

## Research Article

# The Most Perfect Ecosystem: The QANAT KAREZ AFLAJ, Salt Leaching Oasis of The Ancient Silk Road, As The Ideal Model of Aquaculture, Chemical Engineering and Fish Nutrient Supply to Transform Our Present Day Sub-Florescent Soil Agriculture.

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## Abstract

More than 150,000 thousand, QANAT, KAREZ sweet water distribution systems including more than 200,000 kilometers of tunnels still exist in the Middle East, Central Asia and Mediterranean basins. Since the Islamic agricultural revolution which took control of these 3500-year-old mountain watershed sources, water losses of uncontrolled quantities are due to spate irrigation. The original ancient Qanat was designed to direct water to arid zone SABKHA endorheic basins in order to leach sub-florescent salts by dissolving, recrystallizing and precipitating the salts as pure thick slabs of salt crust. Thus developed, from isolated oasis agro-communities supplying a critically needed salt, into highly sophisticated independent biological community ecosystems. The Qanat tunnels are used today only for domestic and local agricultural water supply. However, the engineering and construction of these systems involved an extremely heavy investment, in extreme desert conditions. The human cost of building the tunnels and lines of boreholes could only have been justified by the value of the salt products at times of famine, produced by the irrigation and surge flooding mechanisms. This forgotten technology which included a fish waste nutrient recycling process led to an ancient “hanging garden” eco-system of sub-terrain inverted step pyramids, and pyramid aquaculture hydroponics, has disappeared. This historical misunderstanding has caused the misuse and losses of water supplies for many Central Asian communities which still rely on the ancient Qanat. In addition to the need to revert to this ancient Hydroponic agro-solution for the present expanding world population and save water, there is also a new need to use the huge expanses of many still empty endorheic basins to again produce a pristine white canopy of salt crust, perhaps to control the mean world albedo to either reflect or absorb irradiation, and thereby increase or cool the world mean temperature by a critical +/- 3 degrees Celsius.

**Keywords:** Salt Monopoly, leaching, aquaculture irrigation, NO-tilling, NO-ploughing, money, albedo hanging garden, hydroponic, Silk Road, Qanat.Karez.

## Introduction

Modern “no-tilling” arable field cultivation, has many an advantage in efficiency, including saving water, saving energy, and better use of nutrient fertilizers. Ploughing and furrowing topsoil today, is considered to be soil destructive. Opening the soil to bacteria and fungus requiring insecticides and fertilizers is also problematic. Most of the irrigated water, to agriculture fields, estimated to be at 90% of spate irrigation, is lost to evaporation. So how and why was it ever invented?

The answer perhaps, is that this familiar global tilling, ploughing, technology used today by farmers, which Islam’s Jafari revolutionized and reorganized, was actually developed in ancient Persia for a completely different purpose:- the leaching of salts from the playa saline sabkha alluvial soil, to produce the basic commodity, solid – “commonsalt”. The salt leaching fields of the ancient Qanats of Persia and the Karez of Han China were inadvertently adopted in the 9th century AD to serve growing populations. However at the turn of the millennium, the thriving Silk Road salt supply route had begun experiencing competition from the renaissance of the cheaper natural coastal sabkha lagoons, Meers and Fens which were slowly exposed by lower eustatic sea levels and the Qanat Karez salt leaching lost its importance. Figure 1.

