MALTA RESOURCES AUTHORITY

Economic Characterisation of the Maltese Water Catchment District

Status: Draft
Date: November 2004

Malta Resources Authority
Millenia - Aldo Moro Road - Marsa LQA 06
Tel: 00356 22955110 Fax: 00356 22955200
E-mail: ceo@mra.org.mt

TABLE OF CONTENTS

EXECUTIVE SUMMARY

1. This report examines the economic characteristics of the Maltese Water Catchment District in the context of the requisites of the Water Framework Directive that have to be met by 2004.
2. Surface water and ground water are renewable natural resources. Long-term planning and early actions are necessary to ensure the good status of these waters. By 2010 the Water Resource Authorities must put in place water pricing policies that act as an incentive for a more efficient water use and, at the same time, recover costs of water services. This general rule will be implemented after consideration is given to the social and economic effects of the recovery mechanism as well as the geographical and climatic conditions of the region.
3. The report is developed as follows. An outline of the water management organisation in the Maltese Catchment Basin; ii) a discussion of the socio-economic characteristics of the basin; iii) a presentation of the envisaged baseline scenario for the years' ahead; and iv) an overview of the current level of cost recovery. The main findings, policy recommendations and areas for future research conclude the study.

I Water Management Organisation in the Maltese Islands

4. Two Authorities, the Malta Resource Authority and the Malta Environment and Planning Authority, are responsible for inland and coastal waters, respectively.
5. Public and private producers assure the production and distribution of drinking water. The Water Services Corporation produces and distributes tap potable water. This water is a mixture of desalinated water produced by the Malta Desalination Services Ltd. and ground water. Private firms bottle drinking water and distributes it via retail outlets or directly in economic, large bottles.
6. The Water Services Corporation has been recently entrusted with the management of a wastewater treatment plant. It is responsible at the national level for the collection and treatment of water. The WSC plans to construct three new plants, two in Malta and one in Gozo.
7. In the absence of a connection to the national sewage network, households are bound to collect wastewater in suitably controlled cesspits.

II Demographic, Social and Economic Characteristics of the Water Basin

Population and Housing

8. The Maltese population was 388,000 in 2003. There were another 10,000 permanent foreign residents. If account is taken of the million-plus holidaymakers, the aggregate total population in Malta in 2003 rises to 427,000.
9. Given the past trends in the rate of natural increase of population, the Maltese population is projected to rise to 425,000 by 2025, thereafter falling to 360,000 by 2060.

10. Life expectancy at birth for males is 76 years and for females it is 81 years. At age 65, life expectancy is 15 years for males and 19 years for females.
11. A growing household population is projected: from 119,479 households in 1995,the census year, they are envisaged to grow to 145,639 in 2010 and to 159,926 in 2020. The distribution of this household stock will not undergo significant change but certain population movements have to be anticipated in advance to adjust water supply accordingly. Thus the Grand Harbour area will decline from 9% to 6%. The North Harbour Area will rise marginally from 17% to 18% and the North West Area from 8% to 10%.
12. A higher dwelling density trend is observed taking place. But in the absence of micro-area studies it is difficult to analyse the actual changes under way in terms of population density and the concomitant public utility services, water included, that go with them.

Agriculture

13. Agricultural land covers an area of 11,620ha of which 9,394 are in Malta and 2,226 ha are in Gozo. Agriculture land covers three main categories: dry-farmed land, irrigated land and unutilised garigue land, which covers all non-productive registered agricultural land and represents 13% of total area.
14. The first two categories represent the total agricultural land, which is further sub-divided into two, namely, uncultivated land and utilised agricultural area (UAA) that include arable land, vineyards and orchards.
15. In the past two decades, there has been a significant shift in the type of agricultural land from 'dry' land to irrigated land. It reached 1,509ha in 2001. Sixty four percent of irrigated land is found in the Western and Northern districts with predominance in the area of St Paul's Bay.
16. The average size of holdings is in the 0.88ha to 0.98ha range. Forty six per cent of all agricultural holdings have utilised agricultural area of less than 0.5ha.
17. The structure of farming is very similar in Malta and Gozo. Very few holdings engaged in livestock, ruminants and poultry industry have agricultural land. The majority of farming in agriculture is used to grow crops. Utilised agriculture land can be divided into three categories: arable land, land used under a system of crop rotation, making up 86% of land; kitchen gardens, small plots intended for self-consumption, and amounting to 4% of land; and permanent crops, which are plots of land on which a crop is grown for a period of time normally five years or more.
18. Recently, there has been a shift from fallow land to area under forage, fruit and vegetable. The share of land under potatoes has remained relatively unchanged. The area under crops increased mainly due to an increase of land under vines, which grew from 480ha in 2001 to 615ha in 2003.
19. In 2003, there were18, 600 cattle, 76,000 pigs and 1.4million poultry.
20. Total Final Production of the Agricultural sector at basic prices amounted to Lm56.6million in 2003. Of these, Lm27.2million represent intermediate consumption and Lm29.4million Gross Value Added. Net income at factor prices after allowing for fixed capital formation and subsidies amounts to Lm27.9million of which Lm25.3million, i.e.90.7%, represents entrepreneurial income. Only 4.8% are

paid in wages. Agriculture is mainly a family concern with only a small amount of full-time workers that are salaried.

21. There were 10989 holdings employing 17867 persons in 2003. The majority of workers are males. The total effort in agriculture amounts to 4480 annual work units (AWUs). One AWU is equivalent to 1,800 hours i.e. the time worked by one full time employed person over a period of one year. Only 1579 of the 17867 farmers are full time. The majority of holdings, 5127, are owned by part-time, sole-holder managers who have a major activity outside agriculture. Forty five percent of these land-holders are aged between 45 and 54 years of age.

The Tourism Sector

22. The services gained ascendancy in Malta's economy. It makes up 48% of Gross Domestic Product. Tourism is this sector's main contributor with output representing around 25% of GDP.
23. One million and one hundred thousand visitors came to Malta on holiday, on average, in recent years. They accounted for 11.7 million bednights and generated annual incomes in excess of Lm250million. Earnings from tourism have been declining recently as a share of earning from exports of goods and services. They were 21% in 1999 and 17% in 2002.
24. The capacity of the leisure industry is underutilized. The present plant can support a much higher number of visitors provided that the additional tourists are spread more evenly throughout the year. A Master Plan for the sector, prepared in the early nineties, targeted 1.4million tourists a year. Direct employment in hotels and catering establishments averages about 9,400 jobs.

The Manufacturing Sector

25. The Manufacturing sector accounts for 23% of GDP and employs 27,700 workers, representing 20% of the gainfully occupied. The sector is undergoing a gradual transformation moving to higher capital per employee as the production cost structure changes in the wake of rising costs.
26. Those industries that catered for the local market had operated for many years under a sheltered environment, via a network of tariffs and quotas. But these units are now exposed to competition following Malta's membership of the EU. This is especially true of the units in the agriculture-production sector. They have to be much more cost conscious if they are to be profitable and survive.
27. A proper accounting for water as an input in those industries that consume this commodity in substantial quantities is a necessary undertaking. Failure to account for such an important input will affect negatively the competitive stand of the firms involved

111 The Demand for Water

28. The aggregate demand for water in the Maltese Islands emanates from households and industry. Demand is influenced by habits, the effectiveness of control systems and pricing strategies operated over time.
29. The economic significance of water is difficult to measure. So we proceed to describe the utility of water as this emerges from different indicators. These include the money outlay per period by different water consumers or the share of water costs in total production measured by the value added of an economic activity.
30. The amount of water consumed has been a moot issue. Official data based on billed consumption indicate a 'demand' in the 18million m^3 annually, and suggest that households are the prime consumers. However, independent estimates based on the water needs of different sectors yield annual consumption in the 38million m^3 region. The significant element in this wide gap is Agriculture. A minimum threshold of 14million m^3 annually, which is not registered, is attributed to Agriculture. The importance of this missing element, and other adjustments in consumption by other sectors, cannot be emphasized enough. The sustainability of potable water supply depends on the rate at which groundwater is being absorbed by the community. At the same time, the use of this water input has to be properly accounted for in the cost configuration of industry and services, but mainly in agriculture.

Demand for Water by Households

31. The share of expenditure by Maltese households on water is incorporated with their outlay on electricity, gas and fuels. Altogether, this money outlay represents 2.25% of the expenditure by the 'average' Maltese household.
32. The pricing of water has long been a sensitive political and social issue. Government subsidies ensured price stability for extensive periods for household consumption of water. Annual consumption of water per head of population increased from 28m^3 in 1989 to 34.7m^3 in 1996 thereafter falling again to 28m^3 in 1998 and 1999.
33. Estimates of price elasticity of demand for water, using time series data, yield a short run elasticity coefficient of –0.28 and a long run elasticity coefficient of –0.37. These values suggest that, in general, the response by Maltese households to the price changes that prevailed in the past seems to respond after some time. Hence, although overall price elasticity is relatively inelastic, yet there are indications that households do respond to price changes once they are given time to adapt.
34. Results on households' consumption of water, their reactions to the quality of tap water they consume, and preferences regarding their willingness to pay may be observed from a consumer survey carried out for this study. Tap water is used by 68% of households for cooking and drinking, but almost all households (91%) use it for bathrooms and laundry. It is used by a third of households to water plants and trees.
35. One half of households use bottled water for drinking/cooking. Water Cisterns, the traditional 'providers' of rainwater in homes, account for 6% of water used for cooking and drinking. But they are used by 17% of households for laundry and by 28% for gardening.

36. Households supplement tap water by bottled water because they consider tap water to be inferior in quality. Fifty six percent of households regard tap water quality to be poor or inferior. Only 12% of households consider tap water as 'excellent' for drinking purpose.
37. Sixty percent of households surveyed are not prepared to pay more for tap water. They consider the existing tariffs to be fair in relation to the quality of water they receive in the home. At present, households consume on average 18 litres of bottled water per week.
38. Maltese households are aware of the possibility of using recycled water. A small number of households already generate their own recycled water for bathroom use. However, 54% replied that they are not prepared to consider use of recycled water. The other 46% will consider using recycled water for domestic use or gardening as long as it is 'guaranteed' safe for health purposes.
39. Recycled water will be reconsidered if no extra charges than at present are included.

Demand for Water by the Manufacturing Industry

40. Industry uses water either as an intermediate input or as a final product for sale. This latter position is the case of the Water Services Corporation, the national supplier of piped water to households and industrial units, and of suppliers of bottled water.
41. Water as an intermediate input varies from one industrial sector to another. According to official input-output data, which relies on billed returns for water, the demand for water is relatively low in relation to output. It falls in the 0.1% to 0.45% bracket for most industries; that is out of every Lm100 worth of output the outlay on water varies between 10c and 45c. In Agriculture the share of water in output is Lm2.40 per Lm100; for the electricity generation sector it is Lm1.63 per Lm100; and for services and tourism it is Lm1.46.
42. In the absence of updated production account, a survey was carried out among industrialists to assess the use of water, its quality and relative costs. The response was weak. The survey coincided with the results of a survey on bureaucracy in Malta that suggested a feeling of frustration with continuous data gathering by national statistical agencies.
43. But a pattern emerged from the limited number of returns that corroborate the comments made in par.41 above. Water is seen to represent a small proportion of input except for suppliers of bottled water. Industries do rely on tap water but they are not satisfied with its quality. Tap water is classified as 'hard' with chloride and in some cases it is high in salinity and dissolved solids. Further treatment of tap water is required at a cost of Lm0.25 to Lm0.9 per m^3.
44. Management in the various industries considers the present tariffs to be too high.

Demand for Water in Agriculture

45. Par. 30 above indicated a gross discrepancy in water consumption, attributed to the sector of agriculture. Official data on billed consumption suggest that water consumption by farms amount to 5% of total volume. But the adjusted 'comprehensive' measure, based on independent estimates raises the share of

Agriculture in water consumption to 43%. This is made up of the recorded farm demand of 5% and the 'missing' element about 15million m3, representing 37% of the adjusted water demand total.

46. Recent estimated gross irrigation water amounts to 14.4million m^3 annually. The net demand on groundwater resources is 10 million m^3. Agriculture is the Islands' prime consumer of water.
47. An important policy issue arises. The water thus consumed is not properly accounted for in the cost consideration of producers. Farmers' decisions on what to produce and when are omitting an important input in production because, according to their calculations, they are getting water for free! Compliance with the Water Directive will imply, therefore, the inclusion of an important input at a time when competitive imports of vegetables and fruit is becoming a reality.
48. Of course, a 'zero cost' of water for the farmer does not mean a zero cost for the community. Water is being drawn directly from the subterranean aquifer, with the result that a rechargeable but scarce resource may be gradually depleted. In addition, society is producing water mechanically at a cost. Hence the combined high extraction and costly water purification will bear a strong influence on producers' decisions on the choice of crop and animal bred and on the method of growth and breeding.
49. Complementary considerations refer to the cost of recycled water. These charges depend on the volume of water undergoing treatment and on the fluctuations of demand throughout the year.
50. It is critical for competitive and profitable agricultural production to account for all inputs, including water. Therefore, a reliable production account for the entire agriculture sector is required. As yet no such account exists. Still, farmers and breeders have to be guided in order to optimise on water use in relation to value per unit of output. Ideally, water is channeled to those crops that generate the highest value added, and to the breeding of animals that relate water use and market value. So, water requirement, yields and gross income from specific crops have to be accounted for simultaneously.

Demand for Water by the Tourism Sector

51. The sector of tourism comprises several units that consume relatively large quantities of water. This is especially so in the accommodation sub-sector. However, because of the proximity of many of the hotels to the coastline, the units can rely on seawater pumped from bore holes and either supplied directly to the water supply system or cleaned and pumped thereafter.
52. Data on the costs of production in the accommodation sector do not refer specifically to water consumption. Costs of utilities, amounting to around 15% in 5-star and 4-star hotels and to around 20% in 3-star hotels represent 'administration and general, marketing, property and utility costs'. Data from input-output configurations referring to the nineties suggest that the relative expenditure share on billed water consumption amounted to 1.5% of output. Recent data on the production account of industry in Malta under development yield a relative share of 1.8% in terms of total intermediate consumption and 0.9% of total output at basic prices.

53. More intensive work on this subject is required to identify the integrated water resource network operated by hoteliers and leisure sites. Costs for this network and the disposal of water used will bear an impact on the net contribution to Malta's value added by the million plus visitors that represent the equivalent of 30,000 permanent residents.

IV Demand for Water in the Years Ahead

54. The projected demand for water in the future reflects the projected set of scenarios in the respective areas of demography and housing distribution, agriculture, manufacturing and the leisure industry. Except for demographic and housing stock projections, the roles of agriculture, manufacturing and leisure sectors in the years ahead are not charted beyond very generic statements that seem to suggest a projection of the status quo. This position cannot be sustained because the present production structure evolved in a trade and economic environment that relied on protection and subsidies to induce output and consumption. Under the rules emanating from the single market of the European Union and the single currency, the historic trade environment will be no more after the short transition periods are over.

Population and Housing Stock

55. A residential shift is envisioned in the coming fifteen years. The number of Maltese households is projected to grow to 159,926 in the year 2020. This growth will not be distributed uniformly throughout the Islands. Two regions, the North Harbour and the North West areas, will record an expanding habitat. One area, the Grand Harbour area, will fall from 9% to 6%. No relative change is projected for the rest of the Islands.
56. Water distribution and collection networks will have to reflect these households' migrations. Eventual charges will reflect the efficiency with which such projections are utilized in order to minimize the induced costs that emanate from these migrations. Unless cost-minimising networks are devised, charges will have to reflect the initial costs and running expenses to the detriment of households.

Agriculture

57. Efforts to identify the consumption of water in Agriculture yielded a 'missing' volume of 14 .4million m^3. This element has to be accounted for if an optimal water use policy were to be implemented.
58. This fact is omitted from consideration in the recent document entitled Rural Development Plan 2004 – 2006. The document refers, in passim, to the issues related to water supply but no attempt was made to quantify the volume of water that is extracted. The amount of land under irrigation is rising consistently, but this fact apparently did not lead to the question of the source of the water supply that was making this irrigated land expansion possible.

59. A developing agricultural sector that accounts for the consumption of this large volume of 'zero priced' water is bound to differ from one in which water is charged at a price greater than zero. So one cannot simply project the past and implicitly assume that past behaviour will be repeated in future. This cannot be so because competition will become more aggressive, hence bearing on the past price structure and bringing prices down. Besides, as a result of new regulations that condition agricultural practices the cost of production will tend to rise. Waste management processes and proper charges for water will push up prices and influence the feasibility of profitable cultivation of vegetables, fruit and animal husbandry.
60. An official policy on the agricultural sector in the years ahead, one that comprises these parameters, is not ready. Policies on water and agriculture have to be devised simultaneously if a competitive agricultural sector is to survive in the single market in the EU and a more liberal global agricultural trade set up.

Water and the Manufacturing Sector

61. Manufacturing firms consume water from main water network run by the Water Services Corporation and from own sources. The latter remain unknown. Therefore, any scenarios regarding the development of the manufacturing sector will have to account for this condition. While it is desirable to continue encouraging an active manufacturing sector in Malta, yet the areas of activity may change from the present. It follows that the consumption of water by manufacturers in twenty years time will depend on the industrial configuration at the time.
62. The main thrust will be on identifying economic activities that can thrive on high value added per worker and per unit of capital. Productivity per head and per capital unit will determine the activities that can be undertaken profitably. In the absence of a policy on optimal water use that includes an effective monitoring of water resources by industry, one can assume that the tapping of water resources outside the main water distribution system will continue.
63. An efficient manufacturing set up demands that this resource, like any other resource, will have to be accounted for. Ideally, these costs will be maintained to a minimum after all factors are included in the equation. The way the system has worked to date implies that costs are not all-inclusive with the result that the actual price per unit of water consumed is lower than otherwise. Such an artificial pricing system is influencing decision making for the wrong reason.
64. Similar considerations refer to sewage water treatment. New water treatment plants are being constructed. This recycling process has to be considered as one component in the entire 'water supply – water disposal network' and unit costs arrived at accordingly. The incorporation of water treatment plants per unit of production – this could be one firm or several firms whose water disposal systems will be interconnected in an area – in the national sewage grid may affect the matrix of prices and, thereby, the competitive and profitable production of individual goods.

Water and the Tourism Sector

65. The tourism sector had been given specific targets to follow in the nineties: to reach the 1.5million visitors annually spread more evenly than at present throughout the year. This objective has not been attained to date. The annual visitors reach 1.1 million and they are still heavily concentrated in the June-September months. So it can be presumed that the objective of attracting a greater number of tourists, but primarily in the shoulder and winter months, still prevails.
66. However, the type of visitor will condition the use of water amenities and water consumption per head. Even the type of accommodation used and its location will bear on the water supply/water disposal network and costs per unit. So far, the plans on tourism in Malta have not catered effectively for this consideration. This deficiency has to be remedied in future.
67. The distribution of visitors by locality has to complement the emerging distribution of Maltese households. Altogether, these two constitute the direct demand by permanent residents and visitors at any month of the year. Since demand for water varies with the season, in particular the demand for recycled water, such demographic factors have to be taken into account.

V Cost Recovery

68. The assessment of cost recovery depends on the elements included for cost consideration. In the public sector, the government subsidises financial shortfalls generated by the Water Services Corporation in the provision of water. In addition bank loans undertaken for investment projects by the WSC are backed by government guarantees. Cost recovery in recent years amounted to around two-thirds of the operation.
69. Data do not permit analysis of cost recovery by sector. But analysis for the 1999-2000 period suggests that the industrial and commercial sectors were cross subsidising the farming and the domestic sectors. The subsidy distribution is the direct result of the water tariff system in place. Malta operates a rising block water tariff system, with a service charge paid independently of the amount of water consumed and more favourable tariffs are charged to vulnerable consumers, such as persons receiving social assistance and pensioners. Such measures are in line with the Water Framework Directive, which refers to an ‘affordable price’.
70. The gap between costs and turnover arise because the WSC has substantial real and apparent losses. ‘Real losses’ are defined as unavoidable leakages. ‘Apparent losses’ refer to water that is consumed but not paid for, such as water theft or meter under-registration. The WSC is striving to reduce both types of losses. Real Losses have been reduced from 40% of systems input to 27%. The production of RO water has decreased notwithstanding an increase in demand. Apparent losses are still substantial. A main contributor to these losses is money due to the Corporation. Three fourths of the debtors, owing Lm3.9million, are domestic and commercial users.

71. Cost recovery may be also assessed in terms of the environmental and resource related expenses. The WSC is proposing to refurbish and upgrade the desalination plant while taking account of water quality, security of supply and costs. The proposal seeks to upgrade plant capacity from the 67,000m^3 per day to their original 95,000m^3/d. Such investment will also attend to water quality by reducing chlorides from the present 360mg/l to 200mg/l as well as enhance power efficiency from the present 5.57kwh/m^3 to 4.74kwh/m^3.
72. Since January 2004, the WSC became responsible for the collection, disposal and treatment of the wastewater in the Maltese Catchment Basin. This wastewater is mainly disposed to the sea. Practically all households and commercial enterprises are linked to the main sewer. Three villages not so connected have their own cesspits that are cleaned regularly. In the first eight months of 2004, a government subsidy of Lm4.3million kept this service going. It will be premature to derive cost recovery position with the information at hand.
73. The small volume of municipal waste treated at Sant'Antnin recycling plant goes to agriculture and industry. Three fourths of water treated is used to irrigate 240hectares of land. The water is not metered and is distributed through open troughs against a charge of Lm4 per hectare of irrigated land. The other 25% of recycled water is metered and sold to industry at 4c per m^3. The average cost of recycled water is 13c6 per m^3.
74. The WSC is planning to set up three new plants and reconsider the future of the Sant'Antnin plant. The three plants are estimated to cost 75million euros. By increasing the volume of treated water, the volume of by-products, like sludge, grows as well.
75. Sludge treatment and disposal is under consideration. Treatment includes pre-thickening, anaerobic digestion, post-thickening and de-watering for its application to agricultural land. Incineration, land application, landfilling or sale and distribution can dispose of it. The cost of disposal varies with the method applied. Waste sludge may be applied either on the surface of the soil or injected below the soil surface.
76. Sludge may be sold. It adds considerable organic content and some nitrogen and phosphorus to the soil. But the marketing of sludge must account for the nitrate level already present in the soil locally. One method for disposing of sludge is the introduction of reed beds, which absorb water and nutrients rendering the remains harmless from negative substances.
77. A cost-benefit analysis has to be carried out before a decision is taken regarding sludge disposal. The costs and marketable value of sludge in Malta depends critically on the behaviour of firms that dispose their liquid industrial waste in the sewers in disregard of LN194 of 2002. Unless enforcement is effective, the levels of heavy metals and other potential contaminants may be significantly high in the resultant sludge treated.
78. The level of private extraction of water by the private sector is high. Agriculture alone accounts for an estimated net 10million m^3 annually; these volumes are 'missing' from official data. The level of cost recovery is unknown. But the capital and running outlays are small (capital expense in the range of Lm800; running cost of electricity to operate the motor, generally at subsidised rates). Therefore, true cost of water, which covers the effect of water extraction on society as a whole, is not being

recovered. Such an under-valuation is leading to economically inefficient resource use.

79. Additional environmental effects are generated as a by-product of crop growing and livestock breeding. Manure is one such by-product. Estimates of manure production indicate that 2.45million kg of manure are produced annually. If all manure is applied to the agricultural land, the average nitrogen content per hectare ranges between 151.66kgN/ha to 227,81kgN/ha per annum. The upper range exceeds the parametric value of 170kgN/ha set by the Nitrate Directive and the 210kgN/ha conceded to Malta by the EU Derogation.
80. Additional use of fertilisers renders the position worse. Data on volumes of fertilisers are still being compiles. But data for 2003 show that 10,935,118kg of nitrogen compound were imported. The share of agriculture in nitrogen consumption has to be estimated. The high level of nitrates in the soil may explain the high average nitrate level of water in the aquifers. Although the nitrate level in some of the aquifers exceeds the recommended levels of 50mg/Lt, yet Malta still complies with the Drinking Water Directive because groundwater extracted is mixed with RO water thus neutralising the nitrate level.
81. There is no data regarding extraction by industry or production of RO water by industry. But the limited information on RO plants in private sector suggests that the cost of RO water ranges between 20c and 35c per m^3. This rate is much lower than the tariff charged by the WSC.
82. There is no information regarding the disposal of brine produced by private industry during water treatment. The same can be said of the additional costs borne by the WSC to treat wastewater that contains contaminants emitted by industry. Contaminants increase the cost of treating wastewater and sludge produced from such water. To date it is the Maltese taxpayer that is bearing the costs.

VI Further Research

83. Several data gaps have to be attended to before a comprehensive information base is constructed on which policy plans can be formulated. Four important sets of data are the following.
84. Micro area studies that assess changes in population and the related need for public utility services
85. The total amount of water used by industry in the manufacturing sector and the quality of water firms dispose through the sewerage system.
86. The water supply- water disposal network that prevails in the tourism sector and its impact on the demand for water, the quality of water treated and the quality of water that finds its way to the sea.
87. The quality of water in use in agriculture and the optimal use of such water in relation to the net benefit per crop and animal breeding after account of water cost is made.
88. Demand for recycled water and the optimal way to dispose of sludge.

1. Introduction

This report describes and evaluates the economic characterisation of the Maltese Water Catchment District It addresses the issues in the context of the requisites of Water Framework Directive that have to be met by 2004.

The Directive's main thrust is based on one basic condition: Surface water and ground water are renewable natural resources. The task of ensuring good status of groundwater requires early action and stable long term planning of protective measures owing to the natural time lag in its formation and renewal. Such time lag for improvement is to be accounted for when establishing measures for the achievement of good status of ground water and when revising any significant and sustained upward trend in the concentration of any pollutants in groundwater.

Article 9 requires member states to ensure that by 2010 water pricing policies act as an incentive for more efficient water use and thereby contribute to the environmental objective of the Directive. It also requires member states to secure adequate contributions of different water uses to the recovery of costs of water services. Article 9 permits also the continuation of established practices that are not in line with these two provisions, on condition that it does not compromise the achievement of the environmental objectives of the Directive.

EU member states are expected to adopt water-pricing policies by 2010 that provide adequate incentives for users to make efficient use of water resources. An adequate contribution by the respective water users will reflect the utility of this commodity in industry, household consumption and agriculture. Costs of water services have to be recovered and account for the polluter pays principle. In structuring this pricing policy, member states consider the social and economic effects of the recovery mechanism as well as the geographical and climatic conditions of the region.

The report focuses on three main elements in the economic analysis that has to be carried out before 2004,namely

- A description of the socio-economic characterisation of the Water Catchment Basin
- A definition of the socio-economic and base line scenario.
- An assessment of the current level of cost recovery

Section 2 presents a short outline of the way water management is organised in the Maltese Water Catchment Basin.

Section 3 and Section 4 discusses the features of the socio-economic characterisation of the basin. The work carried out is presented and the key issues from the work are summarised.

Section 5 comments on the projected baseline scenario for years ahead.

Section 6 addresses the current level of cost recovery.

Section 7 concludes and presents recommendations for ongoing work and possible future research.

2. Water management organisation in the Maltese Islands

2.1 The Basin Judicial implementation of the framework directive.

The Malta Resource Authority (MRA) within the Ministry for Resources and Infrastructure is the competent authority responsible for inland water whilst the Malta Environment and Planning Authority (MEPA) is the competent authority for coastal waters. MEPA is also responsible for surface waters found in areas protected by scheduling declarations under the Development Planning Act or otherwise protected under the Environment Protection Act and other areas of ecological and scientific importance according to the provisions of the Development Planning Act or the Environment Protection Act. These responsibilities are assigned by virtue of LN 194 of 2004.

