The evolution of water culture in Malta: An analysis of the changing perceptions towards water throughout the ages

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Summary. Since time immemorial, the provision of water in sufficient quantities has been one of the most pressing national problems. This paper will try to analyze the changing public perceptions towards water and its use throughout the last two millennia, through the development of a correlation between the prevalent social and economic changes experienced.To this end, the background social and environmental conditions characterizing four distinct periods in Maltese history will be analyzed, in order to determine their effects on the popular perception to water.

Keywords. Society - Environment - Water perception - Malta

L'évolution de la culture de l'eau en Malte : une analyse du changement de perception de l'eau à travers le temps

Résumé. *Depuis des temps immémoriaux, l'approvisionnement en eau en quantité suffisante a été parmi les problèmes nationaux les plus urgents. Ce travail tente d'analyser les changements de perceptions publiques vis-à-vis de l'eau et de ses usages au cours de ces deux derniers millénaires, à travers le développement d'une corrélation entre les changements sociaux et économiques dominants. Dans ce but, sont analysées les conditions sociales et environnementales de base qui caractérisent quatre périodes de l'histoire de Malte afin de déterminer leurs effets sur la perception de l'eau.*

Mots-clés: *Société- Environnement - Perception de l'eau- Malte*

I - Introduction

Malta is a small country, which has a semi-arid Mediterranean climate, characterized by a general lack of rainfall during the summer period. The island has no exploitable surface waters, and thus groundwater is the only natural water resource which is available all year round.

Groundwater resources in the island can be broadly divided into two main groupings, primarily based on the accessibility of the resource: the perched aquifers, which are mainly located in the western regions of the island, where groundwater is found in limited quantities but at shallow depths and in free flowing springs; and the sea level aquifers which whilst having a vastly greater exploitation potential than the perched aquifers are difficult to exploit due to the depth of the saturated zone.

The first inhabitants of these Islands must have found enough water for their requirements when they settled on Malta's shores. The harbors, mostly on the east or north easterly coast, are simply the estuaries of old rivers which flowed in an easterly or north-easterly direction, draining the land which slopes gradually from the rocky hills on the west to the sea on the east and north-east. The first settlers, who came by sea, must have stopped close to the shore and moved slowly inland to those parts where natural springs gave sufficient water for their use. Later on, the quality of our rock taught these early inhabitants to excavate tanks and to fill them with rain-water. All over the islands one finds water storage tanks which can be traced back to Mediaeval, Roman, Punic and even to Neolithic times.

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Figure 1. Rock-cut cisterns in the vicinity of the 'Mnajdra' Megalithic Temples which are generally presumed to be contemporary to the temples.

II - The Arab and Medieval period

The Arabs, coming from a similarly arid climate, had a good understanding of how to manage and conserve scarce water resources. Amongst others, they are accredited for the introduction of dry-stone wall construction and field terracing, the introduction of trees and crops with low water requirements (e.g. carob, olive, citrus, figs and cotton) and the introduction of the water wheel (MT: *sienja*)

The total population of the islands during this period is generally considered as being around 20,000 persons mainly living in small scattered villages, with the main fortified settlement, the 'Medina' being located on the western highlands of the island in the vicinity of the perched aquifer springs. The smaller villages were also mainly located in the vicinity of major natural water sources, and in fact one can still find water related place-names around these older settlements. During this period, water supply is not considered as the major problem facing the inhabitants of the islands, although one of the main challenges must have been the storage of water from winter to summer, particularly for the thriving agricultural sector.

In this lesser known period in Maltese history, the Maltese language, the language which was actually spoken by the common people, can be considered as an indicator of the activities which were carried out every day. In fact, when one analyses the Maltese language, one can find a number of words of Arabic origin which describe natural water features such as springs and valleys and also water use activities such as irrigation. These include:

'*Ghajn*' meaning spring. (Ar: نيع)

'*Bir*' meaning well or cistern.(Ar: ريب)

'*Migra*' meaning watercourse or water channel. (Ar: رجم)

'*Saqqaj*' meaning watering place. (Ar: عاقس)

'*Qana*' meaning drain hole. (Ar: قانة)

'*Mellieha*' meaning salt-pans. (Ar: ح□لم)

A more detailed list of such Maltese terms originating from the Arabic language is presented as an annex to this paper.