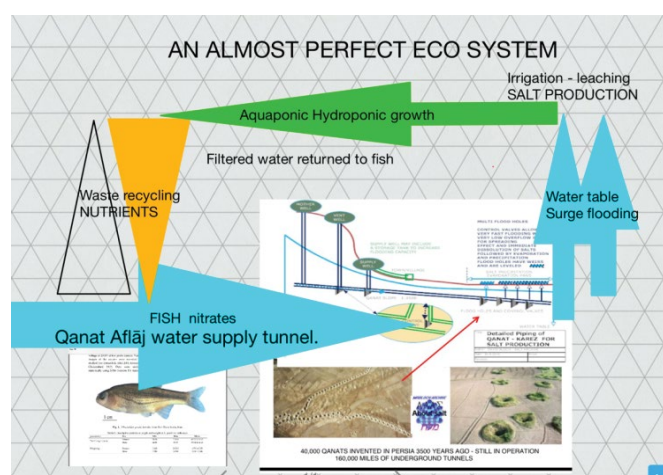


Figure 1

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The Islamic agricultural revolution has been considered by historians to be one of the critical periods of technological advance particularly in irrigation and crop planting including farming of new vegetable types. The agronomic literature of the time, with major books by Ibn Bassal and Abū l-Khayr al-Ishbīlī, demonstrates the extensive diffusion of useful plants to Medieval Spain (al-Andalus), and the growth in Islamic scientific knowledge of agriculture and horticulture. “New” Islamic crop farming needed less sophisticated equipment fewer water lifting devices, less investment, and less experience and knowledge. It only needed simply much more water and flat arable land. Both these last two items were close at hand since the surrounding Qanat desert community field irrigation systems previously used for “farming” leached salt were now standing idle. Due to a renaissance of the salt industries along the China grand canal wetlands and Mediterranean and North Sea coasts, the once critical supplies of the Silk Road could no longer compete with the old Sabkha coastal evaporation lagoons and inundated wetlands which had come back into use with lower eustatic sea levels. Figure 2.

Unfortunately, the leaching, tilling, ploughing technology previously used very effectively to produce slabs of salt, was inherited by the new Islamic crop agriculture revolution. The tens of thousands of ancient Persian Qanat Karez lines of tunnels and boreholes were originally designed to surge irrigate the saline fields by shallow flooding, dissolving the salt by capillary action, followed by recrystallizing and precipitation and produce a pure crust of assorted salts. Irrigation with sweet water from the Qanats concentrated the salts to the topsoil enabling the formation of a solid crust. This was levered up by farmers and shaped into blocks and slabs of salt ready for the camel caravans to transport it to China in the east, and what was to become the Ottoman Empire in the West.

The Islamic movement clearly controlled these salt supplies, mainly sodium chloride, well into the Middle Ages. One of the salts precipitated in this way included potassium chloride the main component of saltpeter, with incendiary characteristics since its early use as “Greek fire”. This process known as “out-salting” produced a crust which also included thin layers of organic protein sediments or microbial mats. This secret salt, the organic version of early explosives, perhaps lent urgency to the hunt for gunpowder.