The Food and Safety Commission (FSC), established under the Food Safety Act 2002, is responsible for regulating the quality of water intended for human consumption. All bottled water and other water used for drinking or as an input to production has to comply with the parametric values listed in LN 116 of 2004.

The Malta Standards Authority (MSA) set by Act XIX of 2000 is the competent authority that gives authorisation to label and monitor natural mineral water that is bottled at source without any treatment.

2.2 Production and distribution of Drinking water

In the Malta Water Catchment District, the production and distribution of drinking water is assured by the public and private sector. The Water services Corporation (WSC) is the only producer and distributor of tap potable water. Tap water in Malta is a mixture of desalinated water produced by Malta Desalination Services (MDS) Ltd. and ground water. MDS Ltd. is responsible for the operation and the maintenance of all reverse osmosis (R.O.) plants in Malta. It also uses its competencies in order to provide services and products related to desalination technology.

A number of private firms produce bottled drinking water which is distributed in retail outlets in bottles of 0.5ltrs, 1.5 litre and 2 litres. The more economic nineteen-litre bottles are distributed directly to households, commercial outlets and the business community.

2.3 Waste Water collection and Treatment

Until September 2004, the wastewater collection and treatment was the responsibility of the Drainage Department. The management of the waste water treatment plant at Sant'Antnin in Marsascala has since October been assigned to the WSC.

Two levels of responsibilities can be distinguished:

- At the national level ,
- At the individual level

At the ***national level***, the WSC is now responsible for the collection and treatment of water (building collectors and wastewater treatment plants). The WSC is planning to construct three waste water treatment plants: one in Gozo, one in the north of Malta and another in the south of Malta. It is not yet very clear whether the existing STP at Sant'Antnin will continue operation when the new plants are in place. This investment will be undertaken because Malta has to comply with the Barcelona Convention whereby the Maltese Government undertook to treat all waste waters before these are disposed in the marine environment.

At the individual level, each citizen is bound to take the necessary measures in order to realise the required level of environmental protection. In practice, this means that, if a public sewerage exists or is planned in the near future (especially in newly developed areas) one has to connect to the public system. If no public system exists or is planned, the individual citizen has to take the necessary measures to collect water in a cesspit. In Malta, people living in Bahrija , Bidnija and Gharb in Gozo are not connected to the main sewer because it is not economically feasible.

The Main Water Actors

Regulators:	Malta Resource Authority Malta Environment and Planning Authority The Food Safety Commission The Malta Standards Authority
Water production:	Public Sector: Water Services Corporation Private Sector: Several Companies

3. Population, Housing Stock and Sectors of Production

The role of water quality and supply cannot be discussed in an environmental vacuum. The relevance and potential success of policies that regulate water uses have to drive inspiration both from the main objectives of the Water Framework Directive and from existing policies in Malta and the present situation. The outcome of demographic, economic and industrial policies is summarised below under four headings: demography and housing stock; agriculture; tourism; and manufacturing. The way these socio-economic sectors evolve in the coming years is bound to influence water uses and, in turn, be influenced by them.

3.1 Demography and Housing Stock

The Maltese population was 388,000 in 2003 and growing at less than 1000 per annum since the year 2000. This natural growth rate reflects a declining birth rate and a fairly stable mortality rate. The CBR fell from 13 per 1000 in the second half of the nineties to 9.9 per 1000 in 2002. The CMR remained in the region of 7.7.

However, total population, which includes Maltese and foreign residents, was 398,000 in 2003. Besides when account is made of the million holiday makers that visit the Islands annually, the aggregated population i.e. Maltese, permanent foreign residents and tourists, reach 427,000 in 2003. The comments below regarding population characteristics refer to the Maltese population.

Life expectancy at birth for males edged upwards to 76 years and for females to 81 years. At age 65, life expectancy is 15 years for men and 19 years for women.

The Maltese population is projected to continue growing for the next twenty years – on one projected scenario reaching 425,000 - and declining thereafter to 360,000 by 2060 if present fertility and mortality patterns persist.

Total households are seen increasing as perceptions of family units change. There were 119,479 households in Census year 1995. One projection exercise prepared for the Structure Plan for the Maltese Islands suggests that households may reach 159,926 level in 2020. Their regional distribution is given in Table 3.1 below. There will be a greater number of households with fewer persons per household. The average household size is seen declining from 3.1 persons recorded in Census year to 2.7 persons in 2015 – 2020.

Table 3.1
Household Projection: Census 1995, Years 2010, 2020

Local Plan Area	*1995*	*2010*	*2020*
Central Malta	31,718	38,595	42,380
Gozo and Comino	9,188	11,651	12,794
Grand Harbour	10,852	8,738	9,596
Marsaxlokk Bay	3,239	5,097	5,597
North Harbour	20,820	26,215	28,787
North West	10,279	14,564	15,993
South Malta	33,383	40,779	44,779
Total Households	***119,479***	***145,639***	***159,926***

A growing household population demands more housing units. The new housing stock configuration will depend on the housing construction policies implemented throughout the period. The percentage household distributions in 1995 and in 2020 are given in Table 3.2, which also presents the distribution of housing stock in 1995.

Table 3.2
Percentage Distribution of Population in 1995, 2020 and Housing Stock in 1995

Local Plan Area	*Percent of Households in 1995*	*Housing Stock 1995*	*Percent of Households in 2020*
CMLP	27	36,282	27
GCLP	8	15,448	8
GHLP	9	13,317	6
MBLP	3	4,689	3
NHLP	17	26,567	18
NWLP	8	19,353	10
SMLP	28	39,544	28
TOTAL	**100**	**155,202**	**100**

Source: Structure Plan, Malta Planning Authority

There has been an increase in a higher dwelling density trend. Table 3.3 presents information for the years 2001 and 2002. In 2001 there was an increase of 645 units constructed on the existing built-up area. There were 1276 additional units in 2002.

Table 3.3
Conversion and Redevelopment – Number of Units built, units lost and balance

	2001			***2002***		
	New	***Old Units***	***Gain/Loss***	***New***	***Old units***	***Gain/Loss***
Conversion	140	106	+34	148	145	+3
Redevelopment	917	306	+611	1692	419	+1273
Total	1057	412	+645	1840	564	+1276

Source: MEPA, 2004

It is difficult to analyse the change regarding population density without micro-area studies. However, wherever high-density changes take place e.g. where one dwelling is demolished and 50 units are re-erected, the demand for water supply will increase and related adequate infrastructure provided.

3.2 Agriculture

Agricultural land covers an area of 11,619.9 ha, of which 9,393.5ha are in Malta and 2,226.4 ha are in Gozo. Agriculture land covers three main categories:

1. dry-farmed land (raba' baghli). This land depends exclusively on rainwater for irrigation of crops but may be watered on a few occasions.
2. Irrigated land (raba' saqwi), that is land that has a continuous supply of water all the year round and is irrigated by water from sources other than rain water.
3. Unutilised garigue land (raba moghxa or xaghri), which is a term used to describe all non-productive registered agricultural land. It represents 12.7% of total area, 1,451ha.

The first two categories represent the total agriculture land, an area of 10,148ha or 87.3% of land, which is further sub-divided into two, namely, uncultivated land and utilised agricultural area (UAA) that includes arable land, vineyards and orchards.

Since 1983 there was a significant shift in the type of agricultural land from 'dry' land to irrigated land. Irrigated land increased by 260% from 580ha to 1,508'8 ha in 2001. A total of 960ha, representing 63,4% of irrigated land, is found in the Western and Northern districts with predominance in the area of St Paul's Bay.

Table 3.4
Land Declared by Farmers by Region and Type – 2001

District	Total land area declared by farmers	Total Agricultural land area (ha)	Utilised Agricultural area (UAA)	Unutilised Agricultural Area	Garigue Land
Republic of Malta	11619.954	10148.87	9656.545	492.04	1471.367
% distribution		87.3	95.2	4.8	12.7
Island of Malta	9393.504	8200.211	7944.421	255.791	1193.293
% distribution		87.3	96.9	3.1	12.7
Gozo and Comino	2226.450	1948.376	1712.125	236.251	278.074
% distribution		87.5	87.9	12.1	12.5

Source: National Statistics Office, Malta. Census of Agriculture, 2001

Table 3.5
Land by Region, District, Locality and Type – 2001

	Total land declared by farmers – Ha	Total Agricultural Land -Ha	Irrigated land - Ha	Dryland - Ha	Garigue land - Ha
Republic of Malta	11619.954	10148.587	1508.759	8639.828	1471.367
Island of Malta	9393.504	8200.211	1378.883	6826.328	1193.293
Island Of Gozo	532.067	490.770	161.334	329.435	41.296
Northern Harbour District	332.150	296.318	73.325	222.993	35.832
South Eastern District	2123.347	1854.491	182.246	1672.245	268.856
Western District	3683.504	3207.604	385.447	2822.157	475.900
Northern District	2722.438	2351.029	571.531	1779.498	371.408
Gozo and Comino	2226.45	1948.376	134.876	1813.500	278.074

Source: National Statistics Office, Malta Census of Agriculture, 2001, Table 28, pp 25 – 29.

Land use is constantly undergoing change. The Farm Structure Survey (FSS) carried out between October-November 2003 indicates that total utilised agricultural land amounted to 10793.9ha, an increase of 645.313ha over the Census data 2001. The area of garigue remained practically unchanged. However, both Census of Agriculture and the Farm Structure Survey records the average size of holdings in the 0.88ha – 0.98ha range. In both sets of records, 46% of all agricultural holdings have utilised agricultural area of less than 0.5 ha.

Arable Land

The structure of farming is very similar in Malta and Gozo. Very few holdings engaged in livestock, ruminants and poultry industry have agricultural land. The majority of farming in agriculture in Malta is used to grow crops. Utilised agricultural land can be split into three categories.

i. Arable area, which is land normally used under a system of crop rotation – 86.1%.
ii. Kitchen gardens, which are small plots intended for self-consumption rather than for sale - 3.9%. These exclude forage used for animals.
iii. Permanent crops, which are plots of land not worked under a system of crop rotation but occupy the same field for a period of time normally 5 or more years – 10%

In the FSS there were no significant changes under arable land since the Census. But there was a shift from fallow land to area under forage, fruit and vegetable. The share of land under potatoes has remained relatively unchanged. The area under crops increased mainly due to an increase of 135ha of land under vines. The area under vine cultivation increased from 480ha in 2001 to 615ha in 2003.

Livestock

In 2001 Census, the total number of heads was 18,417 of which 8,473 were cows. In the FSS (2003), a total number of 18,579 cattle were registered of which 12,286 (66.1%) were bovines found on farms with 100 cattle or more.

The number of pigs is decreasing: in 2001, there were 81,841 pigs. There were 76,010 in 2003.

The number of poultry amounts to 1,381,544 heads. These include 62% broilers, 36.6% were laying hens and a mere 1.7 % were other poultry.

Final Production, Value Added and Incomes

Total Final Production at basic prices amounted to Lm 56.599million in 2003. The total final output by type of product at current market prices is given in Table 3.6 below. Of these, Lm27.2 million represent intermediate consumption. Thus, the Gross Value Added amounts to Lm29.39 million. Net Income at factor prices after allowing for fixed capital formation and subsidies amounts to Lm27.9 million. Lm25.3 million, i.e. 90.7%, of this factor income represents entrepreneurial income; only 4.8% is paid in wages. These data imply that agriculture in Malta is mainly a family concern with only a small number of full-time workers that are salaried.

Table 3.6
Total Final Production by Type of Product at Current Market Prices

	2000	2001	2002	2003
Total Final Product	55127	57641	57906	56599
Livestock	20608	21901	22550	21891
Beef	2088	2032	1850	1486
Pork	1805	8143	8530	8120
Sheep & Goats	215	215	215	232
Horse Flesh	45	64	59	50
Poultry	4144	4336	4736	5021
Rabbit	6310	7111	7160	6982
Other Animal Products	14304	14352	14173	15573
Milk	7261	7302	7229	7452
Eggs	3044	2944	2966	3302
Cheese	3648	3756	3628	4435
Hides & Skins	350	350	350	385
Crop Products	19911	21162	20834	18785
Forage	1887	1772	1968	1532
Vegetables	14938	16385	15796	13973
Flowers & Seeds	852	903	860	887
Other Seeds for Plants	93	93	93	93
Wine	305	226	349	350

Source: National Statistics Office, Malta, Farm Accounts

The Labour Force in Agriculture

There were 10,989 holdings employing 17,867 persons in agriculture in 2003. Eight thousand six hundred of these holdings employing 14,330 workers were in Malta and 2,389 holdings employing 3,537 farmers are found in Gozo and Comino. The majority of workers are males. There are 3,289 female workers in Malta and 533 in Gozo.

The head of household mainly runs the agricultural holdings in the Maltese Islands. Of these holding, 10,045 are sole holder managed. The total effort in agriculture amounts to 4,480 annual work units (AWUs).

The Agricultural Labour Input is calculated in Annual Work Unit (AWU) to account for activity carried out on part-time, hobby farming and seasonal demand. One Annual Work Unit is equivalent to 1,800hours i.e. the time worked by one full time employed person over a period of one year.

Only 1,579 of the 17,867 farmers are full timers. 1,358 work in Malta and 221 farmers work in Gozo and Comino.

The majority of holdings, 5127, are owned by part-time, sole-holder managers who have a major activity outside agriculture. 2314 (45%) of these land-holders are aged between 45 and 54 years.

3.3 The Tourist Sector

The Maltese economy has recorded a switch towards the Services sector, which accounts for around 48% of Gross Domestic Product. Within the services sector, tourism is the main contributor to output, employment and foreign exchange earnings. The sector makes an aggregate contribution to aggregate value added in the region of 30%.

The number of visitors hovered in the 1.1 million region for the past ten years. The projected rise to about 1.4 million envisaged in the Master Plan for the sector in the early 1990s did not materialise. The closest level reached was 1.2 million in the years 1999 and 2000.

The year 1999 recorded the highest number of bednights sold, 11,658 thousand and the highest gross income, at Lm271.4 million. Earnings from tourism represented 21% of total exports from goods and services in 1999, declining to 17.1% in 2002.

