

# WATER MANAGEMENT AND TECHNOLOGIES IN ANCIENT ARMENIA

**Author: Naira Harutyunyan**

PhD Candidate

Central European University

Department of Environmental Sciences and Policy

Nador u. 9, H-1051 Budapest, Hungary

E-mail: [Harutyunyan\\_Naira@ceu-budapest.edu](mailto:Harutyunyan_Naira@ceu-budapest.edu)

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## **Abstract**

Every civilization, be it modern or ancient, has exploited water resources by constructing hydraulic structures with the main purpose of satisfying the everyday water needs. Armenia, with its several-thousand-year-old history, has a special position in creating and exploiting numerous irrigation works and water supply systems for controlling the use of its water reserves. Clearly, the whole range of ancient technologies cannot be covered in one article. This article presents an overview of irrigation and water supply structures in Ancient Armenia during the pre-Urartian and the Urartian period, first named in Assyrian inscriptions around 1250 B.C. It presents hydraulic technology in Urartian urban centers and ancient irrigation systems around Van Lake. The complex hydraulic system on Mount Aragats, dated to pre-Urartian period, is covered with indication of the “cult of water” represented by the *vishaps*, the fish-like monuments of the god of water, which are closely related with irrigation activities. Ultimately, the water works that were constructed in Ancient Armenia demonstrate the elaborated planning and outstanding ingenuity proved by more than two millennia operation, still serving part of its initial aim. The article draws on a review of published literature, materials of museum collections, specialized encyclopedias, atlases, and other useful reference items.

**Key words:** water, ancient Armenia, Menua irrigation canal, Rusa dam, Erebuni, hydraulic system in Mount Aragats

## 1. Hydraulic technology of early urban centers: Urartian civilization

*And the waters returned from off the earth continually and after the end of hundred and fifty days, the waters were abated. And the ark rested in the seventh month, on the seventeenth day of the month upon the mountains of Ararat.*

- *Genesis VIII:4*

Urartu (Assyrian) and “Ārārāt” (Hebrew) is the name of the mountains, where, according to the Genesis 8:4, the Noah’s Aark landed to rest after the great flood. This territory in the Armenian Highlands roughly corresponds to the area between Lakes Van and Urmiah in ancient Armenia (Kyle 1988:955). The history of Urartian Kingdom, referred to as Kingdom of Ararat in many ancient manuscripts, is documented from 1250 B.C. in an Assyrian tablet, which implies a development period of centuries before the manuscript records (Chahin 1987; Mays 2010; Kyle 1988, Garbrecht 1988). The Urartian and Assyrian inscriptions manifest that Urartu was great and powerful kingdom that was able to fight the mighty power of Assyria and prevented its expansion to the North in the period of between 1300 and 600 B.C. (Chahin 1987, Garbrecht 1987). The first King of Urartu was Arame, who gave his name to the Armenians, the successors of Urartians (Garbrecht 1988; Chahin 1987; Kyle 1988; Dyakonov *et al* 1983). The ancient Armenian civilization is considered as a direct continuation of the Urartian civilization (Dyakonov *et al* 1983). Urartu was destroyed in 585 B.C. and was replaced by Armenia (Van de Mieroop 2006:205; Kyle 1988:955). The association between the Armenians and the Hurro-Urartians is comparable with that of the Romans with Etruscans, or Greeks with the Minoans and Pelasgians (Dyakonov *et al* 1983). As inheritors of Mount Ararat<sup>1</sup> and Urartu’s lands, as well we being partially of Hurrian-Urartian racial descent, the claims of Armenians for their homeland to be the Mount Ararat, to which they attach great traditional value, is still valid (Chahin 1987:54)

During the most of its history, the territory of Urartian kingdom was located within an approximately triangular area delineated by the three lakes – Van of the west, Urmia on the east and Sevan of the north (Hoffman 1978, Mays 2010). In comparison with modern states, the territory of Urartian Kingdom lies across the borders of Turkey, Armenia and Iran (see Appendix 1) (Mays 2010; Hoffman 1978).

