

Qanat Irrigated Agricultural Heritage Systems



April 2014

Kashan, Isfahan Province, I.R. Iran

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A An overview of Qanat



THE QANAT TECHNOLOGY

Qanat, an overview





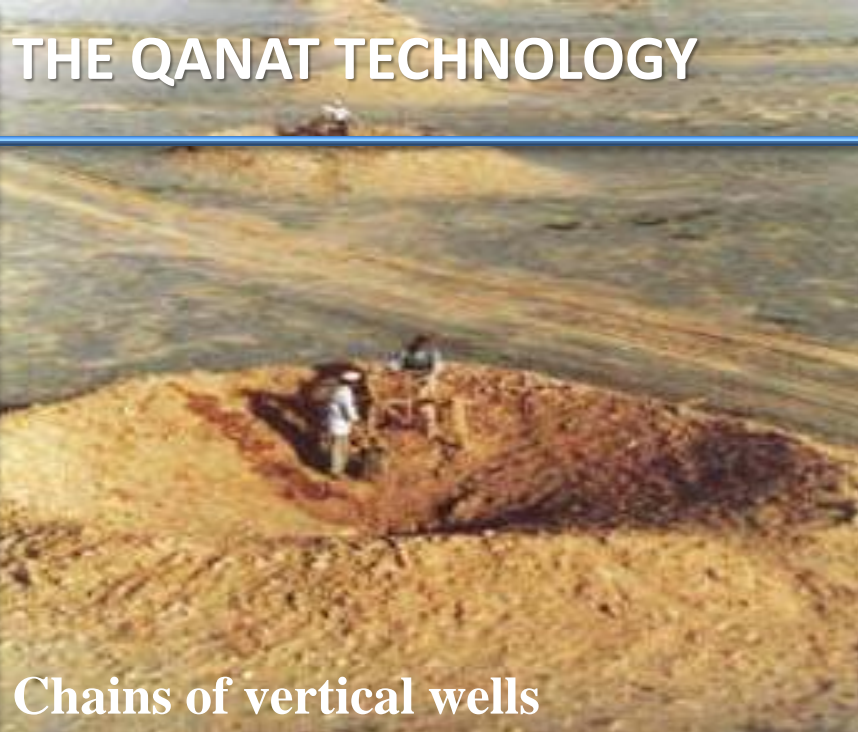
Qanat, an overview





THE QANAT TECHNOLOGY

Qanat, an overview



Chains of vertical wells



Horizontal tunnel



Outlet



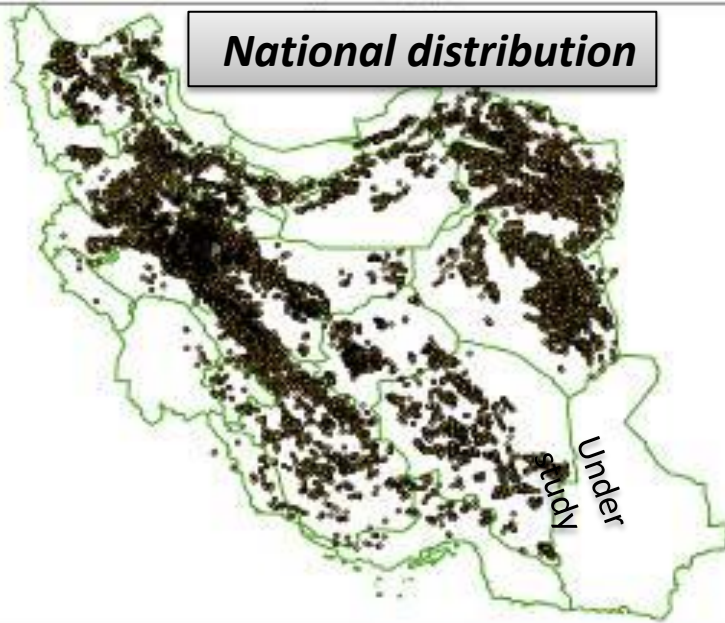
Open irrigation canals



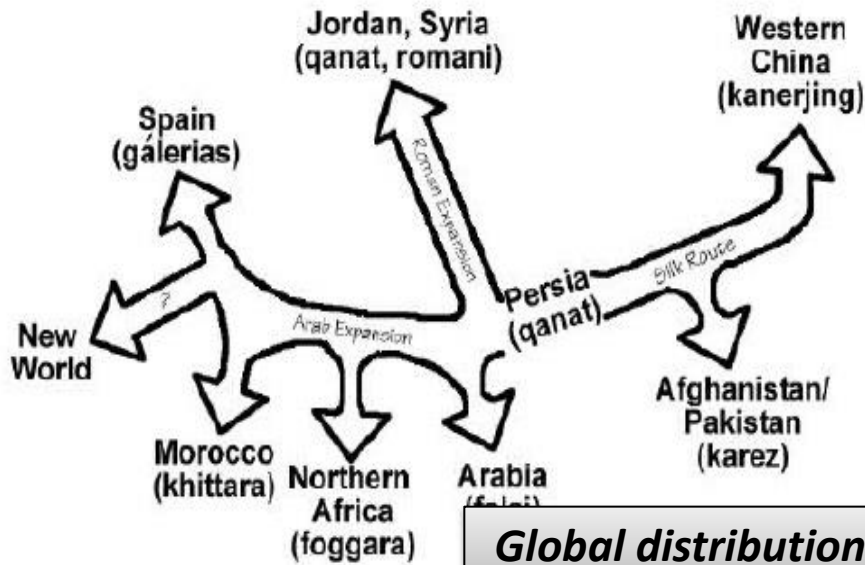
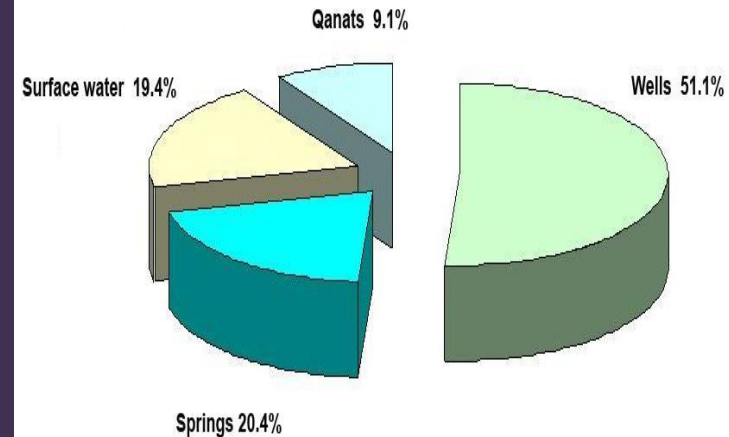
- Qanat first appeared in the mountains of Kurdistan (western Iran) 2,500 years ago.
- The Persepolis was watered by qanats
- extended from the Indus to the Nile,