Direct employment in hotels and catering establishments averages 9400 throughout the year, representing 7% of the gainfully occupied population. But many more depend on tourism in the provision of goods and services in ancillary industries that provide commodities for the leisure sector.

The data, summarised in Table 3.7, suggest that the capacity of the leisure industry is underutilized. The present plant can support a larger number of visitors throughout the year, provided that this flow of visitors is spread more evenly rather than concentrated in the five months May to September.

Table 3.7
The Tourism Sector in the Maltese Islands

	1998	1999	2000	2001	2002
Tourist Arrivals (000)	1182	1214	1215	1180	1133
Days stayed(000)	11326	11658	10267	11067	10599
Gross Income(Lmmil)	254.6	271.4	268.2	260.7	246.3
Gross Income/Exports of G&S (%)	21.8	21.0	17.0	18.6	17.1
Employment-Hotel & Catering Est.	9147	9485	9598	9438	9387
Population equivalent	31031	31939	28128	30320	29038

Source: National Statistics Office, Malta

3.4 The Manufacturing Sector

The Manufacturing sector accounts for 23% of Gross Domestic Product as per SNA95. (This sector's contribution to aggregate value added was in the 26% region in recent years under the SNA53 system of accounts.) The sector employs 27,700 workers, representing about 20% of the gainfully occupied population. It has seen a gradual transformation over time, moving to higher capital per employee as the nature of production changed in the wake of rising costs of inputs, particularly labour.

The manufacturing sector is adapting itself to the emerging cost configuration. This is recorded, for example, in sectors associated with agricultural produce that target the domestic market. The sheltered market environment that gave rise to the growth of these industries is giving way to greater competition following liberalisation of trade when Malta joined the European Union. Future output growth will reflect a changing demand for locally produced goods, which, in turn, will be heavily dependent on value for money. The more cost-effective is the intermediate raw material, the more competitive will processors become.

This argument holds for all industries that depend on water resource as an important input. They undertake investment in recycling plants to minimise water costs and ensure quality. Thus, producers of beverages and water, textiles and electronic components follow carefully the price structure of water input and assess such costs in the context of emerging price and quality demands that are reconditioning the operative environment.

The performance of the Manufacturing sector in general and selected industries is illustrated in Table 3.8.

Table 3.8
Highlights of the Manufacturing Sector in Malta

Value added at Factor Cost Per Capita

	1990	***2000***	***2001***	***2002***
	Lm	*Lm*	*Lm*	*Lm*
Total Manufacturing	9468	12390	10187	10829
Food and Beverages	12056	11663	10503	11388
Textiles	5800	13363	11745	13327
Communication Equipment and Apparatus	24809	39485	21653	19762

Value Added at Factor Cost Per Capita, in Real Terms

	1990	***2000***	***2001***	***2002***
	Lm	*Lm*	*Lm*	*Lm*
Total Manufacturing	9090	11341	8812	9267
Food and Beverages	11120	10676	9085	9746
Textiles	5354	12232	10159	11405
Communications Equipment	22902	36143	18731	16913

Personnel Costs Per Capita

	1990	***2000***	***2001***	***2002***
	Lm	*Lm*	*Lm*	*Lm*
Total Manufacturing	5306	5664	5665	5991
Food and Beverages	4566	4964	4921	5366
Textiles	3276	5247	5698	6429
Communication Equipment	6832	6928	6313	5700

Gross Operating Surplus Per Capita

	1990	***2000***	***2001***	***2002***
	Lm	*Lm*	*Lm*	*Lm*
Total Manufacturing	4540	6726	4522	4838
Food and Beverages	7490	6699	5582	6022
Textiles	2524	8117	6047	6898
Communication Equipment	17977	32557	15340	14063

Source: Economic Policy Division, Economic Survey

Performance of output and profits changes over time, at times depending on the length of business cycles. Yet producers have to pay close attention to their costs especially if their role in a market changes from being price makers to price takers. A cost-effective mentality goes a long way to enhancing a company's competitive position. In turn, producers of intermediate inputs have to be fully aware of their actions, or inactions, especially if they have a dominant and monopolistic position in the economy. Water falls

in this crucial category. It is a final good for households but it represents an intermediate commodity for firms in agriculture, manufacturing and services.

4. Components of Demand for Water

The demand for water in the Maltese Islands emanates from households and industry, the latter term standing for intermediate and final service and good providers. This demand is influenced not just by habits but also by the pricing policies adopted by water providers over time. The relationship between water demand, price and income may differ between different users and over time even for the same users. These relationships are examined below using two sets of data sources: where available, time series is resorted to in order to establish certain parametric values for key policy instruments. A second, complementary set of data is derived from surveys carried out specifically for this study. Together, these data constitute a working base on which analysis is carried out to provide insights for policy formation.

It must be emphasised that the economic significance of water use is difficult to measure. From the economic point of view, it can generally be argued that consumers demand a service until the price corresponds to the marginal benefit of consumption. So, an enterprise will use water until the production value added for the last m^3 of water purchased corresponds to the price of that m^3. Since studies of the total value of individual water uses are not immediately available, an exact measurement of the value of water is not possible. The significance of water can only be described using different indicators. These include the money outlay per time period on water by different users, or the share of water costs in production measured by the value added of an economic activity.

The amount of water consumed in Malta is a subject of discussion. There are relatively big differences between the data based on billed consumption by various units and recent estimates, in particular computations of water consumption by Agriculture. Examples of these data variances are given in Tables 4.1 and 4.2 below. Aggregate water consumed in the year 2000 varies from 18.7million m^3 to 36million m^3. The significant difference arises in the agricultural sector, which seems to be consuming water at minimal/zero marginal cost.

Table 4.1
Water Consumption by Sector (millions m3)

Year	Domestic	Industry	Tourism	Government	Commerce	Farms	Other	Manual/ industry	Total
1995	11.984	1.785	1.451	1.516	1.693	0.614	-	0.211	19.256
1996	13.079	1.702	1.487	0.659	1.691	0.968	0.041	0.207	19.837
1997	14.002	1.149	1.460	1.206	1.369	1.327	0.307	0.182	21.005
1998	10.730	1.129	1.502	1.313	1.130	1.066	0.274	0.096	17.244
1999	11.320	1.141	1.509	1.037	0.938	1.245	0.220	0.001	17.415
2000	11.594	1.736	1.543	1.649	1.048	0.938	0.222	0.001	18.731
2001	11.435	1.333	1.448	1.391	1.028	1.139	0.228	----	18.002
2002	12.305	0.980	1.275	1.517	0.864	0.889	0.780	----	18.613
2003 (E)	12.620	1.135	1.336	1.247	0.941	0.818	0.869	----	18.968

Source: National Statistics Office, Malta, 2002, Environment Statistics; Table 21. Data for 2003, WSC.

Average relative share for the years 1995-2000

	Domestic	Industrial	Tourism	Government	Commercial	Farms	Other	Manual/Industrial
%	64	7	8	7	7	5	1	1

Table 4.2
A "Comprehensive" Water Demand Estimate – based on year 2000 data

Categories	***WSC Billed Consumption***	***Non-Conventional Sources***	***Total (m^3)***	***Total (%)***
Domestic	11,435,000	2,000,000	13,435,000	37%
Tourism	1,448,000	1,500,000	2,948,000	8%
Farms	1,139,000	1,100,000	2,239,000	6%
Agriculture		14,500,000	14,500,000	37%
Commercial	1,028,000		1,028,000	3%
Industrial	1,333,000	1,500,000	2,833,000	7%
Government	1,391,000		1,391,000	4%
Others	228,000		28,000	1%
Total	***18,002,000***	***20,600,000***	***38,602,000***	***100%***

Source: E. Sapiano, 2004.

The demand for water by the respective users is examined below.

4.1 Demand for Water by Maltese Households

The demand for water by Maltese households and its relation to price and income may be traced from the data compiled for Household Budgetary Price Index. In the Retail Price Index currently in place, base year 2000, household expenditure on Water, Electricity, Gas and Fuels has a relative weighting of 2.25%.

Pricing of water has always been a sensitive political and social issue. Successive Maltese governments have persistently followed a policy of supporting water consumption by households and of maintaining such water tariffs stable for several years at a stretch. This policy measure meant that the actual consumption of water by households was not directly conditioned by changes in water tariff, because prices were held constant for successive periods. Thus, in the eleven-year period, 1987-1999, prices were changed four times; there were no price changes between 1987 and 1993 (Price Index = 117.82 with 1995=100). Again, prices remained unchanged during the period 1994 to 1996. Tariffs were raised to 109.03 in 1997 and to 154.17 in 1998 and 1999. The rates are given below.

Table 4.3
Water tariffs for Households

Type of consumer	***Meter rent***	***Consumption charge***	***1998***
Domestic	Lm4	0 –11m^3/person >11m^3/person rebate/person>4	16c5/m^3 110c/m^3 Lm1.40
Social Assistance	Free	0 –5.5m3/person -11m3/person >11m3/person	Free 16c5/m^3 110c/m^3 Lm1.40

Over the 1989 – 1999 period annual consumption per head of population increased from 28m^3 in 1989 to a high of 34.7m^3 in 1996 thereafter falling again to 28m^3 in 1998 and 1999. Two econometric tests were carried out to identify the response of household demand to price changes in the short run and in the long run. The primary aim is to establish whether the impact of a tariff change on demand can be identified in past consumption patterns on the introduction of a price change and after some time has elapsed. Another exercise relates water demand to price and income changes. There seems to be enough information, from the data at hand, to pronounce on these policy parameters, although more work is required on this subject.

The price elasticity of demand in the short run is estimated to be –0.28, and –0.37 in the long run. These results suggest two policy indications. At – 0.28, the short-term price elasticity of household demand for water falls in the elasticity range observed for other countries (Thomas and Syme, 1988; Bachrach and Vaughan, 1994). The higher value of –0.37 in the long run implies that there was a higher response to price change after households were given time to adapt. Tariff changes will be expected to induce a change in consumption behaviour. But, the demand for water remains relatively inelastic, water being a necessity. The relevant logarithmic equation is presented below; the data and statistical coefficients are given in Annex 1.

$$\text{Ln } D_{water\ t} = 3.2209 - 0.2784 \text{ Ln } P + 0.2433 \text{ Ln } D_{water\ t-1} \quad \text{(Eq.2.1)}$$
$$(2.972) \quad (-1.951) \quad (0.8252)$$

R^2 (Adj) = 0.259 F = 2.7485 n = 11 (1989 – 1999)

Where

D water = Domestic demand for water per head

P = Price Index for water charged to households, derived from the series of Consumer Price Deflators published by the National Statistical Office

T, t-1 = Time periods

( ) = t statistics

The response of households' demand for water following price and income changes over time may be gauged from the logarithmic function presented as Equation 2.2. The price elasticity remains in the –0.2 to -0.4 range while the income elasticity is 0.2435. The two parameters 'explain' around 35% of the changes in water demand recorded in the nineties in the bills issued by the Water Services Corporation.

$$\text{Ln D water}_t = 3.220 - 0.3646 \text{ Ln Price} + 0.2435 \text{ Ln Income} \quad \text{(Eq.2.2)}$$
$$(2.3351) \quad (-2.9451) \quad (1.3530)$$

R^2 (Adj) = 0.3457 F = 3.6424 n =11 (1989 – 1999)

Where:

D_{water} = Demand for water by Households

P = Price Index

Income = Income per head

T, = time

( ) = t statistics

Households consume water for drinking and other uses. In a survey carried out for this report in August 2004 among 468 households in Malta and Gozo, it emerges that households use several sources to procure water for consumption. Ninety nine per cent use tap water; sixty five percent buy bottled water. Rain water holding cisterns provide water for 36% of households and 0.9% indicated that they draw water from boreholes. Six percent buy water from outside providers carried to their homes by water bowsers. These water sources are presented in Table 4.4 below

Table 4.4
Source of Water Use

Source of Water	*Number of Respondents*	*% of Respondents*
Tap	461	98.5
Bottled	304	64.9
Cisterns	169	36.1
Bowser	29	6.2
Borehole	4	0.8
Other*	4	0.8

*Other = Water generated from dehumidifiers/air conditioners and recycled laundry water
Source: Water Survey, August 2004

Tap water is used by 68% of households for cooking and drinking. It is generally used for bathrooms (91%), laundry (87%), water plants and trees (34%) and other uses (3.4%).
Bottled water is used also for cooking/drinking by 49% of households. Almost one half of households supplement tap water with bottled water for cooking purposes.
Water Cisterns provide the source for cooking and drinking for 6% of households. But they also are a source for 5% of households for bathroom use; 17% for laundry; 28% for gardening and 5% for other uses.
Water bowsers provide water to 6.2% of households, which mainly goes to fill wells.
Water drawn from ***boreholes*** generally goes for gardening, although in a small number of cases it is used for everyday use.

Households rely on bottled water because they may consider tap water to be inferior in quality. Table 4.5 below classifies the views of households regarding tap water. Fifty six per cent (56%) consider water to be poor or 'not so good'. Another 29% deem it good while only 12% consider it 'very good' or 'excellent'.

Table 4.5
Quality of Water

Water Quality	*Number of Respondents*	*Per cent*
Excellent	15	3.2
Very Good	40	8.6
Good	138	29.5
Not so good	158	33.8
Poor	103	22.0
No reply	14	3.0

Source: Water Survey, August 2004

Regarding the water tariffs paid by households for tap water, sixty percent of surveyed households are not prepared to pay more than the current price (Vide Table 4.3 above for

domestic tariffs). The term 'current price' stands for the bills paid by households in recent months. These bills reflect the existing water tariffs and already includes subsidies on water consumed reflecting the particular household participating in the survey. Respondents pointed out that they consume on average 18 litres of bottled water per week, which they have to buy to replace tap water considered of inferior quality for drinking and cooking.

Data referring to households' 'willingness to pay' is presented in Table 4.7. The policy implications of this social attitude towards water tariffs in Malta are various. These will be discussed below. But it should be clear at the outset to the Authority providing tap water in Malta that households have to be involved directly in all issues regarding pricing and quality of water. Households have to be given reasons for any water price changes and assured of high quality water supply.

