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TRADITIONAL WATER HARVESTING TECHNIQUES IN APULIAN STONE BUILDINGS

Erasmus+

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Introduction

In Puglia, as in many regions of southern Italy, there are long periods of summer drought which cause problems to agriculture. Therefore ancient rainwater collection systems have always existed for both irrigation and civil use or for watering animals.

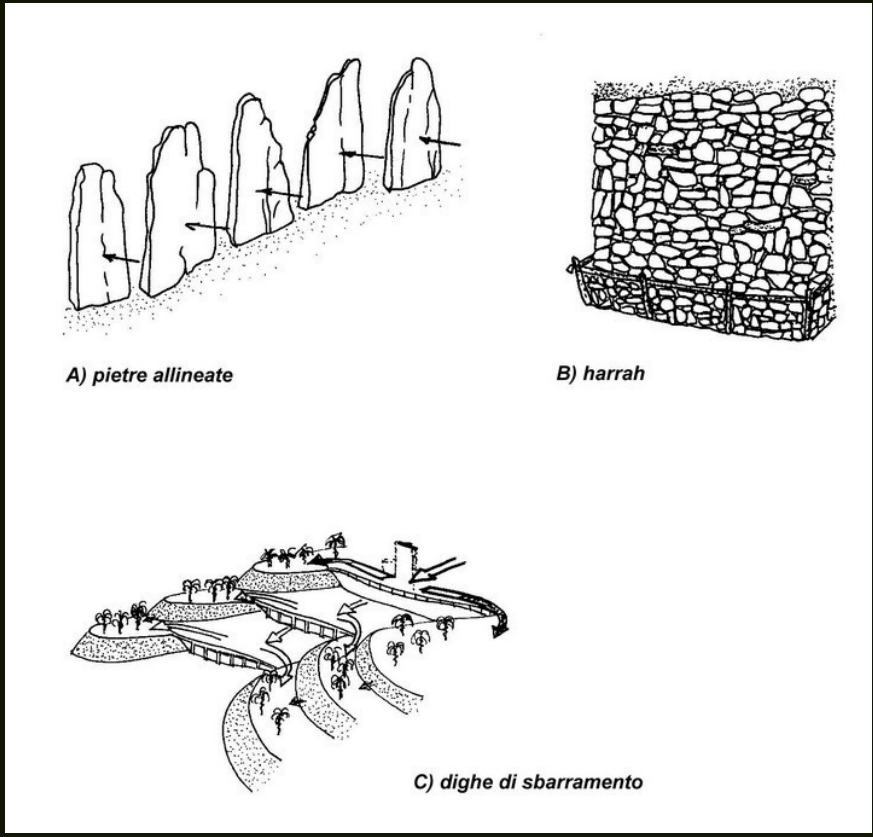
Until the last century first decades there was not running in the houses and only noble palaces and farms had private rainwater collection tanks whose use was reserved for the family.

These cisterns were located on the ground floor of the houses, they had variable dimensions, and extended for several meters below the floor level.
Other features were used to collect water, some have been used since prehistorical societie.

Introduction

Starting from 12,000 to 10,000 years ago, soil support structures, stone walls and clay platforms to capture water were built. In arid areas such as Africa, the Middle East and Anatolia, methods of water capture and management were developed.

Even before the birth of irrigation techniques, the water was used by exploiting atmospheric humidity and water from the soil sediments. In the areas located near basins, waterways and piles of stones that favored the supply of water vapor, the humidity that deposits on the soil played a decisive role. Alluvial soils, the dry courses of the wadis, store water reserves in the upper layers. These geographical areas became the habitat of the first Neolithic societies.



Catchment features

Aligned stones – capture the water released by the humid winds and the condensation that forms during the night

Harrah – stone dams used in Sabaean and Nabataean agricultural systems

Dams along the wadis – dams that block the underground flowing water along the wadis and drain the sediment water through channels that irrigate the terraces at the edges of the riverbed

Specchie

The specchie are piles of limestone scattered across the countryside.

These masses of dry stone, generally conical in shape, work as humidity condensers: as the night temperature drops, it gives rise to the phenomenon of condensation, allowing the accumulation of water.

This very ancient technique is used due to the low rainfall in the area and the lack of surface circulation of water on the calcareous soils.

We can hypothesize that, in the absence of a cave or a spring, the creation of the mound of stones allowed the protection of a water reserve from evaporation as well as the production of water through the condensation of dew.

Tu’ rat

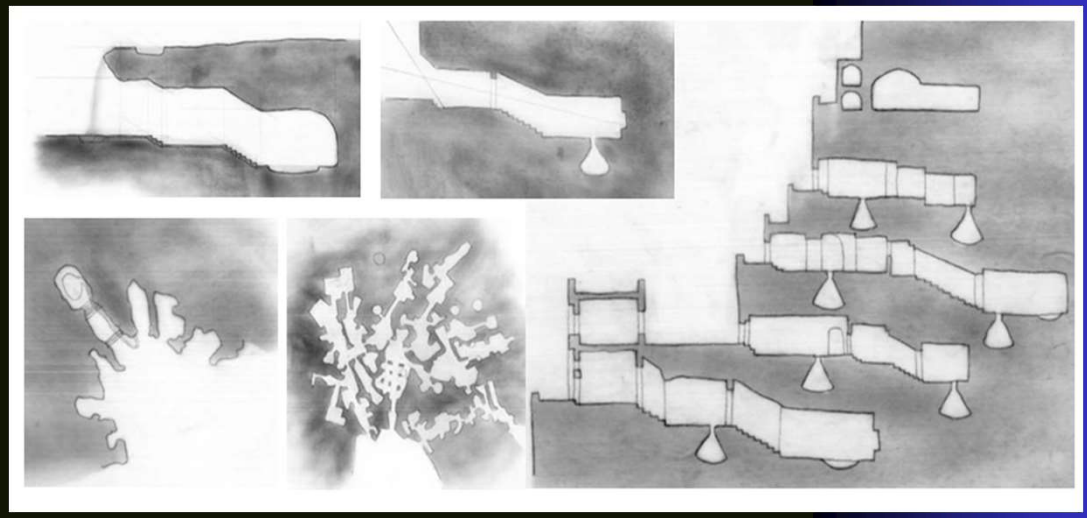
Tu'rat are crescent-shaped stone mounds. By taking advantage of the mists and humid winds of the Ionian coast, it is possible to grow plants and trees inside them due to the accumulation of rainwater.