This mountainous area with semi-arid environment is distinguished by a complex network of streams and rivers connected with the lakes and watersheds, including head waters of Tigris and Euphrates (Hoffman 1978). Indeed, until their rise, the first Urartians were interchangeably called “Nairi” by Assyrians in their reference to the land and the people coming from the “land of rivers” – northern part of Mesopotamia that is between the Euphrates and the Tigris rivers, that flow from sources near Mount Ararat. Nairi were one of many tribes that dominated in the region of the Armenian Pateau in around 2000 B.C. (Lafayette nd). By the 11<sup>th</sup> century B.C., the Nairi were being seized by Urartians for domination in the region, and the Assyrian cuneiforms recorded Urartu as a strong power.

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<sup>1</sup> Politically speaking Mount Ararat it is currently in Turkey, however, it was and will never cease to be an Armenian mountain (Chahin 1987:54)

Evidence from Urartian and Assyrian inscriptions, commemorative records of victories, and archaeological excavations in the capital city Tushpa<sup>2</sup> (modern Van) near Lake Van, Karmir Blur near Yerevan, and other parts of Urartian Kingdom shows that the Urartian people had significant artistic and technical skills, especially in massive masonry construction (Kyle 1988:955; Garbrecht 1988). They were excellent stone-workers, broz-workers and craftsmen specialized in making various goods and used to actively trade with Assyria, Hittite, Greece, Cyprus, Phrygia, Etruria, and Italy (Loon 1977; Hoffman 1978; Kyle 1988). The excavations of Urartian sites revealed exquisite pottery, ivory-carving, decorative cult object, jewelry, bronze belts, cauldrons, war gears, metal amours, decorated shields and helmets, wall paintings, etc. (Piatrovskii 1967; Loon 1977). Nowadays the collections of many museums including the Historical Museum of Armenia, the British Museum and the Berlin Berlin Museum contain Karmir Blur hold fabulous artifacts of the Urartian culture (Piatrovskii 1967).

The comprehensive excavations of Urartian sites revealed Urartian citadels of all shapes and sizes, but with unique characteristic and defining architectural feature, constant from site to site, in detail presented in Hoffman (1978). One of the key architectural features of the Urartian citadels is the presence of multifunctional water systems, complex canal systems, cisterns and drainage pipes (Garbrecht 1980; Hofmann 1978:26; Mays 2010). For example, during excavation in Urartu site in Arin Berd (suburb of Yerevan), two drainage systems were found: under the peristyle court and near the temple Haldi (Hoffman 1978).

Another important type of water collection constructions dated back to Urartian times, which preserved until today, are the *cisterns* that were usually built near settlements and castles (Burney 1972, Orhan *et al* 2006, Hoffman 1978). Large cisterns and water canals along and under the walls were used to ensure water supply to population of citadels. In some cases the long tunnels were dug in the rocks for getting to fresh water sources (Hoffman 1978). Generally, the cisterns used in Urartu period are characterized by rocky steps going up to the castle and multifunctional cisterns at the ground floor. Cistern systems at Van castle and Tushpa city were built under different plans based on location conditions and functions. For example, vertically connected cistern system under the ground level of the Van castle and Tushpa city played very important function of water requirement security and communication especially during the times when the city and castle were beleaguered by the enemy. Another type – the closed circular planned cistern system was built within the Van castle through cutting the rocky ground and paving the way to door frames, cellars, etc. (Orhan *et al* 2006). Cisterns were widely used in antique Greek and Roman cities as well. For example in Pompeii, cisterns were used in storing water from rainfall collection and from aqueducts. The rainwater collected from house roofs through pipes was directed to cisterns for storage and domestic use (Mays 2010). Indeed, the advancements of Urartians in mining and skillful use of work tool such as sledgehammer and iron leverage helped them to progress in construction of water facilities of high quality which is still difficult to reach in such a short time span in terms of technology (Kuslu and Sahin 2009).

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<sup>2</sup> The city Tushap, or Tuspas, Tosp in Moses of Khorene and Turuspa in Assyrian, was probably founded by Sarduris I about 840 B.C. (Sayce1888). Nowadays the city's name is Van and it is in the territory of Turkey.

