Water use efficiency and economic approach

National study Malta

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Final version

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UNEP/MAP Regional Activity Centre

Sophia Antipolis
July 2011

CONTENTS

Overview

The Maltese Islands are densely populated but poorly endowed with freshwater resources. Since the 1980's, the drinking water supply has been heavily dependent on saltwater desalination. The population and the tourism sectors are served with good quality drinking water, but certain trends give rise of concern: groundwater depletion in terms of both quantity and quality; and a growing dependence on oil imports for water for desalination.

Sustainable water resources are vital to Malta's long-term prosperity. Water is necessary for drinking and it supports everyday life at work, at home and at leisure. Water is essential to agricultural and to the health of the natural environment that supports all human activities. Every sector of the economy depends on a secure and sustainable access to water. Despite the very limited resources of the islands and the importance of water to a healthy future, water has not to date been valued as the precious resource that it is. There are no easy solutions to Malta's water shortage, yet the nation requires water security for the future.

The European Union Water Framework Directive (WFD) adopted in 2000 has led to new challenges and requirements for Malta in terms of the management of water resources. Indeed, the WFD asks for new assessments in terms of pressures and impacts in water bodies and on the economic importance of water uses. The Directive also requires the establishment of new monitoring networks in order to monitor for trends in water quality and makes information, consultation and participation of the public and stakeholders an essential part of the river basin management process.

More specifically, the WFD requires the development of a programme of measures for achieving its environmental objectives. This programme of measures which needs to be proposed for public consultation by the end of 2008; should be viewed as forming part of a holistic water resources management programme aimed at:

- increasing the management of natural renewable water resources (groundwater and rainwater runoff);
- protecting and restoring the quality of these waters;
- facilitating the development of alternative sources of water such as the safe re-sue of treated sewage effluent;
- improving the regulatory framework in the water sector in order to ensure more efficient operations in the sector; and
- improving the awareness of the public through targeted communication and information campaigns.

This document presents an overview of the main challenges for Malta to ensure an efficient use of available water resources.

I. The priority actions to be introduced in the country in order to improve the collection of basic data and the production of the efficiency index's various components, accompanied by a cost evaluation for such actions.

1. Introduction

The supply of water in the Maltese islands can be broadly divided into two main categories; namely those involving:

- the water supplied through the public distribution network by the Water Services Corporation (WSC) – which is a public utility body responsible for the supply, production and distribution of water in the Maltese islands; and
- the numerous self-supply points in the agricultural, industrial and commercial/tourism sectors mainly comprising private boreholes and to a limited extent desalination stations.

Current estimates show that on a national scale private supply is of the same order of the municipal supply. In fact, data published by the FAO (2006) estimates the total national water demand at 58.6hm^3; 24.5hm^3 (42%) of which were indicated as being met through private sources.

2. Municipal Sector

The WSC manages the municipal water distribution network. This network consists of about 2,000km of pipework of varying materials and sizes and a further 1,700km of service pipework connecting more than 200,000 premises to the network. The water supplied to each consumer is regularly monitored through water meters installed at each and every site. Moreover, water flow through the distribution network is also monitored through a series of flow meters installed at strategic positions in the network – this being one of the active measures utilised for the assessment of network leakage.

Extensive effort and investment have along the years been devoted to leakage control, improved management practices and water conservation programmes. Central to this programme was the setting up of an active leakage monitoring network within the WSC to identify and eventually replace leaking sections of the network. In more recent years, attention has also shifted to the management of apparent losses. In fact, by 2001 the WSC had finalised a programme aimed at changing the older Class C meters with more reliable Class D meters. This, after tests undertaken by the Corporation in 1996 had shown that consumption measured through Class C meters was an average of 18% less than that measured through Class D meters.

Further research on increasing the accuracy of water meter registration is currently being undertaken by the same Corporation, with the aim of identifying the best meter design to limit under-registration.

Moreover, one should note that Malta operates a rising-block water-tariff system, where successive blocks of water are sold at a higher price – this with the aim of using this financial instrument as a further means of limiting water wastage. Citing the domestic sector as an example; the first 11m^3 of water are charged at a tariff of Eur0.384 per cubic metre consumed, whilst any consumption over and above this threshold is charged at the full price of Eur2.562.(volumes quoted are per billing cycle). More favourable tariffs are charged to vulnerable consumers such as persons receiving social assistance and pensioners.

Further details on the tariff system can be obtained from: http://www.mra.org.mt/water_tariffs.shtml

Real data enabling the calculation of the 'Drinking Water Efficiency' index is therefore being collected; and the main national aim is to increase the reliability of this data though the identification and eventual installation of more accurate flow measuring devices.

3. Private Sector

Private supply of water mainly consists of self-supply by groundwater abstracting boreholes, supplemented by private RO-plants in the tourism sector and the collection of rainwater runoff in cisterns and small reservoirs. Groundwater abstraction is by far the most important source in this area, and FAO (2006) estimated the role of groundwater at around 80% of the total private supply.

Whilst limited data exists for the water producing capacity by desalination in the private sector, it should be stressed that no real data about the water abstracted/collected by the private sector exists with the only data available being the estimates presented in the Water Resources Review, published by the FAO in 2006. These since almost none of the private boreholes are metered.

A new borehole notification process is currently (October 2008) underway with the aim of updating the national register of abstraction sources. This process was enables through the publication of two new pieces of legislation requiring the notification of all private sources and the introduction of the need for a drilling permit for the driving of new sources. Further details on this legislation can be obtained from:

http://www.doi.gov.mt/EN/legalnotices/2008/10/LN%20254.pdf

http://www.mra.org.mt/Downloads/Legislations/LN2008_255.pdf

One should note however, that one of the principal advantages of this situation, wherein water sources are located at the point of use, is that it limits the losses which would have been incurred with the supply of this water through a national distribution network. It is however noted that such a system needs to be better regulated with water meters installed at least in the 'significant' abstraction points; and this in order to better determine the abstracted volume. Financial incentives and disincentives could then be introduced to encourage the efficient use of the abstracted water.

The fact that water availability has always been a constraining factor has helped in the development of a water efficient mentality in the sectors most dependent on this resource. This applies particularly to the agricultural sector, where increased use of water efficient irrigation methods has been registered, and this without the support of specific campaigns in support of such actions. In fact, the Census of Agriculture published by the National Statistics Office (NSO) back in 2001, denotes that in around 85% of the agricultural land classified as being 'irrigated' use was being made of efficient irrigation systems such as drip irrigation technology.

Land-use data including data on the irrigation typologies in place are collected through the 'Census of Agriculture', which is compiled by the NSO very year.

4. Water Recycling

Malta has adopted a centralised approach with respect to waste-water management with wastewater being treated in three wastewater treatment plants constructed at the main outfalls. Recycling in industrial and commercial concerns is also constrained by the small size of Maltese industries; potentially making the initial investment costs still prohibitive. In fact, private wastewater recycling facilities are still limited to a small number of major concerns in the industrial and tourism sector. The availability of data on this factor is also quite limited.

Use by industry of recycled water produced in the centralised plants is also quite low; mainly due to the absence of a dedicated distribution system. In fact, currently only the industry in the Bulebel region meets part of its water needs from the TSE produced at the Sant'Antnin sewage treatment plant. The annual volume of treated effluent supplied is relatively stable and amounts to an annual volume of around 500,000m^3.

However, where locally introduced water recycling has made a significant impact on the industrial concern's municipal water demand. One can quote two main examples:

- an IT-based industry which reduced its consumption from the municipal network from 183,000m^3 to 48,000m^3 through the installation of a rainwater capture and recycling system; a remarkable reduction of 73%; and
- the installation of a 380m^3/day wastewater treatment plant in one of the major hotels on the island yielded a larger volume of recycled water than was required for landscaping and other secondary uses in the hotel; and the excess water was thus made available to the agricultural sector.

Therefore, whilst from a national perspective, all industrial effluents are planned to be treated; the location of the treatment plants at the point of discharge does not facilitate the actual re-use of these effluents. On the other hand, the collation of further data on the existence and treatment capacity of private treatment facilities in industry is recommended; initially possibly through the inclusion of specific questions in industry related NSO questionnaires.

II. The national efficiency improvement objectives (sectoral and total) with deadlines for achieving them

1. National Context

The principal targets to be achieved in the National Context are set by Article 4 of the Water Framework Directive, which sets as its primary objective the achievement of good quantitative and qualitative water status.

Annual groundwater abstraction is currently estimated at 32hm^3. Water balance data indicate that the sea-level aquifers are being abstracted by around 5hm^3 and the perched aquifers by around 2hm^3. Thus the potentially abstractable volume from all the groundwater bodies in the Maltese islands is about 25hm^3. Any abstraction above this figure will lead to over-abstraction with the consequential degradation in the quantitative and qualitative status of the water bodies. Moreover, the re-establishment of the sea-level aquifers is estimated to require a further 10-per cent cut-back in groundwater abstraction from these aquifer systems, thereby reducing the annual recommended abstraction volume to 23hm^3. This situation calls for the implementation of a number of water demand management measures, the implementation of which would in part address the achievement of this target.

A significant reduction in water demand would also be expected to create the need for less production of desalinated water. Given that RO production amounts to around 8% of the national energy demand, such measures could therefore also have indirect benefits in terms of managing the national greenhouse gas emission quotas.

2. Municipal Sector

2.1. Reduction of Leakages in the Municipal Distribution System

The control of water losses in the national water distribution system plays a vital role in the operations of the WSC, particularly as these represent a substantial loss of revenue in real terms. Leakage control (comprising active leakage localization, leakage repair, and pressure control and network infrastructure management) is considered to be a major contributor towards a reduced national system demand.

It has been estimated that leakages have been reduced over the whole distribution system from 2,692m^3/hr in 1995 to about 650m^3/hr in 2007. The unavoidable annual loss of the distribution system is estimated to be 300m^3/hr, and the WSC plans to reach this target by 2010.

2.2. Re-use of Treated Sewage Effluent

The current year (2008) saw the commissioning of two new wastewater treatment plants increasing the existing treatment capacity by 12,700m^3/day. The national implantation plan for the Urban Waste Water Directive requires the construction of a further treatment plant in the south-eastern region of the island of Malta which will have a capacity to treat up to 58,000m^3/day. The process for the construction of this treatment plant has already started. Thus, it is estimated that the total amount of TSE potentially available for re-use will be in the region of 13-14hm^3 per year.

The actual possibilities for re-use are however constrained due to two main factors:

- the salinity of the effluent; and
- the absence of a dedicated distribution system.

In fact, the actual volume of waste water which has been re-used during 2007 (WSC, 2007) amounted to around 750,000m^3; principally produced from the Sant'Antin WWTP.

It is noted that no deadlines have been set with regards to the increase in the share of waste-water re-use.

3. Private Sector

The Programme of Measures for the Maltese River Basin District will eventually include a number of water demand management and efficiency measures aimed at managing the demand in the private sector. As required in the Water Framework Directive (WFD), this programme of measures needs to be launched in 2009 and made operational, at the latest by 2012. This process is still being finalised; and therefore no specific targets have been set.

In Malta, a number of measures are currently being considered targeting the municipal, industrial and agricultural sectors.

3.1. Domestic Sector

The water demand of the domestic sector in Malta is already quite low, with current figures indicating an average demand of around 140litres/cap/day (exclusively for domestic purposes). It should also be noted that when losses and unaccounted form water are taken into account this figure falls to 76litres/cap/day.

However, the analysis undertaken for the identification of potential measures for this sector indicated that there is still scope for further reducing this demand. The main identified actions relate to:

- increasing the efficiency of water use in the home through the installation of water efficient devices (such as aerators, plastic replacement volumes for flushings, …..) and appliances (double button flushings, adjustable shower roses …..)
- increasing the storage and production of water from other sources through incentives aimed at encouraging the construction of rainwater harvesting cisterns and the introduction of grey water recycling facilities in households.