This technique is very ancient and is also widespread in the Negev desert, Peru, the USA, China and New Zealand.

Dry stone walls (*muri a secco*)

Dry stone walls are used in agriculture to fence the fields. They also works as dew collectors and capture the moisture-laden wind thanks to large gaps among the stones.

Surface cisterns in rock architecture



Cisterns carved into the limestone rock has been found in the Apulian territory since the Neolithic,, They reached the maximum constructive complexity in the proto-medieval phase, with the development of the rock architecture of the Ionian-Matera arch. The distribution and use of water occurs according to a rigorous property division criterion.

A complex system of channels cut into the ground and along the limestone walls of valleys and ravines allows a large number of cisterns to be fed in series, arranged at different levels and often positioned inside caves. The caves were used as residences or workshops.

At the same time, rainwater is conducted into the individual courtyards (vicinie), around which the housing units that have the right to use this water reserve (public or semi-public water) are organized. This water collection system has a large impact on the microclimatic mechanisms of the rock architecture, also ensuring that the water is never wasted but used cyclically, passing from more valuable uses to others, progressively less pure.

The *pescare*

The so-called *pescare* or underground *piscine* are widespread throughout the Apulian territory.

It is common to find them near the *iazzi* (ancient shelters for sheep and goats), farms or shallow erosive furrows whose course favored the normal flow of water towards the tanks.

They have often the extrados at street level or up to a meter of protrusionand are characterized by a flat or sloping roof which usually hides a vault inside.

The *pescare*

Despite having different shapes, the pescare are characterized by those architectural features:
- a roofing often at street level
- the collection basin
- a room made of stone or dug into the rock
- the supply channel to fill the chamber
- the drain channel for the overflow
- the settling tank used to make the water drinkable
- the well for drawing water.

The walls are made of limestone or dug directly into the rock and are usually coated inside with lime mortar to increase waterproofing and protect the building from the constant action of water (which creates cracks and fissures).

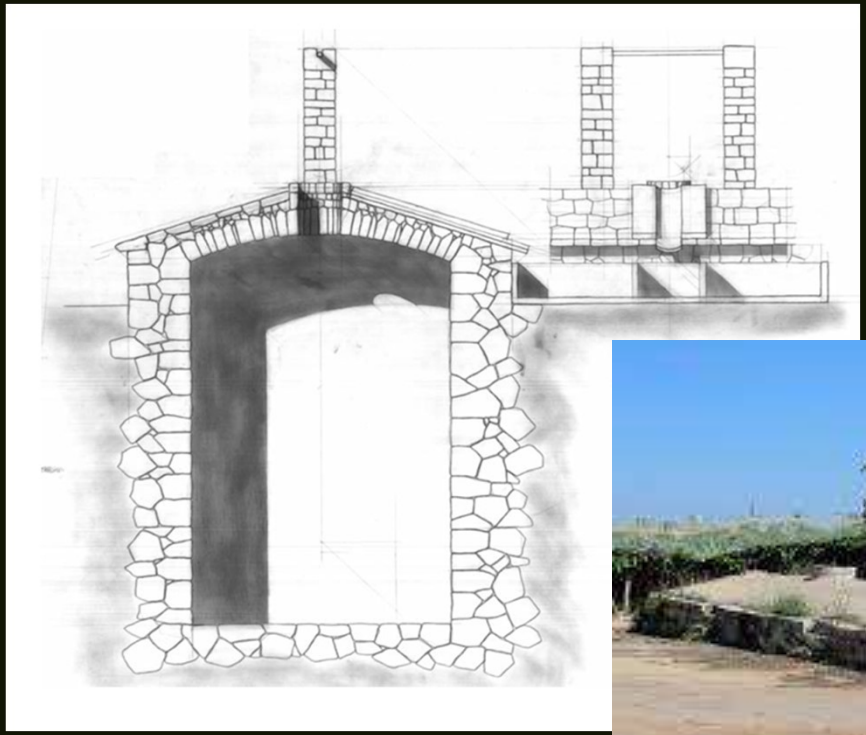
The *pescare*

The extrados of the pescare is usually walkable and made of *chianche or chiancarelle*, typical *basole* (i.e. limestone slabs).