In fact, an analysis of Maltese place names carried out by Godfrey Wettinger in 2000 had identified around 137 places which included the term '*bir*' in their name. Similarly, 87 and 4 place names included the terms '*ghajn*' and '*migra*' respectively. It can be noted that place names are more related to water supply features (sources or storage areas), since significantly less areas were found to be named after water use features. In fact, the above analysis found only 6, 5 and 1 places named after the terms '*mellieha*', '*saqqaj*' and '*qana*' respectively.

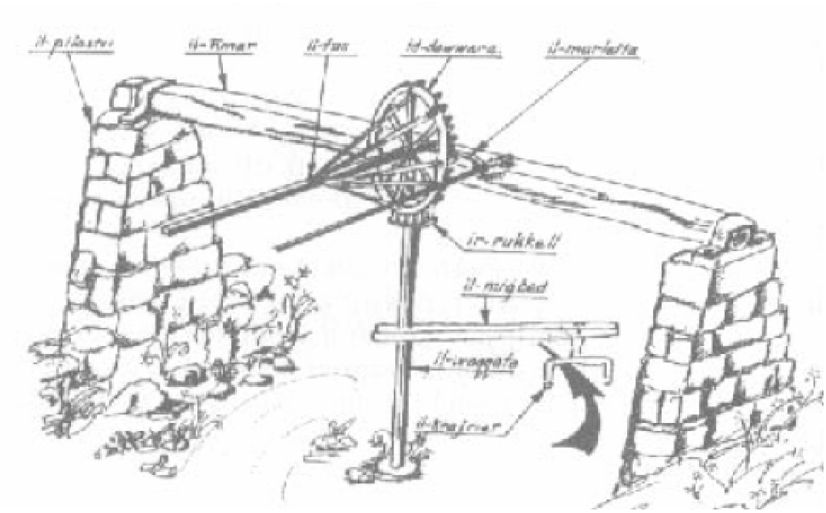

Figure 2. The linguistic contribution of the Arabs concerning irrigation may lead to presumed that they also introduced the *Sienja*.

These terms describe not only, as expected, the main water sources of the period, but also water harvesting techniques, which serve as an indication of the need to harvest water from the wet season to the dry season. Also, one can deduce an organized approach to water use, given that these terms also reflect the regulation of water flow such as the increase of recharge through the construction of infiltration channels and the abstraction and delivery of water. Of interest is also the importance to terms related to the marine sector, such as harbors and saltpans.

Definitely, agriculture was the main economic activity for the islands, and this can also be deduced from the wide variety of terms related to the delivery of water for irrigation. Such terms include:

(i) A simple damming system which was used to veer run-off towards a particular direction known as '*sieqja*', '*ilqugh*' or '*qana*'.

(ii) Harvested water was stored in underground cisterns and reservoirs known as '*giebja*', '*gibjun*' or '*latmija*'.

(iii) The location of a well/cistern in the field was marked either by a stone well-head ('*horza*') or by a '*gabja*' – two poles meeting at an angle with a pulley attached to it.

(iv) Raised stone water channels called '*hwat*' conducted water from reservoirs and wells to fields using gravity along several winding U-shaped stone conduits called '*swieq*'.

(v) Groundwater abstraction goes back a long way: farmers manually dug vertical shafts known as '*spiera*'. An animal driven water wheel called '*sienja*' or '*norja*' raised water from the water table to the surface.