3.2. Commercial and Industrial Sectors

The main measures being considered for implementation in the commercial and industrial sectors relate to incentives aimed at facilitating the introduction of water recycling facilities in these concerns. Given the size of industry in Malta, possibilities for the construction of decentralised treatment plants in the main industrial areas should also be considered.

3.3. Agricultural Sector

Whilst there is still scope for increasing water-use efficiency in this sector; it should be noted that given the high percentage of land already under improved irrigation techniques the margin for improvement is quite low. Efforts however should be made to ensure that the best use is being made of these new techniques; and that the expected reduction in water demand is being achieved. This is mainly possible through the provision of technical help to farmers at the field level.

On the other hand, the major aim of the agricultural sector should be the replacement of part of the demand on groundwater with other sources - mainly through the increased collection of rainwater harvesting reservoirs and the increased use of recycled water from the municipal plants.

Further to this, the alignment of national agricultural and water policies is highly recommended; such that these two policies will have the common aim of managing the sector's water demand; whilst ensuring the financial feasibility of the sector. Moreover, research by the agricultural sector aimed at testing the effects on yield of new irrigation techniques such as 'deficit irrigation' should be encouraged with the aim of eventually introducing these techniques as a further tool in the management of the sector's water demand.

III. Polices and measures adopted, projects implemented (or to be implemented) towards improving sectoral efficiency, with the estimated cost of the various actions and projects

1. Measures implemented

1.1. Leakage reduction in the Municipal Distribution Network

Over the past years, the WSC has embarked on a significant programme aimed at reducing distribution leakages to an ILI (Infrastructure Leakage Index) of 1.5 by 2010. The implementation of these measures has seen the national municipal water demand fall from the high annual figure of 53million m^3 registered in 1994 to a low 30million m^3 registered in 2008; and this in spite of the increased demand generated by an increasing population and generally higher economic activity.

It is estimated that leak repairs cost the WSC around Eur 250,000 annually. In 2004, these repairs resulted in a saving of 1.185million m^3 of water. If these are costed at Eur 1.28 per unit, then the total savings made by the WSC would amount to Eur2.8 million.

1.2. Construction of new waste-water treatment plants

Three new wastewater treatment plants have been planned in order to treat all the municipal sewage in the Maltese islands, thereby fulfilling the obligations of the EU Urban Waste Water Directive. These plans envisage that the effluent will be treated up to secondary stage, prior to discharge to the sea. The location of the three plants was primarily determined by the layout of the national (gravity) sewage network.

The current plans for future sewage and wastewater treatment envisage a centralized approach; with one new treatment plant planned for the southern region of Malta. The construction phase of this plant is due to start later this year and when finalized will have a capacity to treat up to 58,000m^3 of effluent per day (based on 2020 projections and assuming the decommissioning of the Sant' Antnin plant). It is likely that this waste water treatment plant will not be sufficiently advanced so as to produce effluent that could be re-used for agricultural purposes and/or artificial recharge of groundwater, in aquifer zones which are utilized for the abstraction of groundwater for potable purposes. Other treatment plants have been constructed at Ic-Cumnija in the norther part of the island (max. design production: 6,700m^3 per day) and Ras il-Hobz, Gozo (max. design production: 6000m^3 per day). These two relatively small plants are intended to produce water mainly for agricultural use; once problems related to the salinity and the distribution of the effluent have been solved.

To this end, one must note that the WSC has concurrently initiated a process aimed at permitting all discharges to the sewers, manly with the aim of reducing the discharge of brines. This process envisages a wide investigation of the salinity profile in the sewage network with the aim of identifying and addressing the main influx points of salinity. Once concluded this process should result in a significant reduction in the salinity of the effluent; making it usable for irrigation.

2. Planned Measures

As part of the implementation process of the WFD, Malta is currently preparing a Programme of Measures for the purpose of achieving 'Good Groundwater Status'. It is planned that this programme of measures will be launched with the River Basin Management Plan in 2009.

Given that the achievement of Good Quantitative Status is an issue in Malta; a number of proposals have been developed to reduce groundwater abstraction both through Demand Management and Supply Augmentation oriented measures. Currently, these measures are being presented and discussed as part of the public consultation process envisaged in the same Directive.