NATIONAL AND GLOBAL IMPORTANCE

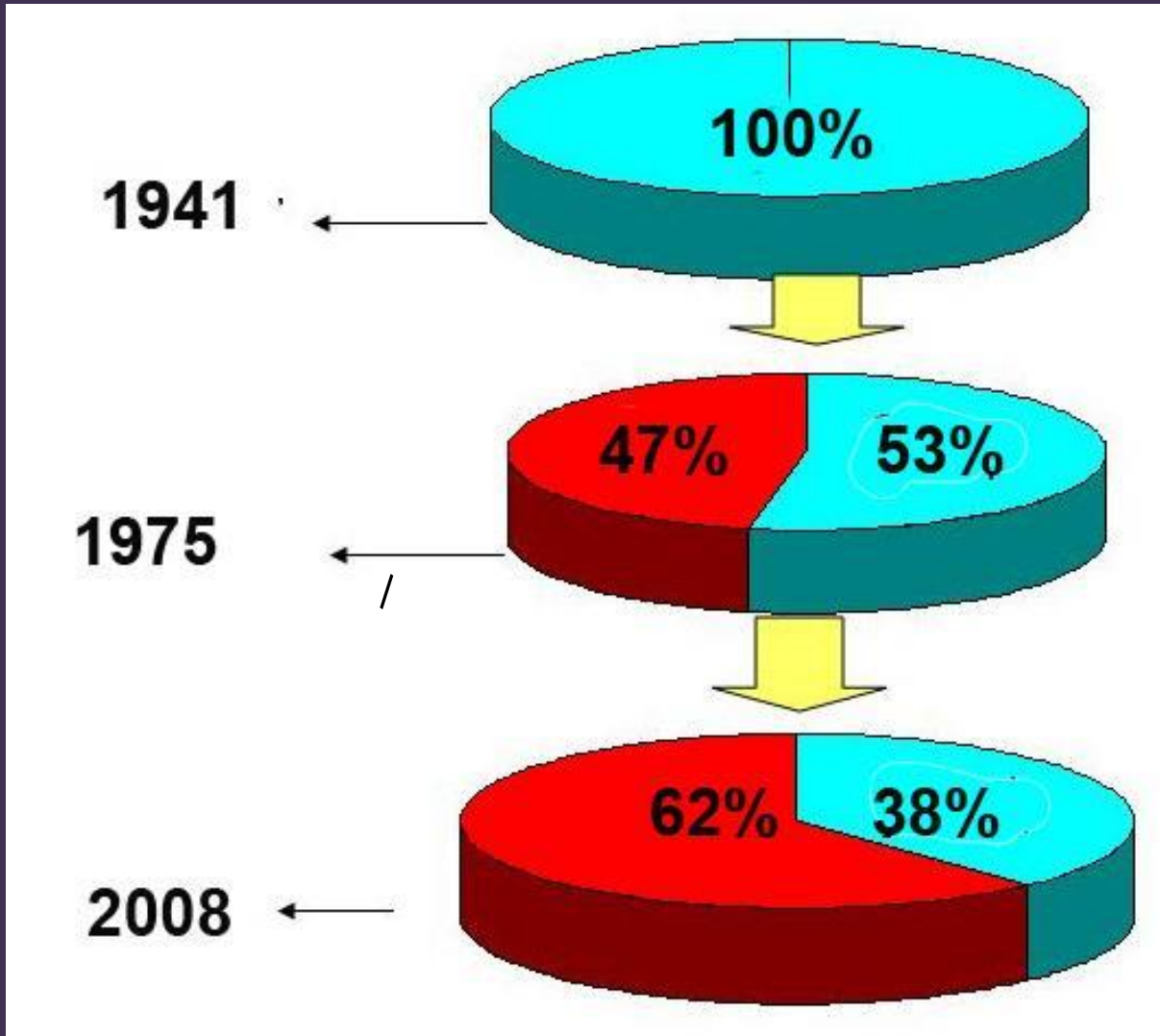
National distribution



share in water supply



About 14% of the Iranian agricultural production and 800,000 ha of farmlands still rely on the qanat water