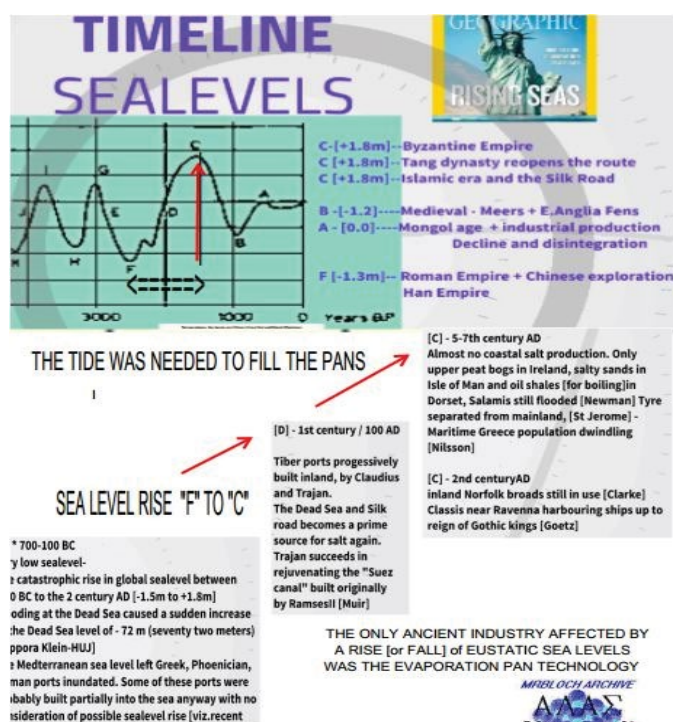


Figure 2

This desert salt leaching was gradually discarded in favor of new industrial processes. The salt fields were converted to crop tilling and ploughing in spite of the high salinity so long as the Qanat water was available. Both the original salt leaching “agriculture” and the hydroponic “hanging garden” horticulture and crop growing technologies mostly invented by the Persians in the previous millennium, had been totally forgotten. The almost perfect micro eco-system of such a typical oasis had consisted of mountain shed water, Qanat fish, (specifically, *Alburnoides bipunctatus*, grown and caught in the qanats, [ Uzineh (Bloch 1782)], recycled water with fish wastes to fertilize a very sophisticated hydroponic horticulture and cascade aquaculture. By the time Marco Polo came looking for this technology, it had been almost totally discarded, together with the anecdotal Arabian One-thousand-and-one nights.

A closer examination of the present universally accepted “tilling” and ploughing has raised many questions regarding its inefficiency, soil destruction, and wasteful water consumption. The question of fresh water supply has become possibly the most critical. The “ancient” hanging garden technology of hydroponic horticulture, has only recently gained ground as a new “start-up” operation, still requiring high investment, but prominently among many advantages, it saves an estimated critical 90% of irrigation water consumption. Many ancient pyramid and inverted step temple systems, which seem to have been built over water sources similar to Qanat systems, and doubtless could well have been sophisticated terrace and cascading aqua-culture, are found in arid zones. Figure 3.

In the Middle East today, water availability has become a “Cassus belli” almost eliminating the calculated cost of new desalination methods. Many centuries ago under almost identical circumstances, common salt: sodium chloride, was in similar critical supply. A translation for war (המחלגת; in Hebrew: -”about salt / bread” חלב) could well serve to remind us of the extreme behavior of even highly developed civilizations in crisis of famine through forced lack of the most basic of supplies.

Almost every community in Central Asia (particularly those in Iran) is built upon the foundations of a Qanat [Kariz] [Falaj] tunnel water supply. Without this purpose built ancient requisite, a sophisticated engineered water system, none of these communities could have come into being. The typical terrestrial locations of such communities are highly saline endorheic basins, in markedly arid zones. To motivate such high human endeavor, an equivalent human need was necessary. With regard to the rationale to live in such desolate locations and to build such an infrastructure, one can only wonder at the resulting richness of the cultures that have since become icons of history. No less an historical explanation must be offered to understand the where-with-all, from which it was subsidized.



Figure 3

These almost perfect oasis ecosystems seem to have existed in almost perfect isolation. With the exception of the salt slabs that we know in hindsight supplied a temporary global famine, these oasis were an exclusive cultural heritage. From the Mediterranean civilizations to the Dynasties of the Chinese coast, salt supplies came from the Taklamakan and Persian deserts, in spite of ‘treaty’ ports and a seemingly more efficient seagoing route.

The Silk Road which historically has claimed to connect East with West, was so named only recently by a German archaeologist since it was recognized that silk from China was a crucial element of that trade. Yet we now know that the Silk was mostly a means of exchange along the trading road, and a stable currency (particularly amongst the Chinese) and only a minimal luxury item, rather than a commodity. The Tuntian [屯田制] of the Han dynasty’s military agro-communities were directed exclusively to initially protect and maintain the eastern Silk Road route which supplied China. The Great Wall logically was developed to protect the routes Qanat industry and has often been compared to the Qanat engineering as a comparable human achievement, from the Han period to the Ming dynasty.

As global eustatic sea levels rose to a peak inundating Sabkha pans causing salt famine, the protection of the western trade route and the Qanat source systems, became the responsibility of the Jafari Islam. This competition to Byzantium and the Crusaders resulted consequentially in the success of the Ottoman Empire. Similarly, competition to the Tuntian [屯田制] military agro-communities were the Mongolians, and those north of the protective Great Wall.

