



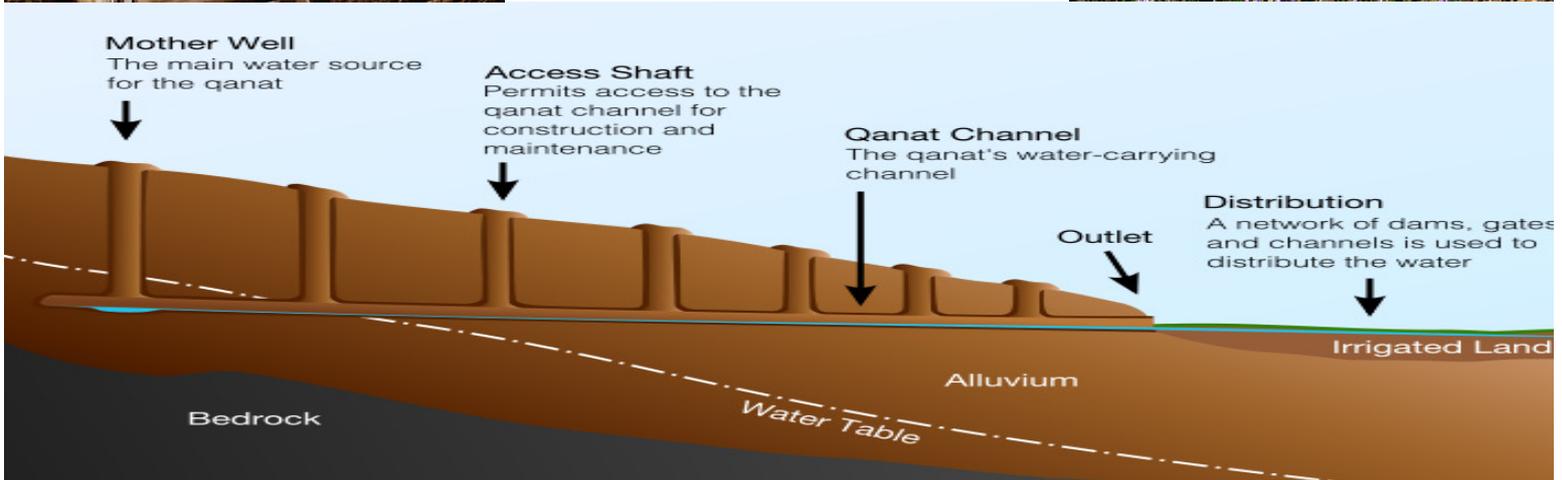
جمهوری اسلامی ایران
وزارت جهاد کشاورزی

موسسه پژوهش‌های برنامه‌ریزی،
اقتصاد کشاورزی و توسعه روستایی

Islamic Republic of Iran
Ministry of Agriculture Jihad
Agricultural Planning, Economic and
Rural Development Research Institute
(APERDRI)



A Proposal for Designation as a GIAHS Qanat –Based Saffron Farming System in Gonabad Gonabad County, Khorasan Razavi Province, Islamic Republic of Iran



December 2018



To the Iranian Saffron Family Farming Producers, especially Khorasan Razavi Province and Gonabad County, and all stakeholders of "Iranian Saffron Value Chain ", whose them efforts and contributions, has conserved this "Globally Important Agricultural Heritage System" for thousands of Years

**تقدیم به تولیدکنندگان کشاورزی خانوادگی زعفران ایران،
بویژه استان خراسان رضوی و شهرستان گناباد، و همه فعالان
«زنجیره ارزش زعفران ایران»، که تلاش و مشارکت آنها،
این «نظام میراثی کشاورزی مهم جهانی» را برای
هزاران سال حفظ نموده است.**

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The candidacy of the **Qanat–Based Saffron Farming System in Gonabad** to be part of the **GIAHS** initiative is to be greatly attributed to the caring, pivotal and forward looking gesture of **His Highness, Mr. Mahmoud Hojati, Minister of Agriculture Jihad (MAJ)**.

In recognition of the uniqueness of this system as part of the heritage and lives of its people, the collaboration and efforts of, **Dr. H. Banaee, Gonabad's People Representative in Parliament; Dr. A. Rashidian and Mr. GH. Mirzaei, Former and Current Khorasan Razavi Province's Governors; Dr. A. Bakhshandeh, Deputy Minister for Planning and Economics and Head of Iran GIAHS National Committee, MAJ; Dr. M.H. Emadi, Ambassador and Permanent Representative of the Islamic Republic of Iran to the FAO and his office team; Mr. H. Fathi, Director General, Bureau of International Affairs and Specialized Organizations and his office team, MAJ; FAO Representative Office in Iran; Dr. A. KianiRad, Research Deputy & Iran GIAHS National Committee Member, APERDRI; Dr. J. Behzadnasab, Head of Agro-Industries & GIAHS Research Group, APERDRI; FAO GIAHS Secretariat and SAG Members especially Prof. M. