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SAFEGUARDING WATER RESOURCES IN THE MALTESE ISLANDS

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CONTENTS

Introduction
E. Cachia, CEO, APS Bank v

Address of Welcome
E.P. Delia, Chairman, APS Bank 1

The new EU Groundwater Directive and its Relationship with Agriculture
Philippe Quevauviller 5

A comprehensive review of Malta's water resources and demand and policy implications
Jean-Marc Faurès 21

Implementation of the Water Framework Directive (CD 2000/60/EC) for surface waters
Sarah Debono & Ramona Scerri 43

The role of the Water Services Corporation in water management
Paula Grech Bonnici 53

Every Drop Counts
Joseph Borg 69

Profile of Authors..... 83

INTRODUCTION

APS Bank had already drawn attention to certain practices and approaches in water management during its annual seminar. Regrettably, since then ecosystems and water sources have continued to deteriorate and these developments have increased society's awareness and consequent demand for sustainable water management systems. It was this situation and the required compliance with the European Union Water Framework Directive that prompted the Bank to explore further and expand on this topical subject once more.

In fact, the Bank's eighth Annual Seminar held on 2nd March 2007 was themed "Safeguarding Water Resources in the Maltese Islands" and this publication documents its proceedings.

The seminar convened a panel of speakers coming from local and international bodies, which included the Malta Environment and Planning Authority, the Water Services Corporation, the Food and Agriculture Organization (FAO) of the UN and the DG Environment of the European Commission. As you will note, the topics covered by the experts in their papers ranged from the Water Framework Directive and its implementation to water reform in Malta.

During the seminar FAO also launched a review of Malta's water resources.

The event brought together regulators, suppliers and consumers who shared the view that an integrated and participatory management approach was required to safeguard the limited available water resources.

Through the organisation of this seminar and the publication of proceedings, we hope to have contributed towards efforts in addressing the most pressing problems related to the conservation, rational use and management of such an invaluable resource.

E. Cachia
Chief Executive Officer
APS Bank

Address of Welcome by E. P. Delia, Chairman APS Bank

SAFEGUARDING THE WATER RESOURCES OF THE MALTESE ISLANDS

Excellencies, Ladies and Gentlemen,

Welcome to the Eighth APS Bank Annual Seminar on the Development of Agriculture and Fisheries in the Maltese Islands. Your participation today signifies interest in a subject – Water Resources - that has to be addressed comprehensively and followed determinedly by concerted action.

These seminars reflect on specific factors that condition directly operators in the sectors of agriculture and fisheries in the Maltese Islands. The roles of co-operatives, insurance, alternative products, and management of fisheries in the Mediterranean were assessed in previous meetings. Today we revert to the theme taken up in 2001, namely, water resources and their contribution to personal and social welfare, in general, and to a competitive agricultural sector in particular.

Two observations made in 2001, reproduced in the published Proceedings of the Seminar*, are the following.

> "Malta is an extreme case of water scarcity well indicated by its extremely high water use/conventional water resources ratio of 362%. The current

situation of irrigated agriculture is unsustainable, as it contributes to groundwater drawdown and seawater intrusion, while also increasing pollution of aquifers that are particularly vulnerable due to their mostly karstic nature. In view of the important competition for water resources with other sectors, but also between users in the agricultural sector, a comprehensive programme of improved water use management in agriculture needs to be set up".(p.35)

Again:

"Groundwater is considered to be a strategic resource of fresh water but there is not enough that can meet the needs of our community. Hence we must adopt an approach whereby we can overcome our natural climatic constraints and concurrently succeed in providing cost-effective supplies of water that can meet the specific needs of various sectors of the economy. A sustainable framework needs to be developed that addresses quality and quantity constraints in an integrated fashion, by recognising the impact of land-use on the sustainable management of natural water resources. A new legal framework is required to apply concepts of water use over natural water resources and regulate the management of ground water in an integrated manner. The present state of affairs is not sustainable and we believe that future regulation should lead to a more rational utilisation that is socially fair, acceptable and respects environmental constraints and public health standards." (p.56)

The key messages that these two quotes convey refer to sustainability of a strategic resource in the face of natural climatic constraints and increasing competitive demands.

These had to be addressed in terms of the EU Framework Directive on Water Policy published in the Official Journal on the 22 December 2000. Apart from establishing the basic regulatory and institutional framework for water management, the Directive contains articles on cost recovery for water services (Article 9), a combined approach for point and diffuse sources of pollution (Article 10), strategies against pollution (Article 16), and strategies to prevent and control pollution of ground water (Article 17). By 2010 member states must ensure that water pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of the Directive.

Today's seminar on 'Safeguarding the water resources of the Maltese Islands' takes stock of the steps undertaken since 2001 to ensure high quality water supply for human consumption and enough water supply for commercial use. We are honoured to have a panel of speakers who have direct experience on the subject and who can assess the various aspects of the theme. Therefore, they can guide this audience through the intricate network of issues related to securing a viable and economic water supply in the years ahead. This year's wintry months, replete with above-average temperatures and lack of rain, are a strong reminder of the importance of water in every day life.

The speakers come from operational units that exercise specific responsibilities. These are reflected in their presentations. Mr Phillippe Quevauviller, from the DG Environment in Brussels, spells out the latest information on the Water Directive, which serves as a backdrop to today's discussion. Mr Jean Marc Faure, from the FAO, who had participated in the APS Seminar in 2001, shares his experience on water resources in the Maltese Islands from first-hand field work based on many months of

research. His views, already encapsulated six years ago in the first quote above, are definitely worth assessment. These presentations are followed by a contribution a regulator, MEPA. Ms Romina Scerri and Ms Sarah Debono review the Water Framework Directive as this affects surface water.

A third round of speakers develops the views of users/ producers, namely, the Water Services Corporation and Farmers. Ms. Paula Grech Bonnici, from the Water Services Corporation, examines the role of the Water Services Corporation in Water Management. And Mr. Joe Borg, from APS Consult, assesses the respective responsibilities of farmers and Maltese Authorities who, together, can collaborate in order to safeguard the water resources of these Islands.

I thank the speakers for accepting to participate in this Seminar and the respective organisations that made their participation possible – the DG Environment, the FAO, MEPA, WSC, and APS Consult. I am sure that there is a lot to reflect upon and a lot more to implement. The proceedings will be published so that the views expressed this morning will be shared with many others.

One final word of thanks goes to the Ministry of Rural Affairs and the Environment who, as in past years, have collaborated to see this annual event come through and to Mr Pierre Hili who was Malta's representative to the FAO. Like his predecessors, Mr. Hili was very helpful during discussions at the FAO.

*APS Bank, 2001, ***Water and Agriculture in a Competitive Environment – Proceedings APS Seminar 2001***

*Philippe Quevauviller, European Commission, DG Environment**

THE NEW EU GROUNDWATER DIRECTIVE AND ITS RELATIONSHIP WITH AGRICULTURE

1. The groundwater policy framework under the WFD

The WFD (Directive 2000/60/EC)[1] is the most advanced regulatory framework for the protection of all (surface and ground) waters in order to achieve 'good status' objectives by the end of 2015. As described below, it is based on specific milestones and operational steps which have to be undertaken by the Member States. With regard to groundwater, the directive stipulates that Member States shall implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater. In this context, Member States have to protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge, with the aim to achieve good groundwater (chemical and quantitative) status by 2015, following the definitions given in Table 1. These requirements include a range of

*The views expressed in this paper are purely those of the author and may not in any circumstances be regarded as stating an official position of the European Commission.

derogation clauses which can be found in paragraphs 4 to 8 of Article 4 of the directive.

Table 1

WFD definitions relevant to groundwater

Ref. WFD	Good status
Good quantitative status (Annex V.2.1.2)	The level of groundwater in the groundwater body is such that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction. Accordingly, the level of groundwater is not subject to anthropogenic alteration such as would result in: (a) failure to achieve the WFD environmental objectives for associated surface waters, (b) any significant diminution in the status of such waters, and (c) any significant damage to terrestrial ecosystems which depend directly on the groundwater body. Alterations to flow direction resulting from level changes may occur temporarily, or continuously in a spatially limited area, but such reversals do not cause saltwater or other intrusion, and do not indicate a sustained and clearly identified anthropogenically induced trend in flow direction likely to result in such intrusions.
Good chemical status (Annex V.2.3.2)	The chemical composition of the groundwater body is such that the concentration of pollutants do not exhibit the effects of saline or other intrusions (as determined by changes in conductivity) into the groundwater body, do not exceed the quality standards applicable under other relevant Community legislation in accordance with Article 17 of the WFD, and are not such as would result in failure to achieve the WFD environmental objectives for associated surface waters not any significant diminution of the ecological or chemical quality of such bodies nor in any significant damage to terrestrial ecosystems which depend directly on the groundwater body.

The Directive also requires the implementation of measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order to progressively reduce groundwater pollution. Under this Directive, the framework for groundwater protection imposes on Member States to:

- Delineate groundwater bodies within River Basin Districts to be designed and reported to the European Commission by Member States, and characterise them through an analysis of pressures and impacts of human activity on the status of groundwater in order to identify groundwater bodies presenting a risk of not achieving WFD environmental objectives. This characterisation work had to be carried out in 2004-2005 and reported to the European Commission. A report giving a synthesis of Member State's report has been prepared by the European Commission and made available on the *europa* website in March 2007.
- Establish registers of protected areas within each river basin district for those groundwater areas or habitats and species directly depending on water, which had to be carried out in 2004-2005. The registers have to include all bodies of water used for the abstraction of water intended for human consumption[2] and all protected areas covered by the Bathing Water Directive 76/160/EEC,[3] vulnerable zones under the Nitrates Directive 91/676/EEC[4] and sensitive areas under the Urban Wastewater Directive 91/271/EEC,[5] as well as areas designated for the protection of habitats and species including relevant Natura 2000 sites designated under Directives 92/43/EEC[6] and 79/409/EEC.[7] Registers shall be reviewed under the River Basin Management Plan (RBMP, see below) updates. In this context, vulnerable zones are defined as *"all known areas of land in Member States territories which drain into the waters affected by pollution and waters which could be affected by pollution and which contribute to pollution"*. For these vulnerable zones, action programmes are required under the Nitrates

Directive to reduce pollution caused or induced by nitrates and prevent further pollution".

- Based on the results of the characterisation phase, establish a groundwater monitoring network providing a comprehensive overview of groundwater chemical and quantitative status, and design a monitoring programme that had to be operational by the end of 2006. Monitoring will have to be reported, following requirements summarised in a recently published guidance document.[8]
- Set up a river basin management plan (RBMP) for each river basin district which will include a summary of pressures and impact of human activity on the groundwater status, a presentation in map form of monitoring results, a summary of the economic analysis of water use, a summary of the programme(s) of protection, control or remediation measures etc. The first RBPM is scheduled to be published at the end of 2009 (after a public consultation to be concluded by the end of 2008). A review is then planned by the end of 2015, and every six years thereafter.
- By 2010, take account of the principle of recovery of costs for water services, including environmental and resource costs, having regard to the economic analysis conducted under Article 5 of the WFD, and in accordance with the polluter pays principle.
- Establish a programme of measures for achieving WFD environmental objectives (e.g. abstraction control, prevent or control pollution measures) by the end of 2009, to be operational by the end of 2012. Basic measures include, in particular, controls over the abstraction of groundwater, controls (with prior authorisation) of artificial recharge or augmentation of groundwater bodies (providing that it does not

compromise the achievement of environmental objectives). Point source discharges and diffuse sources liable to cause pollution are also regulated under the basic measures. Direct discharges of pollutants into groundwater are prohibited subject to a range of provisions. The programme of measures has to be reviewed and if necessary updated by 2015 and every six years thereafter.

2. The new groundwater directive 2006/118/EC

While quantitative status requirements are clearly covered by the Water Framework Directive, it does not include, however, specific provisions on chemical status, i.e. the different conceptual approaches to groundwater protection did not allow achieving an agreement on detailed provisions within the WFD at the conciliation. As mentioned in the above paragraph, this justified including a provision, Article 17, requesting the Commission to come forward with a proposal of specific measures to prevent and control groundwater pollution. This proposal has been adopted by the Commission on 19th September 2003 (COM(2003)550 final) and has been adopted after a conciliation phase among the European Parliament and the Council on the 12th December 2006.[9] The directive 2006/118/EC is based on three main pillars, namely:

1. Criteria linked to good chemical status evaluation, which are based on compliance to EU existing environmental quality standards (nitrates, plant protection products and biocides) and to "threshold values" (playing the same role as EQS) for pollutants representing a risk to groundwater bodies. The latter

category of standards has to be established by Member States, using common methodological criteria, at the most appropriate scale (national, regional or local), taking account of hydrogeological conditions, soil vulnerability, types of pressures etc. They will have to be reported to the Commission by the end of 2008, and will be used as quality objectives for further compliance checking.

2. Criteria for the identification of sustained upward trends of pollutants in groundwater bodies characterised as being at risk. These include measurement principles and requirements regarding trend reversals.
3. Requirements on the prevention/limitation of pollutant inputs to groundwater, which will ensure a continuity of the 80/68/EEC Directive after its repeal in 2013, i.e. the same principle of prevention of hazardous substances introduction and limitation of other pollutants so as to avoid pollution will apply.

Other elements concern clarifications about the groundwater use as drinking water (albeit this is well covered by Article 7 of the WFD) and its relation with the present directive, which relates to WFD environmental objectives. Recommendations to undertake research on groundwater ecosystems are also expressed in a recital, which illustrates the awareness for a needed scientific integration. Finally, review of technical annexes of the directive (in particular concerning the establishment of groundwater threshold values and methods for identifying and reversing pollution trends) is requested, taking into account scientific progress, before the end of 2012 and every six years thereafter. This review will have to be carried out following "comitology" rules, i.e.

adoption of possible decisions by a regulatory committee composed of Member States. Since 2006, these rules imply that the European Parliament will have right of scrutiny on adopted decisions. An evaluation of the functioning of the directive in the light of consistency with parent legislation, in particular agriculture-related directives (see paragraph 3) is also foreseen.

3. Links with agriculture-related regulations

This section examines how various agriculture-relevant directives interact with the groundwater policy under the WFD and 2006/118/EC Directive. As a preamble, it should be kept in mind that agriculture-related directives are part of the 'basic measures' listed in Annex VI of the WFD. In other words, they have to be efficiently implemented to allow for the environmental objectives to be attained.

3.1. The Nitrates Directive

The Nitrates Directive[4] aims to reduce water pollution caused or induced by nitrates from agricultural sources and to prevent further such pollution. It obliges Member States to designate vulnerable zones which correspond to all known areas of land in Member States territories which drain into the waters (including groundwater) affected by pollution and waters which could be affected by pollution and which contribute to pollution. A reference is made to action programmes to reduce pollution caused or induced by nitrates and to prevent further pollution, and to requirements for identifying groundwater vulnerable zones as "those waters which contain more than 50 mg/l or could contain more than 50 mg/l nitrates if an action programme is not undertaken". The link with

groundwater policy is clear in that respect, i.e. nitrate contamination levels should not be over the trigger value set at 50 mg/l (this argument has been used for proposing this value as an EU groundwater quality standard for groundwater in the new Groundwater Directive). The Nitrates Directive requires the implementation of suitable monitoring programmes to assess the effectiveness of action programmes at selected measuring points, making it possible to establish the extent of nitrate pollution in the waters from agricultural sources. As a final remark, let us note that the action programmes under that directive will have to tackle the obligation of reversing significant and sustained upward trends under Article 5 and Annex IV of the new Groundwater Directive.

3.2. The Plant Protection Products Directive

The Plant Protection Products Directive[10] concerns the authorisation, placing on the market, use and control within the Community of plant protection products in commercial form. Regarding groundwater, authorisations are only granted whether plant protection products have no harmful effect on human or human health, directly or indirectly, or on groundwater, and they have no unacceptable influence on the environment, particularly contamination of water including drinking water and groundwater. The "uniform principles" set out in the directive specify that no authorisation shall be granted if the concentration of the active substance or of relevant metabolites, degradation or reaction products in groundwater, may be expected to exceed, as a result of use of the plant protection product under the proposed conditions of use, the lower of (i) the maximum permissible concentration laid down by Directive 80/778/EEC,[2] or (ii) the maximum concentration laid down by the Commission when including the

substance listed in the directive, on the basis of appropriate data (in particular toxicological data), or where that concentration has not been laid down, the concentration corresponding to one tenth of the ADI (acceptable daily intake) laid down when the active substance was included in the directive. The granting of authorisations have to take account of the agricultural, plant health or environmental (including climatic) conditions in the areas of envisaged use (this implicitly concerns groundwater, even if this is not specifically mentioned). These considerations may result in specific conditions and restrictions of use and, where necessary, in authorisation being granted for some but not other areas within the Member State. The directive makes a direct reference to groundwater contamination (with drinking water standards not allowed to be exceeded), which therefore requires to be monitored. Similarly to nitrates, the pesticides values found in this directive have been used to set up EU-wide groundwater quality standards that appear in Annex I of the new Groundwater Directive. The trend reversal obligation also applies to pesticides.

3.3. The Biocides Directive

The Biocides Directive[11] concerns the authorisation and the placing on the market for use of biocidal products. Similarly to Directive 91/414/EEC,[10] authorisation of biocidal products may only be granted if the products have no harmful effect on human or human health, directly or indirectly, or on groundwater, and they have no unacceptable influence on the environment, particularly contamination of water including drinking water and groundwater. Similar principles as the "uniform principles" of Directive 91/414/EEC are set out, which means that the 0.1 Ieg/l quality standard of the 80/778/EC[2] plays a role of maximum concentration

for all groundwater, but that lower standards may be established following the procedure for including the active substance in the Annex I of the Directive. The decision-making provisions of annex to the Biocides Directive follow the same lines as the one described above (related to the Plant Protection Products Directive) with respect to groundwater, and a similar approach has been followed in the new Groundwater Directive regarding EU-wide groundwater quality standards setting and trend reversal obligations.

4. The WFD Common Implementation Strategy: Involvement of stakeholders

4.1. General principles

Soon after the WFD adoption, it has become clear that the successful implementation of the Directive will be, at the least, equally as challenging and ambitious for all countries, institutions and stakeholders involved. Therefore, a strategic document establishing a Common Implementation Strategy (CIS) for the Water Framework Directive (WFD) has been developed and finally agreed by the European Union's Water Directors under the Swedish Presidency in 2001.[12] Despite the fact that the full responsibility of the individual Member States for implementing the WFD was recognised, a broad consensus existed among the Water Directors of the Member States, Norway and the Commission that the European joint partnership was necessary in order to:

- develop a common understanding and approaches;
- elaborate informal technical guidance including best practice examples;
- share experiences and resources;

- avoid duplication of efforts;
- limit the risk of bad application.

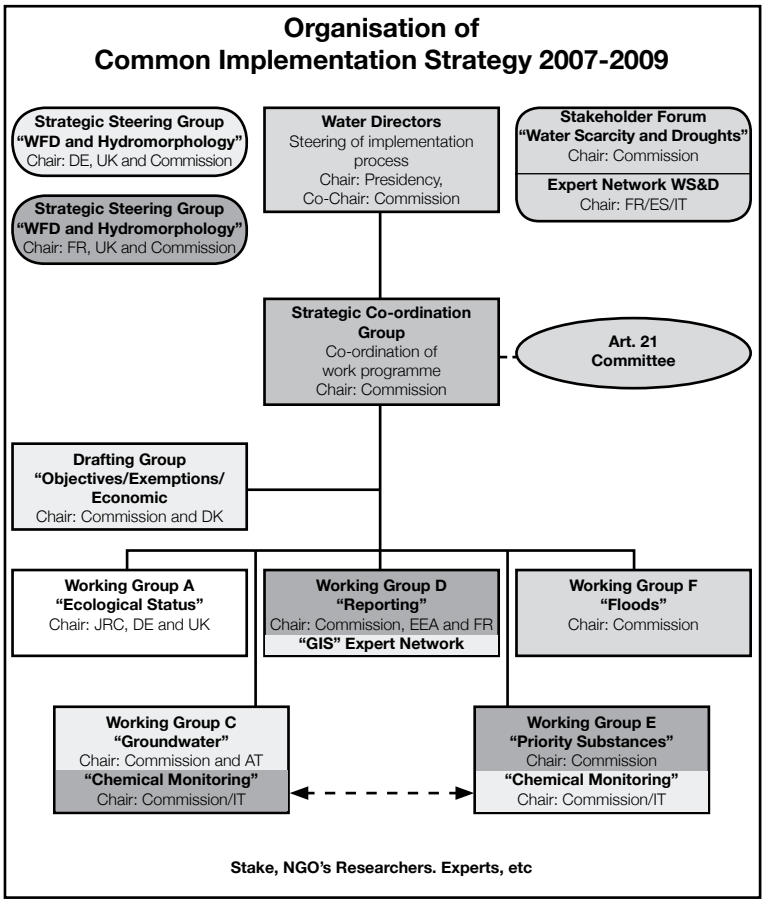
Furthermore, the Water Directors stressed the necessity to involve stakeholders, NGOs and the research community in this joint process as well as to enable the participation of Candidate Countries in order to facilitate the cohesion process. Following the decision of the Water Directors, a comprehensive and ambitious work programme was started of which the first phase, including several working groups, was completed at the end of 2003 and led to the availability of fourteen Guidance Documents which are publicly available (in the form of CD-ROM and on Internet on the WFD *europa* website). The second phase of the CIS (2003-2004) involved four working groups, namely on ecological status (WG A), Economics and Pilot River Basins (WG B), Groundwater (WG C) and Reporting (WG D). These groups were re-conducted in the third phase (2005-2006), and this process is now continued under new mandates for the period 2007-2009 (see Figure 1), which is detailed with regard to groundwater in the section below.

4.2. The CIS working group on groundwater

The CIS Groundwater Working Group (C) aims both to clarify groundwater issues that are covered by the WFD and prepare the development of technical guidance documents and exchange best practices on several issues in the light of the orientations of the new adopted Groundwater Directive.

Figure 1

CIS operational diagram for the period 2007-2009



The Commission / DG ENV chairs the WG C which is co-chaired by Austria. The Working Group is composed of representatives of EU Member States, Associated and Candidate countries, industrial and scientific stakeholders, and NGO representatives (around 80 members in total). Plenary meetings are opened to all participants, while ad-hoc activities are operated by groups of a maximum

of 15-20 participants which develop documents that are scrutinised by the plenary group.

The focus in the period 2003-2006 has been on the development of technical reports and guidance documents primarily focusing on the issues covered by the WFD, namely monitoring, prevent/limit measures and groundwater protected areas. In addition, a specific activity will concern exchange of views on groundwater management in the Mediterranean area (linked to the EU Water Initiative). Activities of the WG were conceived with the view of collecting targeted data and information, avoiding duplication with existing guidance documents and ensuring an efficient use of available data and information. Series of workshops have been held in 2003-2004, which led to three technical reports gathering Member State's practices in the field of groundwater risk assessment, monitoring and programmes of measures [Vide References13-15]. The orientations in 2005-2006 have concerned the drafting of guidance documents on groundwater monitoring, protected areas and measures to prevent/limit pollutant introduction into groundwater.

The perspectives for 2007-2009 are to pursue exchanges in support of the implementation of the new Groundwater Directive along the CIS principles, focusing in particular on:

- Best practices related to groundwater programmes of measures, including measures related to diffuse sources of pollution (including agriculture) and megasites;
- Common methodology for the establishment of groundwater threshold values;
- Compliance, status and trend assessment;
- Recommendations for integrated risk assessment, including conceptual modelling.

The activities of the working group (drafting or exchanges of good practices) will be undertaken with selected WG participants (groups of ideally 20-25 participants) willing to actively contribute to the drafting of documents and to participate in ad-hoc meetings (possibly organised by the activity leaders). Their progress will be reported and discussed at plenary meetings of the WG C held twice a year and organised under the EU Presidency umbrella.

5. Conclusions

The successful implementation of the new Groundwater Directive will closely depend upon an efficient participatory approach and harmonised groundwater risk assessment, monitoring, and programmes of measures throughout the European Union. The CIS Working Group on Groundwater will be an indispensable element supporting this implementation, in particular in view of the preparation of the first River Basin Management Plan expected for publication at the end of 2009. This is to be seen as an opportunity to efficiently manage groundwater resources at EU level and to collaboratively tackle the challenges ahead of us for achieving good quantitative and chemical status of groundwater by 2015.

Acknowledgements
The author is grateful to APS Bank and APS Consult and to the Malta Resources Authority for their invitation to exchange views about the situation of water management in the Maltese Islands.

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Jean-Marc Faurès, Food and Agriculture Organisation of the United Nations

A COMPREHENSIVE REVIEW OF MALTA'S WATER RESOURCES AND DEMAND AND POLICY IMPLICATIONS

Executive summary

The state of Malta's water resources is poor. With the support of the United Nations Food and Agriculture Organisation (FAO), the Malta Resources Authority (MRA) has been undertaking studies and consultations to articulate a national water policy and formulate a set of workable regulations. The rationale behind this process is that involving stakeholders will lead to a policy that is socially and politically acceptable and geared to tackling the complex water-related challenges facing the country.

A water resources review was conducted as part of the policy formulation process. This review shows that, although the demand for groundwater is outstripping supply, there is scope to reverse current trends through demand management, supply augmentation and strategic protection of groundwater resources. Options and opportunities exist for improving the sustainable management of Malta's water resources. Four demand scenarios, combined with different strategies for meeting future demand and achieving sustainable management

of the country's resources are presented and their implications are discussed.

Malta's core water challenge is one of water governance. Decisions will have to be made immediately if the environmental sustainability of Malta's aquifer systems is to be achieved.

Introduction

In July 2002, MRA requested assistance from FAO through a technical cooperation project in the review and drafting of new or amended legislation for the sustainable management of the country's groundwater. As part of the project, MRA and FAO reviewed the current situation of the country's water resources and demand and analysed the implications of possible intervention scenarios. The findings have been presented in the report "Malta Water resources review" published by FAO. They are presented here in a synthetic form.

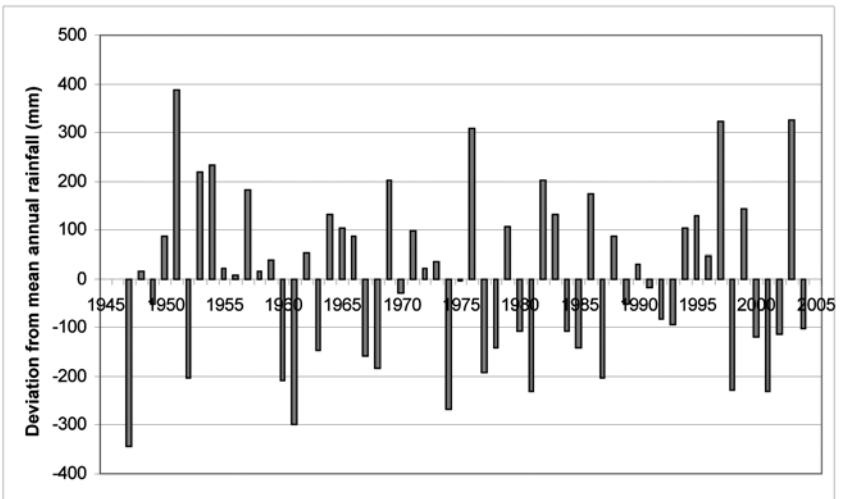
The water resources of Malta

Precipitation

The climate of the Maltese Islands is typically semi-arid Mediterranean, characterized by hot, dry summers and mild, wet winters. The mean annual rainfall was about 550 mm for the period 1900–2000 but with high seasonal and inter-annual variability. Figure 1 presents the deviation of annual rainfall from the long-term average for the Luqa meteorological station. This figure shows that annual rainfall of 300 mm more or 250 mm less than the average is common. With rainfall being the ultimate

source of water for Malta, and given the extremely high population density of the country, Malta is among the countries in the world with the lowest per capita water resources.

Figure 1: Luqa meteorological station: deviation form the mean average precipitation

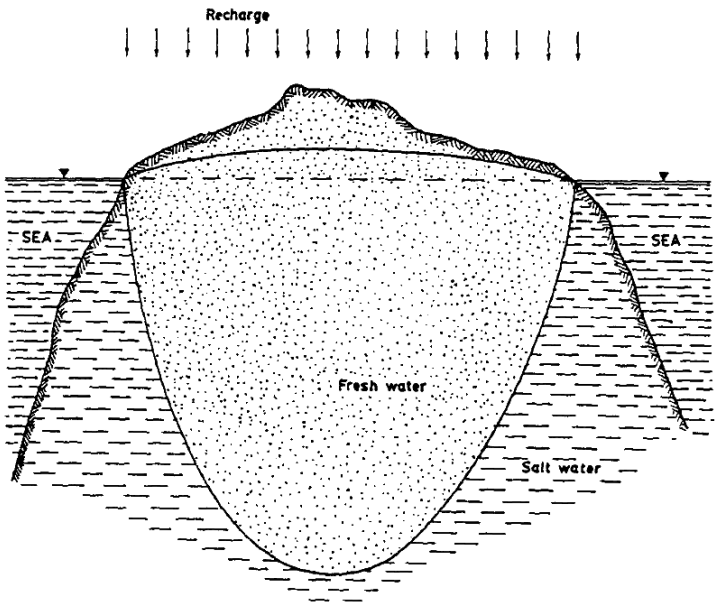


Hydrogeology

The geological formations exposed in the Maltese Islands are of the Tertiary and Quaternary Ages. The two most important formations are the Lower Coralline Limestone (LCL) and the Upper Coralline Limestone (UCL). The UCL and LCL formations are considered to function as aquifer rocks. The LCL aquifer is in lateral and vertical contact with seawater. Because of the density contrast between freshwater and saltwater, the Maltese islands present a typical island hydrogeology, as presented schematically in Figure 2. It consists of a freshwater lens floating on

saltwater with a thickness about 36 times more below sea level than the height of the freshwater surface above sea level. In the central regions of the island of Malta, hydraulic heads of about 4–5 m were recorded in the 1940s when the aquifer was still relatively unexploited. Today, it has receded to levels of about 1 m above mean sea level, mainly as a result of unsustainable groundwater abstraction.

Figure 2: Typical behaviour of an island aquifer



Water production

Figure 3 presents the estimated percentage of water produced in 2003. The total volume of water produced was an estimated 59 hm^3. The Water Services Corporation (WSC) was the single main producer of water in 2003, while

the agriculture sector was the main producer (abstractor) of water in the private sector. The WSC produced slightly more desalinated seawater than groundwater.

Figure 3: Breakdown of estimated water production, 2003

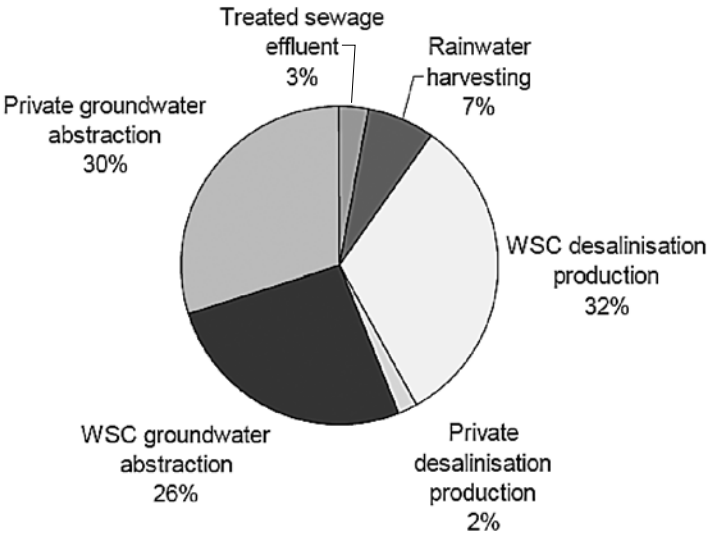
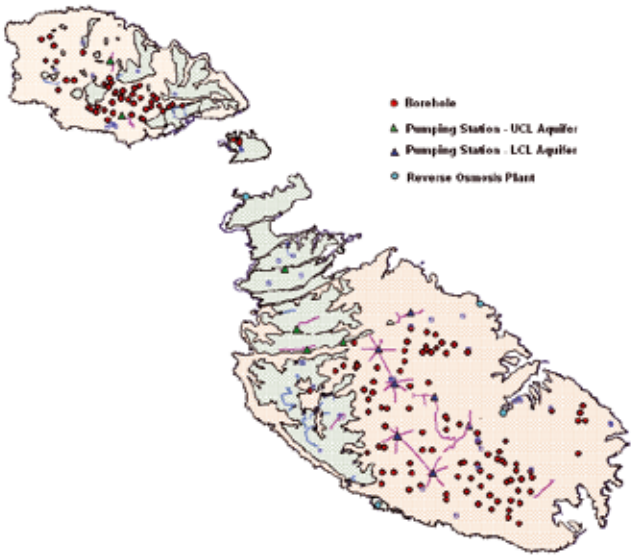


Figure 4 shows the location of the public groundwater sources. These include boreholes and pumping stations. The latter consist of horizontal radiating galleries dug in the rock slightly above sea level in order to skim freshwater from the top of the freshwater lenses that constitute the sea-level aquifers. Public groundwater sources are all known and water extraction is well monitored.

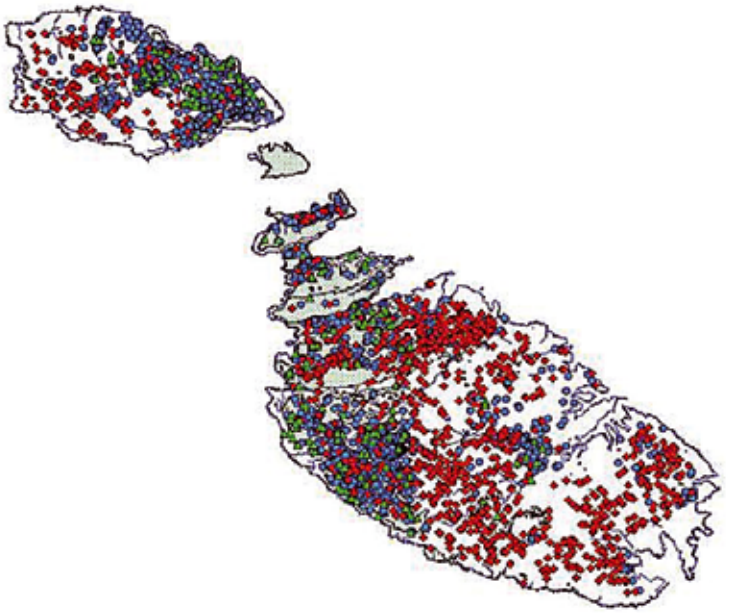
Figure 4: Public groundwater production sources in the Maltese Islands



Agricultural water supply

The amount of irrigated land amounts to just more than 9 % of all agricultural land in the Maltese Islands. Most of the irrigated land is found in the Upper Coralline Limestone (UCL) regions in the north and west of Malta. Historically, the shallow depth of the perched aquifers and the occurrence of natural springs made water resources for agriculture more easily accessible. Figure 5 shows the location of registered boreholes and springs as registered in the 1997 water-source registration process. However, in the last decade, a large number of illegal boreholes have been dug, particularly in the Lower Coralline Limestone (LCL) aquifers, and no information is available on their number and pumping capacity.

Figure 5: Location of registered private water sources in the Maltese Islands



Note: Blue dots – old private boreholes; red dots – new boreholes registered for the first time in 1997; green dots – springs.

Treated sewage effluent

Currently, 13 percent of the total sewage generated in the Maltese islands is being treated and made available for subsequent reuse by the agriculture and industrial sectors. The situation is expected to change by 2007 as the planned construction of three new sewage treatment plants will result in the production of about a further 38 000 m^3/day, bringing the total amount of treated sewage effluent (TSE) available to an estimated 14 hm^3/year. Four agricultural areas were earmarked in a preliminary study carried out

by the WSC in 1998 as test sites where TSE can be safely applied for irrigation and the gradual re-instatement of severely depleted aquifers. Land in these localities is considered to be suitable for irrigation with TSE as the aquifers are heavily overpumped, polluted and not used for the abstraction of water intended for drinking purposes.

Water demand

Table 1 presents the breakdown of estimated water demand by sector for 2003 along with the sources of water used to meet this demand. When apparent losses are taken in account, domestic water use was the sector with the highest water demand (although an improvement on previous years, apparent and real water losses are still very high). Agricultural water use for irrigation was the second largest user of water and the main user of groundwater. Finally, compared with the potential availability of TSE of about 14 hm^3 by 2008, use of TSE in 2003 was very low.

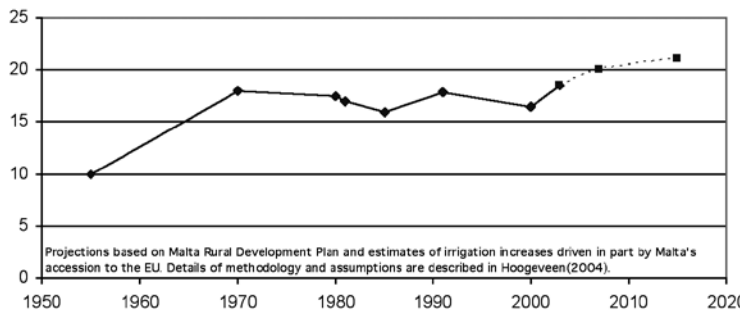
Table 1: General water accounting matrix (2003)

Prodution / Consumption	WSC		Private				Total
	Billed	unbilled	Groundwater	R.O.	Treated effluents	Runoff harvesting	
Domestic	12 620	3 687	1 000			2 000	19 307
Tourism	1 134	331	500	1 000			2 965
Farms	1 336	390	500				2 226
Agriculture			14 500		1 500	2 000	18 000
Commercial	1 247	364					1 611
Industrial	941	275	1 000		500		2 716
Government	818	239					1 057
Others	869	254					1 123
Total consumption	18 965	5 540	17 500	1 000	2 000	4 000	49 005
Real losses		9 636					9 636
Total + losses	18 965	15176	17 500	1 000	2000	4000	58 641
WSC:							
Total apparent losses	5 540	16%				all figures in '000 m3	
Total loss	15 176	44%					

The domestic sector has registered an increase in consumption caused by higher living standards. WSC figures indicate that the consumption of water exclusively for domestic purposes was 142 litres/person/day in 2000/01. This figure falls to 76 litres/person/day when losses and unaccounted-for water are taken into account.

Agriculture water demand is strongly linked to irrigated land. Figure 6 shows historical, current and projected irrigated water use on the Maltese Islands. There is a strong likelihood that irrigated agriculture is going through the "boom and bust" cycle seen in many parts of the world where irrigated expansion has been based on unsustainable groundwater abstraction. The major questions are whether immediate improvements in water-resource planning can prevent the "bust" occurring at all and whether the most severe impacts of a "bust" can be mitigated.

Figure 6: Agriculture water demand: trends and projections



Groundwater balance

Replenishment of the aquifers is by rainfall and leaks from the water-supply system. The amount of water in

storage in the freshwater lens of the main aquifer is of the order of 1 500 hm^3. Before the impacts of groundwater overextraction, this could be considered quite large compared with yearly recharge, whereas the recharge forms a very large percentage of the water in storage in the perched and coastal aquifers. Table 2 presents the groundwater balance for the aquifers in the Maltese Islands as calculated by the project. The groundwater balance is based on an average hydrological year with a precipitation of 550 mm.

Table 2: Groundwater balance for the aquifers in the Maltese Islands, base year 2002

Inflow		hm^3/year	Comments
A	Precipitation	174	Based on an average annual rainfall of 550 mm
B	Surface runoff to the sea	24	Based on a variable catchment area runoff coefficient (excluding coastal built up areas)
C	Actual evapotranspiration	105	Assumed as 68% of the total surface water
D	Natural aquifer recharge	45	B and C deducted from A
E	Artificial recharge from leaks	12	Estimated inflow from potable water and sewage network leakages
F	Total groundwater inflow	57	Sum of variables D and E
Outflow			
G	WSC groundwater abstraction	16	Official WSC extraction for hydrological year 2002/03
H	Private groundwater abstraction	15	Estimate based on water demand of various sectors (industry and agriculture)
I	Subsurface discharge to the sea	23	Estimate based on groundwater modelling
J	Total groundwater outflow	54	Sum of variables G, H and I
Balance			
K	Total groundwater inflow	57	Equal to variable F
L	Total groundwater outflow	54	Equal to variable J
M	Balance	3	Inflow (K) less outflow (L)

Source: Malta Resources Authority (2003).

This groundwater balance calculated at the level of the country masks the fact that individual, important aquifers are in imbalance. Table 3 presents a breakdown of the calculations on an aquifer-by-aquifer basis. It shows that the sea-level aquifers are in gross imbalance when compared with the perched aquifers and that the overall positive balance at country level is being achieved through the combined contribution of the smaller perched aquifers.

Table 3: Water balances of the individual groundwater bodies, base year 2003

Groundwater Body Name	Size (km^2)	Inflow (hm^3)	Outflow (hm^3)	Balance (hm^3)	Major extraction purpose
Malta Main Mean Sea Level	216.6	34.27	36.65	-2.38	Abstraction for potable and agricultural purposes
Rabat -Dingli Perched	22.6	4.64	4.62	0.02	Abstraction for agricultural purposes
Mgarr -Wardija Perched	13.7	2.86	3.46	-0.59	Abstraction for potable and agricultural purposes
Pwales Coastal	2.8	0.69	0.69	0.00	Abstraction for agricultural purposes;
Mizieb Mean Sea Level	5.2	1.11	0.96	0.15	Abstraction for potable and agricultural purposes
Mellieha Perched	4.5	0.75	0.53	0.22	Abstraction for agricultural purposes
Mellieha Coastal	2.9	0.69	0.38	0.31	Abstraction for agricultural purposes
Marfa Coastal	5.5	0.89	0.62	0.27	Abstraction for agricultural purposes
Mqabba -Zurrieq Perched	3.4	0.50	n/a	n/a	Abstraction for agricultural purposes
Comino Mean Sea Level	2.7	0.52	0.30	0.22	Abstraction for agricultural purposes
Gozo Mean Sea Level	65.8	8.66	9.78	-1.12	Abstraction for potable and agricultural purposes
Ghajnsielem Perched	2.7	0.73	0.34	0.39	Abstraction for agricultural purposes
Nadur Perched	5.0	1.15	0.58	0.57	Abstraction for agricultural purposes
Xaghra Perched	3.0	0.71	0.33	0.38	Abstraction for agricultural purposes;
Zebbug Perched	0.4	0.10	0.03	0.07	Abstraction for domestic purposes
Victoria -Kercem Perched	1.5	0.39	0.14	0.25	Abstraction for domestic purposes

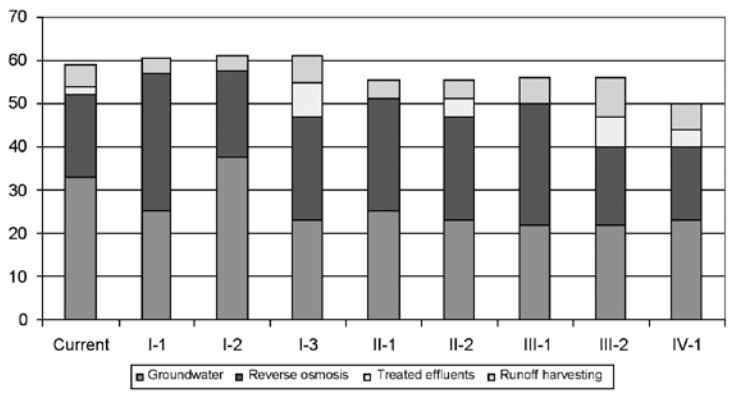
A vision for Malta's water resources

The primary goals of Malta's water policy should include safe and secure drinking-water supply for the population; reliable water supplies to support a sustainable economy; and the protection of the water-dependent environment. In order to reach these goals, the first priority is to restore public water-supply aquifers and remove volatility in groundwater supply. The second is to maintain a strategic reserve and minimize social and economic risks to Malta's economy that are inherent in a water-supply policy based on imported energy. The third is to achieve "good" status linked to commitments to the European Union. Achieving this vision will call for a mix of economic and regulatory measures to be applied, some as a matter of urgency. Different options and opportunities exist to improve water management in Malta and contribute to the vision. They are presented in a synthetic way in Annex 1, together with the type and scale of impact they can induce.

Scenarios for water demand and supply

It is assumed that a combination of the options and opportunities listed above will form the backbone of a new water policy. Four water demand scenarios, combined with possible water supply strategies have been selected on the basis of information collected by the project and discussions with key stakeholders. Annex 2 presents the demand scenarios along with various supply strategies. Figure 8 presents the results of the different scenarios and water supply strategies in terms of water supply.

Figure 8: Comparison of water supply for different demand scenarios and water supply strategies



The scenarios cover the most probable limits of demand based on current trends and projections of the main water-using sectors. For each of the scenarios, there is one or more strategies for achieving the overall vision of the proposed water-policy. Table 4 presents the overall potential of each strategy for achieving this vision. The "business as usual" scenario (Scenario I, Strategy II) is

unacceptable because it does not contribute to achieving any of the elements of the vision.

In any case, it is anticipated that a strategy to address current water management situation will require the inclusion of measures for:

- raising awareness of the poor condition of the sea-level aquifers and the potential consequences of continued mismanagement;
- the regulation of existing water users and sources in such a way that respects the hydrogeological integrity of the aquifers;
- the introduction and allocation of water supplies to users for purposes considered as beneficial to the economic development of the country;
- the recognition of sectoral priorities in groundwater use based on the social, economic and environmental benefits to be derived from such use;
- the introduction of cost-recovery mechanisms that take into consideration the environmental benefits derived from water using activities.

Table 4: Analysing scenarios in terms of the main elements of the vision

Demand Scenarios	**I**			**II**		**III**		**IV**
Supply Strategies	**I**	**II**	**III**	**I**	**II**	**I**	**II**	**I**
Levels of ground and surface water use regulated according to sustainable abstraction levels	?	X	?	?	?	?	?	?
Sea-level and perched aquifers restored to a status that represents a strategic reserve equivalent to 18 months of demand	X	X	?	X	?	?	?	?
Water quality of all aquifers within permissible limits	X	X	?	X	?	?	?	?
Widespread use of local solutions (e.g. cisterns, pollution control)	X	X	?	X	?	?	?	?
High levels of collective responsibility (at all levels) for managing and protecting Malta 's water resources	X	X	?	X	?	X	?	?
Potential to achieve all aspects of the vision	**X**	**X**	?	**X**	?	**?**	?	?

Conclusions

Malta's groundwater resources are poor and threatened by overexploitation and pollution. Reversing this trend requires a clear understanding of the situation that can guide policy decisions and help in setting up the necessary legal, institutional and implementation mechanisms. Time is of the essence. The process of putting policy into practice has to start as soon as possible if current trends are to be reversed and Malta's overall water-resource base brought to a position from which long-term sustainability can be assured. What is now needed is the vigorous support of all Maltese to promote a national water policy. Once endorsed by all stakeholders, it will serve as the basis for the development of a set of legal, institutional and operational instruments and programmes aiming at guaranteeing a sustainable supply of groundwater for the benefit of the Maltese community as a whole.

References

This paper summarises the findings presented in the publication "Malta Water Resources Review" prepared by Manuel Sapiano, John Mangion, Charles Batchelor and a team of FAO experts and published by FAO in 2006 as a result of project FAO/TCP/MLT/2901 "Comprehensive legislation for groundwater management"

Annex 1: Options and opportunities for improving water management in Malta

Options/ opportunities	*Main components*	*Potential nature & scale of impact*
Improved awareness of the characteristics and vulnerability of Malta's water resources and the potential consequences of different courses of action	*Carefully targeted and structured awareness campaign for decision-makers at all levels* *Educational campaign in schools*	*Islandwide long-term impact on decision-making at all levels* *Higher levels of collective responsibility for the management of water resources*
Improved access of all stakeholders to quality-controlled water-related information	*Establishment and management of a common water-related information base including consensus building among stakeholders on the status of water resources*	*Islandwide long-term impact on decision-making all levels* *Improved stakeholder dialogue as using the same information as a basis for discussion*
Improved policy-level water governance	*Alignment of policies that have the potential to affect the supply of or demand for water resources* *Apolitical approach to long-term water resource planning* *Regulatory systems that have more independence from government*	*Islandwide impact at the policy level* *Policies that no longer promote groundwater use in excess of sustainable levels* *Emphasis on long-term planning*
Improved strategic water governance	*Alignment of planning processes that have the potential to affect the supply of or demand for water resources*	*Groundwater extraction will be reduced to and maintained at sustainable levels* *Introduction of EU WFD catchment-planning procedures*
Establish water governance arrangements that facilitate greater involvement of stakeholders in water resources planning and management	*Establish a stakeholder platform that includes representatives from all the main sectors and that holds regular meetings and consultations*	*Better involvement of stakeholders in decision-making processes* *Better ownership of plans, regulations, etc.*

Immediate regulation of users of groundwater who are damaging the integrity of the sea-level aquifers	*Identification of deep boreholes and/or boreholes from which there is a high rate of abstraction; fitting of meters and issuing of licences*	*Reduction in localized upconing of seawater into the sea-level aquifers* *Potential for slow recovery in the water quality of sea-level aquifers*
Staged regulation of all groundwater users	*Registration of all boreholes, issuing of licences, introduction of tariffs and other relevant demand-management instruments* *Costs of implementing the regulatory system are recovered*	*Reduction in groundwater use to sustainable levels* *Allocation of water to uses that have the highest social, environmental and economic value* *Promotion of efficient and beneficial use*
Improved regulation of all activities that have the potential to pollute surface and groundwater resources	*Identification of polluters and polluting activities* *Enforcement of polluter pays principle*	*Improvement in surface-water and groundwater quality*
Establishment of a groundwater strategic reserve	*Relaxing groundwater extraction for a period of time sufficient to allow a strategic groundwater reserve of acceptable quality to be established*	*This will reduce the risk of major disruption to the Maltese economy that might result from problems with RO production resulting from, say, a major pollution incident and shortage of energy for RO production*
Pricing of TSE at an acceptable level, investment in infrastructure for better distribution of TSE and protection of aquifers from low-levels of pollution from TSE	*Fixing the price of TSE at a level that will enable profitable production of high-value crops and profitable commercial use* *Construction of an appropriate reticulation system* *Use of precautionary principle when deciding on areas/ aquifers to be supplied with TSE*	*Relaxation of the pressure on groundwater by providing groundwater users with a substitute TSE source* *Users of groundwater currently faced with deteriorating groundwater quality have the potential to stay in business*
Increased water harvesting in urban areas. Also increased water harvesting in rural areas wherever there will not be negative downstream impacts	*Increasing use of well-designed and well-constructed local solutions (including cisterns) for making better use of runoff particularly during years with good rainfall* *Provision of fiscal incentives where appropriate*	*Reduced pressure on groundwater* *Cost savings to users that substitute harvested rainwater for water supplied by the WSC*

Strict regulation of activities likely to increase the salinity levels of drainage water	*Banning of hotel use of seawater in dual plumbing systems* *Banning of the dumping of brine from small RO plants in drainage systems*	*This will improved the quality of sewage effluent and reduce treatment costs* *Leaks of sewage into aquifers will have a lower pollution risk*
Regulating the sale of groundwater	*Licensing and imposing a charge for tankers selling water*	*Reduced pressure on groundwater* *This will reduce the use of tankers as a means of avoiding regulation based on block tariffs*
Long-term protection of aquatic ecosystems and rare habitats	*Planning procedures that give a high priority to maintaining rare and important ecosystems*	*In addition to being the right policy, this will help Malta meet obligations under the EU WFD*
Improvement in conveyance efficiency (i.e. leak reduction)	*Continued efforts by WSC to reduce water lost in the form of leaks, illegal connections, etc.*	*Reduced pressure on groundwater* *Reduced risk of pollution* *Better and more economic service delivery*
Improved water-use efficiency by agricultural users	*Improved irrigation and cropping practices leading to a reduction in demand by individual farmers and the agriculture sector as a whole*	*Reduced pressure on groundwater*
Increased recycling of water	*Tariffs and incentives are used to encourage relevant industries to install the necessary equipment to recycle water* *Tariffs and incentives are used also to encourage household-level reuse of water*	*Reduction in pressure on groundwater and reduced risk of pollutants leaving the relevant industries* *Reduced costs for users*
Use of agro-environment funds aimed at protecting aquifers	*Range of practices include funding set-aside strategies or a more permanent switch from irrigated agriculture to rainfed land uses*	*Reduced pressure on groundwater* *Improvements in biodiversity and in scenic and touristic value of islands*
Hotels are encouraged to install RO plants to meet the demands of any increase in tourism	*Tariffs and incentives are provided to hotels to install RO plants*	*Reduced pressure on groundwater and the supply infrastructure during the summer months*

Sufficient resources allocated to enable water law to be implemented	*Staff and equipment are in place so that a regulatory system can be operated effectively and efficiently* *Confidence is built among stakeholders that an equitable and just approach is being taken to implementing the regulatory system*	*This is a precondition for the successful implementation of a regulatory system*

Annex 2: Demand scenarios and supply strategies

Water demand scenarios	**Potential demand scenarios based on current trends**	**Water supply strategies**	**Strategies for meeting current and future demands (i.e. 2015)**
I	Municipal demand remains fairly constant at current values or increases at about 1–2%/year while agricultural demand increases reaching a maximum not exceeding 21 hm^3 as projected.	I	Agriculture is given priority over the use of groundwater and, consequently, the urban supply is increasingly sourced from RO plants.
		II	No action is taken and groundwater abstraction remains unregulated.
		III	A reduction in groundwater abstraction is implemented in order to achieve a sustainable abstraction strategy allowing the setting up of a strategic groundwater reserve. The available abstractable groundwater quota is then allocated on a 50/50 basis between the WSC and all other users. Options involving artificial recharge of groundwater and improved rainwater harvesting will also have to be implemented in order to augment groundwater availability. Agri-environment schemes and smart irrigation techniques are used to encourage low-water-using farming systems.

II	Municipal demand remains fairly stable at current values or increases at about 1–2%/year while the agricultural demand decreases to pre-EU Accession levels (of 15 hm^3/year) driven mainly by market forces.	I	Agriculture is given priority over the use of groundwater with the potable supply being increasingly sourced from RO plants. Effluent from wastewater treatment plants viewed primarily as an option to supplement water supply to the agriculture/industrial sectors, thus, further reducing the pressures on groundwater.
		II	A cut-back in groundwater abstraction is implemented in order to achieve a sustainable abstraction strategy allowing the setting up of a strategic groundwater reserve. Available abstractable groundwater resources are then allocated on a 50/50 basis between the WSC and all other users. Increased use of unconventional water sources in the agriculture sector will be encouraged.

III	Municipal demand decreases to about 27 hm^3 because of significant investment in local water conservation and reuse; while agricultural demand increases, reaching 21 hm^3 as projected.	I	Agriculture is given priority over the use of groundwater and, consequently, the urban supply is increasingly sourced from RO plants. Treated effluent is used in agriculture to address possible regional overexploitation of groundwater.
		II	A cut-back in groundwater abstraction is implemented in order to achieve a sustainable abstraction strategy allowing the setting up of a strategic groundwater reserve. Available groundwater is then allocated between the WSC and all other users. Because of the projected decrease in treated effluent availability, the proportion of groundwater allotted to agriculture should exceed that allotted to the WSC. Options involving artificial recharge of groundwater and improved rainwater harvesting will also have to be implemented in order to augment groundwater availability.
IV	Municipal demand decreases because of significant investments in local water reuse, while agricultural demand decreases to pre-EU accession levels (of 15 hm^3), driven mainly by market forces.	I	A cut-back in groundwater abstraction is implemented in order to achieve a sustainable abstraction strategy allowing the setting up of a strategic groundwater reserve. Available groundwater is then allocated between the WSC and all other users.

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IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE (CD 2000/60/EC) FOR SURFACE WATERS

Introduction

Traditionally, water scarcity and management has focused almost exclusively on groundwater abstraction and use. However modern policy has reinterpreted water management in a more holistic manner. This paper aims to present the complementary role and importance of surface waters within a wider water management perspective and is an expansion upon a presentation on the matter delivered by the authors at the APS Seminar held on 2 March 2007 entitled "Safeguarding the Water Resources of the Maltese Islands".

The Water Framework Directive (CD 2000/60/EC) (WFD) represents a major revision in water management and protection in Europe, through focusing on a more holistic approach based on the concept of river basins. The Water Framework Directive was transposed to Maltese legislation by the Water Policy Framework Regulations, 2004 (Legal Notice 194 of 2004) issued under both the Environment Protection Act of 2001 and the Malta Resources Authority Act of 2000. Both the Malta Environment and Planning Authority (MEPA) and the

Malta Resources Authority (MRA) are designated as competent authorities under these regulations.

MEPA is the Competent Authority for surface water, which includes coastal and territorial waters as well as inland surface waters found in protected areas or housing protected species.

Identification and assessment of status of surface water bodies

Water bodies are the basic units in the River Basin District to which the environmental objectives of the Directive must apply. The primary step in implementing the regulations was the characterisation of surface waters and assignment to specific 'types'. Various factors were taken into consideration, including depth, substratum and other characteristics such as pressures and impacts, including modifications, since each water body needs to be of homogenous status. This assessment was then used to identify discrete and significant water bodies. Coastal waters are designated from the coast up to one nautical mile from the baseline. Nineteen coastal water bodies and ten inland surface water bodies (rivers, lakes and transitional waters) were identified.

It is important to clarify the interpretation of the terms 'rivers' and 'lakes'. Malta has no rivers and lakes in the traditional sense. However the Water Framework Directive applies to all bodies of water and one of its main aims is the protection of terrestrial ecosystems and wetlands directly depending on the aquatic ecosystems. Specific guidance for Member States indicates that small, but significant water bodies still need to be identified as such within the context of the Directive. Within this

framework, and given the high ecological significance of a number of Malta's inland surface water bodies, which host a number of rare and endemic species, the following inland surface water bodies were identified: Wied tal-Lunzjata, Wied tal-Bahrija, Wied il-Luq, l-Ghadira, is-Simar, il-Qattara, l-Ghadira ta' Sarraflu, is-Salini, il-Maghluq ta' Marsascala, il-Ballut ta' Marsaxlokk. Figure 1 illustrates the identified surface water bodies.

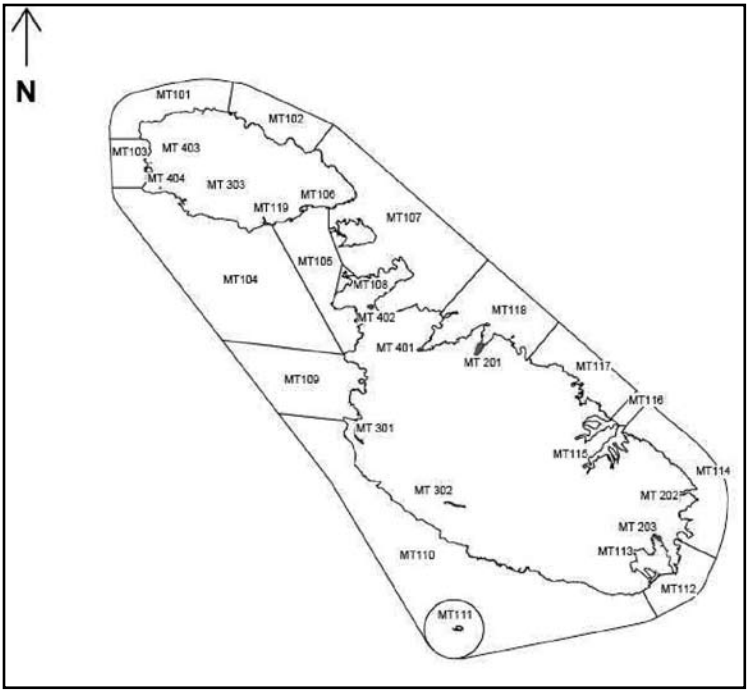

Figure 1: Identified surface water bodies for Malta

The different types of surface water bodies identified are detailed in Table 1.

Table 1: Characterisation of surface waters –results

Surface water Category	Number of types identified	Number of water bodies occurring in each type
Rivers	1	3 – calcareous, small, temporary
Lakes	1	4 – calcareous, small
Transitional	2	2 – polyhaline, permanent 1 – mesohaline, transient
Coastal	5	5 – rocky, intermediate 1 – rocky, deep 2 – sedimentary, shallow 5 – sedimentary, intermediate 6 – sedimentary, deep

The Directive acknowledges that water bodies may have undergone extensive hydromorphological changes over time, to accommodate human activities and economic drivers. Indeed, water bodies could have been artificially created where none existed before, due to human intervention. Member States may therefore opt to designate 'artificial water bodies' and 'heavily-modified water bodies'. Malta has provisionally identified eight (8) heavily modified water bodies and no artificial water bodies. The heavily modified water bodies identified are: il-Port ta' l-Imgarr, ic-Cirkewwa, il-Port Hieles, il-Port il-Kbir-Marsamxett, is-Salini, Bahrija valley system, Wied il-Luq and Wied tal-Lunzjata. Heavily modified water bodies need to achieve 'good ecological potential', rather than 'good ecological status'. Further work for the finalization of this designation is planned within the context of the water catchment management plan and the programme of measures as part of the implementation process of the Directive.

With water bodies clearly identified, the next task was the identification of significant pressures and the resultant risk of water bodies failing to achieve 'good ecological

status' by 2015. A significant pressure is considered as one which will cause a water body to fail to achieve good ecological status by 2015. Pressures on inland surface waters and coastal waters were identified and assessed based on the limited data available and expert judgement. The most important pressures on coastal waters were identified to be: the discharge of untreated urban wastewater, sludge disposal to sea and morphological alterations. The most significant pressures on rivers, lakes and transitional waters are pressures from agricultural activities, leaks from the sewerage system, abstractions, morphological alterations, littering and the introduction of alien species.

Economics

A holistic approach to management of water cannot exclude the economic context and driving forces behind water uses and resources. The Water Framework Directive integrates economics directly into the planning and management cycle for water, both explicitly in Article 5 and 9, as well as implicitly in other aspects such as the designation of heavilymodified and artificial water bodies.

MEPA carried out an analysis of surface water use as part of its implementation of Article 5. The study concluded that the contribution of coastal water-related activities to the Maltese economy is of the order of one-seventh, as they generate 13% of GDP and around 15% of employment. These are relatively high shares, indicating the fact that coastal resources are relatively abundant in Malta. On the other hand, inland surface waters are relatively scarce in Malta and their contribution to GDP

is minimal, consisting mainly of agricultural use and recreational, educational and touristic value.

The direct extraction of resources from coastal waters is an economic sector comprising mainly fishing, fish-farming and the provision of water services, contributing only 0.5% of GDP. More than two-thirds of activity within this sector is attributable to the provision of water services, including the production of potable water mainly through reverse-osmosis processes and sewage services, while fishing and fish-farming account for one-fourth of such activity. The fisheries industry in Malta is small, with the total number of full-time fishermen at fewer than 400, and mainly artisanal, there being less than 50 vessels which are considered to be industrial. Fish-farming on the other hand developed rapidly in Malta, with production rising ten-fold over the past decade to over 3,000 tonnes annually.

More than half of the coastal water-related economy in Malta is tourism. In total, tourism directly and indirectly generates around one-fifth of economic activity and one-fourth of export sales; and caters for over a million visitors annually, raising the effective population by around 7% on average and by around 11% during the peak seasons. This aggravates the pressures on coastal waters of a population density in excess of 1,200 persons per square kilometer, which is one of the highest in the world.

Another important element of coastal water activity is marine transport, which generates just over one-third of the contribution of the coastal water sector to the economy, or around 5% of the economy-wide activity. The main activities falling under marine transport are shipping, trans-shipment services, bunkering and yachting.

The lack of available economic information was an over-riding consideration in the compilation of this report for the economic analysis of surface water use in Malta.

This is partly due to the fact that this was the first time that such a study has been undertaken. A more in-depth cost-benefit consideration is planned for later stages in the conceptualization of the programme of measures.

Monitoring under the Directive

For Malta to achieve good ecological status/potential for its surface waters, it needs to confirm the Article 5 assessments and plan actions to achieve the objectives of the Directive where it has resulted that a status gap exists. One very important tool for this task is the monitoring of surface waters during which data for biological, chemical and hydromorphological parameters needs to be collected. The overall objective of monitoring is to establish a coherent and comprehensive overview of water status within the River Basin District and to allow the classification of all surface water bodies into one of five ecological status classes – high, good, moderate, poor, bad. The final ecological status is determined by the lower of the biological and chemical status.

The WFD requires Member States to set up three types of monitoring networks, each with its own specific roles. These are surveillance, operational and investigative. Although the WFD allows Member States to group water bodies of the same typology for monitoring purposes, Malta needs to monitor all bodies of surface water individually, in the light of the significant data gaps identified in its Article 5 report.

The objectives of surveillance monitoring of surface waters are to provide information for supplementing and validating the impact assessment procedure under Article 5 of the Directive and the assessment of long

term changes resulting from widespread anthropogenic activity. Surveillance monitoring under the WFD is a suitable opportunity to validate the characterisation results and gather consistent information on the state of surface waters within the Maltese River Basin District.

Operational monitoring of surface waters refers to monitoring for quality elements which are most sensitive to the pressures to which the body or bodies are subject. If a body is not identified as being at risk because of discharges of priority substances or other pollutants, no operational monitoring for these substances is required.

Investigative monitoring may be required in specified cases, such as when the reason for any exceedance is unknown or to ascertain the magnitude and impacts of accidental pollution. Investigative monitoring is thus designed to the specific case or problem being investigated.

MEPA has been carrying out monitoring of coastal waters for several years, although not to the degree and extent required by the WFD. Monitoring of inland surface waters is, on the other hand, a new endeavour, and greater efforts in this regard are needed. There is at present active work ongoing to finalise a holistic monitoring programme for surface waters, incorporating the necessary hydro-morphological, chemical and biological quality elements as required by the Directive.

The Programme of Measures and River Basin Management Plan

Monitoring results will feed into the river basin management plan and the programme of measures, which is essentially an action plan detailing how the water

bodies identified 'at risk' will achieve good ecological status/potential by 2015.

Diffuse pollution from agricultural sources has been identified as an important pressure on inland surface waters and, to a somewhat lesser degree, on coastal waters. In fact, nearly 21% of surface water bodies are considered to be at risk due to diffuse pollution in general In view of this, and subject to additional information obtained through monitoring, Malta's Programme of Measures will need to address this pressure. One important tool for consideration in this regard is the Nitrates Directive (CD 91/676/EEC), which has been transposed as LN 343/2001 under the Environment Protection Act of 2001. The aims of this Directive are both preventive and curative, though the management of activities giving rise to this diffuse pollution source. It seeks to identify areas of land which drain into waters affected by pollution and waters which could be affected by pollution if action is not taken. These areas are known as Nitrate Vulnerable Zones and all of Malta has been designated as such under LN 233/2004. Nitrate Vulnerable Zones are listed as protected areas under Annex IV of the Water Framework Directive. The implementation of the Nitrates Directive is a 'basic' measure under the WFD Programme of Measures.

Various instruments may be taken on board the Programme of Measures with specific relevance to diffuse agricultural pollution. These include the implementation of the action programme, the permitting of farm activities (individually or collectively through IPPC), sustainable pesticide use and cross compliance. MEPA needs to look closely at the opportunities these media provide for achievement of the WFD objectives for surface waters, including their predicted benefits as well as costs. Economic considerations will need to be looked into. In

fact, any programme of measures needs to be backed by solid economic evaluations of cost effectiveness.

The WFD also calls for the added protection of other protected areas as listed in its Annex VI, among these are areas that have been designated as Special Areas of Conservation (SACs) under the Habitats Directive (CD 92/43/EEC) and those designated as Special Protection Areas under the Birds Directive (CD 79/409/EEC). The inland surface waters and one coastal water identified by MEPA form parts of SACs and thus the Natura 2000 network. These areas host natural species and habitats of European and National importance, and thus their conservation status should be kept at favourable.

The protection of the water resources found in such protected areas can be achieved by a number of measures. Due to the large percentage of agricultural land that is found in them, the application of measures identified in the Rural Development Strategy for Malta may be beneficial towards the aims of the WFD. The EU's Rural Development Policy identifies the need for adequate land management to address the needs of EU Biodiversity legislation and WFD objectives. Other measures to improve the status of habitats and species found in protected areas include the proper implementation of the Code of Good Agricultural Practice, and measures to mitigate the reduction of surface water flow due to groundwater abstraction, amongst other factors.

Choosing the right set of 'tools' and using them together effectively will be an important challenge for every Member State. Involving and consulting the general public and stakeholders, and making sure that the right information reaches the right target group will be an important contribution to the successful achievement of good ecological status for all surface waters.

Paula Grech Bonnici, Manager - Laboratory,
Water Services Corporation

THE ROLE OF THE WATER SERVICES CORPORATION IN WATER MANAGEMENT

Introduction

The Water Services Corporation (WSC) is responsible to produce and distribute good quality potable water to consumers at the most economic value. Moreover, it is responsible to collect safely urban wastewater and to treat it prior to discharge into the seas.

The Water Services Corporation strives to achieve these objectives whilst abiding by the most stringent regulations and through constant improvements and investment in infrastructure. WSC pursues the objective of financial sustainability that can only be achieved with the cooperation of our customers, stakeholders and general public.

Use of Water Resources in WSC Operations

In Malta there are three types of Natural Water Resources:

1. The **Groundwater** – this is the water which is below the surface of the ground in the saturation zone

and which is in direct contact with the ground or subsoil.

2. The **Seawater**
3. The **Surface water** – also known as runoff water or stormwater

As we all agree, natural water resources should be safeguarded mainly from man's activities and from the direct or indirect effects of man's activities. These effects could be various like, for example, the misuse of the natural water resources or from over exploitation of these resources. Pollution or contamination of the resource with a chemical contaminant or a contaminant of a microbiological nature may result in a deleterious effect on either human health or on the quality of aquatic ecosystems or terrestrial ecosystems. This thus leads to damage of the material property and may result in the impairment or interference with amenities and other legitimate use of the environment.

Basically, such activities will lead to deterioration in the quality of the water resource, thus making it no longer fit for its intended purpose and may also lead to a reduction in volume of the resource, thus limiting its availability.

In its operations, the Water Services Corporation utilises groundwater. The water being abstracted from the ground may originate from two types of groundwater sources:

1. **The Pumping Stations** – These are groundwater sources having galleries that run horizontally just above the water table, converging to a point from where the water is abstracted.
2. **The Boreholes** – These being just a vertical shaft into the water table.

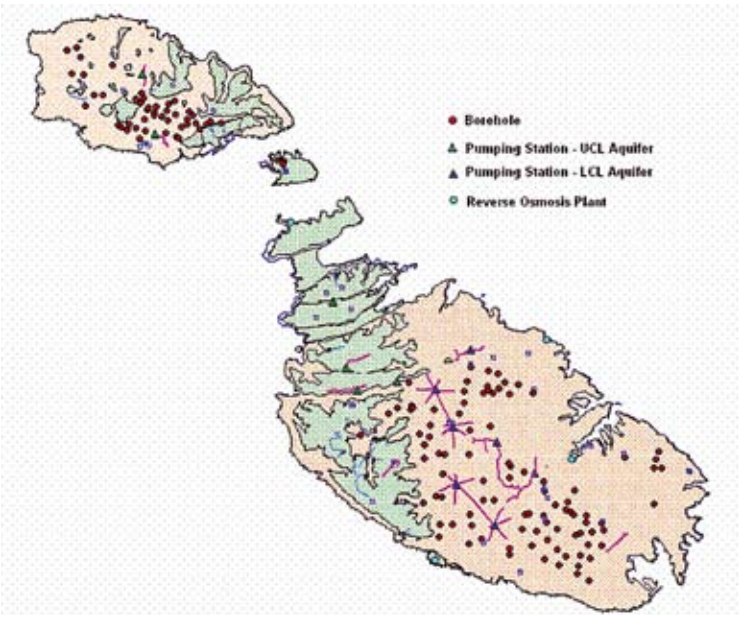

Figure 1 gives an illustration of the geographical position of groundwater sources used by WSC.

Basically, the WSC has 11 pumping stations and 90 boreholes in Malta and 2 pumping stations and 44 boreholes in Gozo. In total these have an extraction capacity of about 55,500m^3/day. A breakdown of the amount of groundwater extracted by WSC from Pumping stations and boreholes in Malta and Gozo is shown in Table 1.

Ground Water Sources	Malta		Gozo		Total	
	No	Capacity m3/day	No	Capacity m3/day	No	Capacity m3/day
Pumping Stations	11	23,000	2	800	13	23,800
Boreholes	90	22,700	44	9,000	134	31,700
Total		**45,700**		**9,800**		**55,500**

Table 1

The intended use of the groundwater by WSC is for potable means. Over the years, however, there has been an overall reduction in the use of groundwater by WSC as can be deduced from the figures quoted in Table 2. From Year 2002 to the following year, the total ground water extracted has been reduced by 46.4%, from Year 2003 to 2004 this has been reduced by 44.5% and from Year 2004 to Year 2005, there has been a reduction of 45.7%.

The deterioration of groundwater can also be seen from the graphical representation in Figure 2 which gives a plot of how an indicator parameter such as chlorides has increased over the years even though groundwater extraction by WSC has been decreased. In this graph, one can also observe the trend in quality with production over the past years.

Source	2002/2003			2003/2004			2004/2005		
	m3/annum	% Change	% Total	m3/annum	% Change	% Total	m3/annum	% Change	% Total
PS Malta	8,370,524	-4.8	24.6	8,130,712	-2.9	23.9	7,603,273	-6.5	24.2
PS Gozo	210,960	-13.5	0.6	117,580	-44.3	0.3	340,893	189.9	11
PS Total	8,581,484	-5.1	25.3	8,248,292	-3.9	24.3	7,944,157	-3.7	25.3
BH Malta	5,209,930	4.2	15.3	4,809,009	-7.7	14.2	4,393,710	-8.6	14
BH Gozo	1,964,516	-6.7	5.8	2,058,320	4.8	61	2,005,032	-2.6	6.4
BH Total	7,174,446	1	21.1	6,867,29	-4.3	20.2	6,399,741	-6.8	20.4
GW Malta	13,580,454	-2	40	12,939,721	-4.7	38.1	11,997,983	-7.3	38.3
GW Gozo	2,175,476	-7.4	6.4	2,175,900	0	6.4	2,345,925	7.8	7.5
GW Total	15,755,930	-2.8	46.4	15,115,621	-4.1	44.5	14,343,908	-5.1	45.7

Table 2

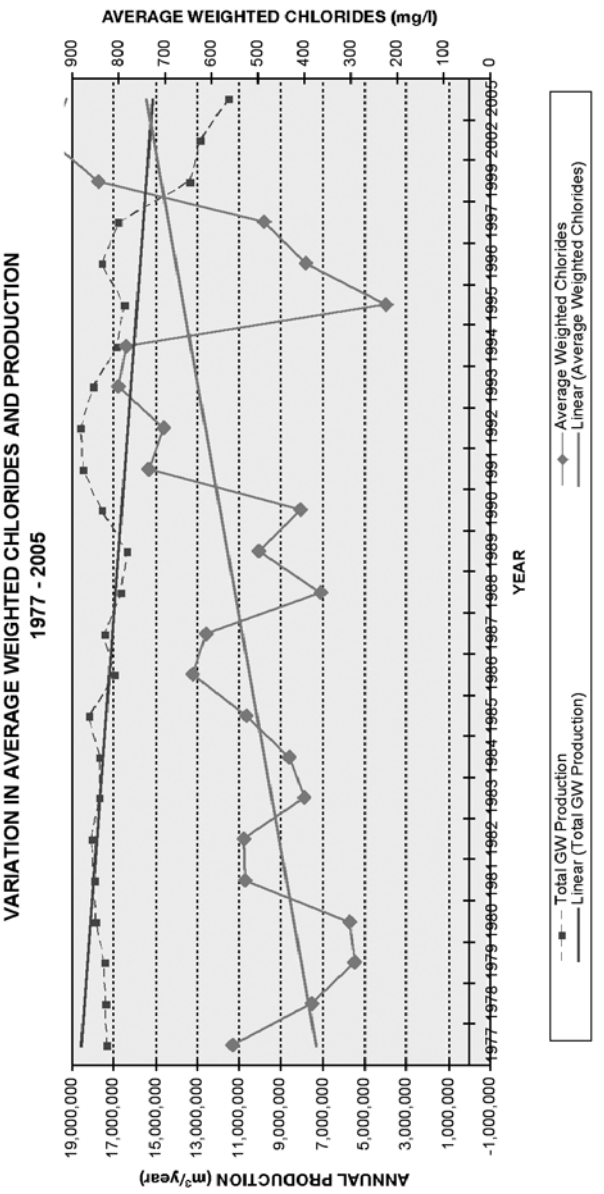

Figure 2: (Micallef P. Unpublished Ph.D)

This reduction in extraction has been attributed to the deterioration of the quality of the groundwater which could be due to various factors. Some of the factors affecting the quality of groundwater include surface man-made activities such as uncontrolled dumping in quarries, valleys and near groundwater extraction points; over extraction from sources; over-use of fertilizer and pesticides; sewerage leakages; toxic wastes and spillages such as oils and hydrocarbons. Figure 3 shows a diagrammatic representation of the groundwater pollution risks.

Consequently, because of such deterioration in groundwater quality, the WSC had to find alternative means of obtaining good quality potable water which is up to the Food Safety Act specifications (Legal Notice 23 and 116 of 2004) and EU directive 98/83/EC. Basically, this is presently being done by blending the groundwater

with water produced by Desalination in reservoirs prior to distribution.

The WSC owns 24 potable water reservoirs (17 in Malta, 6 in Gozo and 1 in Comino). The overall storage capacity of these reservoirs is around 350,000m^3 in Malta and 50,000m^3 in Gozo amounting to 400,000m^3 overall. Figure 4 illustrates the distribution system in Malta showing how the groundwater sources feed the reservoirs and are then blended with water from the Reverse Osmosis plants.