Table 4.7
Willingness to Pay: Water Tariffs in Malta

Multiple of Tariff	*Number of Respondents*	*Percent*
Five times	8	1.7
Three times	9	1.9
Two Times	39	8.3
One and Half Times	96	20.5
Twenty percent more	18	3.9
Current Price	271	58.0
Less	13	2.8
No reply	14	2.9

Source: Water Survey, August 2004

Recycled Water

Maltese households are aware of the possibility of using recycled water. As pointed above, in fact, a small number of households already generate their own recycled water for bathroom use. Replying to a direct question on this subject, 54% replied that they are not prepared, at the time being, to consider the use of recycled water. However, 46% will consider paying for such water provided its quality is 'guaranteed' safe for health purposes including use for gardening or other domestic uses.

An addition condition cited by some respondents was that no extra charges than at present will be introduced. This means that they are not willing to pay for any additional infrastructure costs that the water supplier may have to incur for distribution. Those households that already resort to water bowsers to obtain water indicate that they will be willing to consider buying recycled water as long as it was cheaper than the price they presently pay for water taken to their homes by bowsers.

4.2 Demand for Water by Industry

Industry uses water either as an intermediate input or a final product for sale. This latter position is the case of the Water Services Corporation, the national supplier of piped water to households and industrial units, and of suppliers of bottled water. The use of water as an intermediate input may be observed from data on industrial input-output relationships. Such data are last published for 1996; a new data series meant to derive the output by sector for the purpose of computing the Gross Domestic Product by the output method is in the process of being compiled.

The data presented in Table 4.8 give the average value of water requirement per Lm100 of output for various sectors. The table includes Agriculture and Tourism for comparative purposes; but these two sectors are assessed in more detail below. One main point emerges from these data: if Agriculture, Electricity and Tourism are excluded, the demand for water by the various industrial sectors included in the data is very low. It falls in the 0.1% to 0.45% region, except for the beverage industry which records 0.78%, that is 10c to 45c, and 78c, respectively, per Lm100 worth of output. In the case of Agriculture, the value of water used in production is set at Lm2.40 per Lm100; for Electricity, it is worth Lm1.63 per Lm100 of output; for Services and Tourism, it is Lm1.46.

Table 4.8
Cost of Output, Average for Years 1994-1996

	Water requirement per Lm100 of output	
Industry	**3 year average output in Lm'000s**	**3 year average water value in Lm requirement per Lm100 of output**
Agriculture	1097	2.40
Mining and quarrying	14	0.37
Food	118	0.43
Beverages	183	0.78
Tobacco	1	0.19
Textiles	22	0.32
Footwear	2	0.17
Wearing Apparel	25	0.19
Furniture/Fitting	22	0.19
Printing	18	0.14
Leather	13	0.44
Chemicals	30	0.20
Non-Metallic Minerals	45	0.15
Metals	14	0.18
Machinery	60	0.05
Rubber, Transport & shipyards	110	0.40
Miscellaneous	73	0.32
Construction	82	0.30
Gas	5	0.36
Electricity	507	1.63

Services and Tourism	3076	1.46
Other production and trade	3539	0.79
Other industries	/	0.20

Source: National Statistics Office, Malta, ***National Accounts of the Maltese Islands, Input Output Tables***

In the absence of an update on the production account, an attempt was made to derive information of industrialists' use of water in production and, also, to identify their reactions to the price structure for water as well as the quality of water. A survey was carried out among industrial units operating from the industrial estates at Bulebel.

The response to the questionnaire was very weak, notwithstanding the direct intervention of officials from the Malta Resource Authority. It represents a data gap that has to be addressed in the coming months. It is here pertinent to point out that in a recent survey on bureaucracy carried out in August 2004 by the Malta Chamber of Commerce and Enterprise industrialists 'objected' to the National Statistics Office initiatives to compile new data sets. For industrialists, this information is already 'available' and they seem reluctant to keep filling forms! Surveys meant to compile new data are being considered a 'bureaucratic harassment' by industry. The survey on water use coincided with this 'feeling of frustration'. It is an eye opener for future research.

However, persistent attempts should be made to convince all stakeholders that it is in their long-term interest to build up a data bases referring to production cost. The viability of their enterprise depends on such data, which will be a useful indicator for water policy in terms of the Water Framework Directive. Transition periods can only be meaningfully ascertained once economic and social factors are considered if reliable data sets are available. Planning of surveys should account for the potential inconvenience that surveys create for respondents!

Ten industries coming from different industrial sectors in manufacturing and tourism completed the questionnaire. Despite emanating from a very limited coverage, the replies are worth reporting. Water use is seen to represent a small proportion of input, except for suppliers of bottled water. Industries rely on tap water and are not satisfied with its quality. Tap water is hard, high in chlorides and, in some cases, it is high in salinity and dissolved solids. Tap water has to be treated before use in production at an additional cost, which could range from Lm0.25 to Lm0.9 per m^3.

Industries consider the present tariff as being too high. These tariffs are presented in Table 4.9 and Table 6.2 below.

Table 4.9
Water Tariffs for Industry

Type of consumer	*Meter rent*	*Consumption charge*	*1998*
Agriculture and agro food	Lm8	0 –2270m^3 >2270m^3	9c/m3 3.20c/m3
Personal Health Use in field	Lm4	0-5m^3 .5m^3	9c/m^3 35c/m^3
Industrial	Lm8		35c/m^3
Food and beverage	Lm8		35c/m^3
Tourist Flats	Lm8	0 –84m^3 >84m^3	75c/m^3 Lm1.10/m^3
Hotels	Lm8	0 – 14m^3/bed >14m^3/bed	75c/m^3 Lm1.10/m^3
Laundry	Lm8	0 – 2270m^3 >2270m^3	75c/m^3 Lm1.10/m^3
Sea Craft	Lm8		Lm1.10/m^3
Government	Lm8		Lm1.10/m^3
Boat house, Garden & garages	Lm4	0 – 10m^3 >10.m^3	85c/m^3 Lm1.10/m^3
Non-Commercial	Lm4	0 –57m^3 >57m^3	Free 35c/m^3
Commercial & other	Lm8	0 –57m^3 >57m^3	50c/m^3 Lm1.1/m^3

A similar exercise to the one carried out for agriculture was attempted for manufacturing industry. The aim was to establish the real volume of water consumed by this sector, since the data obtained from WSC do not appear to give a true picture. However, the efforts did not produce satisfactory results that can be applied for policy purposes. Work on this matter is currently ongoing in collaboration with the NSO, MRA and WSC.

4.3 Demand for Water by Agriculture

There are several issues arising from considering water demand by agriculture. These refer to the actual volume of water consumed, the actual ensuing charges, and the quality of water that follows from the huge volume of water that supports the expansion of irrigated production. These considerations may be assessed under three headings, namely, volume, tariffs, and optimal water uses.

4.3.1 Amount of water consumed in agriculture

The demand for water by Agriculture is not directly identified from the data on billed consumption, which are generally the data sets applied to derive the water demand by different consumers. Recent work carried out by the Malta Resource Authority derived a radically different consumption pattern. As illustrated in Tables 4.1 and 4.2 above, only billed farm consumption is included in data supplied by the Water Services Corporation. These statistics suggest that farms account for 5% of total volume of water on which bills are issued. Table 4.2, however, gives a totally different picture. It more than doubles the volume of water used on the Billed result; and, more significant, it allocates a 'missing'

component – Consumption of water by Agriculture – that is estimated to be 14.5million m^3. This 'missing' component represents 37% of the adjusted water consumption. Altogether, farming and animal breeding account for around 43% of the adjusted water demand.

This statistic has been supported yet again by another exercise carried out by the FAO team of consultants who are collaborating with the Maltese authorities on a project regarding water demand in Malta (FAO, 2004). This exercise gives the following results. The gross irrigation water requirement is 14.4million m^3 annually. 1.5million m^3 of these are derived from water recycled at Sant'Antnin Sewerage Treatment Plant and 1.5million m^3 from surface water collected in reservoirs. The total annual demand from agriculture on groundwater is therefore estimated to be 11.4million m^3 of which 15% flows back to the hydrological cycle. So the net annual demand of agriculture on the groundwater resources is about 10million m^3.

4.3.2 Actual Charges for Water Uses

Since the 16million m3 of water are unaccounted for by the Water Services Corporation, they are not charged. This means that their costs as intermediate inputs are practically zero for farmers and are not accounted for properly in farmers' decisions on choice of product, timing of production, and volume of output. Since Maltese farmers will have to comply to the Water Framework Directive while operating in the single market after a period of transition, ending at the latest for some sectors by 2009, account will have to be taken of the cost of water per crop or/and per animal bred.

However, a 'zero cost' for farmer does not imply a zero cost for the community. Water is being drawn from the aquifer, and therefore it is utilising a rechargeable resource but at a rate that may render the recharge inadequate. Besides, society has to produce water mechanically, hence at a higher cost than it takes to extract water from the underground sources. The combined supervision of water extraction and charges will bear a strong influence on producers' decisions on the choice of crop and animal and the method of growing or breeding.

A complementary consideration refers to charges of recycled water. These depend on the volume of water undergoing treatment and the fluctuations of demand throughout the year. The volume of treated water will have to increase in the coming years as Malta approaches its deadline to meet the conditions of the Barcelona Convention.

4.3.3 Optimal Use of Water for Crops

It is crucial for efficient and profitable production of agricultural produce to account for all inputs, water included. Farmers have to consider, for example, the cost of capital projects to support the water supply infrastructure, labour, water and marketing risk. In the case of water, it is not only the volume of water consumed in the process of growing crops or rearing animals but also the net benefit they get from the product. A reliable

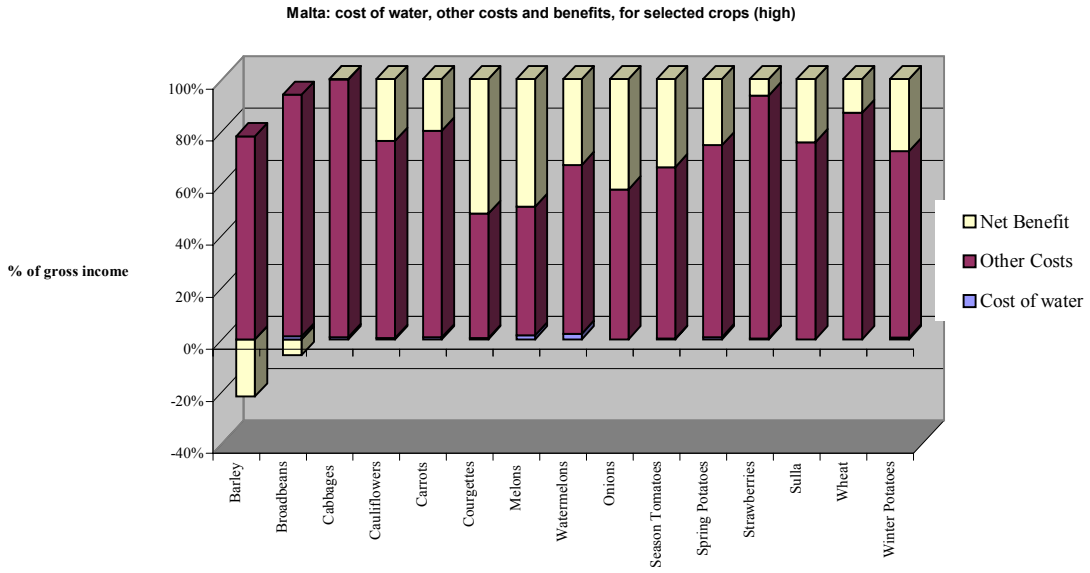
production account for the entire agricultural sector is indispensable for an integrated policy formation. **As yet such an account is not available.**

This limitation notwithstanding, farmers and breeders have to be guided in order to optimise on water use in relation to value per unit of output. Ideally, water is channeled to those crops that generate the highest value added, and to breeding animals that relate water use and market value. Such considerations are bound to be time-bound; they may change with technology and market conditions.

Such relationships may be established under three scenarios:
i) ***Low*** water requirement, yield and gross income
ii) ***Average*** water requirement, yield and gross income
iii) ***High*** water requirement, yield and gross income

In turn, gross income may be changed into net benefit per crop by deducting the cost of water and other expenses.

Such an exercise was carried out on data sets for 1997 in Delia C. (2004) where the two sets of data were combined and expressed in percentage terms setting the highest value in the data set at 100. This exercise yielded a set of indications regarding the profitability per crop throughout the year. It may pay to emphasise the production of particular crops in one season but not in another as the consumption of water changes with the seasons; other costs are held constant. A similar exercise was carried out for more recent data on the distribution of crops and their respective sales value. One result is presented in the graph below. The other scenarios are presented in Annex 2. The exercise assumed that the price of water per m^3 is 4.4cents.



A comparison with the 1997 data elicits the following remarks.

First, crops that were profitable to produce in 1997 yielded losses in 2004. Thus, under the high scenario, for example, it was profitable to produce barley and broadbeans in 1997. It was no longer so in 2004. Conversely, it was not worthwhile to produce season tomatoes and strawberries in 1997; but it was financially rewarding in 2004.

Secondly, as costs are contained, it is market prices that determine the worth of a crop. Therefore, the viability matrix of crops varies with the timing of product flow and the resultant price effect. If supply can be timed in such a way as to yield a constant flow of product to support a price structure, and if this system is complemented by an efficient organisational set up to contain input price increases, then profitability margins will be affected accordingly. Conversely, changes in water pricing, abuse of water use at highly subsidised rates resulting in overabundance of perishable crops, and a dampening of product price following the inflows of imported produce will bear heavily on the worthiness of the respective crops. This last observation, which arises in part from EU membership, is a main parameter change from the 1997 scenario. The higher cost of seeds, fertilisers and fuel also contributes to higher input costs and, hence, to lower net benefits.

Similar considerations refer to the breeding of animals. In the case of water use, if part of the water consumption is not accounted for, or if investment has to be undertaken in order to support production – like waste management plants – then the entire cost configuration will change and net benefits per unit of output will be affected. The value of imported meat will depend on the EU's negotiating stand at the World Trade Organisation.