III - The knights of St John

When the Order of the Knights of St John accepted King Charles V's offer of the Maltese islands, this they did reluctantly. The delegation they had sent on a fact-finding mission on the conditions of the islands, prior to their acceptance, described Malta as barren and lacking greenery and afflicted by contagious diseases. This report also describes in great detail the availability of water at the existing settlements in particular the old city of Mdina and the fortified cities in the harbour area. From the report one can conclude that the Maltese noblemen, who lived predominantly in the city of Mdina, derived their drinking water from underground tanks whilst the springs that fed the western part of the citadel were used for the irrigation of the gardens. The city could also afford the luxury of two water fountains in the main squares.

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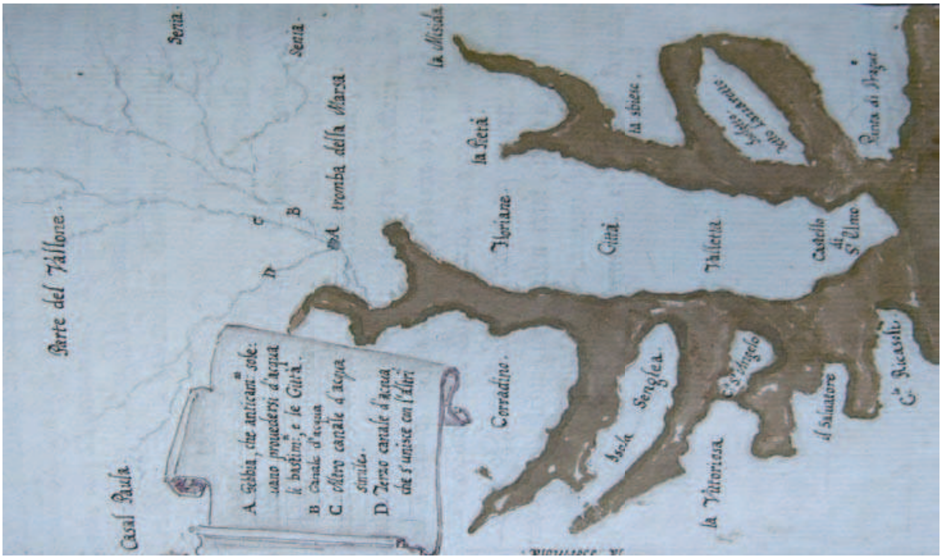

Figure 3. Detail from an old map of the Maltese islands illustrating the location of the fortified cities in the Harbour area (Vittoriosa, Senglea and subsequently Valletta) and the Marsa springs denoted by the markers A – D.

The conclusions of this first report were further corroborated in 1536, when the Knight Quintinus Haedus reconnoitred a descriptive study of Malta where he portrayed the water situation as follows:

"…The water is salty and putrid, but there are good springs which are probably due to rain fallen in winter time. The origin of these springs is not very deep, they often disappear in summer but they always diminish in volume. One generally drinks rain water collected in tanks or in ditches…"

The Knights of St John being primarily a seafaring Order, however established themselves at the *Borgo*, or Vittoriosa as it was later known, which is situated in the Harbour area. In fact, this period inevitably shows increased settlement and economic activity in the eastern regions of Malta, where however lack the presence of natural freshwater supplies. In fact the nearest sources of fresh water were the springs at Marsa, located around 3 km inland, which contemporary reports suggest that were also rather brackish. Moreover, these springs were used extensively by the fleet and therefore, Birgu depended heavily on rain water stored in tanks hewn from the stone underneath the houses and in public areas. In this period one finds an increased emphasis on these water storage facilities and in a number of document surveys outlining the number and capacities of the various cisterns present in the fortifications and cities around the islands were regularly carried out.

Table 1. Survey of water storage facilities carried out by Romano Carapecchia in 1723.