## 2. Menua canal

In his work Chakhin (2001) mentions that the kings of Urartu constructed many water structures including canals, some of which are still in use. In particular, he refers to Menua<sup>3</sup> (810-786 B.C.), who built one of the most interesting and important canals - *Menua Canal*, in the heart of most ancient part of Armenia called Hayots-Dzor<sup>4</sup>, East of Lake Van. The Menua canal with most of dams constructed in Urartian period are still in use for the same purpose as it was planned for in ancient times (Mays 2010).

In that period, Tushpa city, which was located at the shore of the Lake Van, was the capital of Urartu Kingdom. However, the waters of the Lake Van<sup>5</sup> were not suitable for drinking or irrigation due to high sodium carbonate concentration, high alkaline with a pH of up to 9.8., salinity of 22%, and the calcium concentration of only 4 mg L<sup>-1</sup> (Garbrecht 1980; Litt *et al* 2007). Therefore, in order to provide a stable water supply for the needs of population and agriculture, the King Menua started a grandiose project on construction of a water canal that started from crowded water spring a mile from Mzenkert, and after irrigating the vineyards, orchids and gardens of Tushpa (as it is still doing today), flowing into Lake Van with total run of about 56 km, watering an extensive region (Chakhin 2001; Garbrecht 1980; Mays 2010). This became a superb hydrotechnical installation in Urartu with multiple reservoirs and dams, irrigation works and terracing (Garbrecht 1980). Water was captured just below the spring using a simple stone and earthworks. Interesting feature of the Menua canal is that it crosses over Engil creek through the aqueduct bridge. Nowadays, the water system near the spring has a concrete structure that is used in the same way as it was used in Urartian times (Mays 2010). Figure 1 presents the map of the water supply system of the Urartian Kingdom by the Lake Van with dams and the Menua canal. Interestingly, during the construction of the Menua canal, the King Menua has installed 14 inscriptions that confirm that the canal was constructed by him making it also a “inscription monument” (Belli 1997:16; Mays 2010; Garbrecht 1980).

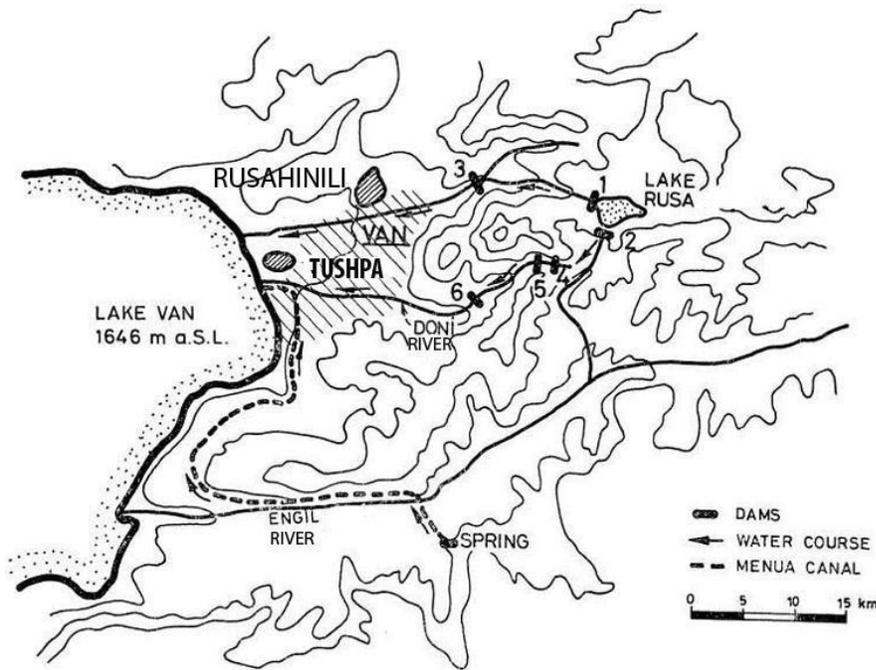
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<sup>3</sup> Sayce (1888) in his works on deciphering and translating the inscription of Urartian cuneiform refers to Menua(s) – King of Ararat.