4.4 Demand for Water by the Tourist Sector

The tourist sector comprises several industrial units that consume relatively high amounts of water. This is especially so in the accommodation sub-sector. However, because of the proximity of many of the hotels to the coastline, these units can rely on seawater pumped from bore holes and either supplied directly to the water supply system or cleaned and pumped thereafter. This water can be recycled and, at some stage, remitted through the main drainage system. In addition, hotels rely on water supply that is carried to site by water bowsers.

Since 2000, the 1.1million visitors spent around 10.5million days in Malta and Gozo. Attempts were made to compile data on water consumption through surveys carried out among hoteliers and restaurateurs, but, so far, the response rate has been very poor. The timing for restaurant owners may not have been opportune; they were debating the issue of smokeless restaurant/bar environment effective in October. Their minds were elsewhere! On the part of hoteliers contact with the Malta Hotels and Restaurants Association may eventually lead to a survey that accounts for a cost schedule that identifies water production and purchase separately. To date, data refer to Food Costs, Beverage Costs, Departmental Expenses, Payroll Costs and Unallocated Expenses. Unallocated Expenses represents 'administration and general, marketing, property and

utility costs'. They amount to circa 15% in 5-star and 4-star hotels and around 20% in 3-star hotels.

Data for Input/Output relationships, referring to 1994-1996, the last time that they were published, suggest that the expenditure on water amounted to 1.5% of total output (Table 3.8 above). More recent data for the year 2000, relating the demand for 'collected and purified water and distribution' by hotels and restaurants to intermediate consumption and total output, yields a value of 1.8% of total intermediate consumption and 0.9% of total output at basic prices.

This subject has to be pursued further. Visitors represent the equivalent of 30,000 permanent residents annually, but having a relatively greater demand for water consumption during their relatively short stays. This means that their per capita consumption of water is higher than that of a Maltese resident.

5. Demand for Water in the Years Ahead – Baseline Scenario

Projecting future water needs and related development of the water supply and draining network implies an identification of the evolving demographic, economic and social scenarios. Politically, the Maltese Islands are seen as members of an expanding European Union and subject to the water directives of the Union and the fiscal means to attain them.

Sections 3 and 4 above presented a basis on which various scenarios may be constructed. But such projections will have to be adopted as national policy targets and a set of strategic tools devised in order to attain such targets. Otherwise, they objectives remain projections with no real policy significance.

This section outlines the envisaged demographic changes and industrial policies as identified in 2004. One important feature stands out in official documents on sectorial economic development: water use has not been identified as an explicit strategic resource. So gaps in policy targets arise and these will be noted. They will have to be approached by the relevant policy strategists and a comprehensive water policy drawn. Investment needs and pricing options can be realistically assessed only after such an exercise is undertaken.

5.1 Population and Housing Stock in 2020

A residential shift is envisioned in the next fifteen years. The number of Maltese households is projected to grow to 159,926 in the year 2020 (Table 3.1 above). It was 119,479 in census year 1995. By itself, this statistic implies an increase in the quantity of water demanded for consumption.

However, this increase is not the outcome of a uniform growth throughout the Islands. In general, the distribution pattern of households is expected to remain unchanged in three areas, namely, Central Malta, 27%; Gozo and Comino, 8%; and South Malta, 28%. These areas account for 63% of households.

Relatively marginal increases are projected for the North Harbour Area – from 17% to 18% and the North West Area, from 8% to 10%. No relative changes are projected for the Marsaxlokk area, 3%.

A significant change is expected for the Grand Harbour Area – a drop from 9% to 6% of the household stock.

These demographic shifts have to be addressed in advance otherwise water distribution planning will suffer, perhaps even putting pressure on the aquifers. In such conditions, the quality of national water services network will fail to meet the water needs. Satisfying such needs will become more costly. If the tariff system is to reflect production costs, then the objective of cost containment per unit of water supplied will have to be

rigorously pursued. Failure to meet such an objective will mean a higher outlay per family on water and, consequently, fewer resources allocated for other consumables or saving. A larger volume of water produced mechanically through RO plants will absorb a higher amount of electricity thereby inducing an induced cost of such a utility service.

5.2 Water and Agriculture

The present report highlighted the discrepancy in water consumption attributed to unrecorded water consumption in agriculture. As indicated in section 4.3 and Table 4.2 above, total water consumption in the Maltese Islands amounts to 38million m^3, of which 14.4 million m^3 are directly attributed to Agriculture, over and above those recorded for Farms by the billed consumption data of the WSC.

This glaring under-recording of water use is not accounted for in the recent official document presenting the **Rural Development Plan 2004 – 2006** (Ministry for Rural Affairs and the Environment, June 2004). The problems related to water extraction are noted, in passim, (pages 62- 64), but they do not re-appear in the rest of the document. This means that an important input in the survival of the agricultural sector remains an 'unknown' for planning purposes and, consequently, does not induce provisions for its economic and profitable use. The Plan notes that the output of irrigated land is substantially higher than that of non-irrigated land and stops there.

The Planning document is meant to guide farmers in regulating their investment in the medium term on the strength of financial incentives (e.g. grants). It notes that there could be a decline in output in the next few years but it does not go beyond the generic thrust of searching for appropriate niches following Malta's membership of the EU. (The report was originally drawn in 2002. It was included without any changes in the Plan).

A developing agriculture sector that accounts for the huge amounts of 'free' (not priced) water will differ from one that accounts for priced water and, hence, an optimal use of this scarce resource. Section 4.3 above indicated the relationship between the economic and technical use of water. Future plans will have to be based on such dual criteria in the context of a revamped Common Agricultural Policy and in terms of the Water Directive of the EU. Surely, one cannot omit such important input as water and claim to have a potential blueprint for the future development of an economic sector.

This report, therefore, assumes that agriculture will continue to be encouraged to strive for efficient and profitable production and, at the same time, take account of a fairly priced water supply. Only an optimal use of water as an input will lead to competitive resource allocation and the sustainability of the respective economic sectors.

5.3 Water and the Manufacturing Sector

The use of water by industry is estimated from the data bases pertaining to the mid-nineties. These data sets refer to the billed water consumed. However, these input-output relationships may be misleading for selected productive sectors. The actual amount of water consumed in production is significantly higher than the billed input. Alternative sources of water, like unlicensed water extraction from underground sources, remain unrecorded.

Moreover, even in the case of reported water used, such as the case of water and soft drink producers, the future of the industry depends on complementary policy rules that may render the continuation of such activity in its present set up not viable. For example, the ruling to allow bottling of water products in disposable plastic containers may render imports competitive with the result that a local bottling operation will turn into an import deport. Local production will cease.

As the various measures incumbent on Malta as an EU member unfold, the future of water using industrial projects will demand a continuous re-assessment. One can assume that in the absence of these measures and any action by the regulators in Malta the present situation will continue. But this scenario is not possible. Measures that impinge on industry will enter in the coming years, especially after the short term periods of derogation are over.

A continuous assessment of water use and its share in total costs is necessary. The attempts carried out in recent months for this report did not produce he desired statistical base. These efforts will have to continue in the coming months building on the understanding that seems emerging. But such initiatives have to be located in the context of a national design that highlights the main guidelines for industry. Many commentators refer to the need to generate employment, rising incomes and output. At the same time the issue of subsidies and other forms of industrial support are to be addressed. In the absence of specific guidelines, policy measures cannot be translated into real-world costs and sales unless the volume of inputs and their prices are identified correctly. In so far as water is concerned, the correct configuration of water use in industry is still missing.

5.4 Water and the Tourism Sector

Similar remarks may be made for the sector of tourism. The 1990 Master Plan for the sector, drawn by the firm of consultants Horwath and Horwath, projected an increase of visitors to circa 1.5million, staying an average of 10days. These targets were never met. At present, a re-assessment of the tourism strategy in place in recent years in underway. One awaits the outcome.

However, it must be emphasised that the leisure sector, in its entirety, will have to be addressed collectively especially in the context of the approaching commitment of water sewage treatment, a requisite of the Barcelona commitment.

It will also have to be addressed in the context of the demographic shift, and increase in numbers, explained in section 5.1 above. Population movements and the concentration of visitors particularly in the May-September months have to be accounted for in the planning of water distribution and sewage treatment networks.

6. Current Level of Cost Recovery

6.1 The Waterco guidance document

The guidance identifies four different types of information necessary to assess the levels of cost recovery, namely:

1. The costs of water services including financial, environmental and resource cost. The financial costs are to include the operating, maintenance and capital costs.
2. The price tariff currently paid by the users and evaluation of tax transfers.
3. Assessment of the extent of the financial and environmental cost recovery by water service and the private sector.
4. Assessment of contribution of cost recovery from key water uses.

A review of incentive pricing properties of existing tariffs is necessary to evaluate the effort that is necessary to meet the 2010 deadline. Principles for allocating water costs to categories of water users are to be defined in a coherent way. The main output in this economic analysis is the assessment of cost recovery.

6.2 Water Services in the Maltese Catchment District

In this district the following water services are defined:

- The extraction, production and distribution of drinking water by the Water Services Corporation.
- Public collection and purification of waste water
- Self services concerning the extraction of groundwater
- Self services concerning the production by Reverse Osmosis (R.O.) water as an input to production (e.g. tourism and industry)
- Self services regarding the purification of wastewater.

6.3 Level of cost recovery in the public sector

The assessment of the degree of cost recovery depends on the elements included for cost consideration. Table 6.1 summarises the degree of cost recovery for actual water supply services in relation to direct production and distribution costs. Sales from billed consumption do not cover the full costs of water supplied. Table 6.1 suggest that cost recovery in recent years amounted to around two-thirds of the operation.

The costs incurred by the Water Services Corporation are subsidised directly by government. In addition bank loans undertaken for investment projects by the Corporation are backed by government guarantees. The amount of government subvention has been declining in recent years. Bank loans amounted to Lm9.782million in 2002 and Lm10.067million in 2001. The Corporation's exposure with the banks, in loans and overdrafts, were Lm31.836million for the Corporation in 2002.

Table 6.1
Costs of Water Production, Sales and Cost Recovery

Year	Cost of Production & Distribution (Lm mil)	Sales (Lm mil)	Cost Recovery -% Col.(2)/ (1)
1998	21.243	8.686	41.46
1999	20.207	8.853	43.81
2000	16.685	10.356	62.07
2001	19.271	11.785	61.15
2002	18.710	10.889	58.20
2003	17.923	11.486	64.09

Source: Cols 1 and 2: Water Services Corporation

The data available do not allow an analysis of cost recovery by sector. This is one policy consideration that demands attention so that the distributional element of the financial support will be identified and potential corrective measures assessed.

However, a breakdown of consumption by sector for the years 1999/2000 (Delia, C., 2004: 20) shows that the industrial and commercial sectors were cross subsidising the farming and domestic sectors. Pensioners and consumers who received social assistance benefited from the highest subsidy. Of the other categories of households only 6% received financial support from government. These subsidies are now seen to vary inversely to family size.

This subsidy distribution is the direct result of the water tariff system in place. Malta operates a rising block water tariff system, as may be observed from Tables 4.3 and 4.9 above and Table 6.2 below. Table 6.2 presents the present charges. A service charge is paid independently of the amount of water consumed; it includes a sewerage charge. More favourable tariffs are charged to vulnerable consumers, such as persons receiving social assistance and pensioners. Such measures are in line with the Water Framework Directive. Article 12a refers to 'an affordable price' in order to guarantee a basic level of domestic water supply.

Table 6.2
Water Tariffs

Type of consumer	***Service rent***	***Consumption charge***	***2002***
Domestic	Lm12	0 –33m^3/person >33m^3/person	16c5/m^3 110c/m^3
Social Assistance	Free	0 –16.5m^3/person -16.5m^3/person >33m^3/person	Free 16c5/m^3 110c/m^3
Agriculture and agro food	Lm24	0 –6810m^3 >6810m^3	16c5/m^3 35c/m^3
Personal Health Use in field	Lm24	0-15m^3 >15m^3	22c5/m^3 60c/m^3
Industrial	Lm18		85c/m^3
Food and beverage	LM24		60c/m^3
Tourist Flats	Lm24	0 –252m^3 >252m^3	75c/m^3 Lm1.10/m^3
Hotels	Lm24	0 – 42m^3/bed >42m^3/bed	90c/m^3 Lm1.10/m^3
Laundry	Lm24	0 – 6810m^3 >6810m^3	75c/m^3 Lm1.10/m^3
Sea Craft	Lm24		Lm1.10/m^3
Government	Lm24		Lm1.10/m^3
Boat house, Garden & garages	Lm24		Lm1.10/m^3
Non-Commercial	Lm12	0 –171^3 >171m^3	Free 35c/m^3
Commercial & other	Lm12	0 –33m^3 >33m^3	16c5/m^3 Lm1.1/m^3

The gap between costs and turnover arises mainly because the WSC has substantial real and apparent losses. 'Real losses' are defined as unavoidable leakages while 'apparent losses' refer to water that is consumed but not paid for, such as water theft or meter under-registration. The latter type of leakages also include data analysis and processing errors between archived data and data used for billing, data collection and transfer errors between meter and billing system or meter errors arising because meters do not accurately register volumes passing. These relationships between real and apparent leakages for the years 1998 to 2004 may be observed from Table 6.3.

Table 6.3
Real and Apparent Losses

Year	*System InputMil m^3*	*Billed Cons.*	*Percent (2)/(1)*	*Real Losses*	*Percent*	*Apparent Losses*	*Percent*
1998	42.673	17.244	40.4	17.091	40	8.339	19.5
1999	40.060	17.415	43.5	14.441	36	8.204	21.5
2000	38.643	18.731	48.5	13.035	34	6.877	17.8
2001	35.800	18.002	50.3	11.869	33	5.929	16.6
2002	36.675	18.613	50.8	11.098	30	6.963	19.0
2003	36.589	18.969	51.8	11.500	31	6.120	16.7
2004	33.932	18.425	54.3	9.317	27	6.191	18.2

Source: Water Services Corporation, 2004

In recent years the WSC is actively striving to reduce both leakages. ***Real leakages*** have effectively diminished from 40% of systems input or production to 27%. As a result of its success production of water has decreased notwithstanding a rising demand. Leak repairs during October 2002 – September 2004 cost the Corporation Lm104,000. They reduced leakages from 11.5million m^3 in 2003 to 9.317million m^3 in 2004. Estimating cost per meter cubed at 55cents, these water savings amount to Lm1.2million. This estimate excludes the external cost arising from a higher consumption of energy to produce the water thus saved.