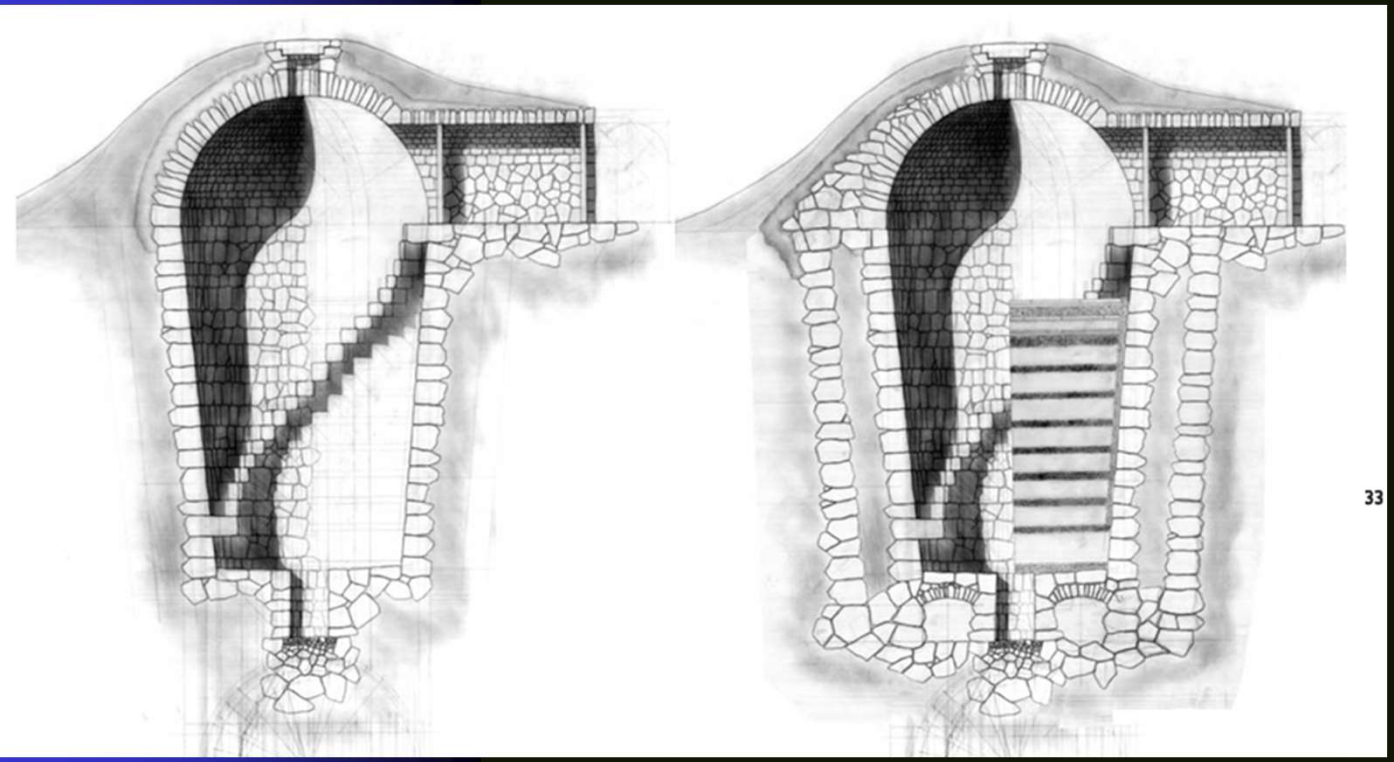
The water of the pescare was fresh thanks to its very architecture: the thick masonry and the position of the basin below the street level.

Cisterns

The cisterns are either architectural and landscape features.
They are arranged close to depressions in the ground, in the middle of agricultural fields or close to farms and various kinds of buildings to collect water from roofs and terraces.
A well for water extraction is connected directly with the cistern. Aside the wells there are often tanks for watering the livestock.



Operation of an underground ice house

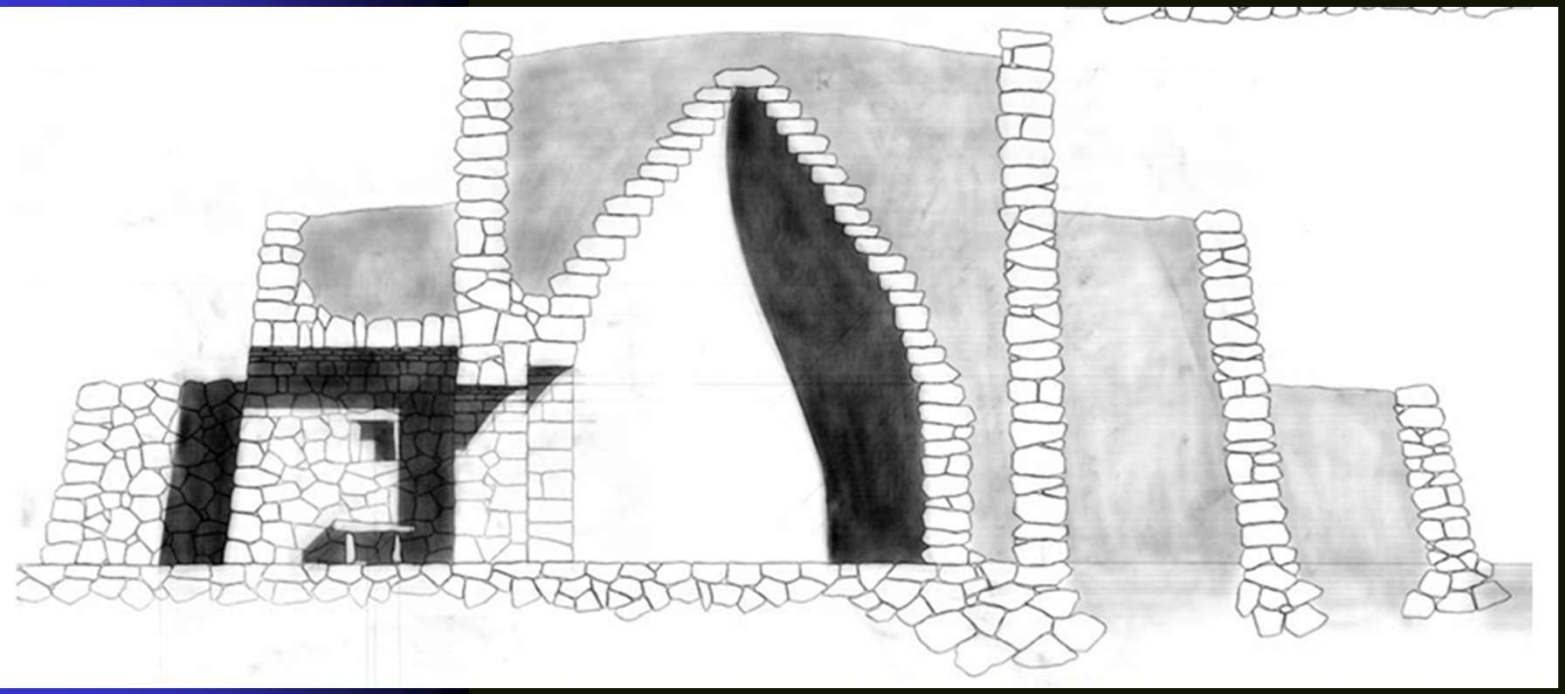


The left scheme has the same formal and functional characteristics of the right one but highlights some technical differences:

- the strengthening of the insulation from the ground through a double-facing wall system with an air chamber,
- the introduction of a foundation level on a crawl space which favors quicker disposal of residual water and increases insulation with respect to soil humidity.

Underground ice house (*neviera*)

Operation of an epigeal snow house



In this typology thermal insulation is obtained through the contribution of the wall mass and large volumes of earth which simulate the behavior of an underground structure. This typology is an hybrid, a point of conjunction between mound structures, such as mirrors, and more advanced tholos typologies, such as *trulli.*

Epigeal snow house

Water harvesting in the *masserie* (farms)

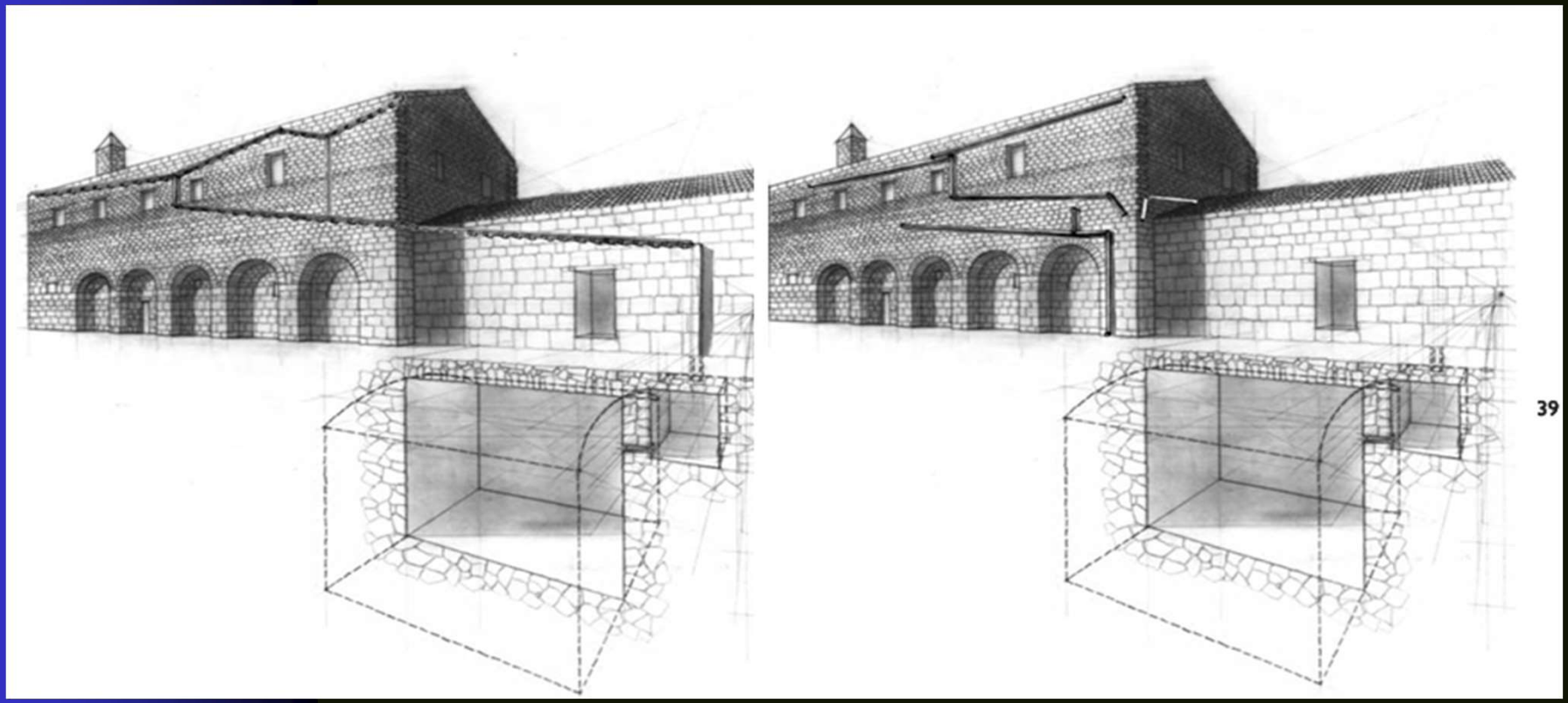
MASSERIADELL'ASSUNTA(ALTAMURA)

Management of water resources:
the water problem is solved by collecting rainwater through a series of gutters which, set at different levels, convey it into the underground cistern.

The decaying of the structure led to the partial destruction of the gutters that ran along the façade. The gutter system was restored in the modern era with a new system that did not follow the trend of the previous one. This system, on the other hand, no longer conveyed the water towards the inlet of the cistern which, consequently, is no longer powered (a solution probably created following the connection of the farm to the water mains).

Furthermore, recent restorations have also led to the disappearance of the second gutter system, definitively contributing to cancel the very meaning of the cistern and its original connection with the farm structure and the conformation of the surrounding area.

MASSERIA DELL'ASSUNTA(ALTAMURA)



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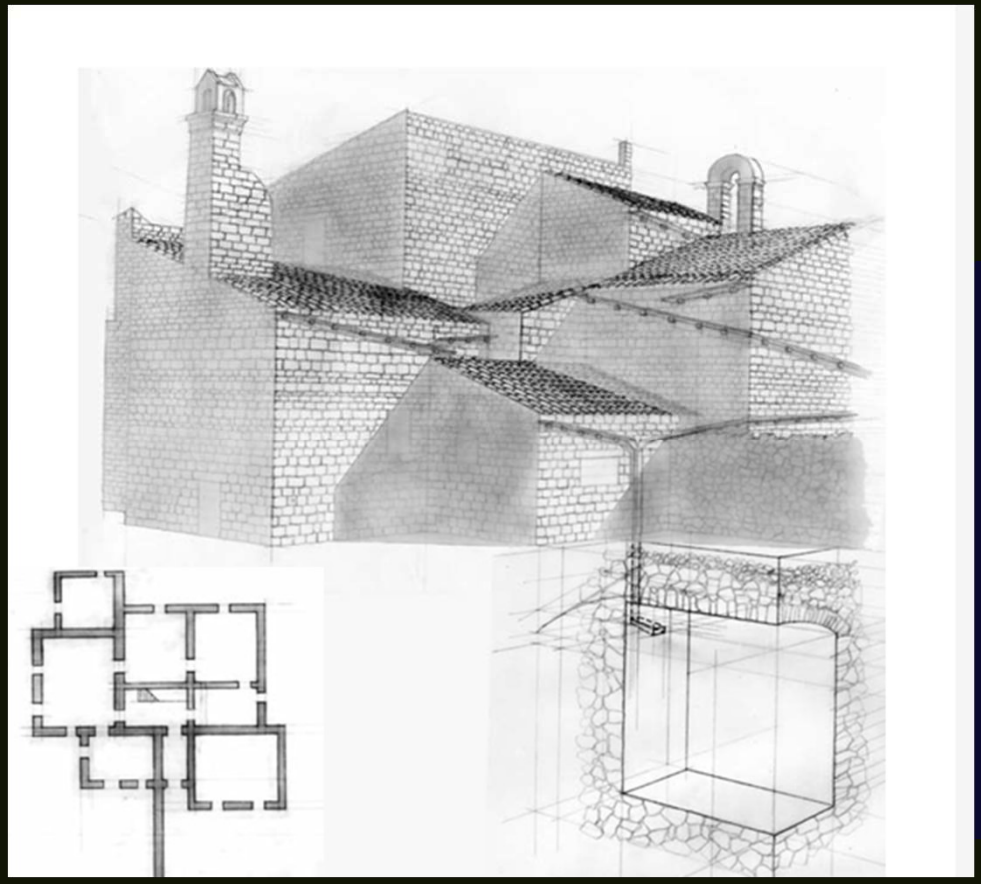
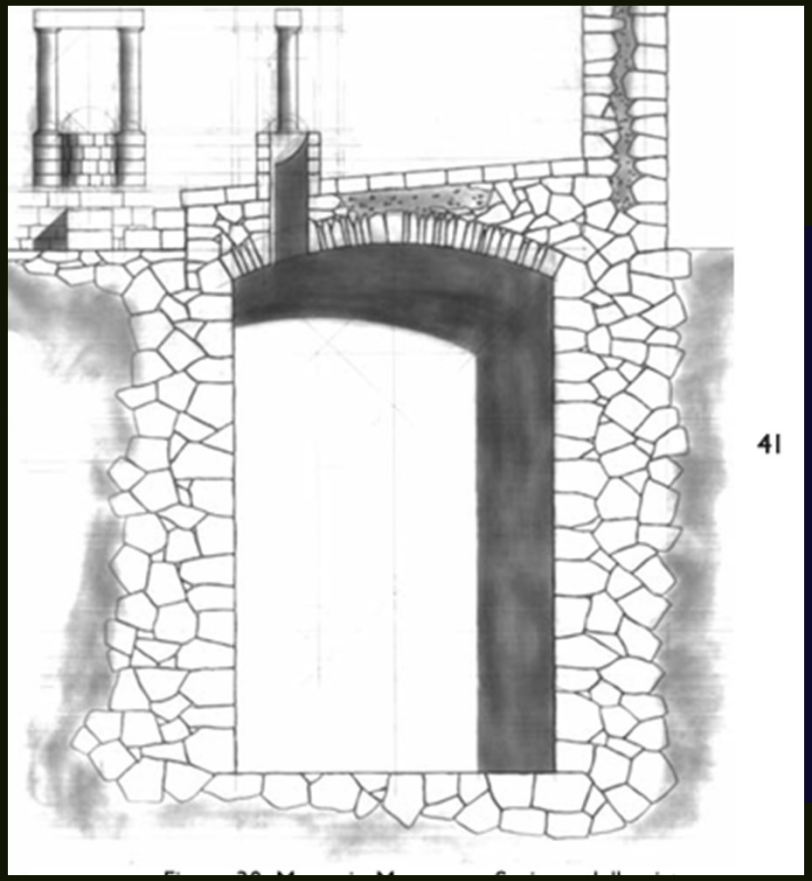
The two images show the flow of the gutter lines and the supply system of the cistern located at the end of the farm.
The second system, relatively recent, no longer feeds the cistern and disperses the water drained from the gutters into the ground.

MASSERIA NUNZIATELLA (ALTAMURA)



Management of water resources:
Here too the water requirement is satisfied by the collection of rainwater through gutter lines that direct the water into a cistern located close to the system. Unlike the previous case, however, thanks t the good conditions of the building, we can read the complex original structure of the gutter lines and the pitches which convey the water from different heights roofs into a single access duct to the cistern.