<sup>4</sup> Valley of Armenia (translation from Armenian)

<sup>5</sup> Nowadays the Lake Van is considered as a key site for climatologist to get precise insights into the climate evolution in the region. The Lake Van is covered by a layer of sediments that has the potential to grant long continental records on several glacial-interglacial cycles that can be used as proxy climate data (Litt *et al* 2007).

**Figure 1. Water supply system of the ancient Urartian Kingdom capital Tushpa**



*Source:* Adopted from Gerbrecht (1980)

Nowadays, water engineers during the design of the irrigation water systems among other things are guided by the criteria that the required water should be transferred at design water levels and no erosion of canal bottom and banks should occur (Depeweg and Mendez 2007). The study of the Menua canal physical design features revealed that the bottom slope of the canal is on a level that does not contribute to erosion. The Urartian water engineers designed the canal of major flow in parallel to contour lines as it is done by engineers in our days (Kuslu and Sahin 2009). The literature revealed a number of references to the Menua Irrigation Canal with supporting dams as a working masterpieces of hydraulic engineering of the Kingdom of Urartu and an example of sage planning and particular craftsmanship (Garbrecht and Fahlbusch 2003; Orhan *et al* 2006; Kuslu and Sahin 2009). For more than 2500 years the Menua canal has been flowing uninterruptedly with some reparation works done in 1950 in the middle part of the canal. Currently, it is used as a part of a system irrigating 5000 ha and produces 5 megawatt electricity (Kuslu and Sahin 2009). Figure 2 presents the view of Menua canal at present times.

**Figure 2. Menua channel today (constructed in 805-785 B.C.)**



Source: Ozis (nd)

### **3. Erebuni citadel**

The King Argishti I (r. ca. 785-753 B.C.), son and successor of King Menua, continued the dynastic tradition and constructed powerful fortress Erebuni in 782 B.C. He left the cuneiform inscription indicating the purpose fortress and the names of the founders (Burney 1972). Erebuni was built on the top of Arin Berd hill (suburb of present day Yerevan, capital of modern Armenia) on the valley of Arax River to serve as a military fort for overlooking the Ararat plain and ensure expansion to Sevan Lake region abounded with cattle (Piotrovsky 1967).

Water supply to Erebinu fortress was provided via gravity-fed underground pipe network. The water pipeline was made of stone pipes with carved junctures (Figure 3). The pipes were about one meter long, with an external and internal diameter of 0.4 and 0.1 meter, respectively. Some sections of a pipe had carved rectangular apertures designed for controlling and cleaning the water flow. As a sophisticated engineering structure, this type of pipes set the norm for subsequent centuries and was in use for almost 2000 years (Erebuni Museum).

**Figure 3. Water pipes in Erebuni**



Source: Author's picture of water pipes from Erebuni Museum in Yerevan, Armenia

The fertile soil and abundance of water of the Ararat Valley inspired Argisti I to construct a number of water constructions for irrigation of gardens and vineyards. Many of these irrigation systems, including the Shamiram irrigation canal (near Ashtarak) are still in use today.

#### **4. Rusa Dam**

After the reign of the King Menua the capital of the Kingdom of Urartu was moved from Tushpa to Rusa city or Rusahinili in 700 B.C. (Mays 2010). Again water was needed for the new residence of Kings. Water was found in 30 km away from the city in the shallow Rusa Lake. The King Rusa king initiated another major water management project. By damming the natural outlets of the naturally flat water reservoir, the Rusa King transformed it into an artificial Rusa Lake and re-directed its waters and the waters of river Alaini to the new capital Rusahinili, making the surrounding land arable and suitable for agricultural development (Garbrecht 1980; Burney 1972; May 2010). Again as with the case of Menua, inscriptions were left by the King Rusa about the date, planning, and construction works. They were found on huge stelas near the Lake Rusa. Some part of the inscription text taken from Garbrecht (1980:310) includes:

“... Mountains, massive quantities of water I dammed here for canals and flow; I decided its name to be Lake Rusa. I directed a canal from here to the city of Rusahinili, and for the land which was later to be cultivated, which had previously remained uncultivated. ... when I had founded Rusahinili, when I had built this artificial lake (with its dams), I decreed ... the land in front of the city of Rusahinili ... which was uncultivated and neglected, should .. be made completely arable...”