Apparent losses are still substantial. A main contributor to these losses is money due to the Corporation. At the end of June 2004, debtors aged 1 –5 years represented Lm2.856million or 55% of total aged debtors. Another 11% of debtors owed monies due for more than five years. Three fourths of debtors, owing Lm3.9million, are domestic and commercial users. A more effective credit control unit within the WSC will improve recoveries and reduce the amount of subsidy from government.

In addition to direct production and administration costs, the cost recovery may be assessed in relation to the environmental and resource related expenses that result from current water use in its broader sense.

The production of drinking water has two types of environmental and resource costs. If groundwater abstraction is high, and greater than groundwater recharge due to low precipitation, the resource will diminish. Hence more RO water will be produced. Since RO water production is more expensive, the cost of piped water supply, which is a blend of groundwater and RO water, increases. A greater reliance of RO water adds to the social costs associated with a greater demand for energy.

The WSC is proposing to refurbish and upgrade the desalination plant while taking account of water quality, security of supply and costs. Such an upgrading will reduce the financial and environmental costs. The proposal seeks to upgrade plant capacity from the

present 67,000m^3 per day to their original 95,000m^3/d. Such investment will also attend to water quality by reducing chlorides from the present 360mg/l to 200mg/l as well as enhance power efficiency from the present 5.57kwh/m^3 to 4.74kwh/m^3.

A merit of this investment will be the support it gives to maintain water quality if the quality of groundwater deteriorates. The investment is estimated to cost 77.887million euros.

A second category of costs is associated with the effects on the natural habitats. Abstraction results in reduced water flows in the basin's watercourse. The imputed costs of these effects on natural habitats will be treated in a separate study.

6.4 Public Collection and Purification of Waste Water

Prior to October 2004, the Drainage Department was responsible for the collection, disposal and treatment of the wastewater in the Maltese Catchment District. This wastewater is mainly disposed to the sea from the Gozo, Cumnija and Wied Ghammieq outflows. Practically all the Maltese households and commercial enterprises are linked to the main sewer. The villages of Gharb, Bidnija and Bahrija with a population of 800 inhabitants are not connected to the main sewers but have their own cesspits that are cleaned regularly. The WSC considers prohibitive the infrastructure costs to connect these sparsely populated villages.

The financial responsibility of running the sewers was delegated to the WSC in January 2004. Total operating expenses for the 8-month period, January to August, amounted to Lm3,598,386. This statistic is inclusive of a depreciation charge of Lm2,265. Turnover of the draining sector for the same eight months was Lm4,333,866, made up of Lm285 in sewage fees and a government subsidy of Lm4,333,581 (Management Accounts, Water Services Corporation, for the 11 months ending August 2004).

An exercise is currently under way to charge the infrastructure costs into the bills system. The WSC is compiling the stock figures of the drainage sector to derive the full stock valuation. An enhanced presentation of the accounts is necessary before a classification distinguishing between fixed and working capital may be obtained.

It is therefore premature to derive the cost recovery position with the information at hand. However, it is evident that costs are being subsidised mainly by government. New developments pay a contribution that goes to cover the costs of connecting the premises to the network. Funds from this fee during the January-August 2004 period amounted to Lm975,000, which is the equivalent of 27% of total operating costs for the period. But these fees are not transferred to the WSC; ten percent, i.e. Lm97,500 were paid to MEPA.

A small volume of municipal waste is treated at Sant'Antnin sewage treatment plant. This plant was designed to treat a maximum of 17000m^3/d. However, it never reached this limit. The maximum amount of recycled sewage hovered around the 8000m^3/d.

Three fourths of treated water is used to irrigate 240hectares of land. This water is not metered and is distributed through open troughs against a charge of Lm4 per hectare of irrigated agricultural land. The other 25% of recycled water is metered and sold to industry at 4c per m^3. The volume of treated water varies from month to month depending on the crops grown and the amount of precipitation. Costs of production are relatively fixed. Hence the more water that is recycled, the lower the average costs. The average cost hover around 13c6 per m^3. Cost recovery is nil.

The agriculture sector claims that the quality of water is not good because there is high conductivity. There is therefore no security of supply. It is maintained that the security of supply may be secured by complementary water supplies from boreholes; this flow is more reliable! Officials at the Department of Agriculture contend that farmers may be willing to pay a maximum 25c per m^3 of treated effluent if the water flow is constant and of a good quality with low salinity value. This second class water must not negatively affect the plant growth and the yield for the farmers.

An investment of Lm250,000 is needed to continue operating the Sant'Antnin plant. Part of these costs may be offset by a fall of 50% in the running costs once WSC start managing the plant.

The WSC is aware that recycled water produced at Sant'Antnin is high in chlorides. This may be either caused by illegal discharges in the sewers by operators in manufacturing or tourism sectors, or caused by sea infiltration, or by both. The WSC urgently needs to identify the cause/s and improve the quality of the effluent. If the source of high chlorides is illegal discharge, the costs incurred will be those in enforcing existing legislation. Very few operators seem to be aware of, or abide by, LN 159 of 2002 regarding the quality of discharges into the sewers! However, if seawater infiltration is high, then heavy investment will be needed to rectify the position. But, in the first place, it is necessary to identify the source/s and plan an action plan on the findings.

Malta is a signatory to the Barcelona Convention and is therefore committed to treat all wastewater before they are dispersed in the marine environment. In fact, Malta is planning to set up three new recycling plants: one in Gozo, one in the north of Malta and one in the south of Malta. The first two treatment plants are expected to become operational by the quarter of 2006; the south plant is planned to be functioning by 2007 if the necessary finance is raised.

The new plants are designed to receive a maximum of 13,600m^3, 13,600m^3 and 30,600m^3 daily inclusive of storm water. The average daily flow of sewage from these new treatment plants will be 4,300m^3/d, 3,900m^3/d and 42,400m^3/d i.e. a total of 50,6000m^3/d. The average daily flow is estimated on the basis of a sewage production to water consumption ratio of 0.8. This figure is based on flow measurements conducted in 1991 during the formulation of the Sewerage Master Plan. The water consumption is the mean taken over the years 2000, 2001 and 2002 and is calculated by deducting leakage from water production.

6.5 Cost of Sewerage Treatment Plant

The cost of setting up these plants is listed in table 6.4 below.

Table 6.4
Costs of Setting Sewerage Treatment Plant

Euros

	Gozo	***North***	***South***
Capital Cost	7.2mill.	7.5mill.	60.0mill.
Operational and Maintenance	0.467mill.	0.467mill.	2.034mill.
Administration	N.A	N.A	N.A
Depreciation W/E Installation	0.072mill.	0.075mill.	2.034mill.
Depreciation Civil Works	0.288mill.	0.3mill.	2.4mill.

Source: Water Service Corporation

The capital outlay is essentially shared evenly between mechanical and electrical installation and civil works. The civil works are designed for 12.5 years equivalent to a depreciation rate of 2% per annum. Mechanical and Electrical works are depreciated at 8% annually. The workings of the cost per m^3 of water produced by every plant and the average cost of the three plants are given in Table 6.5.The costs for the item 'all flows' does not include the disposal of sludge that may amount to another 2c5 per m^3.

Table 6.5
Cost of Recycled Water Per Plant

Plant	**Tertiary Treatment Effluent Price of Production per m^3**	**Secondary Treated Effluent Price of Production per m^3**
Gozo	14c	11c
North	15c	12c
South	5.5c	4.5c
All flows	7c	

Source: Water Services Corporation

6.6 Environmental Costs

Sludge is the byproduct of sewage treatment plants. In Malta, actual treatment of sludge and its eventual disposal are still under consideration. Treatment includes pre-thickening, anaerobic digestion, post-thickening and de-watering for its application to agricultural land.

Incineration, land application, landfilling or sale and distribution can dispose it. The cost of disposal varies. Incineration is very expensive both financially and environmentally. It may receive a considerable amount of public disapproval. Waste sludge may be applied either on the surface of the soil or injected a few centimeters into the soil surface. In the United States of America only non-food production is grown on this soil. Sludge may also be sold. It adds considerable organic content and some nitrogen and phosphorus to the soil. Sludge may be used for landfilling. This method of marketing sludge has to be carefully considered and take account of the nitrate level in the soil and nitrate content of manure that is annually produced by breeders of livestock. The nitrogen level of this manure per hectare of agricultural land may exceed the 170kgN/hectare. See Table 6.6 below.

Reed beds (phragmites) may be considered for sludge disposal. This process was pioneered in Europe in 1950 and is land intensive. If land is available for construction of reed beds, the process is considered to be one of the most economical that be found in today's technology.

Whichever method of sludge disposal is used, a detailed cost-benefit analysis has to be carried out. All stakeholders, namely, the MRA, MEPA, WSC, the Department of Agriculture, Health Authorities, Industry, Insurance companies and NGOs, are to be consulted and alternative possibilities assessed. The use of sludge in agriculture or domestic use will require the drying up of water. It is estimated that over 70% of every ton of waste is water. The drying up process may be costly and the net return may be low or even negative if there is no market for the dried sludge.

Farmers and the food industry abroad have expressed their concern regarding agricultural use of sludge. Sludge may affect the safety of food products and the sustainability of agricultural land. It may pose a potential economic liability. In Malta, the problem may be compounded if firms continue to dispose of their liquid industrial waste in the sewers and disregard their obligations as laid down in LN194 of 2002. Unless enforcement is effective, the levels of heavy metals and other potential contaminants may be significantly high in the resultant treated sludge. This condition may restrict the use of sludge for application to agricultural land.

6.7 Self- Service Concerning Extraction of Groundwater

The level of self-service extraction of groundwater, especially by the agricultural sector, is expected to be high. It is set at 11.4 million m^3 per annum.
Extraction of groundwater by industry is also existent, but not quantified. The data on billed consumption by industrial sectors suggest that the amounts of water consumed by several industrial producers are unrealistically low. However, in the absence of values of turnover and output by industrial sector – data that are being compiled – it is difficult to derive the volumes of water consumed and identify the 'water gap'.

6.7.1 Cost Recovery

The level of cost recovery in the private sector is not known. But it can be assumed that the financial costs incurred by the private sector firms, such as those in the beverage, construction and laundry businesses, are fully recovered. These costs are internalised in the cost of production and passed on to consumers according to the demand conditions.

6.7.2 Extraction by Agriculture Units

In agriculture water is practically obtained at zero cost. Capital expenditure for a borehole is Lm800. Besides, there are the costs of electricity to pump water as running costs. In such instances, farmers are exploiting a very scarce resource, water. But they reap all the benefits from such use and, at best, pay only a very small amount of the costs, usually the recurrent costs of pumping and the depreciation of the drilling/pumping operation. They rarely pay the external and opportunity cost of the water extraction; indeed the electricity rates may be even subsidised! This under-valuation leads to economically inefficient resource use. Figure 6.1 illustrates the total costs incurred and the costs borne by users of groundwater extraction. The full economic costs include the capital costs, the operational and maintenance cost, the resource administration cost, the foregone values of alternative uses present and future and the opportunity cost. Farmers only pay the capital, operational and maintenance costs.

Figure 1 : Total Costs Incurred by Operator and Society

	Water Supply Costs				**Social Cost**	**Opportunity Cost**
Cost of Ground Water extraction	Full Economic costs	Capital Cost	Operational & Maintenance Costs	Resource Administration Cost	Foregone values of alternative uses present and future	In situ value cost of salaries, sea intrusion and use of buffer during droughts and oil slicks
	Paid by Users	Capital Cost	Operational & Maintenance Cost (Energy often subsidised)			

Hence the allocation of resources and the production of crops is not driven by market forces. Costs incurred by farmers underestimate the true cost of water, which is a vital input in production. Breeders of livestock also use more water for cleaning than their European counterparts. The Department of Agriculture confirms that the sludge produced by pig farms in Malta, for example, is more watery than that generated on European farms mainly because Maltese breeders have easy access to underground water sources.

In addition, environmental costs are generated as a by-product of crop growing and livestock breeding. Manure is a by-product of breeding animals. The volume of manure produced annually and the nitrogen content of this manure are listed in Table 6.6.

Table 6.6
Estimated Annual Production of Manure and Nutrients

Animal Type	*Number*	*Average Lightweight (kgs)*	*Total Fresh Manure ('000kg)*	*Total Dry Manure ('000kgs)*	*Nitrogen ('000kgs)*
Dairy Cows	8656	550	72808	31437	385 - 428
Heifers	5060	400			
Beef	4000	400	46000	18350	225 - 250
Sews	7622	170			
Boars	394	220			
Fatteners	130000	100	210517	12631	255
Broilers	5000000	1.8	10500	8000	126 -510
Layers	500000	205	19750	7193	255 –560
Sheep	7900	45	5250	700	60
Goats	5450	40	2650	260	35
Rabbits	2400000	2.5	23115	5199	265 -330
Horses	600	450	5077	760	31

Source: Peter Jackson, Animal Waste in the Maltese Agriculture, September 2001

Table 6.6 suggests that the production of manure is 2,459,000 kg annually. If all manure is applied to the 10,794ha of agricultural land, the average nitrogen content per hectare ranges between 151.66kgN/ha to 227.81kgN/ha per annum. The upper range exceeds the parametric value of 170kgN/ha set by the Nitrate Directive, and the 210kgN/ha conceded to Malta by the EU Derogation up to 2006.

Additional use of fertilisers renders the position worse. Data on volumes of fertilisers used are being compiled. The data for 2003 show that 10,935,118kg of nitrogen compound were imported. The average import of nitrogen for the past five years is 8,024,957kg. But it must be pointed out that nitrogen is also used for other uses beside agriculture. So the relative share of agriculture in the consumption of nitrogen has yet to be established.