Location	Private wells	Capacity (botte)	Public wells	Cisterns	Capacity (botte)
Valletta	1,637	146,702	13	40	39,584
Vittoriosa	821	46,926		21	4,354
Senglea	878	22,762	7	9	5,660
Bormola	870	25,352	15	3	7,798
Fort St Elmo				6	4,762
Fort St Angelo				12	6,230
Bighi				18	2,576
Fort Ricasoli				10	10,278

Issues of water availability were also given due consideration during the planning and construction of the new city of Valletta. In order for this new city to provide a reliable stronghold for the Order, it had to be equipped with a sufficient water storage capacity capable of sustaining the population held within its walls for a very long period of time. The issue of water storage gained further importance due the fact that the land chosen for the construction of the new city had no natural water sources. In fact, a Commission appointed by the Grand Master Jean de La Vallette to draw up regulations for the building of the new city houses laid down that:

"…every house should have an underground tank for the collection of rainwater, under penalty of fifty scudi for failure to comply…."

Moreover, the Knights designed a public drainage system connected to a network of pipes that carried sewage outside the city walls, thus preventing the risk of contamination of the rain-fed tanks from sewage leakage. This is the first documented plan for the prevention of water supply contamination in Malta.

Prominence is given to the construction of water cisterns.

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Figure 4. Detail from a watercolor depicting the construction of the new city of Valletta.

The building of the city of Valletta brought about an increase in the population both within the new city and in the surrounding areas together with an increased economic activity. By the late 1500's, it became clear that the water storage facilities in the city could not cope with the daily water demand and so a supply of water for Valletta had become a necessity, "*not only for its usefulness but also for its honor*". In 1596, the Council of the Order decreed that a project to "*convey spring* *water from the western hills to the city had to be carried out*". For this purpose, 20,000 *skudi* where set aside but the amount was insufficient to cover all the costs, and for this reason the project failed to be realized.

However, following two exceptionally dry years (1608, 1609), the question of water supply became an urgent one, since the water stored in Valletta was soon becoming exhausted. Grand Master Wignacourt, pressed by the drought, thought that the time had come when the city should have its reliable water supply and the fountains of water as the other great cities of Europe. Work on the aqueduct started in earnest in 1610 and was commissioned in 1615. It had a supply capacity of around 1,400m^3/day supplying around 30,000 people. It should be noted that the great majority of water available for public supply through these new developments was only available to the inhabitants of the cities, whereas rural villages depended on their local underground cisterns.

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Figure 5. Illustration of the Wignacourt Aqueduct.

The arched structure ensured the delivery of water by gravity from the natural springs on the western highlands of the island to the developing fortified cities on the eastern coast.

The Wignacourt Aqueduct continued to provide the only lifeline for the towns and cities on the eastern coast of the island and the availability of water in these areas brought about an increase in the population which reached 114,000 persons by 1798. Moreover, the water security brought about by this new infrastructural development resulted not only in an increase in the population of the island but also in the development of a number of towns and villages alongside the route of the aqueduct.

IV - The British colonial period

The start of the British period is characterized by two major developments:

(i) An increasing water demand brought about by the needs of an ever increasing population and a general increase in the standard of living; and

(ii) An increased economic activity in the harbor areas and the setting up of dense urban centers in these areas.

These conditions brought about a major strain on the water supply infrastructures on the island, and one might say that the applied solution was typical of the British Empire at the time - an engineering solution aimed at augmenting the available resources.

In fact, under British rule, various major infrastructural works were undertaken including the digging of a deep well close to Valletta and the installing of a motorized pump in 1851. This was a very important development since it represent the first organized exploitation of the sea level aquifers. Improved drilling and pumping technology developed during these years, permitted the exploitation of the sea level aquifers and resulted in drastically increasing the water supply potential of the islands. Exploitation of the lower aquifer system was further increased with the construction of groundwater collecting galleries spread over the whole aquifer system.

Other important works undertaken over the years included: the construction of galleries and a pumping station at Wied il-Kbir, and the installation of a pipeline water system supplying Valletta, Floriana, Sliema, Birkirkara, Zebbug, Siggiewi, Rabat and Mdina in 1887; the construction of galleries and pumping stations, the Fiddien Reservoir (91,000m^3), the Qrendi Reservoir (54,500m^3) and major pipelaying works between 1955 and 1961.