After 2700 years the four connected dams leading to the Van plain are nowadays workable undergone only minor reparation works (Belli 1997). Figure 4 depicts the Rusa Dam in present days.

**Figure 4. Bottom sluice of Rusa Dam today (constructed 700 B.C.)**



Source: Kuslu and Sahin 2009

According to Mays (2010), in the Near East, only the significant irrigation works and a well-planned water supply system of Urartians were comparable to those in Egypt and Mesopotamia. Even more, taking into account the technological limitation of the period, Garbrecht (1980) compares the irrigation and drinking water supply systems at the Urartian capital Tushpa (Van) with grandiose modern technical achievements such as the National Water Carrier in Israel and California Water project in the USA.

## **5. Hydraulic system in Aragatz**

The major irrigation constructions in ancient Armenia were connected with the “cult of water”, represented by astonishing monuments – *vishaps* (dragons). These are fish-like stone monsters (3-5 meters long), attributed to the god of water (Figure 5). At the beginning of the 20<sup>th</sup> century, archeologists discovered a number of *vishaps* in different parts of present day Armenia. It was revealed that *vishaps* are closely connected with ancient irrigation systems (Kalantar 2003).

**Figure 4. Vishap from Mt. Aragats**



Source: Kalantar 1994

The most archaic *vishaps* were found on Mount Aragatz. They are located near key points of the water system such as water collecting reservoirs, the artificial intermediate lakes, and the main and secondary channels that were linked together into a highly organized irrigation network. All the structures are designed to serve the common goal of using water sources of Mt Aragatz to ensure a constant water supply to the lower lands of the valley (Kalantar 2003). According to Kalantar (1994), the whole irrigation network with its structures and components closely relates to the relics of pre-Urartian settlements – the period before the 9-8<sup>th</sup> centuries B.C. This period could be described as tribal and belong to the archaic phase of Armenian history featured by stock-breeding and agriculture as the main parts of the economy.

An essential peculiarity of Mt. Aragats irrigation system is that it is designed for gathering water from the perennial snow reserves of the mountain rather than rivers. The general structure follows the natural relief of the mountainside to be used as water collecting spots, dams, and canals. The network was upgraded to enhance the relief features to serve as an efficient irrigation mechanism. Two types of lakes were found. Water collecting lakes or the main reservoirs located at the high slopes of the mountain, close to the summit, to collect melting water and source the main canals. The second type lakes were located at lower levels around the main canals and artificial dikes. There were also two types of channels observed in the area. The main channels were running from the summit to the piedmont, connecting smaller artificial lakes and flowing into larger lakes served for irrigation of the lower lands. The secondary channels were running from primary channels to feed irrigation lands or flow into the lakes (Kalantar 1994). There were also a number of hydrotechnical constructions found in the system, such as a large structure of ground and boulders lifted up to re-direct the water flow from natural stream into the irrigation channel. The construction and maintenance of such a complex water system indicates about existence densely populated area that required a political and economic stability. According to Kalantar (2003), this society later ceased after the invasion of Urartians in the 8-7<sup>th</sup> centuries B.C.

## 6. Conclusion

Water was an important part of life of ancient societies inhabiting Armenia. It shaped many aspects of life of ancients, including religion, politics, economy, and international affairs. It was a life source and cornerstone of civilization emergency and development in ancient times. Development of agriculture and early urbanization was conditioned by increasing sophistication in irrigation techniques and water supply networks. Backed by sound engineering skills for designing and managing complex hydraulic systems, the ancients in Armenia achieved incredible advancement in their waterworks that were comparable with those in ancient Egypt and Mesopotamia. Having in mind the technological limitations of that period, hydraulic systems in Ancient Armenia can be parallelized with some of grandiose modern technical achievements. Even more, having borne the test of time, a number of these technologies set the norm for subsequent centuries and have been used for thousands of years with some of them, such as Menua Cannel, Shamiram Canal and Rusa Dams, still in serve in the third millennium A.D.