The use of sludge as a soil condition may aggravate the problem further and increase the environmental costs. Hence a comprehensive approach to this matter has to be taken. Trade and agriculture policies have to be combined with the aim of generating an agricultural sector that is consistent with the respective EU Directives. While imports may not be restricted, yet farmers have to become familiar with the Code of Agricultural Practice. Only in this way can sustainable, profitable and competitive production emerge in the sector of agriculture.

The high level of nitrates in the soil may explain the high average nitrate level in the aquifers, such as those of Bingemma Perched Aquifer and the Malta MSL aquifer. These average values are given in Table 6.7.

Table 6.7
Average Nitrate (mg/Lt)

Aquifer	1995	1996	1997	1998	1999	2000	Average
Bingemma Perched	114.47	107.01	101.02	105.68	109.94	107.28	107.56
GozoMSL	29.71	23.50	26.61	46.20	42.12	43.80	37.23
Malta MSL	65.03	67.97	63.88	68.46	67.88	68.42	66.94
Mizieb	45.50	43.30	41.40	4.050	40.50	44.30	42.58

Source: National Statistics Office, 2002, Environment Statistics

The average nitrate level in Table 6.7 exceeds the parametric values of 50mg/Lt established in Directive EC/98/83. It is highest in Bingemma perched aquifer at 107.56/Lt i.e. at twice the value. This may reflect leaching of nitrate that arises from intensive farming, high use of fertilisers, leakages from sewerage system and animal husbandry.

Although the nitrate level is higher than recommended, Malta still complies with the Drinking Water Directive since all groundwater extracted for drinking is mixed with RO water thus neutralising the nitrate level.

The main capital cost needed by WSC to reduce nitrate levels is estimated at Lm450,000. This represents the cost of renewal and upgrading of transfer mains connecting Ta' Qali Reservoir and the Luqa Reservoir. The costs of producing energy used in the RO water applied in the dilution of nitrate-contaminated water have to be worked out.

6.7.3 Extraction by Industry

The volume and extent of water extraction by industry is not known. This is a missing element that has to be addressed. The results obtained from the survey among industrial units for this report did not produce the desired results. But the returns submitted provide an insight into this important factor. This matter has to be pursued further in order to complete the picture on which an effective water policy can be constructed.

6.8 Self-service concerning the production by RO water as an input to production

There is no published data regarding RO production by industry. However, hotels situated close to the coast integrate such systems in their water generation and distribution network. They aim to be self-sufficient in water rather than buy piped water supplied by the WSC. The cost of RO water is comparatively low and very competitive.

It ranges between 20c and 35c per m^3. It is therefore much cheaper than the tariff charged by the WSC.

The beverage industry also operates its RO plants. Groundwater extracted may be high in chloride. It is treated before production. Tap water is also treated before used as an input in production. The financial cost of treatment is incorporated in the cost of production. There is no information regarding the disposal of brine produced during treatment.

These 'missing' links in the information chain mean that the operators in manufacturing and tourism are generating environmental costs that are as yet not quantified. But these costs are not borne by the 'polluter'. The cost of cleaning this wastewater is borne by the WSC and, ultimately, by the taxpayer since treatment cost are paid for by government subsidy.

In a survey on the type and quantity of waste generated by different types of industries in Malta, Callus and Camilleri (1997: 115) found that food, beverages, tobacco, metal and non-metal firms produce relatively large amounts of wastewater as well as liquid chemical wastes. Metal and non-metal industries produce large amounts of spent oils. Tanners and electronic firms release heavy metals and cyanide in their wastewater.

These contaminants increase the cost of treating wastewater and sludge produced from such water. Moreover, the quality of the sludge may be poor and, as a consequence, its commercial value may be minimal.

6.9 Self-services regarding the purification of wastewater

Information on wastewater purification in industry is very scanty. This subject has to be investigated further to identify the real situation. Only then can such results be relevant for policy formation.

7. Concluding Remarks and Further Research

This report outlined the state of water supply from ground sources and recycling and the net work that facilitate water sewage disposal. It built on existing material but succeeded to establish important facts necessary for the formulation of an effective water policy and strategy in the Maltese Islands. The primary contribution refers to the derivation of a wider consensus on the actual water consumption among interested stakeholders, in this instance the Malta Resource Authority, the Department of Agriculture, the National Statistics Office and the Water Services Corporation.. This result is the outcome of inter-agency collaboration and thus augurs well for the future. Agriculture consumes around 15million m^3 of water annually that to date have not been recorded. Total water consumption is estimated to be 38million m^3 rather than the 19million m^3 that appeared on billed consumption data.

Such a result brings a series of adjustments to existing databases in its wake. This mainly affects the costs per unit of water from different water sources and the resultant distortion in the price matrix that condition decision making in the various sectors of the economy. The main effects are surely observed in the sector of agriculture where the wrong water price configuration is leading to an expanding area of irrigated land but based on misleading cost consideration. There cannot be a resilient agricultural policy in the absence of good quality sustainable water supply at a competitive price.

Similar remarks apply to certain units in the manufacturing sector that may be tapping water sources illegally by extraction of water from underground sources, either directly or indirectly through supply by water bowsers. This phenomenon may be happening to a lesser extent, perhaps, in the sector of tourism. Attempts to build up a data set on water sources and cost relationships in these two sectors did not produce the desired results. The degree of response from operators in these two important sectors was very poor. The research coincided with two 'events' in the respective sectors. Industrialists feel that they are overburdened with surveys since the National Statistics Office adopted an approach that relies on surveys to collate data. Industrialists maintain that some data are already available in one format or another and therefore the data gathering process needs to be evaluated.

At the same time, operators in the leisure industry were taken up with debate on smokeless environment and a trade flow that was less attractive than expected. They focused on these issues and did not find time to concentrate on water use.

Therefore, these data gaps will have to be filled in the coming months. The collaboration of the representative bodies was never in doubt. So, a longer time frame for conducting research on these issues will benefit all and will draw a higher degree of collaboration as happened in the case of agriculture and water use.

As observed in the preceding sections, the distribution of visitors throughout the year and throughout the Islands will bear on water consumption and its disposal. So there has to be the same synergy between the respective objectives and strategies for manufacturing

industry, tourism and water that has been noted for agriculture and water. In the end it is this integrated, holistic national plan that brings together the respective policies. They have a common element apart from the consumption of water. That is price. 'Water consumption' has to be turned into 'water consumption at a competitive price' in a national strategy for profitable trade.

7.1 Research

Research that has to be carried out in the coming months will have to focus on three important issues.

1. Micro area studies to assess the changes in population density and the related needs for public utility services.

2. The correct amount of water used by industry in the manufacturing sector and the relative share of piped water in such an amount. It is important to establish whether water is being obtained through extraction of underground water. Besides, industrialists have to make their views known regarding the efficient way of recycling water and, also, regarding the volumes of water they are prepared to re-use and at what price.

3. The water supply and water recycling network that prevail in the accommodation sub-sector in tourism and their related costs. The information available is not enough to construct an informed policy.

4. The quality of water in use in agriculture and the optimal use of such water in relation to the net benefit per crop as explained above.

5. Demand for recycled water and the optimal way to dispose of sludge.

This new information will provide policy makers a wider data base on which to draw up different scenarios in time to meet the Water Directive objectives.

References

Angelakis, Andreas N., ***Wastewater Recycling and Reuse in Malta,*** FAO & MRA**,** Nov. 2003

Bacharah, Miguel and Vaughan, William J, 1994, ***Household Water Demand Estimation***, Inter American Development Bank, Working Paper, ENP 106.

Borg, Victor, 1997, ***Farm Accounts***

Callus, J. and Camilleri, R., 1997, ***Pollution Prevention: A tool in the management of industrial waste in Malta***, Unpublished Dissertation, B.Sc (Hons), University of Malta.

COWI Consult, 1992, ***Malta Sewerage Master Plan for Malta and Gozo, Working Papers 1 and 2.*** A report prepared for the Ministry for Development and Infrastructure, Malta.

Delia, Carmen, 2004, ***Economic Considerations Regarding Markets for Water in the Maltese Islands*** (Report prepared for the FAO on Water Resources Review for the Maltese Islands)

FAO, 2004, ***Water demand by Agriculture in Malta***

Gatt, Kevin, 2004, ***Quantifying Water consumption as a basis for determining its impact on Groundwater Resources in the Maltese Islands.***

Grech, Manuel, 2004, ***Farm Accounts***

Sapiano, E., 2004, ***Interim Report on Water Use in the Maltese Islands***

Thomas, J. F., and Syme, G., 1988, "Estimating Residential Price Elasticity of Demand For Water" ***Water Resort Research***, Vol.24. No.11: 1847-1857.

.

Annex 1

Elasticity of Demand: Price and Income

Year	Ln Y	Ln X1	Ln X2
	Water consumption (1989-1999)	Price index	Per Capita Income
1989	3.351551852	4.769158036	7.8043289
1990	3.334665765	4.769158036	7.873544496
1991	3.457514701	4.769158036	7.913447862
1992	3.497416239	4.769158036	7.937963808
1993	3.493077443	4.769158036	7.965041974
1994	3.39802569	4.605170186	7.99639467
1995	3.472587378	4.605170186	8.04503364
1996	3.546912583	4.605170186	8.06990246
1997	3.502579996	4.6998438	8.111568071
1998	3.338044567	5.03805589	8.120671967
1999	3.357280325	5.03805589	8.184881886

Regression Statistics	
Multiple R	0.690367006
R Square	0.476606604
Adjusted R Square	0.345758254
Standard Error	0.062655909
Observations	11

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.028598673	0.014299336	3.64243498	0.075043478
Residual	8	0.031406104	0.003925763		
Total	10	0.060004777			

	Coefficients	*Standard Error*	*t Stat*
Intercept	3.220999772	1.379360887	2.335139268
X Variable 1	-0.364605471	0.137842378	-2.645089823
X Variable 2	0.243545701	0.179996321	1.353059327

Elasticity of Demand: Price and Lagged Consumption

Year	ln Y Water consumption(1989-1999)	ln X1 Price index	ln X2 Water consumption (1988-1998)
1989	3.351551852	4.769158036	3.439616492
1990	3.334665765	4.769158036	3.351551852
1991	3.457514701	4.769158036	3.334665765
1992	3.497416239	4.769158036	3.457514701
1993	3.493077443	4.769158036	3.497416239
1994	3.39802569	4.605170186	3.493077443
1995	3.472587378	4.605170186	3.39802569
1996	3.546912583	4.605170186	3.472587378
1997	3.502579996	4.6998438	3.546912583
1998	3.338044567	5.03805589	3.502579996
1999	3.357280325	5.03805589	3.338044567

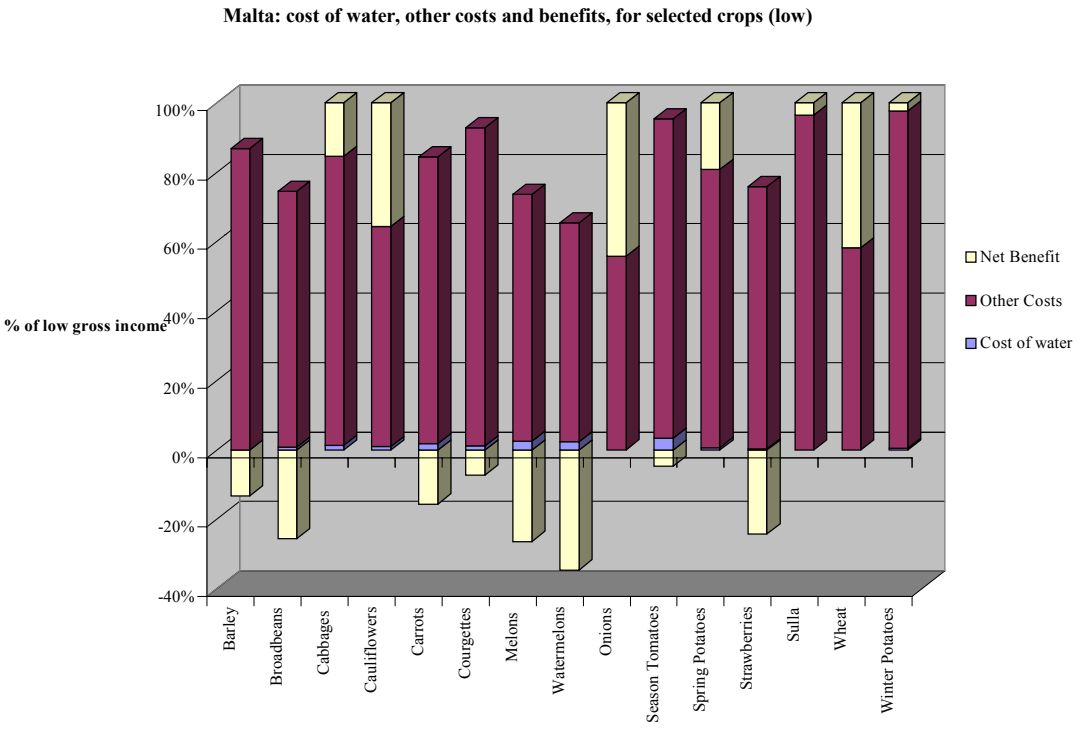
Regression Statistics	
Multiple R	0.638187704
R Square	0.407283545
Adjusted R Square	0.259104432
Standard Error	0.066676288
Observations	11

	df	*SS*	*MS*	*F*	*Significance F*
Regression	2	0.024438958	0.012219479	2.7485894	0.12342068
Residual	8	0.035565819	0.004445727		
Total	10	0.060004777			

	Coefficients	*Standard Error*	*t Stat*
Intercept	3.922387938	1.342938929	2.920749302
X Variable 1	-0.278452206	0.142713711	-1.951124408
X Variable 2	0.24330357	0.294836476	0.825215299

Annex 2

The relationship between water and crop output and crops, costs and net benefit



Malta - cost of water, other costs and benefits for selected crops (average)