■ Qanats and Springs

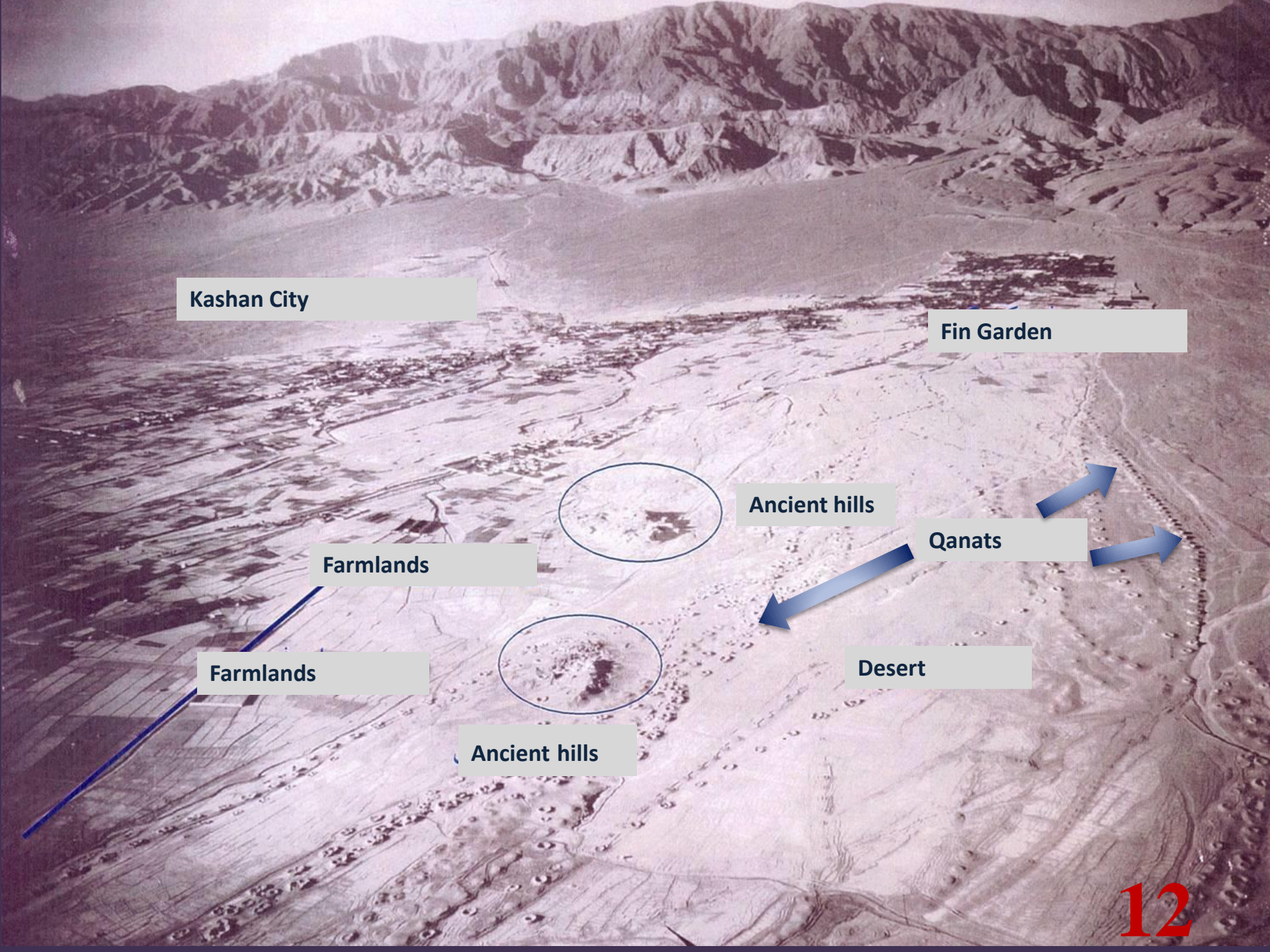
■ well



C

Qanat irrigated agricultural heritage systems in Kashan: Characteristics





Kashan City

Fin Garden

Ancient hills

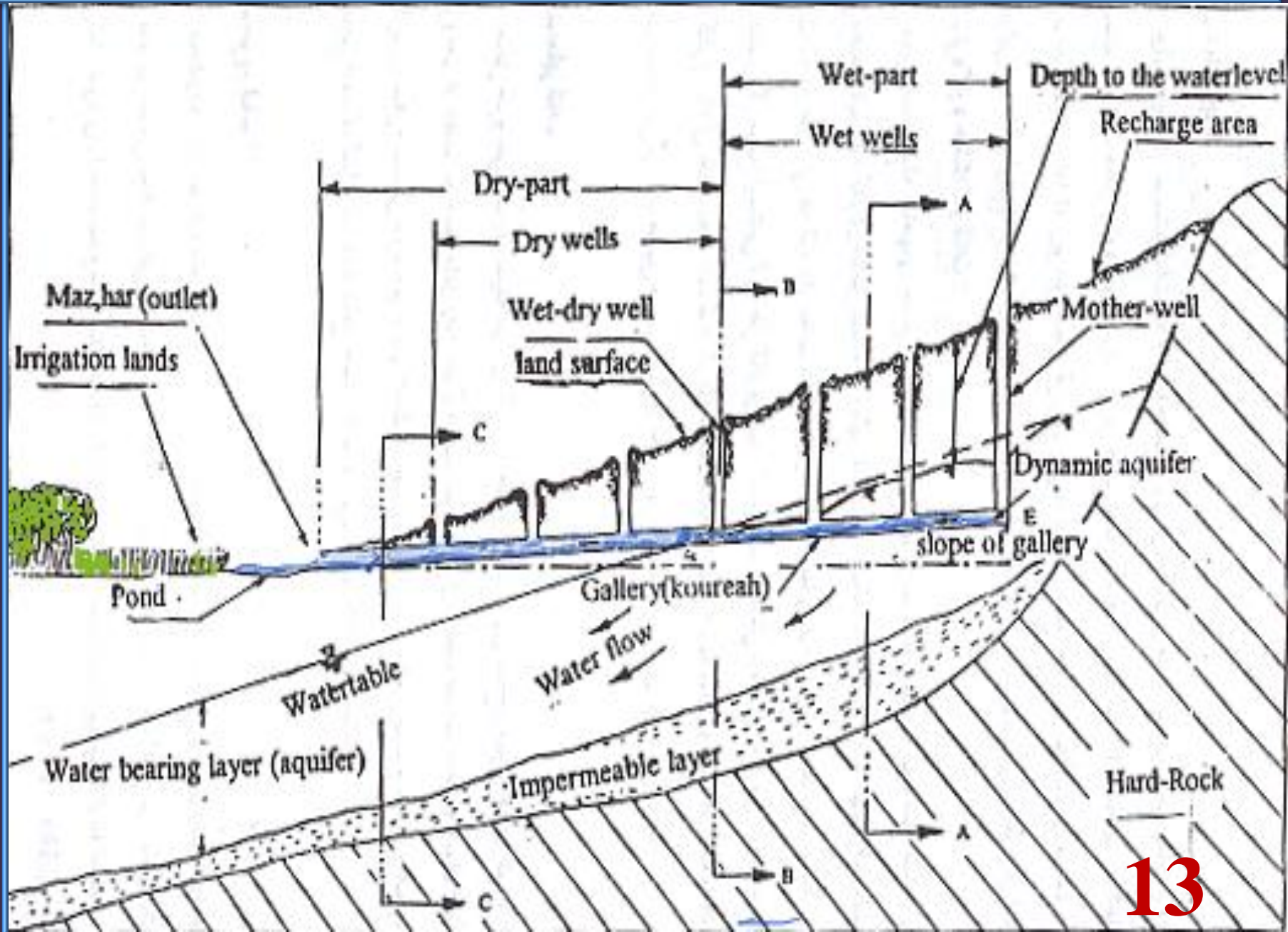
Qanats

Farmlands

Desert

Farmlands

Ancient hills





THE SIGNIFICANCE OF THE QANAT IRRIGATED AGRICULTURAL HERITAGE SYSTEMS IN KASHAN

Characteristics

The Qanat irrigated agricultural heritage systems in Kashan represent an integrative system based on the use of indigenous knowledge in sustainable management of land, water, and biodiversity in a close relationship with nature and culture.

The system has contributed to enrichment of the landscape in the Kashan region which otherwise should have been a desert. The system has acted as a strong element of de-desertification by diversification of the landscape.



About 75 % of the water requirement in Kashan is supplied from qanats (127 million cubic meters) and springs (23 million cubic meters). The rest is supplied from 432 pump wells.

A typical landscape in the hinterlands of Kashan where the qanat irrigated agriculture is established: a pomegranate orchard




A pomegranate orchard in a closer view



A typical landscape in the hinterlands of Kashan where the qanat irrigated agriculture is extended to: a rose flower orchard



95 % of the rose flower orchards in Kashan are irrigated from qanats

A woman in a brown dress and white apron is seen from behind, picking roses from a large bush. In the foreground, three children are sitting on the ground, looking towards the woman. The scene is set in a lush green field with many pink roses.

Production of rose flowers in Kashan is rooted in history, but it is still a dynamic and prosperous sector in Kashan's economy. Rose flower production is an integral part of the qanat irrigated agriculture system in the region.



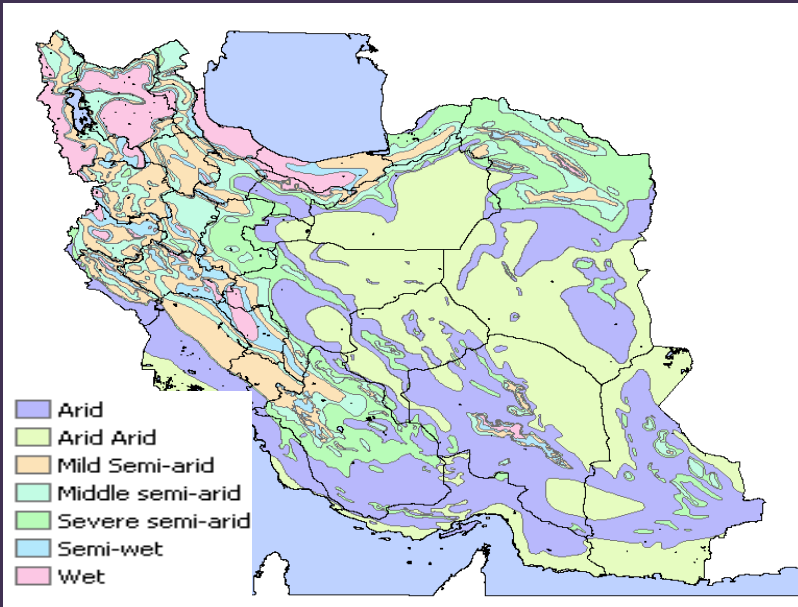


A traditional mixed fruits and flower orchard in Kashan, irrigated from qanat. The stony mountain is seen behind the trees



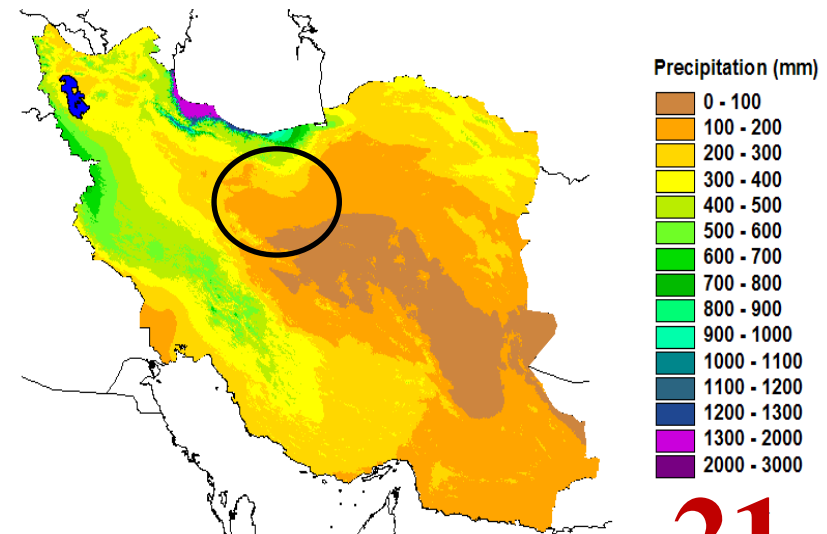
THE ROLE IN FOOD SECURITY AND LIVELIHOODS OF KASHAN

Characteristics



Iran is an arid to semi arid country, with an average annual precipitation of about 250 mm. Kashan is situated in the center of this dry and arid climate.

In Kashan, the annual rainfall is 153 mm, and annual evaporation rate is 2,800 mm. Food security, livelihoods, and even life could not be possible in Kashan without qanats.





THE ROLE IN FOOD SECURITY AND LIVELIHOODS OF KASHAN

Characteristics

Fruits	Area	Production (tons)
Pomegranate	1890	11700
Rose flower	1500	3599
Almond	620	450
Plums	516	4110
Walnuts	495	594
Apricot	425	656
Vines	367	4587
Pistachio	312	337
Quince	170	1836
Olive	132	135
Apple	128	1352
Cherry	83	624
Fig	62	520
Sour cherry	31	165
Saffron	24.1	0.126
Pear	22	356
Peach	20	152
Other fruits	18	165
Date plum	14	65
Hazelnut	7	11

	Production (tons)	Area (ha.)
Field crops	100,000	7,350
Perennials	67,000	7,000
Livestock	90750 (head)	-

25% of the GDP and 20% of the employment in Kashan relies on agriculture

Crops	Area (ha)	Production (tons)
Barley	1700	8670
Wheat	1200	5040
Protected Veg.	766	11490
Summer crops	743	17560
Forage crops	610	8950
Industrial crops	605	2112.5
Cotton	600	2100
Alfa alfa	500	4900
Other crops	390	5850
Onion	240	9840
Tomato	200	5000
Cucumber	170	5950
Potato	120	2520
Water melon	120	1800
Other crops	97	290.8
Pea	70	126
Beans	60	120
Other forage crops	60	2550
melon	50	1750
Clover	50	1500
Maize	10	80
Tobacco	5	12.5

About 75% of water in Kashan is supplied from qanats and Springs. The livelihoods of 20,000 farmers depend on qanat irrigated agriculture.