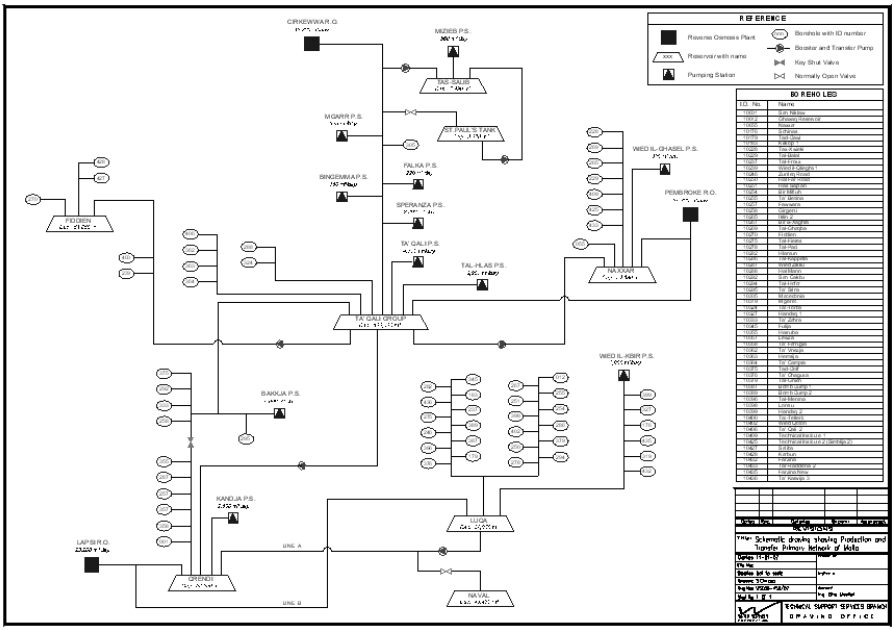

Figure 4

Consequently, the WSC makes use of another natural water resource in order to produce good quality drinking water. Potable water is produced from seawater using desalination plants. The use of desalinated water is an expensive solution but the only way WSC could achieve

its targets with respect to water quality. However, this solution is highly dependent on the quality of the Seawater. Therefore the whole population needs to safeguard the seawater resource since apart from being a natural environment having a lot of ecosystems of flora and fauna (all of which can be greatly affected by its pollution), it is used by bathers, and it is being used by industry for a variety of uses. It is also being used to produce potable water up to the required water quality standards. The quality of seawater may be affected by various sources and activities. These include any type of land-based pollution, the shipping industry, tourism, sewage contamination and illegal disposal or dumping into the sea.

The WSC owns three Seawater Reverse Osmosis plants (desalination plants). All three are situated in Malta but the water is also distributed to Gozo and Comino. One should note the strategic location of the Reverse Osmosis plants. This is important so that in the eventuality that there is a seawater contamination, not all RO plants would be affected and thus the WSC would not loose all three RO plants together. The WSC continuously monitors the seawater it is using for its desalinated plants and it has also established an open link with the civil protection department as a precautionary measure for the protection of the RO plants.

The largest Reverse Osmosis plant (RO plant) is the Pembroke RO plant and produces about 9,842,135m^3 which is 56% of the total amount of the water produced from desalination plants. The second largest plant is the Lapsi RO plant which produces 4,330,502m^3 amounting to about 26%. The smallest RO plant is the Cirkewwa plant. This produces about 3,272,655m^3 of water and amounts to about 19% of the total amount of desalinated water

produced by the WSC. (Refer to Figure 5) Between the three RO plants, there is a production of approximately 17,445,292 m^3 per annum. This amounts to about 57% of the overall water being distributed in the water mains.

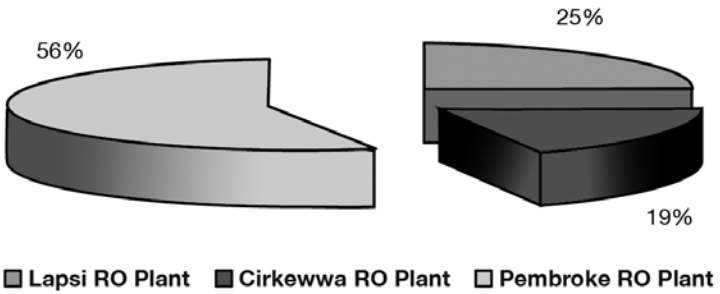

Figure 5

Table 3 gives the production levels and trends from Year 1997 – 2006. It shows that the production from RO plants has increased by 2.7% over the previous year.

Year	Production	Lapsi	Cirkewwa	Pembroke	Subtotal Seawater Plants
1997 – 1998	**Production m3 % Difference over previous year**	5,717,995 -7.54%	3,777,559 +0.89%	11,753,338 -11.95%	**21,248,892 -8.83%**
1998 – 1999	**Production m3 % Difference over previous year**	3,933,032 -31.22%	3,787,597 +0.27%	10,566,473 -10.1%	**18,287,102 -13.94%**
1999 – 2000	**Production m3 % Difference over previous year**	3,511,275 -10.72%	3,669,047 -3.13%	10,079,919 -4.60%	**17,260,241 -5.62%**
2000 – 2001	**Production m3 % Difference over previous year**	3,088,413 -12.04%	3,704,523 -0.96%	9,789,731 -2.87%	**16,582,667 -3.93%**
2001 – 2002	**Production m3 % Difference over previous year**	3,547,538 +14.87%	3,970,447 +7.18%	10,413,776 +6.37%	**17,931,761 +8.13%**
2002 – 2003	**Production m3 % Difference over previous year**	3,829,721 + 8.83%	4,046,030 + 1.97%	10,352,358 - 0.60%	**18,228,109 +1.66%**
2003 – 2004	**Production m3 % Difference over previous year**	4,250,263 +10.98%	3,706,696 -8.39%	10,945,033 +5.73%	**18,901,992 +3.70%**
2004 – 2005	**Production m3 % Difference over previous year**	4,040,670 -4.93%	3,256,417 -12.15%	9,689,635 -11.47%	**16,986,722 -10.13%**
2005 - 2006	**Production m3 % Difference over previous year**	4,330,502 + 7.17%	3,272,655 +0.5%	9,942,135 +2.61%	**17,445,292 +2.7%**

Figure 6 gives a graphical representation of the overall blending ratios of water being produced from desalinated plants and groundwater during the past years. As depicted, the overall use of desalinated water has been on the increase over the past years. As already stated above, the reason for this increase has been the deterioration of groundwater quality.

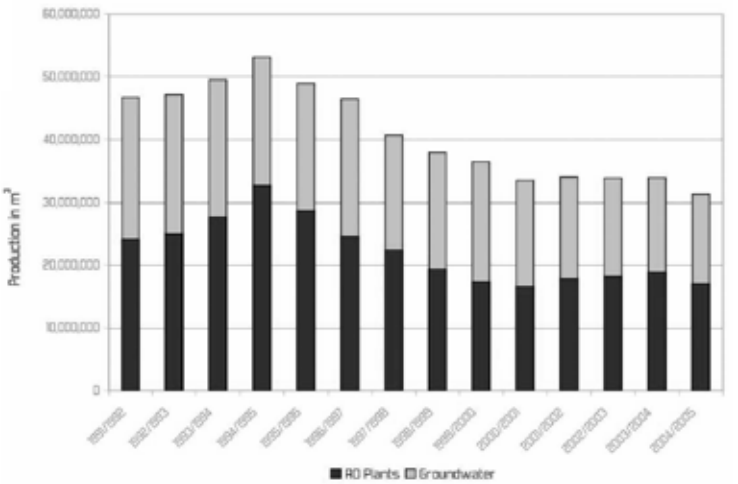

Figure 6

WSC General Operations and Initiatives to Safeguard Water Resources

The WSC has always been foremost in taking certain initiatives in order to safeguard water resources. This is seen throughout its general operations.

- The WSC co-operates with the Malta Resources Authority in protecting the water resources in the Maltese Islands.

- It uses groundwater wisely in order to prevent its deterioration and in so doing reducing the level of purification treatment required in the production of drinking water.
- It has performed a lot of work in reducing leakages in the potable water system. One should appreciate that the 3,900m^3/hr of unaccounted for water in Year 1995 was reduced to about 590m^3/hr in Year 2006. Consequently, the Infrastructure Leakage Index (ILI) was reduced from over 10 to 2.6.
- The WSC has strict control over the potable water which it is extracting, producing and distributing through extensive and rigorous monitoring programmes. This is not only essential in determining the quality of water being distributed to the consumers but also in determining the blending capabilities. Such monitoring is performed at its own laboratory which was the first laboratory to be locally awarded laboratory accreditation to the ISO 17025 standard by both the United Kingdom Accreditation Services (UKAS) and the National Accreditation Body (NAB-MALTA). This accreditation was first awarded in Year 2004.
- By the end of Year 2008, the WSC will have completed three new Urban Wastewater Treatment Plants which shall be located :
  - In ic-Cumnija, limits of Mellieha. This shall be producing about 2.5 Mm^3/year of treated sewage effluent.
  - At Ta' Mgarr ix-Xini, limits of Ghajnsielem Gozo. This shall be producing about 2.2 Mm^3/ year of treated sewage effluent.
  - And at Ta' Barkat, limits of Xghajra in the south of Malta. This shall be producing about 21.9 Mm^3/ year of treated sewage effluent.

The Sewage Treatment Plants shall improve the quality of the marine environment in line with the requirements of the EU Urban Wastewater Directive (91/271/EC). It will virtually eliminate raw sewage contamination of beaches and bays like Ghajn Tuffieha Bay, Gnejna Bay, Anchor Bay and Paradise Bay and will also address marine pollution in Kalkara, Xghajra, Marsascala and Marsaxlokk.

- The WSC has set up the Sewage Discharge Permit Unit so as to be able to control better the various types of contaminants that are reaching the sewers from industry, small and medium enterprises, agricultural sector, hotels and restaurants and other trading establishments. Improvement and control of the quality of the incoming effluent will result in better quality of the treated effluent from the sewage treatment plants. This results in better re-use options of the treated effluent and better acceptability of the treated effluent.
- The WSC is investing heavily in the improvement of the sewerage network system. It is changing pipes and performing various other work. The less breakages and less blockages there are in the network system, the less leakage there is, thus the less likely there is groundwater contamination with raw sewage.
- Various other projects are underway by the Wastewater Operations Unit of the WSC in order to tackle two particular problems it is presently facing. The first being the illegal domestic connection of storm water overflows to the sewer network like yards, roofs, cisterns and storm water infiltration from surface run off through manhole covers. The second problem is the infiltrations from seawater to low lying sewers and pumping station sumps which have to be made water tight.
- The WSC has set up a new wastewater laboratory in order to assist the operations of the three sewage

treatment plants once they are in operation, to assist the wastewater operations in terms of leakage detection, to monitor closely what is being discharged into the sewage network by third parties and thus enable the WSC to regulate this operation better and also to monitor the quality of the effluent of the sewage treatment plants in order to ensure that legal notice specifications are met.

- The WSC, through its research and development section, also actively participates in research projects on the re-use of storm water and treatment of secondary class water. Recently, it has embarked on the formulation of a Storm Water Masterplan for the Maltese Islands. Its aim is to provide sustainable solutions to the flood hazards whilst creating the potential for the establishment of profitable multi-purpose water utilisations systems.
- The WSC has always sought to educate its customers on the use of water wisely.

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Joseph Borg, Consultant, APS Consult

EVERY DROP COUNTS

Global Warming

The United Nations' IPCC February report of this year, drawn up by around 2500 scientists hailing from over 130 countries, has confirmed its 2001 suspicions that global warming is caused by man [IPCC 2007]. It forecasts a scenario of rising temperatures, the occurrence of floods, a rise in sea water level caused by the high rate of melting of the Antarctica and Greenland glaciers and a reduction in rainfall.

Over the last 100 years, Africa's mountain Kilimanjaro recorded a drop in rainfall levels on its slope by 30%. Its glaciers have lost more than 80% of their area since 1912 [Andreas Hemp, 2006]

Mild winters in northern and central Europe this year have resulted in more glaciers of mountains in Europe melting at an abnormal rate.

Knowing and experiencing all this, what are the responsibilities and expectations of Maltese farmers? We know that underground water in Malta, being a national commodity, is protected by our Constitution. Therefore it is every citizen's duty to protect it rather than to

egoistically exploit it. It is the duty of the Malta Resources Authority, since 2001, to regulate it.

Local Scenario

Our Meteorological office declared January 2007 as the hottest month on record. It registered 2.5 degrees Celsius above average, while January of last year was the second wettest in 83 years. April 2006 was warmest and driest in 84 years. May 2006 was a warmer and drier than average when the 23rd of that month reached a temperature of 35.3 degrees C- the warmest on record. Last December was the second warmest since 1922. Therefore we are experiencing higher temperatures, lower rainfalls and irregular patterns of rainfall and of temperature regimes

We can list the effects of all this quite simply. Farmers have increased their irrigation programmes, hence more water extraction from impoundments, cisterns, springs and boreholes. This is leading to more pressure on our water resources. Our acquifers have a total production capacity of approximately 28 million cu. mtrs per annum. But extraction is estimated to be more, namely around 31 million cu. mtrs p.a. [J.Mangion , 2001]. MEPA, in its 2005 State of the Environment Report, states that for the year 2003, it estimated private water extraction accounted for 30% of total water extraction Recently, extraction for irrigation purposes was estimated to be up to 43 % of the total productive capacity of the acquifers [Delia, 2005]. This over-extraction has contributed to increased salinity and nitrate contents, which definitely affects the choice of crops to be grown as well as their quality. The effects of the expected 20% drop in rainfall levels as well as the 3 degrees rise in temperature during this century must

be understood by all stakeholders, including the farmer. Another problem is that if sea water levels rise, this exerts more negative pressure on the mean sea level acquifers.

