

# WATER AND ARCHAEOLOGY FOR SUSTAINABLE TOURISM

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**ABSTRACT.** – **Water and Archaeology for Sustainable Tourism.** Water is undoubtedly the most precious resource of the planet and the accessibility to water resources marked the history of mankind since the dawn of times. Water has been indeed very central to archaeology and anthropology, that studied the ways in which water was provisioned, tanked, distributed, worshipped, exploited for agricultural irrigation or to power machines like water-mills, used for leisure, hygiene and healing, or abused to confer power on particular groups ,and how it played a central role in political and economic strategies. More than any other factor, waterways marked cultural and economic developments in history. This paper outlines examples of water resources management throughout the ages, in Cyprus and the Hellenic Civilization on different aspects of the use and management of water, investigates technical issues and gives suggestions, thus promoting a new approach to archaeological heritage and sustainable tourism.

**Keywords:** Water resources; sewer systems; sustainable tourism; ancient water technologies.

## 1. INTRODUCTION

Archaeological studies have established that the basis for many modern technological achievements in water resources was established in ancient Greece with the most advanced cultural developments taking place in semiarid areas with the lowest rainfall and the most limited water resources. Studies of climatic conditions in the Mediterranean carried out in the last 5000 years showed unstable conditions but there was never an abundance of water resources (Lionello, 2012 ). Rainwater harvesting was then practiced where collected and stored usually in artificial reservoirs, known as cisterns. This water is used for household purposes such as bathing or washing, household uses, laundering clothes, irrigation or other urban uses. The design and development of such water collecting systems is an emerging technology encouraged by the need for water conservation and water taxes. It can be of great value where water is scarce but in many circumstances it is still expensive and not necessarily beneficial to the environment. This applies to Cyprus and the Hellenic civilization as well. The study of ancient technologies on water management is certainly expected to upgrade the understanding of these ancient operations and certainly promote sustainability in the tourist industry.

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In this paper, wastewater and urban drainage systems are reviewed based on the results of archaeological studies. Emphasis is given on the progress made during the Hellenistic and Roman periods in the construction, operation, and management of sewerage and drainage systems. A brief description of the historical periods is followed by a description of the systems implemented. The need of integrating the ‘water issue’ in the development of innovative strategies for reducing the impact of tourism on environmental and cultural heritage and to ease the pressure on water resources, suggests further capitalising existing knowledge and building upon the extraordinary archaeological heritage, would release ‘full-packages’ of replicable interventions at different levels.

## 2. A BRIEF HISTORY OF PREHISTORIC TIMES

In Minoan Crete the technology of surface and storm water storage was highly developed. Water was conveyed into cisterns, a technique still practiced today in rural areas of the island. In fact, this practice has been widely used throughout the history of Crete. In ancient Crete the technology of surface and rain water storage for water supply was very well developed and was continuously used up to modern times. In the city of Phaestos no wells or springs have been found. Special care was given to securing clean surfaces in order to maintain the purity and hygiene of collected water. In Fig.1, (left) clear surfaces used are shown for collecting runoff water, and (right) filtration process through coarse sandy filters is shown, before storage into the cisterns in order to maintain the purity of water. This water was mainly used for washing clothes and for other cleaning tasks.



**Fig. 1. Phaestos palace. Open yard (left) and special cistern with sand filter (right)**

Archaeological evidence indicates that the first Cypriot settlers arrived on the island as early as the 9<sup>th</sup> or 10<sup>th</sup> millennium BC during the Neolithic Age (ca.8500 3900 BC).

In the Bronze Age (ca. 2500 – 1050 BC), Cyprus witnessed a rapid transformation of technology and economy that led to further population growth. Trading with Near East, Egypt and the Aegean flourished. Mycenaean Greeks arrive and settle on the island spreading the Greek language, religion and customs, and also bringing with them advanced techniques in the management of water resources. The first city-kingdoms of Pafos, Salamis, Kition and Kourion are

established during this period. Population growth led to further water demand and eventually the need for a better wastewater management. Storm water was collected in every house, carried through terracotta conduits (Fig. 2a) and stored in cisterns found in the house yard (Griva, 2008). A detailed section of one of these terracotta pipes is shown in Fig. 2b.



**Fig. 2.** (a) Round terracotta pipe installed under the floor possibly carrying storm-water and (b) Terracotta pipe with inspection aperture from Amathus.