THE ROLE IN FOOD SECURITY AND LIVELIHOODS OF KASHAN

Characteristics



Qanat irrigated plums, grapes, pomegranates, walnuts, cherries, almonds, pistachios and berries constitute the backbone of horticulture sector in Kashan





THE ROLE IN FOOD SECURITY AND LIVELIHOODS OF KASHAN

Characteristics



With 1,500 fish farms (producing 35 millions of fish), Kashan supplies 40 % of Iran's ornamental fish. 80% of this sector depends on qanat, creating jobs for 4,500 people



- Thanks to the qanat irrigated agriculture system, a wide variety of species, high value crops, fruits and trees have developed and still are maintained and cultivated in a region which is supposed to be barren or very sparsely vegetated: eg. pomegranates, rose flowers, almonds, plums, walnuts, apricots, vines, pistachios, quince, olives, apples, cherry, figs, sour cherry, saffron, pears, peaches, and date plums.
- Surrounding these agricultural heritage gardens are the cultivation of variety of field crops e.g. maize, wheat, pulses, cereals, pea, beans, potato, alfalfa, clover, eggplant, okra, onions, tomato, melons, water melons, cucumbers, cotton, tobacco.
- Local sheep races differ in the plains and the mountainous areas. In the plains, the local Baluchi and Naeeni races, and in the mountainous areas, the Lori, Afshari, and Qomi are dominant.

About 32 types of different field crops and 20 types of fruits constitute the qanat irrigated agriculture system in Kashan

- Kashan is also rich in the flora of wild species.
- Some of the species found in the region are endemic, rare or botanically important at the national or global level.
- Some of the species endemic to the region area, the Central Deserts, or Iran, which are found in Kashan include: *Anthemis gayana*, *Aphanopleura breviseta*, *Ducrosia anethifolia*, *Echinophora platyloba*, *Echinops cephalotes*, *E. elymaiticus*, *Euphorbia malleata*, *Ferula Hirtella*, *Linaria michauxii*, *Nonnea suchtelenioides*, *Onosma demawendicum*, *Paracaryum cyclhymenium*, *Persicum*, *Pycnocycla spinosa*, *Anabasis calcarea*, *Anthochlamys multinervis*, *Nepeta prostrate*, *Benth sessilifolia*, *Salvia eremophila*, *Samoliflorum Heliotropium*, *Reseda buhseana*, *Tanacetum lingulatum*.



As its name shows, *Cousinea kashanensis* (Asteraceae) is introduced to the world from Kashan.

Qanat waters are also inhabited by about 25 different species of fish, crabs, aquatic plants, invertebrates, and aquatic insects. In 2009, a new species of fish, named *Albominoides qanati* was reported from the Kerman qanats to the fauna of the world. The blackfish species *Gambusia holbrooki* is unique to the qanats of the Eastern Iran.



Albominoides qanati

The suitable water quality (EC and hardness) and the currency of the qanat waters are influential in sustaining the diversity of the aquatic life.



The Qanat water is fresh, with low content of salts and undesirable minerals. **There are two main reasons for better quality of water delivered by qanats**, as compared to other systems:

- ***Qanats do not draw water from the bottom of aquifers, but from the top.*** Whereas, pump wells are constructed to maximize water output from aquifers, and normally reach close to the bottom of aquifers (That's why the life span of wells are less than 20 years while there is no time limitation for life span of a Qanat). The force used in pumping water needs fossil fuel energy and takes the soil with the water. The natural gravity system used in Qanat has resolved this issue.
- ***Water flowing over long distances in qanats results in gradual sedimentation of suspended matter, and therefore self-purification.***



Fin Outlet

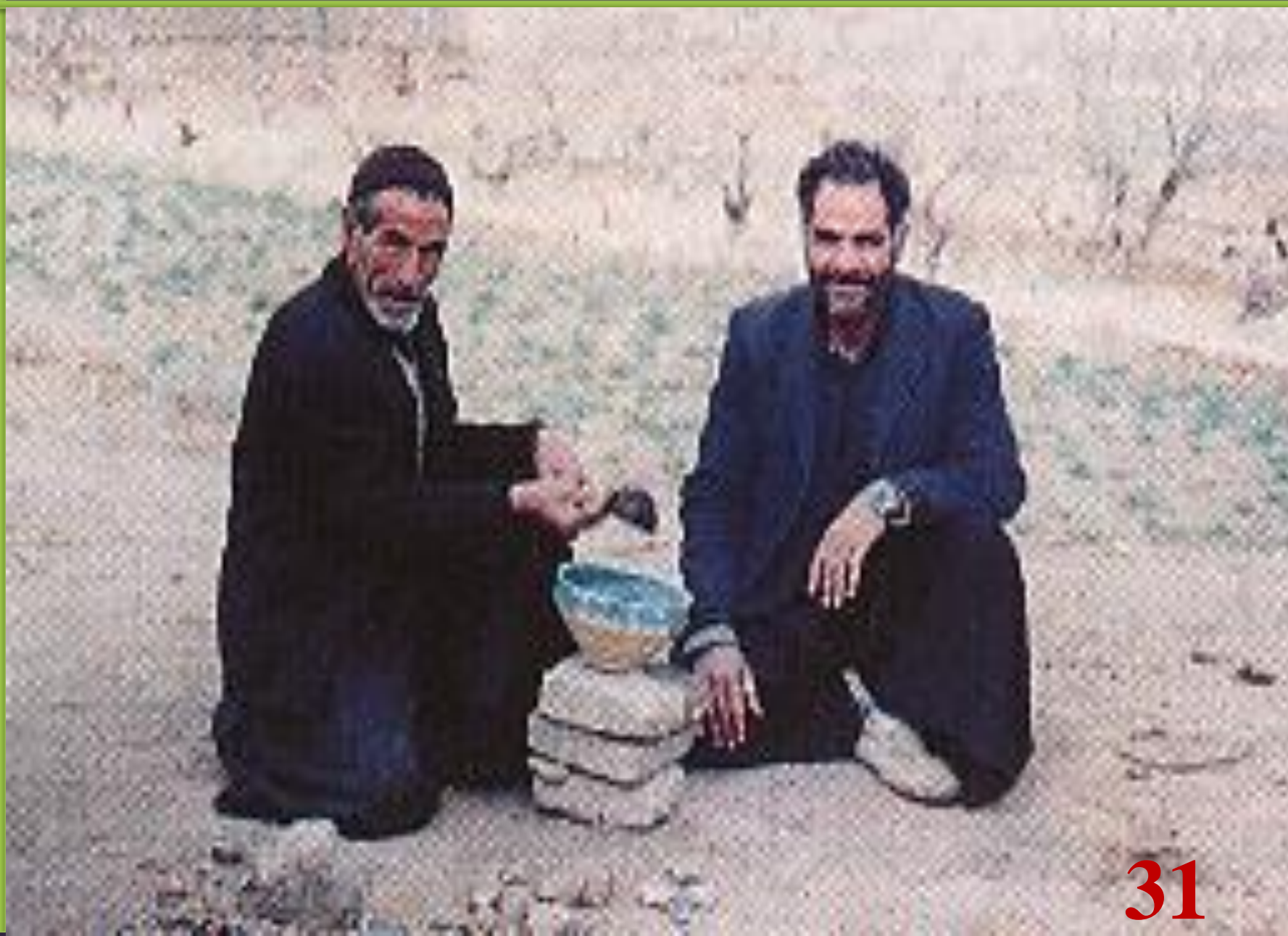
Crops irrigated with qanat water are of better quality and more resistant to drought. Qanats in the Kashan region are associated with growing a variety of fruits and crops, **some of which are unique and famous in the whole country** for their special quality, flavor or other unique characteristics: **The *Fin* and *Zaghe Yaghuti* pomegranates, *Qamsar Muhammadi* rose flower, *Lat-hor* cucumber, *Majdabad* tobacco (also known as *Kashan Tobacco*), pears, almonds, plums, cherries, walnuts and apricots**



Characteristics



The informal but highly respected arrangements established over centuries by the local communities for distribution of qanat water are the basis for a fully functional water distribution system. **This Participatory management system is an example of how carefully the local communities can incorporate the socio-economic and agro-ecological aspects to assure the sustainability of land and water use.**