MASSERIA *MUSACCO* (TURI)



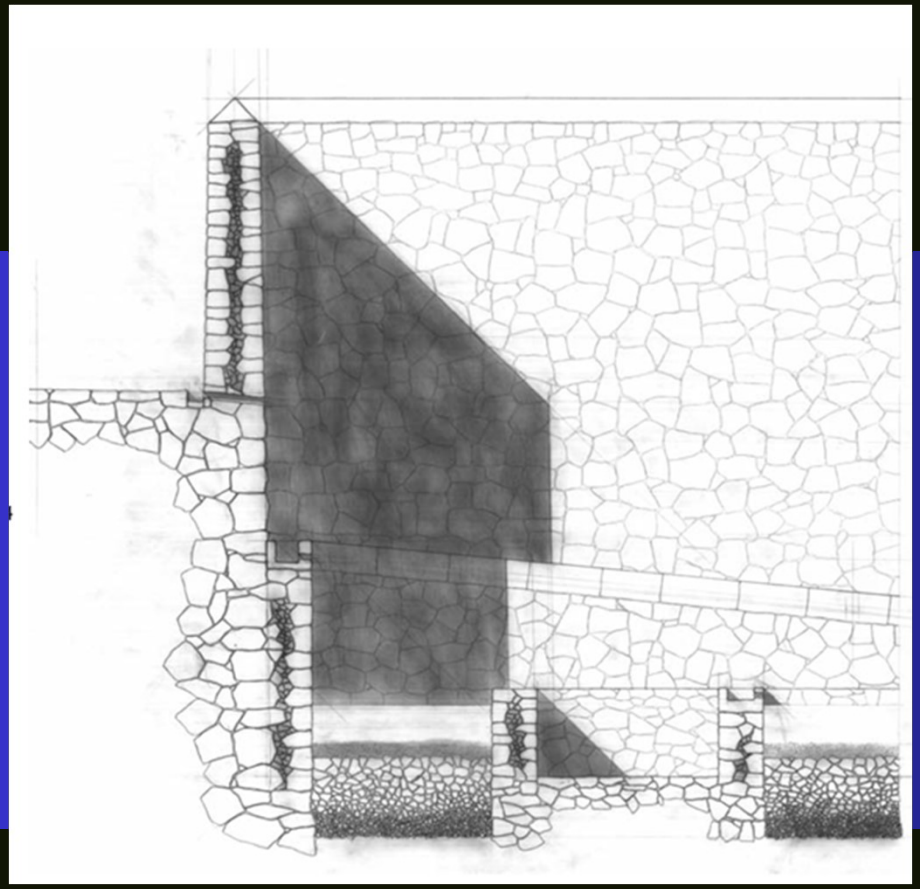
Management of water resources: The water reserve is guaranteed by a cistern used to collect rainwater drained from the roofs and the paved courtyard. Unlike other systems analysed, the cistern takes on considerable dimensions and construction complexity and is accompanied by the presence of a well. The extreme precision in the construction of the system and the size of the cistern may have been determined by defensive needs and the need to survive for long periods, barricaded within the walls of the farm, in the event of an enemy attack.

MASSERIA *MUSACCO* (TURI)

MASSERIA *LOSCIALE* (MONOPOLI)

Management of water resources:
the water reserve is guaranteed by a cistern used to collect rainwater drained from the roofs and the paved courtyard. Unlike other systems analysed, the cistern has considerable dimensions and construction complexity and is accompanied by the presence of a well. The precision in the construction of the system and the size of the cistern may have been determined by defensive needs: people had to survive for long periods, barricaded within the walls of the farm, in the event of an enemy attack.

MASSERIA *LOSCIALE* (MONOPOLI)