To-date only the Water Services Corporation meters its water extraction from the acquifers. Private individuals, farmers, firms, contractors, etc extract water at will.

It is opportune to note that 3000 registered bore holes [actual number was 3027] during the study period of 1976/78 carried out by the Centro Studii Ricerche of Catania [CSR 1976 / 78], were registered as follows:

- 1626 extraction by hand / wind pumps
- 248 extraction by pumps
- 70 extraction by auxiliary pumps

A census carried out in 1998, twenty years later, following the publishing of Legal Notice 120/ 1997, on bore holes, registered 800 new wells in addition to about 3000 existing [and only registered] ones [Mangion, 2001]. The present situation, if anything, now is worse.

The sharp increase in extraction as well as in the drilling of more bore holes is due to:

- More efficient pumps, especially submersible ones.
- More efficient and less bulky [hence less obtrusive] drilling equipment.
- Political inertia by successive governments to enforce existing regulations even though this problem is officially acknowledged in official reports [SOE 2005]
- The increased accessibility to use the main grid of electricity and the use of mobile, efficient generators even in remote areas.
- The low fees, charged by pirate contractors for illegal drilling which is estimated at something between Lm 1 to Lm 1,25 per 30cm [approx. 1 foot] depth. This means that for a 30mtrs [100 foot] shaft it costs less than Lm

150, which in addition to the cost of a submersible pump as well as running costs, work out cheaper than buying water in bulk, by bowser at 50 c per cubic metre [Cremona, 2007]

- Increased demand by the commercial and tourism sectors and also by swimming – pool owners.

What should be done by…..

A] THE FARMER , THE GROWER, THE LIVESTOCK BREEDER?

Registering and metering Boreholes.

The only solution, advocated by experts but never implemented, is to register all boreholes and springs within a fixed time frame, offering a reprieve and other incentives [indicated further on] and to have them fixed with a meter. It is a bitter pill to swallow, but it is essential for future generations.

The installation of a meter in a borehole, conditions the owner to know the exact amount of water he is using for each operation [whether for irrigation or otherwise]. This helps the farmer not only to give his crops only the amount of water they actually need, thus avoiding wastage of water and fuel, but also to see which crops are financially viable for irrigation.

One would immediately think that once a meter is fixed a charge per cubic metre of water extracted will follow. This line of reasoning is not off the mark. It is opportune to mention that the EU Water Framework Directive requires member states to adopt a Water pricing policy by

the year 2010. Knowing that the acquifers in any country are administered by the Authorities for the common good of the entire population, member states of the E U have to adopt water pricing policies which should also take into consideration social and economic conditions of the country. Costings of the Water Services Corporation of water production from bore holes, works out at 5c5 per cubic mtr [The Times, Malta, 8.11.06 –Parliamentary Question]. This figure does not include capital expenses, depreciation and distribution costs.

This process of metering of boreholes could commence in tandem with the process of connecting farms to the treated water networks as the sewage treatment plants come into operation. This exercise could form part of a reprieve to owners of illegal boreholes, once they accept to register and meter the boreholes. Since the authorities have ample means to trace illegal boreholes a period of grace for registering illegal boreholes would encourage voluntary registration.

In dry winters, as is the case this winter, the Catholic Bishops in the Maltese Islands recommend prayers for rain. Has the owner of an illegal borehole ever thought of the fact that while praying for rain he is being a hypocrite? Asking for rain to enable him to draw more water from his bore hole at the expense of the common good?

Government has stated that, apart from the commissioning of the two sewage treatment plants now under construction in Mellieha and in Gozo, by the middle of this year, another large plant at Xghajra, to cater for approximately 80% of waste water generated in Malta, is expected to come into operation within the next two years [Minister A. Gatt –The Times, Malta 22.10.06] This means that large amounts of treated water will become available to both agriculture and to industry. Depending on the

level of polishing of treated water, there is a possibility that not all the 80% of the sewage could be treated for agriculture because a portion of the sewage originating from the harbour area might be diluted by sea water leakages.

In our opinion another important element is the upgrading and the extending of the distribution network of the treated water produced at Sant'Antnin. The rudimentary and wasteful use of open stone channels should be replaced by a piped network reaching the dockyard and the industrial estates of Zejtun and Marsa. [J Borg, 1998]. All service connections to the treated water distribution network will obviously have to be metered.

In passing, one should also mention the often suggested proposal to seriously consider re-charging the water table with well polished treated water. [Mangion, 2001].

Impoundments in valleys

Although Malta alone has a surface area of less than 300 sq. km, it offers a great variety and diversity in valleys. Major valley systems extend for approximately 100 km, while minor ones almost double that figure. Fields and farms bordering valleys have been drawing water from impoundments and dams since the time they were constructed by the Knights of Malta or the British Colonial Government or successive governments. The strategic importance of fields flanking valleys cannot be under estimated. But here, farmers and growers also have a duty to protect the valley and its water quality. The use of agro chemicals in these areas should be used with extreme care and only when in dire need so as not to increase the pollution of the water course. The horrible

example of one farmer should never even cross our mind. I met a farmer who boasted that he fertilizes his crops whilst watering them, not by using a diluter, but by pouring a measure of sulphate of ammonia in his borehole and then pump the water so 'fertilized'! The only way I think I have persuaded him to stop this practice, harmful to the water table, was by pointing out that his neighbour was never seen carrying fertilizer bags in his field as the latter's borehole was also receiving a dosage of fertilizer from his actions!

This diligence should also be applied to the physical management of these fields. Breaches in retaining walls need to be repaired to prevent soil erosion. Soil erosion leads to the accumulation of silt in the impoundments to the detriment of the impoundments' capacity to hold water [Yussuf, 1975]. Soil erosion lowers the depth of soil in the field which in turn will need more watering.

Prunings and unwanted vegetation should never be dumped in the valley not only to avoid the spreading of pests and diseases, but also to avoid obstructing the water flow.

Where possible, especially on escarpments flanking the valley, the spontaneous vegetation of the flora should be left growing because vegetation has a cleaning effect of run off rain water [S.M. Haslam, J. Borg 1998].

The on-going campaign by the authorities, vintners, farmers, NGOs, to plant more trees, vines and olives should be continued as much as possible without abatement. Tree planting helps to recharge the water table [J. Borg 2005]

Farmers should take extreme care in disposing of agro chemicals and fuels. One gallon of petrol can contaminate 750,000 gallons of water in the acquifer [Haslam and Borg, 1998].

Choosing crop varieties

The choice of crop and fruit tree varieties should be based not only on yield levels but also on their water requirements. Choosing seeds and stock plants which have a higher degree of drought tolerance should be borne in mind now and more so in the future.

We must not discard our landraces of fodder crops, vegetables, vines and fruit trees as these have withstood the test of time over the years [Borg, 2001]. It is a step in the right direction that a start has been made by the Ministry for Rural Affairs and the Environment to identify and register local varieties of vines, olives and fruit trees and to the use of a gene bank [Maureen Delia, 2007].

B] BY THE AUTHORITIES ?

Advisory service

Drawing on experience acquired when the Sant' Antnin treated water was made available for the first time to farmers in the south who were not experienced in irrigated farming, I see the need for the authorities to immediately launch an intense advisory programme [farmers meetings, visits, demonstrations of equipment etc] targeted to farmers who will be serviced with treated water in both Malta and Gozo.

Public reservoirs and impoundments

There are in Malta & Gozo a substantial amount of public reservoirs, underground water storage structures

and impoundments in valleys. Their existence and whereabouts, a list has been published by the author [Borg, 2002], should not be forgotten. There are over 80 underground reservoirs, mostly old village tanks, as well as over 40 dams in Malta alone. A survey of the state of these reservoirs and impoundments should be carried out urgently in order to assess what repairs need to be done. A management plan for both public reservoirs and impoundments is also needed in order to maximize their potentiality in the preservation of run- off rain water.

Monitoring of possible pollution levels

The frequent monitoring of the quality of run off rain water in valleys need to be taken seriously. A visual check on the species of aquatic plants present along water courses should initially be enough to ascertain if chemical analysis are needed, since water plants found in valley water courses are good pollution indicators. Plants are very sensitive to the condition they live in. It is a known fact that species of the wild flora do not tolerate the same levels of pollution found in impoundments and in water courses.[SM Halsam, J. Borg 2000]. Hence the monitoring, by the Authorities between autumn and spring, of macrophytes [aquatic plants] as pollution indicators, is a quick, inexpensive method of grading pollution levels.

Building permits and cisterns

Once the Malta Environment and Planning Authority, is allowing the construction of deep basements in new developments, the age old tradition [or obligation] of having

a cistern in each house or building, is being abandoned. Although there might be technical reasons for allowing this to happen, yet , in my opinion, it can be remedied by taking alternative action. One could build more communal reservoirs for entire government housing estates [as has been done in some parts of government housing estates in Zejtun and San Gwann]. This suggestion applies for industrial estates too. There is also an opportunity for more built up areas to channel or direct their run-off rain water into valleys carrying impoundments. In this case, depending on possible pollution levels caused by road traffic and by raw sewage leakages, steps should be taken to mitigate these pollution levels.

Non farming activity

Since water extraction by non- government entities is not metered, one cannot quantify it [SOE 205] However it is a fact that apart from agriculture the leisure sector and industry, there are private individuals who have a swimming pool in their residences. They, too, have a finger in the pie, since most of the water they require is extracted from the aquifer whether legally or not. Therefore, a well managed network of public reservoirs as well as the use of treated effluent [especially for industry] can come into play as an alternative source of second class water to borehole water.

Land Tenure and Soil Improvement

The question of land tenure needs to be tackled by the authorities at least in so far as government owned land

is concerned [Borg, 2005] The building of reservoirs, and the maintenance of retaining walls warrant substantial investment, therefore farmers, as other investors, are entitled to a long tenure agreement.

Shallow soils dry faster, hence attracting more irrigation frequencies. Therefore increasing the depth of soil in shallow fields will result in reducing water requirements of crops. Apart from the diligent application of the Soil Preservation measures [L.N.6 of 1970], the authorities could look into the possibility of utilizing the material and debris of the old Luqa tip [in Valletta road] which was accumulated in an era of time before the advent of plastic and of large scale industrial waste, to produce a basic growing medium already containing a high amount of organic matter [J. Borg 1998]. A small trial using this material for a tree planting project in the Marsa industrial estate in the early nineties, was successful. This, in addition to compost produced locally by Wasteserv, offers an opportunity to increase soil depth in shallow fields.

International Technical collaboration

Technical collaboration between local government institutions and foreign stations or Institutions specialized in the various sectors of agriculture is of paramount importance. However due to global warming, contacts with institutions in the Middle East and North Africa should be increased. These countries have had to face drought over a long period of time and so reputable institutions, such as ICARDA [International Centre for Agricultural Research in Dry Areas] of Syria, can offer invaluable help. This Centre, for instance, has carried out extensive research on wheat, barley and other

crops, tolerant to heat and drought. In the animal sector ICARDA made genetic improvements in various breeds of sheep leading to increased milk and meat production in low rain fall farms. Research on the use of industrial by-products, such as brewery grain, poultry litter, olive seed cake and other by products for the production of feed blocks for sheep feeding, gave positive results. [ICARDA, 1997]. There are other renowned centres in the Middle East which with ICARDA form a network of expertise for tackling problems of dry areas. It is in Malta's interest to tap this source.

C] BY LOCAL COUNCILS ?

Our Local Councils, also have a responsibility towards preserving our water resources. It is worrying to note that a number of local councils, whether in rural areas or close to the sea shore, use herbicides to control weeds. Whereas in Denmark [a high rainfall country], a buffer strip 2 mtrs wide of spontaneous vegetation is now required by law all along streams [S.M. Haslam 2000], to help in the purification of water run off, we, in a dry country are still using herbicides. In my opinion local authorities should only use this method of weed control after obtaining expert advice and after assessing other methods of weed control. One must bear in mind that run off rain water from streets, buildings, alleys, etc. especially in rural areas is often channeled to cisterns. Polluted water does not help farmers, growers and other consumers.

Conclusion

The most awe inspiring creations are the sun and water.

Even in Biblical times, well waters were sacred [Jacob's well]. The Catholic church uses water, made holy by blessing. St. Francis refers to sister water, precious and pure.

In St. Paul's Bay a spring carries a marble slab proclaiming in Latin that " *the spring beneath the stone on the coast was opened by St. Paul the Apostle. Those who pass by salute it with your hearts while remembering it was brought forth by St. Paul himself who was saved from drowning*".

And yet we, these islands' inhabitants, first managed to pollute it, because up to a few years ago a notice was still there affixed to the fountain, carrying the warning "UNFIT FOR DRINKING' and now the spring has run dry! Even Holy water now is not protected from our actions!

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