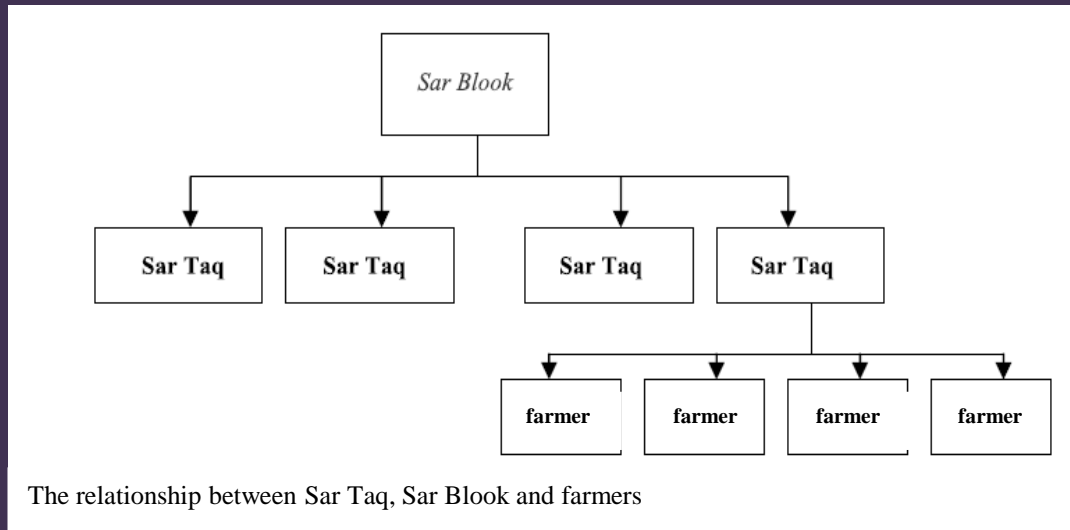
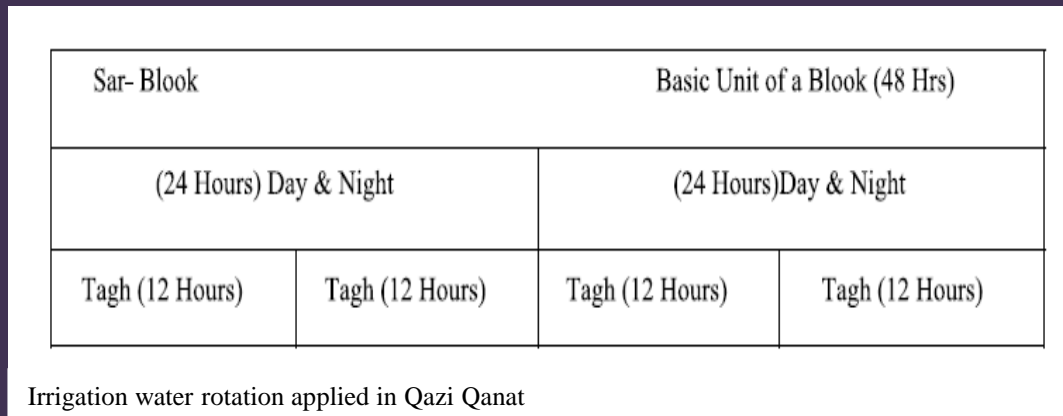
Characteristics





KNOWLEDGE SYSTEMS: PARTICIPATORY WATER MANAGEMENT

Characteristics



In this participatory system, old owners are retired in lieu of upkeeping and protecting qanats, division of water, or even a share of the production.



KNOWLEDG SYSTEMS: REGION-WIDE AGRICULTURAL DECISION MAKING

The Qanat Irrigated Agricultural Heritage Systems is associated with a highly intelligent *region-wide participatory agricultural decision making system*. In this holistic system, the *mirrab*, the backbones of the qanat water management system, are also given the task by the local communities to plan the cropping pattern. Each one or two years of cultivation the land is left for fallow.

This system effectively resolves the issue of small and fragmented farmlands: the farm plots are classified into three parts, based on their distance from the spring of qanat. Every year one section of the plain (or one *jarib*) is allocated for cultivation in autumn and another *jarib* for spring. The third *jarib* is left for fallow . All the community members are aware of what is being cultivated and where, thereby protecting crop diversity.

Characteristics

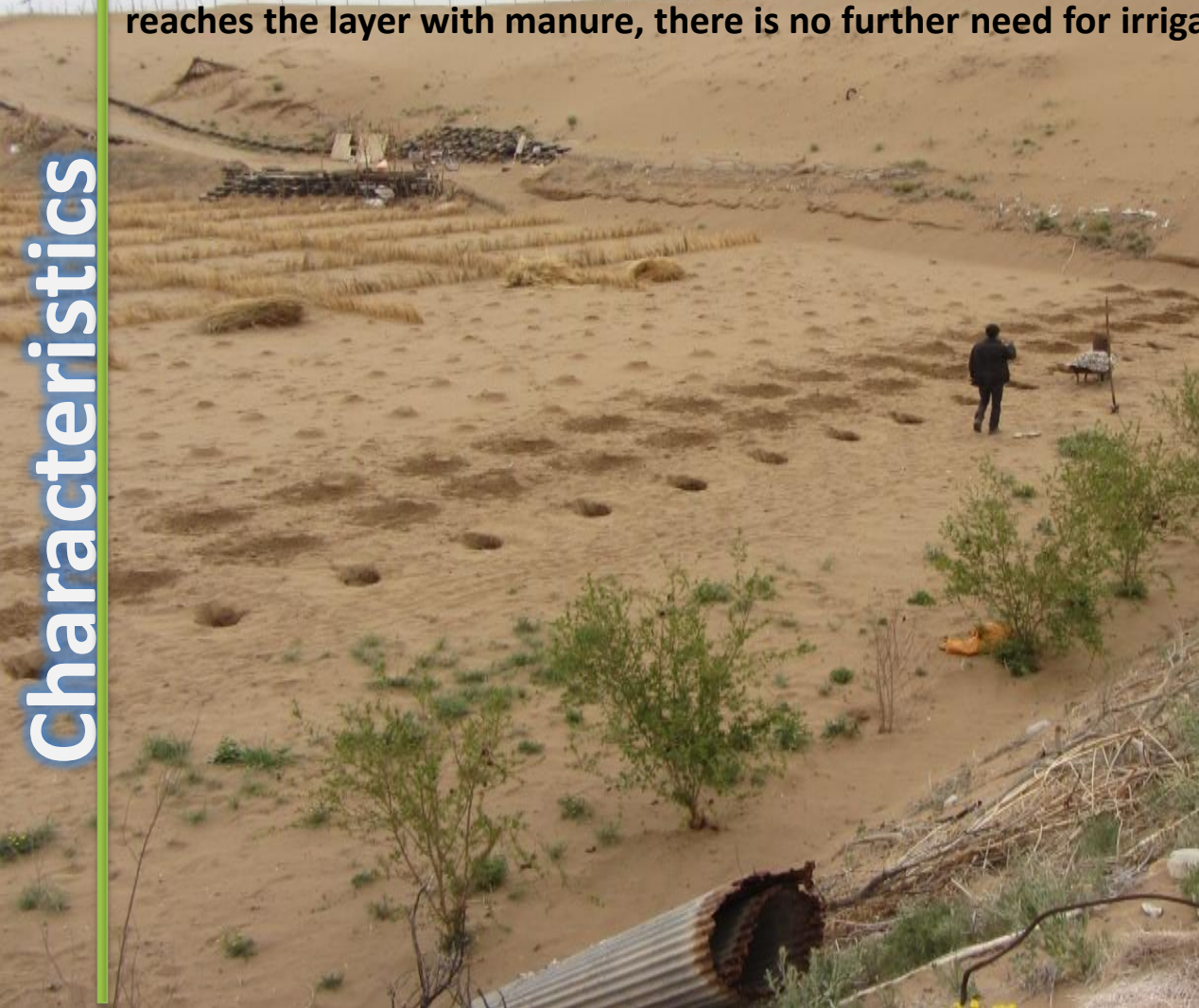




ADAPTIVE SYSTEMS: WATERMELON IN THE MIDDLE OF THE DESERT

This method of cultivation is called Sombak (named after Sombak Plain of Ghazi Qanat area in Kashan). The farmers dig 1 m deep and 30 cm wide holes. They place the seeds inside the soil and prepare barrier against the moving sand and wind. Then they fill the holes with different layers of soil and manure. The seeds grow gradually with the water captivated in the basin. Once the root reaches the layer with manure, there is no further need for irrigation.