### 3. HISTORICAL TIMES

In Amathus, a very important finding discovered was the underground Nymphaeum, an ancient tunnel of at least 120 m long together with a water spring. After the destruction of the Nymphaeum by the earthquakes of 15 BC and 76/77 AD, a reservoir and a fountain were constructed. Further excavations in Amathus have revealed a well preserved stone conduit (pipeline sculptured in stone) which was most probably used for the supply of freshwater from the water reservoir (Fig. 3a and b). It consists of carved stone pieces of variable length but consistent internal and external diameter. The variable length is probably a result of the stone pieces they had available to carve the conduits. The gradient is steady and relative to the ground elevation. Square stone pieces are present at given distances of about 2 m in order to support the conduits by preventing settlement (Fig. 3b). Apertures also exist on every piece of pipe covered by a flat stone and sealed with lime mortar for access in case of blockage or when ventilation was required.

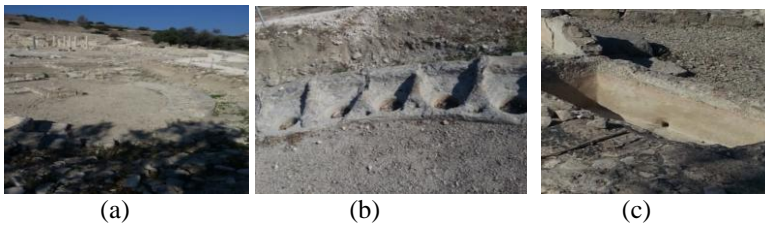


**Fig. 3.** (a) Stone conduit (sculptured stone water pipeline), with equally spaced small apertures used as inspection holes and (b) Detailed stone conduit connection point found in Amathus.

The During the Hellenistic Period (*ca.* 323-67 BC), and following the death of Alexander the Great, the Ptolemaic rule brought peace and prosperity to Cyprus. Culturally Cyprus is considered as part of the Greek world and is embellished with various public buildings .

In Amathus excavations of the agora in the 1980s have revealed a public bath building (balaneion) consisting of an enclosed circular space and adjacent rooms and hallways (Figure 4a and b). A hall realized as a roofed palaestra (exercise room) or as a dromos (race course) is present. Patrons could come to this area for exercise and then proceed to the circular bathing area. In the center of the bathing area one can observe the foundations for the furnace and of the hot water reservoir (Fig. 4a). Two groups of eight little baths (pueloi), which are narrow and lacking drain holes, are aligned against the east and west walls in the southern area (Fig. 4b). Here servants (parachytai) with buckets could rinse the patrons with cold or warm water. As no drains were found in the balaneion (baths), it can be assumed that grey water was removed by the servants possibly disposing it to the large drain system which runs westwards under the street collecting storm water and the runoff from the Nymphaeum and reservoir.

This circular room was partially remodeled in the second century BC when five of the little baths were replaced by larger plunge baths (Fig. 4c) in which the user could be submerged (Aupert, P., 2000).



**Fig. 4.** (a) View of the Hellenistic Baths and (b) a detailed view of the ‘Pueloi’ (little baths) inside the Hellenistic Baths-in Amathus. On the right (c), plunge baths in Hellenistic Baths (balaneion) in Amathus.

#### **Roman Period (*ca.* 67 BC-330 AD).**

In Roman times sacred values were associated with the water element, originating from its importance to human life (Monteleone, 2008). Sewers and water pipes were not though invented by the Romans; they existed in other Eastern Civilizations as old as the Minoans (Angelakis *et al*, 2005). Romans have perfected them and applied this knowledge into major infrastructural works to serve all citizens (Lofrano, 2010).

The House of Theseus in Paphos dates back to the late Hellenistic period but was built on ruins of earlier houses probably belonging to the second half of the second century A.D.

The bath of this huge villa is included within the original plan. A large frigidarium (cold pool area) contained two big and one small basin for cold water storage. The spacious warm part composed of a tepidarium, sudatorium and

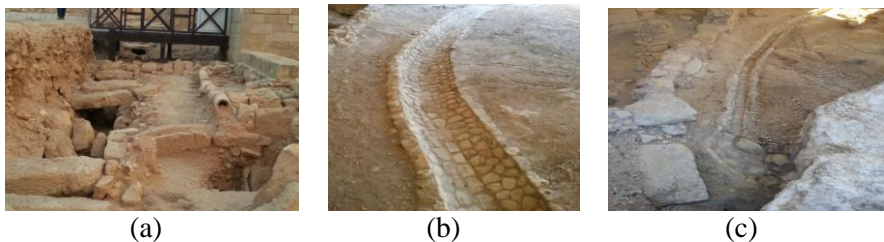
caldarium was provided with three warm basins. Hot water was distributed by means of lead pipes and cold water by terracotta ones. An ingenious system of drains allowed for the diverting of used water for flushing latrines (Fig. 5a and b). This shows that the Romans realized that they could recycle wastewater from spas and baths by using it in flushing latrines before discharging into sewers leading to the sea (Lofrano, 2010).