**Conclusion**

The traded, ultimate ‘spice’ commodity, produced mainly along the Silk Road circumventing the Taklamakan Tarim basins during an extended period of coastal salt famine, monopolized by two main parties each to their own ends, was slabs of ‘common salt’ to China, and blocks of ‘common salt’ to Rome. The means of exchange were primarily silk from China and gold coins. As a direct result of the coastal salt famine, the oasis communities became exclusive models of an almost perfect ecosystem sometimes employing pyramid cascade technology. Today’s new ‘startup’ aqua-cultures including hydroponics, are in fact very ancient technologies, directly linked to the original Qanat Karez design and highly efficient in their use of water which today, could prevent much of our present political conflict. The oasis micro eco-systems based upon the Qanats are surely a perfect model ideally suited to modern sprawling populations, each seeking local individuality and independent identities. Figure 4-8.



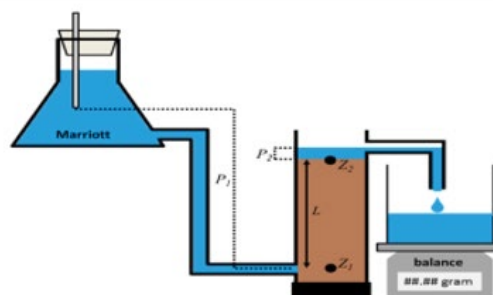
Figure 4: levering up slabs of layered salt crust



Figure 3: Forming salt crust slabs showing clear Microbial layers [Salt Archive]

Figure 5

Figure 6



Darcy test setup.  $P_1$ ,  $P_2$ ,  $Z_1$ ,  $Z_2$  and  $L$  are as defined for Eqs. 4 and 5

Figure 7

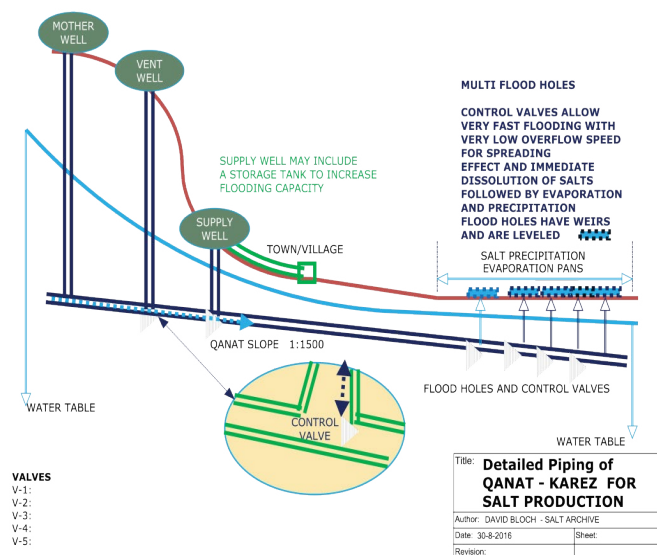


Figure 4

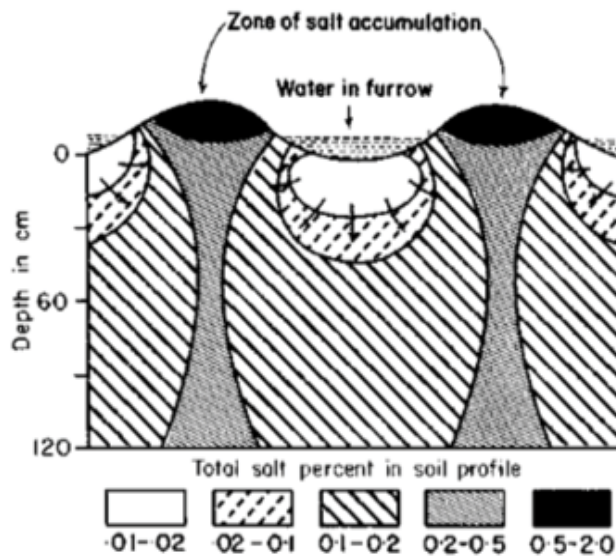


Figure 8

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