Characteristics



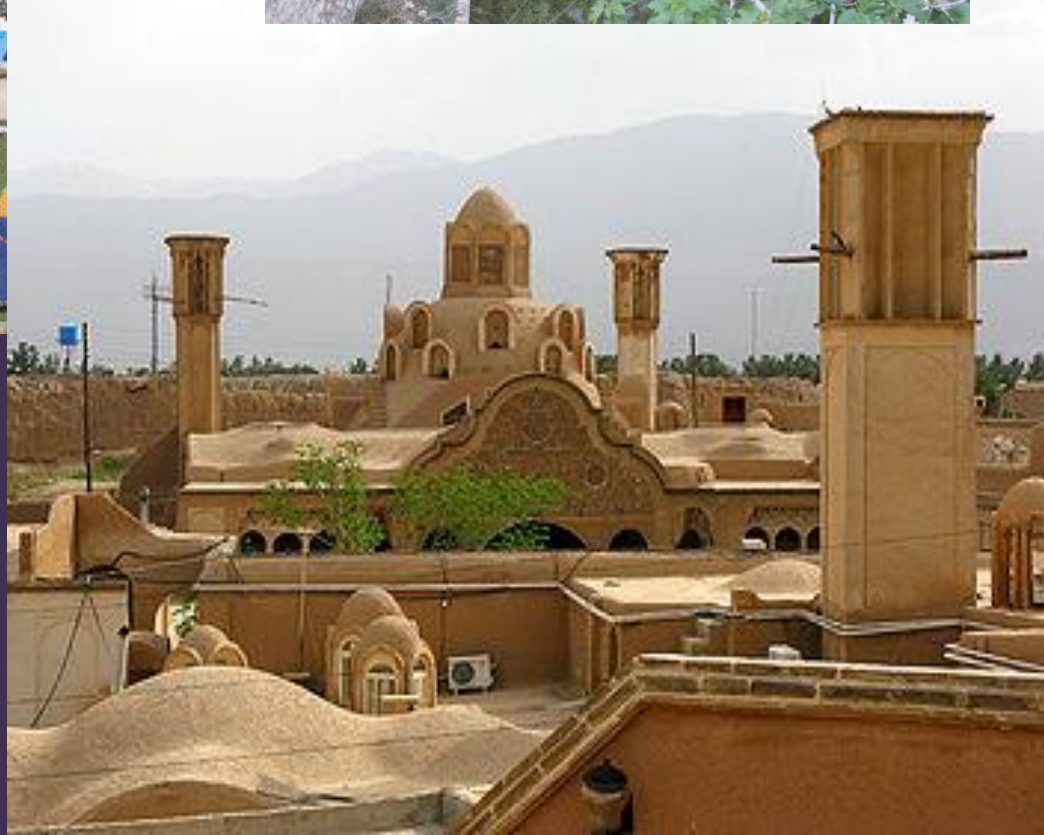


ADAPTIVE SYSTEMS: WATERMELON IN THE MIDDLE OF THE DESERT

(Supported by GEF/SGP)

Characteristics





Other (Social, cultural, architectural) functions of the system



- **Vaghf (endowment)**

Qanats are made a benefactor or beneficiary of the public goods.

- **Gendering Qanat**

Qnats are personified as masculine or feminine.

- **Endearing qanats**

The local communities mourn for drying-up a qanat.

- **Harim (sacred buffer zone)**

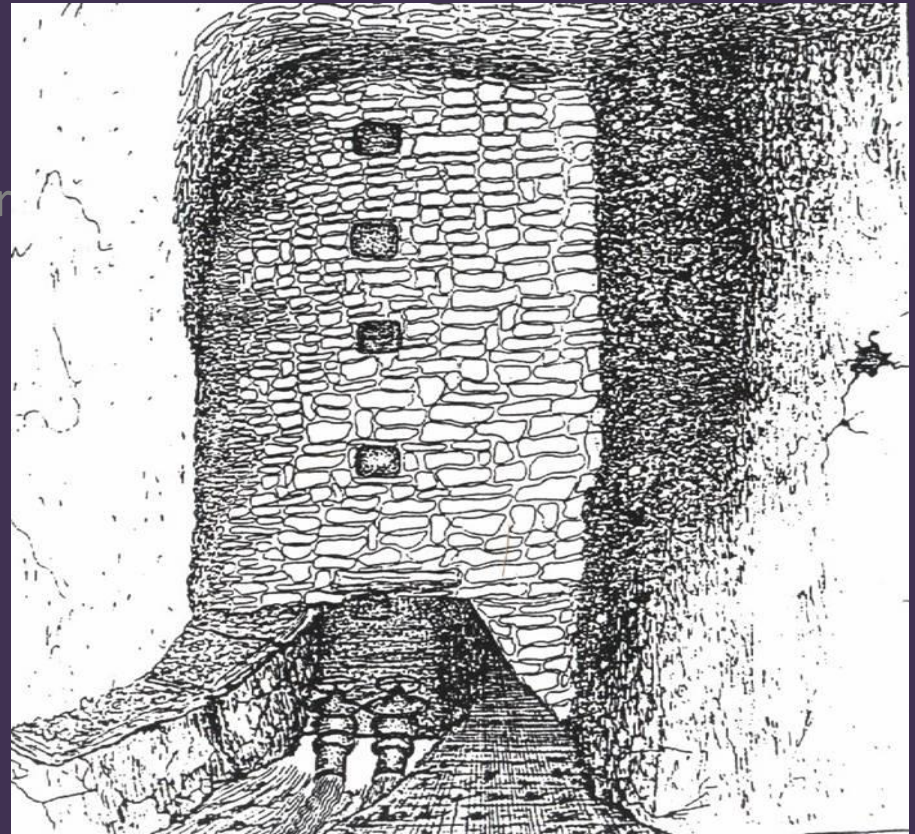
A respected Harim (buffer zone) along the route of each qanat.

- **Qanat as a source of social esteem**

Qanat water share holders , muqannis and miraabs have a high social esteem

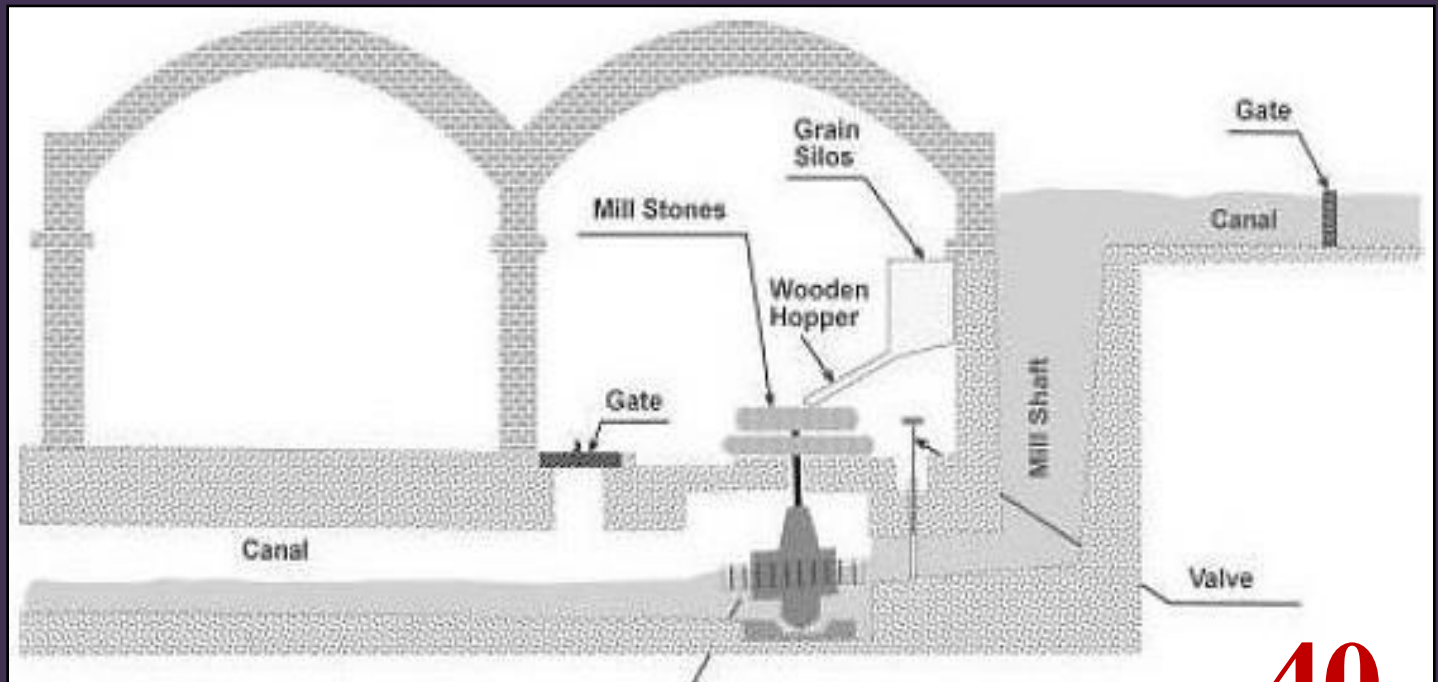


- **Ab-bandan (Underground dams)**
- **Water Mill**
- **The cistern (abanbar)...**
- **Wind-Tower**
- The scheme of a wind-tower oper...