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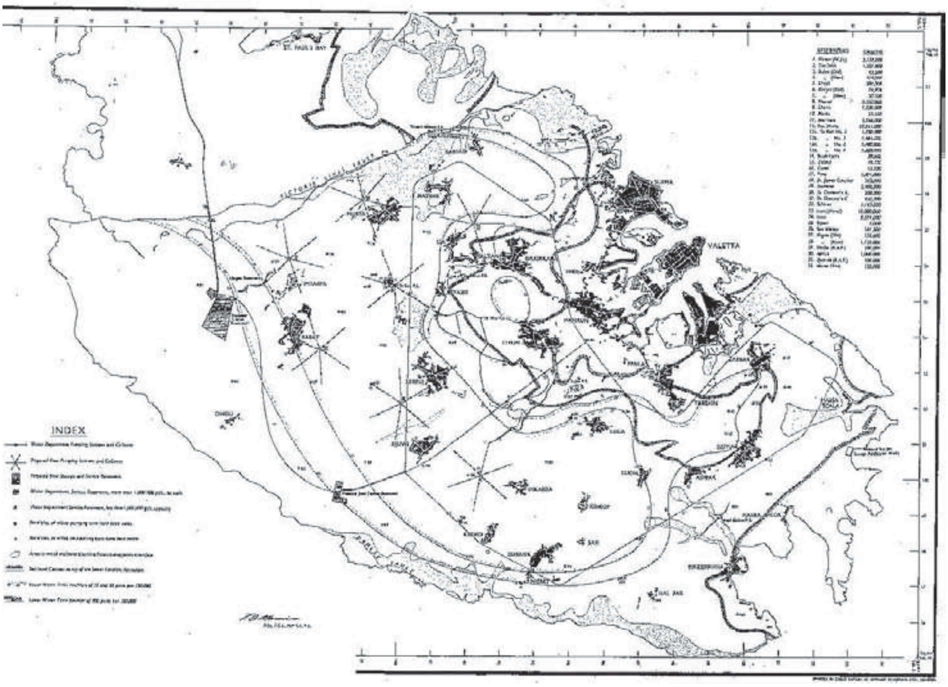

Figure 6. Outline Map illustrating the (British) Water Development Plan for the Maltese Islands.

The application of improved technologies in response to the increasing water demand continued with the installation in 1881 of a boiling-type distillation plant at Tigne', in order to counter for the increased demand generated by new urban development in the area.

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Figure 7. The first sea-water distillation plant constructed at Tigne' in 1881.

The economic stability and the resulting increased standard of living is not only reflected in an increased water demand but also in an increased expectation on the quality of the supplied water. The year 1909 is one of the most important milestones in the evolution of water quality in Malta. On the recommendations of Sir Temi Zammit and Major A. H. Morris, sterilization via chlorination was initiated thus rendering the public supply safer. Another measure taken was to replace the open channel system by a closed pipe system. These measures brought a marked improvement in the standard of living and a definite decrease in the death rate. The Health Authorities initiated a routine quality control program and results were documented in Annual Reports.

The protection of water quality was also further regulated through the enactment of new legislation. In the Maltese islands, the Civil Code and the Code of Police Laws are the earliest legal sources regulating water resources. The Civil Code regulates the collection of natural water resources and identifies who has the right to collect water which flows naturally on land. Water management under the Civil Code is mainly regulated under Title IV of Praedial Easements. These provisions indicate that the competent authorities of that time recognized the need to regulate the use of natural water, and they tried to adopt a system where natural water will be collected and not wasted.

On the other hand the Code of Police Laws tries to protect 'public waters', a term which one can assume to refer to groundwater. Furthermore it was under the Code of Police Laws, that the regulation of pollution was first introduced. This is the earliest piece of legislation indirectly applying the 'polluter pays' principle.