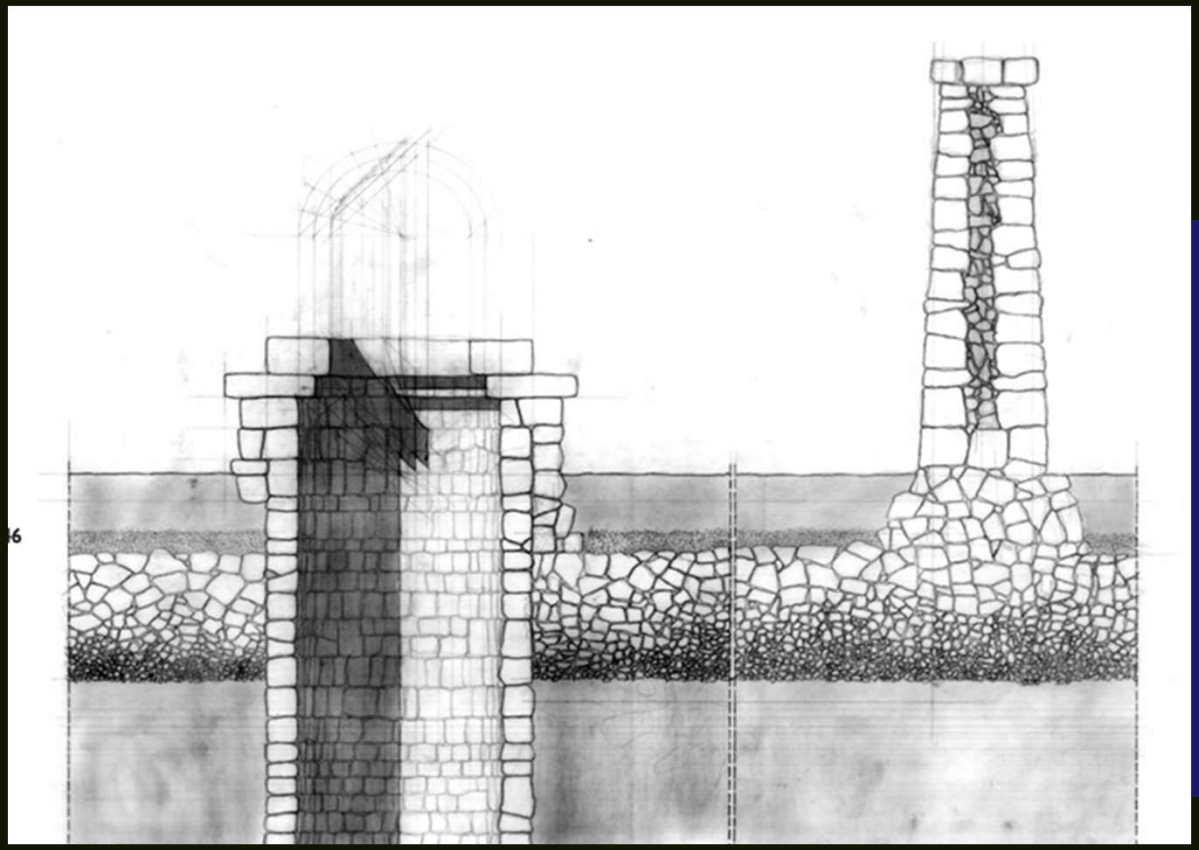


Rainwater collection system in a field cultivated with citrus groves and vineyards. The section highlights the composition of the drainage layer of the soil and the existence of a perimeter canalization which guarantees the simultaneous supply of the different levels of the agricultural terrace.

MASSERIA *SANT'EUSTACHIO* (GIOVINAZZO)

Management of water resources:
Water resources are guaranteed by the digging of a well in the area of the vegetable garden.
This highlights a particular geological conformation of the site: a substantial surface aquifer, reachable through the construction of a well and capable of providing a constant water reserve to the farm plant.
Generally the first founding act of the settlement was the search of a significant water reserve around which, later, the community of the farm was developed.

MASSERIA *SANT'EUSTACHIO* (GIOVINAZZO)

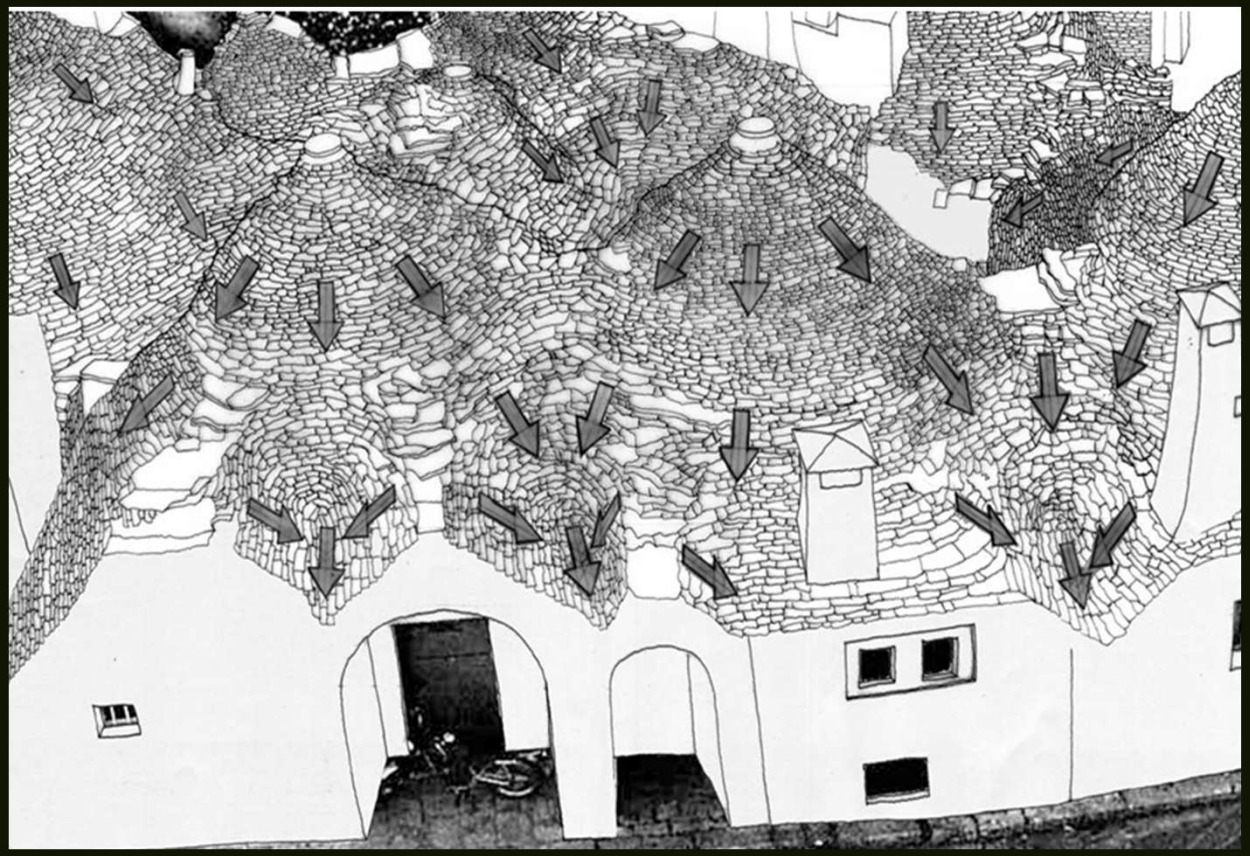


Section of the well located inside the vegetable garden

Water harvest in *trulli* settlements

In the Apulian land the very well known UNESCO Alberobello site is also one of the most interesting under the point of view of water resource control processes.