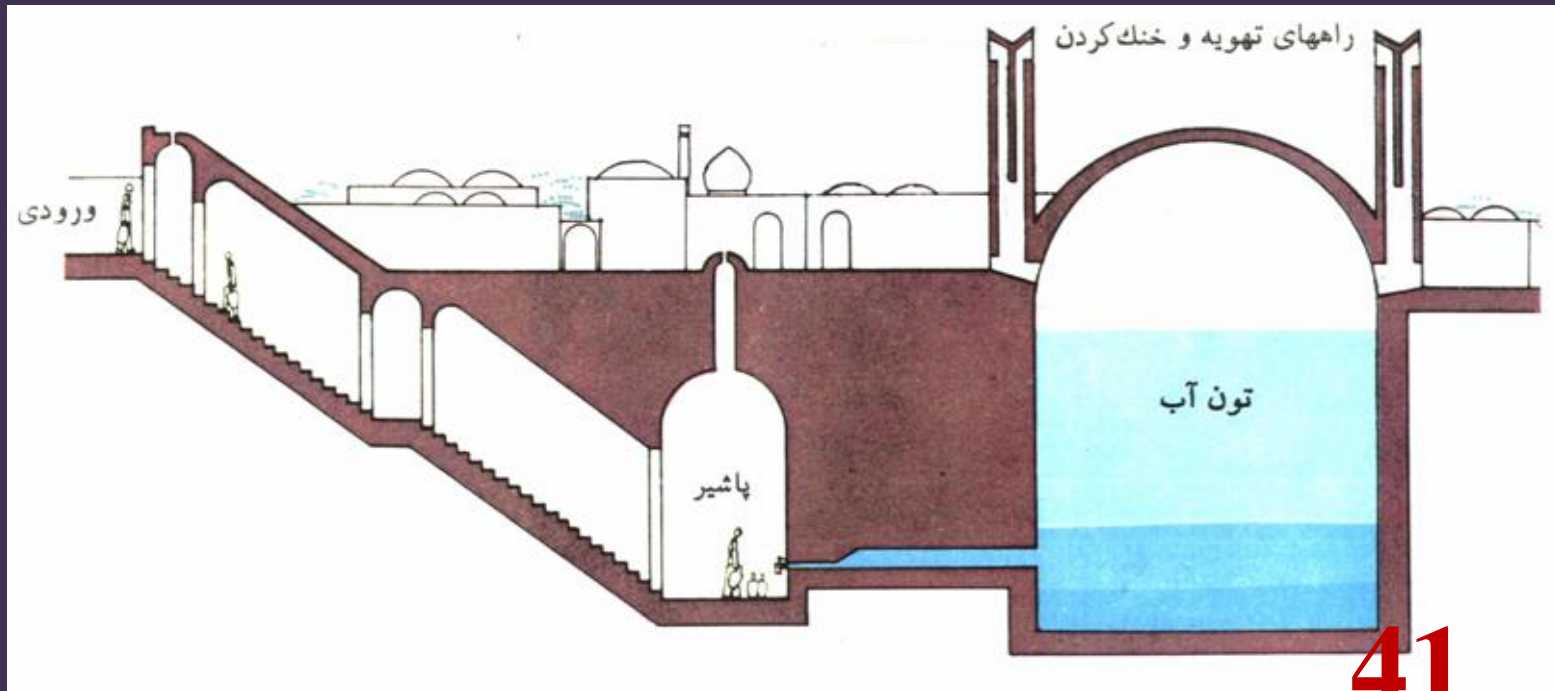


- Ab-bandan (Underground dams)
- **Water Mill**
- The cistern (abanbar)... A way station
- **Wind-Tower**
- The scheme of a wind-tower operated with Qanat water





- Ab-bandan (Underground dams)
- Water Mill
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- The scheme of a wind-tower operated with Qanat water



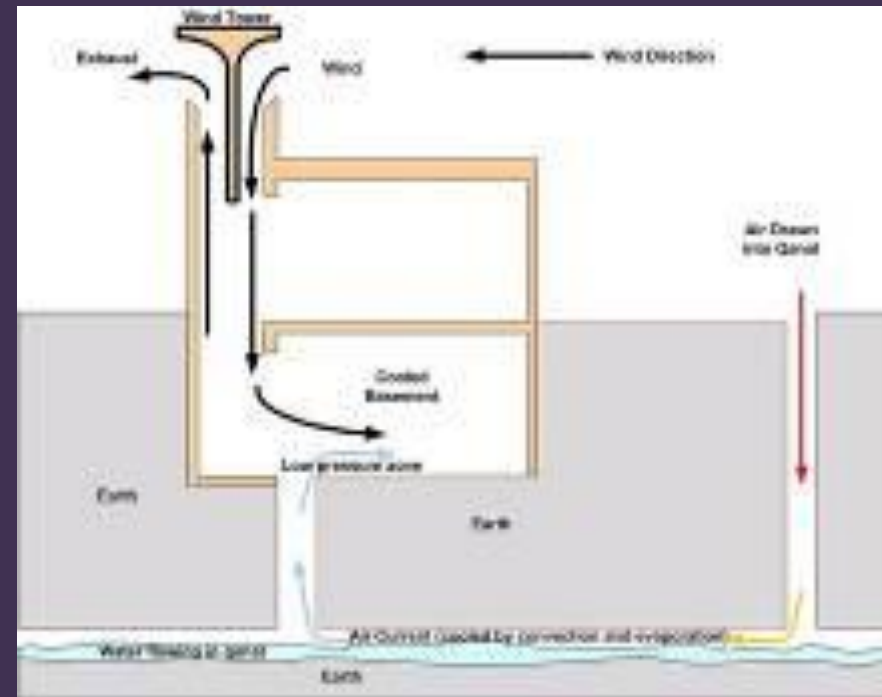


- Ab-bandan (Underground dams)
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- The cistern (abanbar)... A way station
- **Wind-Tower**

Other functions



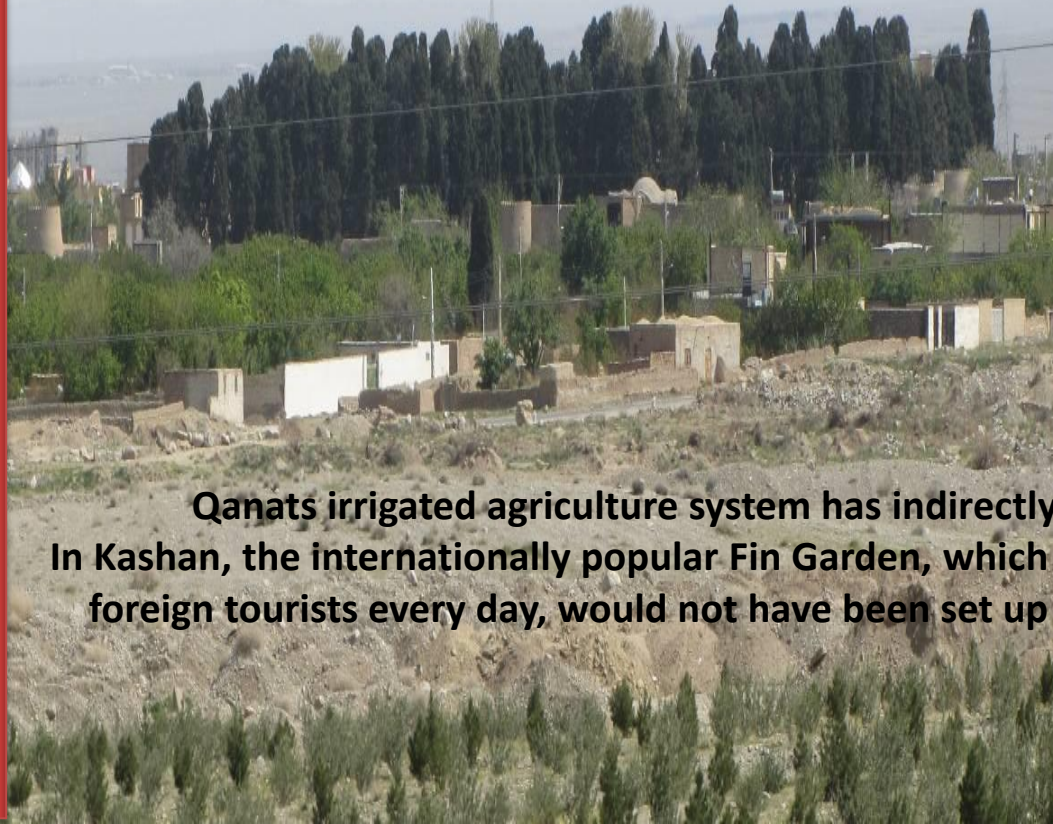
The wind-tower in the Bujerdis House



The scheme of a wind-tower operated with Qanat water



THE ROLE IN TOURISM



Qanats irrigated agriculture system has indirectly served tourism in many ways. In Kashan, the internationally popular Fin Garden, which is visited by hundreds of domestic and foreign tourists every day, would not have been set up and survived without the Fin Qanat.