V - Post-independence

The 1960's saw a period characterized by a high population increase, a rapid economic growth and an increase in the general standard of living of the population. This had the effect of increasing the overall water demand on the islands, where increased abstraction of groundwater to meet the ever increasing demand resulted in deterioration in the status of the aquifers, with the annual average chloride level of the municipal supply reaching highs of 840ppm. This fact compelled the Government to look for alternative sources of water and a supply augmentation approach was adopted. In fact, in 1963, it was decided that a multi-stage flash (MSF) distillation plant be built in conjunction with the 'B' station of the Power House of Marsa. At that time, this process was proved to be the most successful and economical way to produce water for potable purposes; however due to changing global scenarios such as the increasing fuel costs in the early seventies, only four MSF's were installed and were operated only sparingly. The peak output from these plants reached around 4.5 million m3 per annum. This production did To make up for lack of production, in 1972, it was decided to exploit further groundwater and an intensive drilling campaign was commissioned. The drilling of boreholes spread over the mean sea level aquifer was originally recommended in a study carried out by the ATIGA Consortium. This would have, theoretically, guaranteed about 36,900m^3/day as a safe yield and these would have been so extracted as to allow a good distribution over all the aquifer. In fact, about 150 boreholes were drilled mainly in the central and southern regions of the island, which resulted in a marked increase in production but alas, a deteriorating chemical quality. By 1980, the average annual salinity had reached 1600mg/l. Production from the MSL aquifer alone reached 48,650m^3/day. This figure could not meet the water demand and yet once again the Government had to diversify ways to produce more water artificially to make up for the lacking groundwater production and deteriorating quality.

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Figure 8. Reverse Osmosis Desalination Plant at Ghar Lapsi.

During the late seventies, a new desalination technology had made great strides and progress. Due to the high fuel prices, the Government turned its attention to a relatively novel desalination technology, namely Reverse Osmosis. It was decided that a 20,000m^3/day plant be installed on the SW part of the island namely at Ghar Lapsi. This would guarantee water to the worst affected part, namely the central and southern part of Malta, where rapid industrialisation and urbanisation were taking place. In 1982, the Ghar Lapsi plant was the largest to be built in the world.

A second sea water Reverse Osmosis Plant was commissioned in 1986. This was located in the touristic Sliema area at Tigne'. Surprisingly enough, increased production produced an increased demand. Water conservation methods and concepts were still primitive. Studies in Groundwater Management, distribution leak detection and water conservation methods were therefore commissioned. One can consider this as a very important milestone, since once water production and availability issues were addressed, the focus shifted on the management of the water demand. The results of these measures proved to be very promising since to date, Malta can boast to have almost 50% of its desalination potential as spare capacity.

Modern housing and a heightened demand for better quality drinking water has indirectly created a market for new sources of water supply. Consumption of bottled water has shot up in recent years, reaching an estimated annual volume of 50-60 million liters; while an increasing number of property owners source their recreational needs (swimming pools etc) from private 'bowser' suppliers who use groundwater as their main source of supply. 'Swimming pool' demand is however determined by the total physical volume of pools and MRA databases indicate a total number of around 3,500 registered pools in the Maltese islands with a total combined volume of approximately 250,000m^3.

VI - Conclusions

The acceptance of the application submitted by Malta to become a Member State of the EU triggered the process of harmonization. This led to a major re-evaluation of Malta's legislative system, particularly in the field of environmental management. As an EU Member State, Malta is obliged to take a more sustainable and integrated approach to groundwater management than was previously the case. The regulation of groundwater management in Malta has also needed to be harmonized with the relative sources of the *acquis communautaire,* which are comprehensive and holistic in their approach.

Within this legislative framework, integration aspects play a key role for guaranteeing the success of implementation of both the Water Framework and the Groundwater Directives. In this view, 'integration' refers to consideration of (i) other environmental policies with impact on groundwater protection; (ii) interactions of groundwater with surface water and terrestrial ecosystems; (iii) scientific development and technological progress and (iv) socio-economic aspects.