In as much, what follows is an outline description of some of the measures proposed for inclusion in the national Programme of Measures; and therefore since these measures are not finalized; no deadlines can be presented.

2.1. Distribution of water saving devices in households

This measure consists in distributing to each household a set of domestic water saving devices on the basis of a preliminary communication/information campaign, and demonstration pilot projects in public buildings. These water saving devices are designed to be fitted on existing appliances. They include aerators, discharge limitation devices and pressure reducers (for taps and showers) and equipment for flushing (plastic volumes to be added in the toilet reservoirs).

The water saving potential of this measure is estimated at 6m^3 per household (15% of water used in taps, showers and toilet flushes). Assuming a rate of adoption of 50% (85,000 residences), the potential annual effect of the measure amounts to around 500,000m^3.

The total cost of this measure is estimated to amount to Eur 485,000. It is noted that this estimate excludes costs related to the public information campaign; which is envisaged as a horizontal issue across all proposed measures.

2.2. Establishment of a tax-rebate for the installation of water saving devices in households

This measure consists in providing a tax-rebate for the purchase of low water consumption household fittings such as adjustable taps and shower rose, double button flushes etc. Households will progressively adopt this measure as they replace their equipment.

The water saving potential of this measure is estimated at 19.2m^3 per household per year (40% of the water used for toilet flushing, showers and washing machines). Assuming a maximum 25% implementation rate; the potential saving effect of this measure amounts to around 225,000m^3/year.

The total cost of this measure will depend on the level of rebate agreed with stakeholders.

2.3. Development of decentralised waste water re-use in industrial areas

This measure suggests the construction of treatment and reuse facilities in industrial areas; so as to have the treated waste water available at the point of use. Such a measure needs the use of Best Available Technologies in each relevant industry in order to reduce the flux of pollutant and segregation of very concentrated solutions, which have to be considered as waste and sent to an appropriate destination.

Inevitably, the adoption of such a measure will depend on the industry typologies at each industrial estate and the possibilities for inclusion of treated water in the respective production process.

2.4. Construction of new run-off storage facilities in the agricultural sector

This measure envisages that incentives are given to farmers to construct new reservoirs. Runoff storage is recommended as an alternative source of water; and therefore this measure will help to develop a procedure to ensure that groundwater abstraction is actually reduced. Applicants should prove that they have the necessary catchment area to collect runoff and the required ancillary connections to convey the run-off to the reservoir.

The potential effect of this measure; assuming an adoption rate of 10% of all farmers having a registered private well (irrigators) will amount to an annual volume of 250,000m^3.

The investment costs required for the construction of a reservoir will vary depending on the land-setting where the reservoir will be sited. Currently, estimated costs are still being set with the Agriculture Department.

IV. The performance indicators used to assess the effectiveness of these actions (volume of water saved, for example)

1. Performance indicators for measures being implemented

1.1. Leakage reduction programme

Table 1 – Leakage reduction

Performance Indicator	Unit	Value during 2007
Total Water Production	m^3	30,310,745
Groundwater Production	m^3	13,417,160
Total Sea-water Desalination	m^3	16,974,914
Infrastructure Leakage Index		2.74
Total Leakage	litres/property/day	2.61
Total Leakage	m^3/km/day	4.56

Source: Sapiano, 2008

1.2. Construction of Treatment Plants

Table 2 – Production of non-conventional water resources

Performance Indicator	Unit	Value during 2007
Treated sewage for year	m^3	13,000,000
Re-used effluent for year	m^3	726,326

Source: Sapiano, 2008

2. Performance indicators for the measures proposed for inclusion in the River Basin Management Plan

2.1. Distribution of water saving devices in households

Table 3 – Distribution of water saving devices

Performance Indicator	Unit
Number of 'kits' distributed	
Rate of adoption	%

Source: Sapiano, 2008

2.2. Establishment of a tax-rebate for the installation of water saving devices in households

Table 4 – Number of appliances changes

Performance Indicator	Unit
Number of appliances changes (rebate applications)	
Rate of adoption	%