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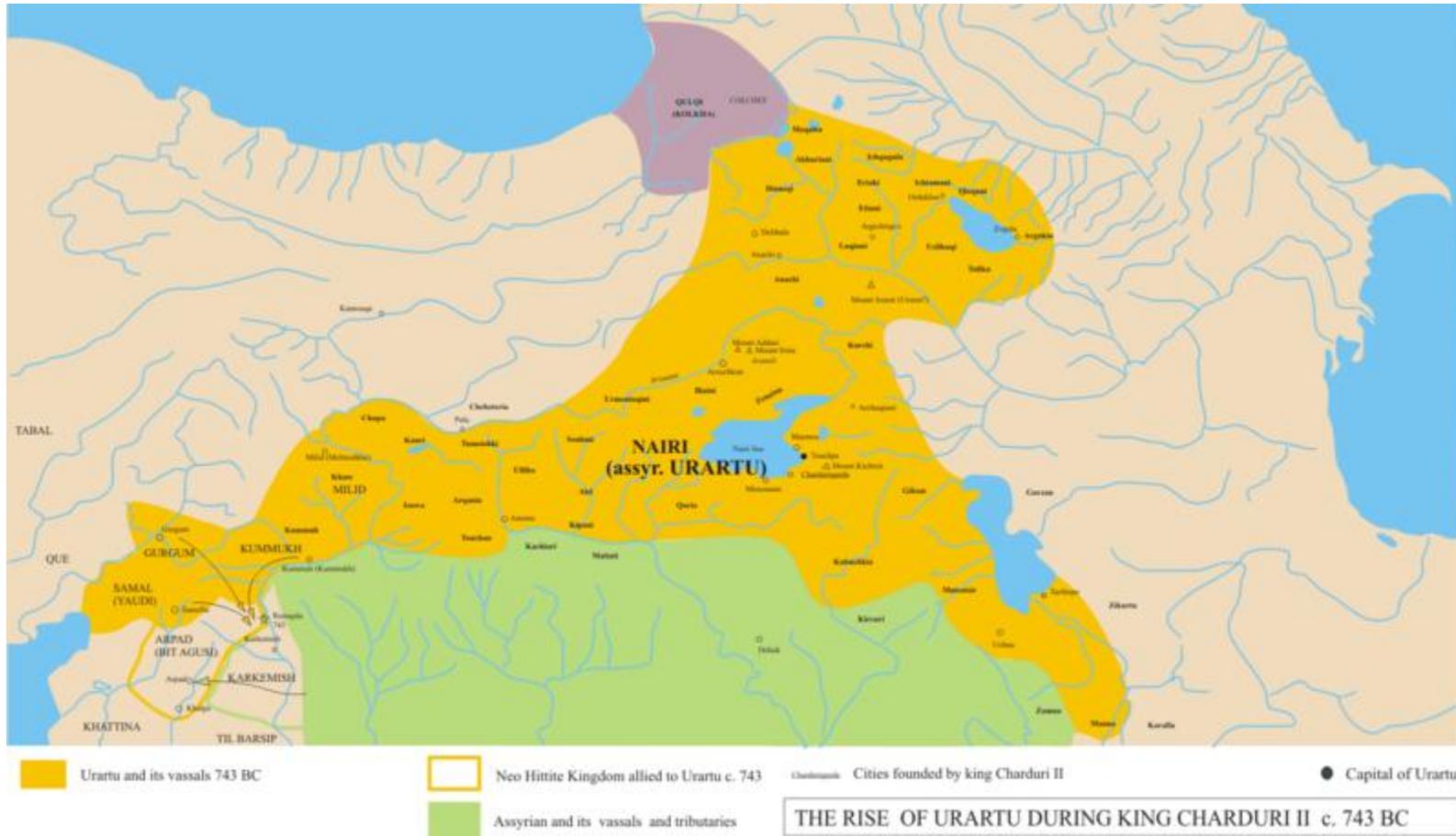
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Appendix 1. Map of Urartu in 743 B.C.



Source: <http://en.wikipedia.org/wiki/File:Urartu743.png>