THE ROLE IN TOURISM

Other functions



Ghamsar Kashan is the main production center for the highest quality rose water. The traditional methods are still widely used. The people collect roses, boil them in special pots and collect their water in beautiful containers. The sacred Kaaba is washed with rose water from Ghamsar Kashan.



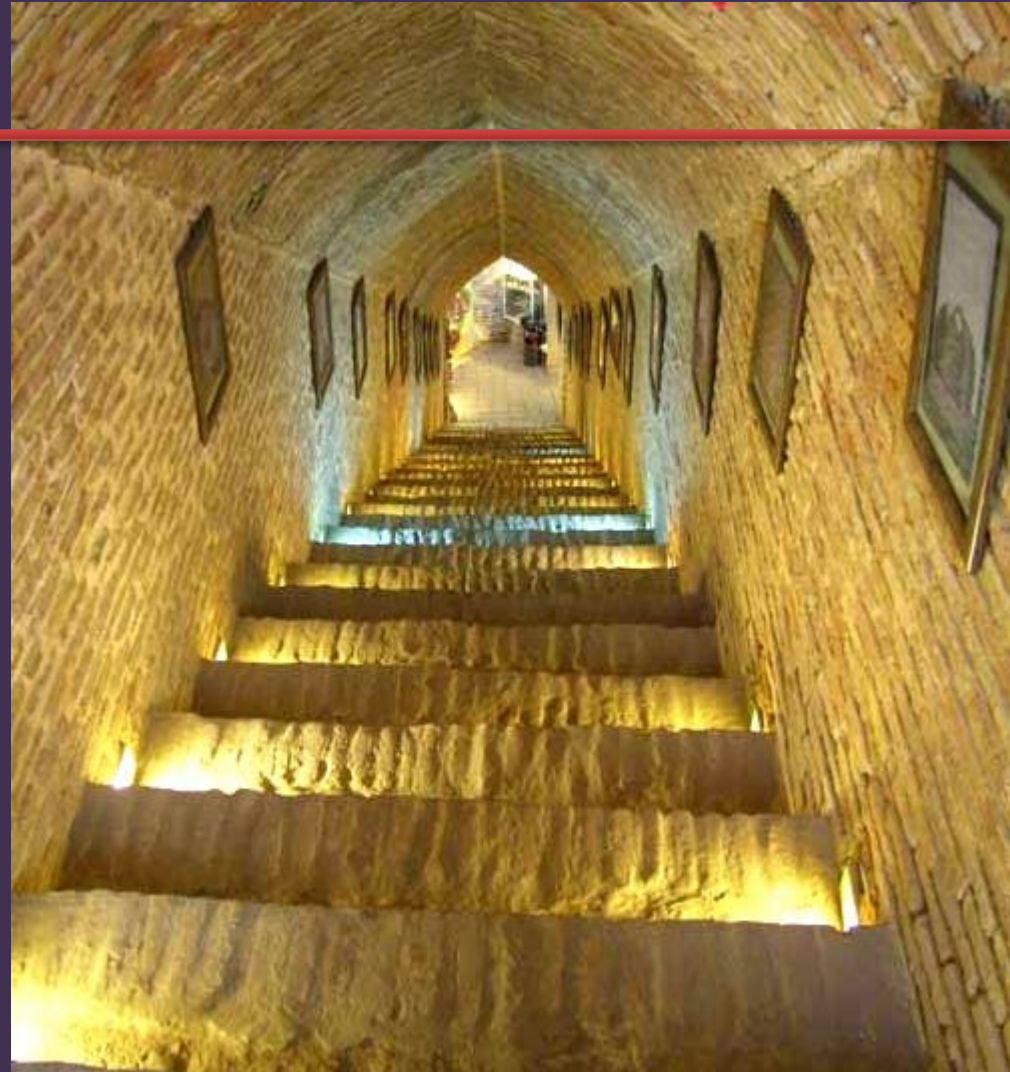


THE ROLE IN TOURISM

Every year during the second half of May to mid-June, the Rose and Rose Water Festival are held in Kashan. **About 80,000 tourists from different parts of the country and abroad visit Kashan every day to participate in this festival.**

Other functions





Other functions

Qanat as a direct tourism site is a subject that is gaining great attention recently. Some interesting projects have been implemented : The qanat is renovated, then facilities are installed for receiving and entertaining tourists inside the galleries or around the open outlet ponds of the qanat. The Ardestan two-staged Moon Qanat is being prepared for this purpose.



T

Threats and challenges

- Depletion of the aquifers
- The changing agricultural land ownership and management system
- The Declining number of professional muqannis



Way Forward

- 1998-2008
 - National Program for the Renovation and Maintenance of Qanats ;
- Qanat reconstruction projects in 2013:
 - Formulation of the detailed Terms of Reference of studies for reconstruction of Qanats ;
 - Reconstruction projects through tender bids for consultants, contractors, and muqannis (real and legal persons) ;
 - Development of a GIS-based national databank on Qanats ;
 - The implementing agencies and collaborators of the Program for the Renovation and Reconstruction of Qanats have been organized in coordination with Provincial Governor Offices throughout the country ;

- Introducing a degree program on Qanat at Bachelor's level at Scientific-Vocational University.
- A High School Diploma Course has also been introduced on Qanats.
- Signing of MOUs with the Cultural Heritage Organization, Minister of Energy, and Fisheries Organization on multi-purpose use of water resources.
- Cooperation of the Ministry of Energy in the establishment of the International Center of Qanat and Water Historical Structures covered by UNESCO.
- Appointment of the joint working group for Qanats in collaboration with the Ministry of Energy and the International Center of Qanat and Water Historical Structures.

- The envisage activities(Fifth Five Year National Development Plan (2011-2015):
 - Revising the existing legislation
 - Convening fresh laws, rules and regulations concerning Qanats.
 - Delineation of the buffer zones of Qanats
 - Training and extension of innovations and advanced technologies for the improvement and revival of Qanats.
 - **Organizing the traditional muqannis in terms of economic and social aspects**
 - Establishment of joint working groups of the Ministries of Jihad-e Agriculture and Energy to finalize the terms of reference and other technical criteria for initiating watershed management projects upstream of Qanats and for protecting Qanats against floods.

The proposed GIAHS will complement the above activities by incorporating a holistic approach to promote the Qanat irrigated agriculture system in the Kashan region. Specifically, the following activities were identified in consultation with the stakeholders:

- (actions on agriculture, biodiversity and qanat irrigation system):
 - Designing the optimal cropping pattern based on the carrying capacity of Qanats.
 - Formulating and implementing a participatory Conservation Plan
 - Providing advice to the Government on enhancing the sustainability and comprehensiveness of the large-scale Program for Qanat Renovation

- Shift from civil engineering towards integrated system management.
- Adapting the recently introduced methods in consultation with the traditional practitioners of Qanats irrigated agriculture.
- Scaling up and strengthening the marketing efforts
- Formulating and promoting measures to address the ecological carrying capacity of the region
- Promoting the Qanat-fish production system.
- Promoting the Integrated Pest Management

- (actions on local community empowerment and institutional development):
 - Strengthening the community-based management
 - Advocating the need for full allocation of the approved funds
 - Reflecting the needs and expectations of the professionals and workers involved in Qanat irrigated agriculture system.
 - Establishing the multi-stakeholder provincial and national GIAHS promotion board.

- (Education, information supply. Documentation):
 - Supporting the ongoing initiatives for introducing Qanat as an academic subject.
 - Providing advice to the relevant institutions to improving the existing Qanats Database
 - Initiating a GIAHS promotion campaign with the assistance of the mass media, the CBOs and the TV.
 - Initiating a project for documentation of the multifunctional services of the GIAHS.

Thank You for Your Attention