Source: Sapiano, 2008

2.3. Development of decentralised waste water re-use in industrial areas

Table 5 – Wastewater produced & reused in industrial sector

Performance Indicator	Unit
Number of installations developed	
Volume of effluent treated	m^3
Volume of effluent re-used	m^3

Source: Sapiano, 2008

2.4. Construction of new run-off storage facilities in the agricultural sector

Table 6 – New run-off storage facilities

Performance Indicator	Unit
Number of reservoirs constructed	
Increase in storage volume	m^3

Source: Sapiano, 2008

V. Potential financial savings to be made through the implementation of water demand management measures

Table 7 - Case Study: Distribution of water saving devices in houses

Measure Code	QUAN_1	Full name of measure	Distribution of water saving devices in houses
Type of measure	Supplementary	WFD measure Type (see WFD Annex VI)	Water demand management
Sector(s) concerned	Households	Geographic focus/area	Malta and Gozo
Description of the measure	The measure consists in distributing to each household a set of domestic water saving devices in houses, on the basis of a preliminary communication / information campaigns, and demonstration pilot projects in public buildings. Those water saving devices are designed to be fitted on existing appliances. They include aerators, discharge limitation devices and pressure reductors (for taps and shower) + equipment for flushes (plastic volumes to be added in the toilet reservoirs)[1]. The measure will be implemented in two steps : Step 1: Pilot projects ex: Water savings in government housing estates and building (one per local council) Step 2: Communication / information campaign with distribution of water saving devices		
Target population for the measure	Description of individual units targeted by the measure		All Malta residences (188.360). Given that many households spend part of the year in their secondary residences, the devices will be distributed per residence. Whilst the cost of distributing devices should be based on the number of residence, the effectiveness should be based on the number of households
	Criteria relevant to the identification of the total number of units/total population that can be targeted by the measure		
	Sources of data for quantification of the total number of units/total population		NSO data on residences
Implementation	Current rate of implementation of the measure		Minimal number
	Expected rate of implementation of the measure by 2015 (baseline)		Adoption rate is supposed to increase by 5% by 2015 (9418 residences)
	Expected adoption rate with the measure		The devices will be distributed in all residences. It is expected that only 50% of the beneficiaries will actually install them. With the measure, the rate of adoption will reach 50% (additional 84762 residences)
Cost of measure	Direct costs	Investment	The cost of the devices distributed is estimated at 2.3 Eur/residence. The cost from installation during phase 1 concerning public buildings is estimated to 35,000Eur. Total for residences= 450,000Eur. The measure will be accompanied by a horizontal public information campaign (across all proposed measures) Total cost= 485,000Eur
		Equip. lifetime	5 years
		Recurring costs	nil
	Administrative costs		
	Costs of accompanying & organisational measures		An information campaign targeting the entire population of Malta wills the required. Given that this campaign is envisaged as part of the WFD implementation process, its costs are not included here.
	Indirect costs (and benefits):		Saving of water bills for households (volume saved * 0,37 Eur/m^3)=190,000Eur Saving of government subsidies (2.19Eur per m^3) = 1,000,000Eur (assuming consumption at the first block of the tariff system)
	Energy use and related air pollution (kwh, CO2 emission)		nil

[1] A similar action has been implemented in Italy

Measure Code	QUAN_1	Full name of measure	Distribution of water saving devices in houses
	Other (non water related) environmental costs		
	Sources of information		
Effectiveness	Unit of effectiveness (e.g. m^3 saved or reduction in kg of N)		m^3/year
	Expected effect per targeted unit		Water saving is estimated at 15% of water used in taps, showers and toilet flushes) ie 6 m^3/year
	Additional expected effect resulting from measure implementation by 2015 (baseline)		5% of the household install it spontaneously before 2015 = 9418 households. Total water saved = 9418*6 m^3 * 46% (share of groundwater abstraction in tap water) = 25 994m^3
	Remaining potential effect (with measure)		84762*6 m^3 * 46% (share of groundwater abstraction in tap water) 233 943 m^3/year
	Sources of information		

Source: Sapiano, 2008

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