**Fig. 5. (a) Latrines in the house of Theseus and (b) Detail view of water supply through a terracotta pipe built in the wall**

These latrines found in the House of Theseus are very similar to others from the same period or even from latrines dating back to the Minoan period. They could accommodate 12-14 persons. Although only the vertical dividing stone walls are present, we can assume that there was also a horizontal stone plate covering the void space and resting on the vertical supports. This was used as a latrine seat. A terracotta pipe built in the wall (Fig. 5b) is most likely a provision for fresh water supply.

Between the House of Aion and the Villa of Theseus excavations have revealed a large sewer (width at top: 700-750 mm, and at bottom 38 mm) cut in the rock to the depth of 1000-1200mm built up with blocks and covered by stone slabs (Fig. 6a).



**Fig. 6. (a) Combined sewer drain (left), and water supply terracotta conduit (right). (b) Storm drain channel in Kourion and (c) Storm sewer also from Kourion**

In Kourion (about 50 km east of Paphos), the remains of the House of Eustolios were found. This House was reconstructed on the ruins of an earlier palatial private residence which was completely destroyed by the earthquakes of the late 4<sup>th</sup> century AD. Stone clad rain channels probably used for rainwater harvesting are also present on site (Fig. 6b, c). One can notice that the channel's width is about twice the channel depth indicating that the people of the period had some practical knowledge of basic hydraulics, and on efficient design. These

sections are the most efficient in designing open channels. It is also evident that people of that period had the expertise and knowledge as well as environmental consciousness to develop a mixed drainage and sewerage system something that can be seen in today's modern societies.

#### **4. SUSTAINABLE TOURISM**

UNEP and UNWTO organisations defines 'sustainable tourism' as *"Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities"*. Thus, we should (i) make optimal use of environmental resources that constitute a key element in tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity, (ii) respect the socio-cultural authenticity of host communities, conserve their built and living cultural heritage and traditional values, and contribute to inter-cultural understanding and tolerance., and (iii), Ensure viable, long-term economic operations, providing socio-economic benefits to all stakeholders that are fairly distributed, including stable employment and income-earning opportunities and social services to host communities, and contributing to poverty alleviation.

It is then expected that we maintain a high level of tourist satisfaction and ensure a meaningful experience to the tourists, raising their awareness about sustainability issues and promoting sustainable tourism practices amongst them. Our natural and cultural heritage then have a key role in achieving the above goals.

Suggested measures may include further studies on the state of the art for different aspects of the use of water in the past, thus promoting a new approach to archaeological heritage. The archaeological sites are there, but little is still known about their functional and technical issues regarding the management of water resources. An effort in integrating new and existing knowledge and know-how in regional and national policy frameworks can lead to developing instruments for water management inspired by archaeology of water, establishing networks that would pool different expertise to foster the definition of best practice for sustainable tourism and respectful use of water resources.

The development of efficient mechanism for transfer of knowledge to local operators, will empower stakeholders with new tools to orient the tourist offer, and promote the creation of new qualified jobs. Participation of private sector (SMEs) and civil society by means of identifying thematic programmes and pilot activities for the selected areas, ensures an effective use of research outcomes. Promoting the adoption by tourism operators of standards for a sustainable water use that would be inspired by our past should be a necessity.

Let us then design a replicable comprehensive strategy for facing the challenges of the present and of the future relying upon the extraordinary heritage of the shared Balkan and Mediterranean past.



## 5. CONCLUSIONS

It is evident that since antiquity various water management methods have been practised not only for rainwater harvesting but also for the sustainable use of grey water for cleaning latrines and other sewage fixtures proving that people had a working knowledge of basic hydraulics. This is further supported by the fact that later Greek and particularly Roman civilizations have used and perfected the existing technologies on a larger scale. Ancient people realised the benefits of mixed sewer system with stones at the bottom not only for economic reasons or easier completion, but also for reducing water flows and providing higher infiltration for groundwater recharge.

Mediterranean area in general will continue to have low water availability not only due to population growth but also due to climatic changes. The development of a sustainable water resource management system then is crucial, and will assist in the conservation and protection our precious resource from pollution and extinction.

The need of integrating the 'water issue' in the development of innovative strategies for reducing the impact of tourism on environmental and cultural heritage and to ease the pressure on water resources, suggests further capitalising existing knowledge and building upon the extraordinary archaeological heritage, that would release various interventions at different levels.

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