This because the *trulli 's* urban fabric works like a single, huge, draining surface that captures every drop of water and conveys it into the city's countless water circuits .
In fact, the trulli settlements work like a single lithic surface that includes either the roofs and walls of the houses and also the surface of streets, alleys, open spaces and squares, imposing on the rainwater a labyrinthine path that imprison it in the cisterns.



Water harvest in *trulli* settlements

There are three levels of water property:

1) The water kept by the roofs of the trulli. It was conveyed towards the internal cisterns of the dwellings and had a private character .

Water harvest in *trulli* settlements

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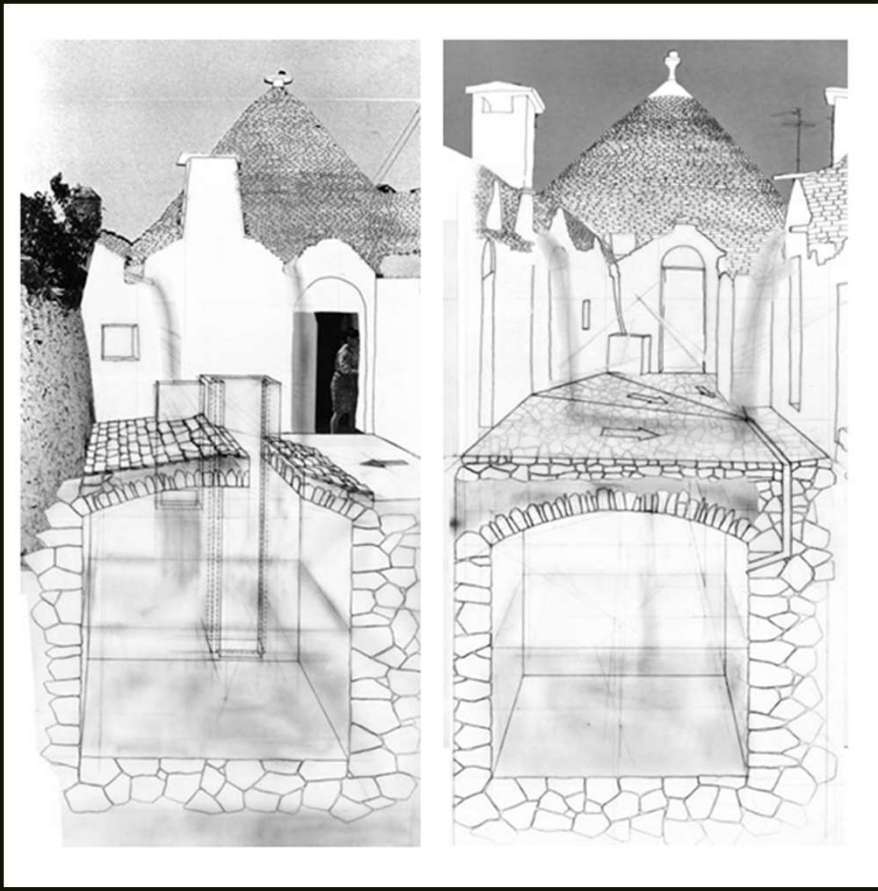
2) The water from the roofs of groups of *trulli* arranged around a courtyard. This water was collected in a common cistern, larger than the private ones, which is usually positioned in the center of the courtyard. There it was available to inhabitants of the neighborhood. In this specific condition, the convective motions within the courtyard associated with the evapotranspiration of the water of the underlying cisterns increased the humidity of the air and improved the local well-being conditions.

3) Water intercepted from alleys and main urban streets.
This water, dirtier than the previous ones, went to the large urban cisterns (usually positioned at the maximum orographic depression and at the edge of the settlement). It was available to the local population for food of livestock.



Final conclusions

In the lates 100 years we have lost this kind of knowledge of building.
In many urbanized areas of our countries the situation is so compromised that it requires comprehensive interventions.

To re-establish the lost water balance a lot of job is necessary.
The main objective of sustainable rainwater management is to alter as little as possible the natural circulation of water at a local level, to reuse precious water, to prevent excess rainwater from leading to catastrophic events.

Final conclusions

The new approach of sustainable management of rainwater runoffs involves the pursuit of some main objectives including:

- reducing surface runoffs;
- lighten the sewerage collectors and treatment plants;
- reduce the hydraulic loads concentrated on natural watercourses and reclamation canals, which constitute the terminal receptacles of the sewerage networks;
- increase local recharge of underground aquifers;
- improve the urban micro-climate by increasing evaporation; • preserve and restore, as far as possible, the natural function of the soil
- prevent the formation of surface runoff from rainwater at a local level, reducing impervious surfaces or choosing permeable or semi-permeable forms of paving;
- implement measures for the use and/or percolation of rainwater, as close as possible to the place of formation;
- create local or central reservoirs to reduce flow rates.

Final conclusions

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It is necessary that these measures to be integrated into the planning and regulation of land uses and into the technical projects of settlements and infrastructures.

Sustainable management must also be extended to existing settlements and infrastructure and that certain choices must be shared and accepted by the property owners.

Their implementation therefore requires attention not only to the technical aspects but also to the cultural and social ones.

Recupero delle acque piovane per uso domestico nell’area mediterranea Politecnico di Bari Dipartimento di Ingegneria Civile e dell’Architettura Dipartimento di Ingegneria delle Acque e di Chimica
chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://iris.poliba.it/retrieve/handle/11589/23905/6163/Recupero%20acque%20piovane.pdf

Sistemi di captazione dell’acqua – Water catchment system
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https://www.restauroeconservazione.info/le-pescare-pugliesi-bene-prezioso/

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