South Africa. World Waternet is acting as a coaching partner in this concept.

In this respect World Waternet is working on establishing partners in the north in order to participate in this triangle concept of capacity building of water operators on the African continent. Several water operators in the Netherlands have joined this effort. In the south, World Waternet is aiming at partnerships with ACWUA, AfWA, WOP-Africa etc. to be involved in this approach of North-North-South-South partnerships.

We know that public water operators in the north are restricted by law and regulations in sharing know-how with colleagues in developing countries.

That is why World Waternet is addressing politicians all over the world.

## POLITICIANS:

Stimulate public water utilities to maintain WOPs by creating political, legal and financial support!

After all:

The world would be a much better place for the poor if all public water utilities in the north maintained a long lasting partnership with colleagues in the south!

## General conclusions and recommendations





# General conclusions and recommendations

*“A holistic approach is essential for the success of Water Loss Reduction, and needs to be promoted and encouraged within water utilities”*

## TECHNICAL AND TECHNOLOGICAL ASPECTS:

1. A holistic approach is essential for the success of Water Loss Reduction, and needs to be promoted and encouraged within water utilities.
2. Short-term (technical level) operations and long-term strategies (design, planning and political decisions) should be complementary and coordinated.
3. Financial viability depends on revenues, revenues depend on metering efficiency (installation of high accuracy water meters and minimization of metering process inaccuracies due to human error).
4. GIS is a useful tool to store and manage data and information at all levels, from the technical infrastructure to the customer.
5. Consumption peaks of major users should be reduced – pressure management is a must to cut down losses.
7. Economic/financing tools are necessary in the early stages of WLR projects to define optimum levels of water consumption.
8. WLR technologies and financial tools are useful, but should be embedded in institutional developments and capacity building.
9. Water loss causes more damage than the value of the water being lost.
10. Competition between technical solutions and investments (water loss reduction vs. desalination) is increasing; cost/benefit analysis is necessary to find the optimum solution.

## ADMINISTRATIVE AND REGULATORY ASPECTS:

## FINANCIAL AND ECONOMIC ASPECTS:

11. IWA standards for water loss reduction are useful and should be adapted to the context of the Arab world, where there is often a lack of meters and data is of poor quality and unreliable. An Arab language version of the standards would be useful.
12. Regulators in the Arab world are still weak and should be promoted in non-revenue water (in other countries in Africa they play a major role).
13. Consistent administrative management requires proper customer surveys and a large

amount of data.

14. In the Arab region illegal connections are still an important issue.
15. More focus is needed on those water connections that are most cost-benefit relevant from the consumption point of view.
16. Setting up call centers and involving micro-companies are an efficient way to ensure speedy notification/identification and fast repair of leaks.
17. Skilled labour and well-trained technical staff are a must.

## THE WAY FORWARD

1. The outcomes of this conference should find their way to decision-makers and politicians, who need to know more about the potential benefits associated with a reduction of water losses.  
Key tools: Proceedings – International fora – Policy briefs – Training for policy-makers
2. Increasing efforts should be made to develop capacities within water utilities at different levels (technical, administrative, institutional management).  
Key tools: Training courses – Staff exchange programmes – Incentive programmes
3. Awareness-raising campaigns on non-revenue water and water loss reduction are needed for the different target groups (general public, children, middle management, policy-makers).  
Key tools: Information packages – Appropriate language – Dissemination channels

## Annexes







# Programme

## 20 JANUARY 2010

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### 10:00 Opening and Welcome

Chairperson: Ms. Eng. Nadia Abdou, President of ACWUA

#### **Welcome by the Country Host**

H.E Secretary of Energy, Mining, Water & Environment, SEEE, Morocco

#### **Welcome by ACWUA**

Nadia Abdou, President of ACWUA & CEO of Alexandria Water Company, Alexandria, Egypt

Khaldon Khashman, Secretary General, Arab Countries Water Utilities Association, Amman, Jordan

#### **Welcome by the Organization Host**

Ali Fassi Fihri CEO, ONEP-Office National de l'Eau Potable, Morocco

Samir Bensaïd, CEO, IEA-ONEP, International Institute for Water & Sanitation; Morocco

#### **Welcome by United Nations**

Dr. José Luis Martin Bordes, Programme Officer / UNW-DPC, United Nations University, Bonn, Germany