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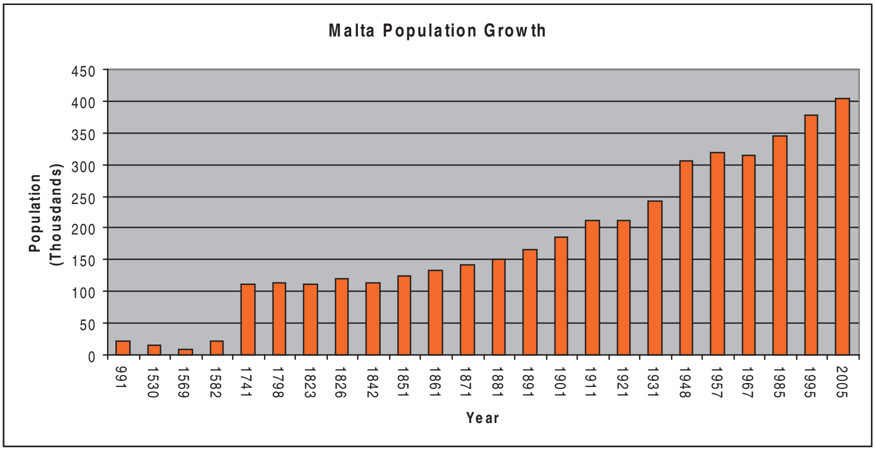
ANNEX I – Malta population growth



Source: BRGM, 1991.

ANNEX II – Water related terms in the Maltese language (originating from the Arabic period)

Baqqiegha	Low place in which water stops and is dammed, marsh
Bewla	Slowly leaking ground
Bewwiela	Easily flooded field
Bir	Well, cistern (pl: Bjar)
Curcara	Waterfall
Fawwara	Spring, fountain of water
Giebja	Large Cistern (pl: Gwiebi)
Gwejbiet	Small Cistern
Gadaf (Gadus)	Water wheel bucket or water pipe or spout
Ghadira	Stagnant water or pool
Ghajn	Spring (pl: Ghejun)
Ghewejjen	Small springs
Ghodor	Lakes
Hawt	Trough or small water reservoir
Herza	Stone curb surrounding mouth of well or cistern
Ilma	Water
Maqghad	A place where water stagnates
Marg (Marga)	Flood plain
Megin (Megil)	Reservoir (swamp)
Marsa	Harbour, anchorage
Mellieha	Salt pans
Mgajra	Little watercourse
Migra	Watercourse, water channel (pl: Mgarr)
Mahsel	Washing place (pl: Mhasel)
Migbed	Long beam of the water-wheel of a well or cistern
Menqa	Water enclosure or reservoir (pl: Mineq)
Mixta	Animal watering place (pl: Mxieti)
Mizieb	Waterspout, water outlet, gutter (pl: Mwiezeb)
Mnejqa	Small water reservoir (pl: Mnejqet)
Mrajga	Little marsh (dim of Marga)
Mwiegel (Murigen)	Reservoirs
Nixxiegha	Natural water spring (pl: Nixxieghat)

Noqra	Small hollow in the ground especially one in which water stagnates.
Nqojra	Dim of Noqra
Pwales	Swamp, Marsh
Qadus	Water-wheel, bucket or scoop used in irrigation
Qana	Drain hole
Qattara	Dripping stream of water
Salina	Salt-pan (pl: Salini)
Saqqaj (Saqqajja)	Watering place
Saqwi	Irrigation land
Sebha	Pool, pond or lagoon (pl: Sebhat)
Sieqja	Water Channel (pl: Swieqi)
Spiera	Groundwater borehole (pl: Spejjer)
Taflija	Clayey area
Wejjed	Small valley
Wied	Dry Valley (pl: Widien)

Source: Wettinger, G., 2000.