Dr. Faraj El-Awar, Programme Manager, Global Water Operators Partnerships Alliance, UN-Habitat, Kenya

#### **Address by World Water Council**

Mr. Loic Fauchon, President of WWC

#### **NRW Management, State-Of-The-Art**

Mr. Paul Reiter, Executive Director of IWA, International Water Association

### 11:30 Tea/Coffee Break & Posters Visit

### 12h30 Group Photo, followed by Lunch Snack

#### Room 1

#### 14:00 Management of NRW Case Studies

Chairperson : Mr. Ameer Chakouk, Head of  
The Industrial Pole, ONEP, Rabat, Morocco

*Management of UFW in Egypt: Sharkia Potable  
Water & Sanitation company -case study-*

Salah Bayoumi, Chairman of SHAPWASCO  
and Manager of SHAPWASCO Project for  
UFW and SOP, Egypt

*Algeria's Experiences for NRW Strategy and  
Management*

Sid Ali,Souk Ahars, Algeria

*Experiences of the City of Nablus/Palestine in  
NRW*

#### Room 2

#### 14:00 Monitoring and Financial Strategies

Chairperson: Mohammad A. Ramahi, Director,  
Abu Dhabi Co., Chairperson ACWUA WG  
Benchmarking

*Application of a Financial Model for  
Determining Optimal NRW Management in  
Developing Countries*

Alan S. Wyatt, MS. Senior WS Specialist,  
RTI International

*Development of a Water Balance Distribution  
Network in North Lebanon*

Katia Fakhry, Lebanon

*Principals for the Management of NRW in*

Eng. Farouq Masri, Manager Nablus Water Supply & Sanitation Department, West Bank, Palestine

*Water Loss Reduction Pilot Project, Aleppo, Syria*

Moustafa Abdul Wahab, Leader of Water Loss Reduction Unit Aleppo, Syria

*Experiences for Loss Reduction in Morocco*

Mr. François Coulange, SEM-Rabat

*Water Loss Reduction in CAIRO - Ain Shams case study*

Eng. Hamdy Mohammed Shata, Technical G. M., GCWC, Egypt

*Relation to Commercial Aspect*

Driss Bahaj, A. Harriz ,ONEP, Morocco

*Economic Aspects of Drinking Water Loss Reduction within Integrated Urban Water Management*

Prof. Dr K.U. Rudolph, Coordinator of UNW-DPC WG on CD for Water Efficiency

*Leak Detection & Reducing Losses in Alexandria Water Company*

Eng. Faten EL Kholy, General Manager for Technical Support Administration. Alexandria Water Company. Egypt

20h00 Dinner Gala offered by ONEP

## 21 JANUARY 2010

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### Room 1

#### 9:00 Rehabilitation Methods

Chairperson: Mr. Khalifa E. Al Mansoor, Asst. Undersecretary Sanitary Engineering, Ministry of Works & Housing, Manama, Kingdom of Bahrain

*NRW Reduction Potential in Saida, Libanon*

Ahmed Nizam, General Manager of South Lebanon Water Establishment, Lebanon

*NRW Plans in Practice: Development, Implementation and Follow up*

Ison Simbeye, Ian Nzali Banda, Thomas Petermann, Chingola, Zambia

*Comprehensive, Performance-based NRW Approaches – From Theory to Real Reduction*

Udo Kachel, Dorsch Consul, Amman, Jordan

### Room 2

#### 9:00 Customer Relations Management

Chairperson: Jamal Krayem, Director General, Etablissement des Eaux du Liban Nord, Tripoli, Lebanon

*Customer Management is the Key for Controlling the Administrative NRW*

Eng. Arwa HUMADI, CSS Project Manager LWSC-Aden

*Al Ain Distribution Co. NRW Reduction Strategies*

Mohammed Obaid, O&M Manager of Water Networks Al Ain, United Arab Emirates

*Implementing a High-accuracy Water Meter Strategy to Reduce Client-Side Leakages*

Panagiotis Georgiadis, Technical Consultant, Oxide Ltd, Paiania, Greece

10h45 Tea/Coffee Break

## Room 1

## 11:15 Pressure Management Strategies

Chairperson: Mr. Ibrahim Safi, General Manager of Jerusalem Water Undertaking, Jerusalem, Palestine

*Water Loss Reduction through Intelligent Pressure Management (IPM)- guidelines & Implementation*

Dr. Dörte Ziegler, GTZ, Eschborn, Germany  
Lutz Happich Director PMI/VAG, Mannheim, Germany, Mr. Baader, Project Eng., VAG, Mannheim, Germany

*Management Software (DCMMS) for Physical NRW Reduction*

Eng. Abdul Raqeeb Al Sharmani, Tech. Manager, Yemen

*Maintenance of Water Mains with Amsterdam Water Supply for Non-systematic Control of Loss due to Leakage*

Kees van der Drift, Manager R&D Water Distribution Amsterdam Water Supply

## Room 2

## 11:15 Tools and Strategies for Capacity Development

Chairperson: Eng. Mousa Jama`ani, Secretary General, Jordan Valley Authority, Amman, Jordan, Chairperson Working Group Management of Utilities

*Tools and Strategies for Capacity Development*

Hocine Zaier, Algérienne des Eaux - ADE - Algeria

*Effect of Social Factors and Attitudes on Non Revenue Water Conservation Experienced by Jordan Women*

Eng. Lina Ahmad Hiyari, Jordan Valley Authority, Amman

*NRW Management, Capacity Building Approach*

Eng. Mostafa BIAD, DAE, ONEP, Morocco

## 12h30 Lunch Snack &amp; Posters Visit

## Room 1

## 14:00 Performance Based Contracts for NRW Reduction

Chairperson: Tom Williams, IWA

*Introduction to Performance Based Contracts for NRW Reduction*

Jan G Janssens, WEDIS Consulting  
*Opportunities and Support for PBSs and NRW Reduction*

Patrick Mullen, International Finance Cooperation

*Using local Private Sector to reduce NRW by improving billing and collection – the Case of the Micro-PSP in Madaba, Jordan*

Dieter Rothenberger, Programme Manager, German Technical Cooperation, Amman, Jordan

## Room 2

## 14:00 Peer Support through Water Operators' Partnerships (WOPs): a Tool for Improving WSS

Chairperson: Dr. Faraj El-Awar, GWOPA, UN-Habitat, Nairobi

*Part 1: General Introduction to WOPs and the Global WOPs Alliance*

Dr. Faraj El-Awar, GWOPA, UN-Habitat  
*Public-Public Partnership between ONEP (Morocco) & SNDE (Mauritania)*

Samir Bensaïd, CEO International Institute for Water & Sanitation, IEA-ONEP, Morocco  
*Water Operators Networking in Africa*

Gerard Rundberg, Director of World Waternet, Amsterdam, The Netherlands

*Part 2: Match Making Meeting for ACWUA Utilities*  
Facilitated by the Global WOPs Alliance

## 16:00 Resume, Closing

Chairperson: Eng. Samir Bensaid, CEO, IEA-ONEP

*"Lessons Learned from World-Wide Experiences on Water Loss Reduction"*

Dr José Luis Martin-Bordes, Programme Officer, UNW-DPC, Bonn, Germany

Closing remarks by

- Ms Eng. Nadia Abdou, President of ACWUA
- Khaldon Khashman, Secretary General, Arab Countries Water Utilities Association,
- Mr Samir Bensaid, CEO, IEA-ONEP, International Institute for Water & Sanitation
- Dr Faraj El-Awar, Programme Manager, Global Water Operators Partnerships Alliance, UN-HABITAT
- Dr José Luis Martin Bordes, Programme Officer, UNW-DPC

## **22 JANUARY 2010**

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9:00-12:00

*ACWUA Board of Directors Meeting*

Moderator: Khaldon Khashman, SG of ACWUA

13:00-17:00

*Working Group for Capacity Development & Training*

Moderator: Eng. Samir Bensaid, CEO IEA-ONEP

*Working Group for Utilities Management*

Moderator: Eng. Mousa Jama`ani

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# Photo gallery

















The UN-Water Decade Programme on Capacity Development (UNW-DPC) is a joint programme of UN agencies and programmes cooperating within the framework of UN-Water and hosted by the United Nations University.

## Adding Value in Water-Related Capacity Development

The broad mission of the UN-Water Decade Programme on Capacity Development (UNW-DPC) is to enhance the coherence and integrated effectiveness of the capacity development activities of the more than two dozen UN organizations and programmes already cooperating within the interagency mechanism known as UN-Water and thereby support them in their efforts to achieve the Millennium Development Goals (MDGs) related to water and sanitation.



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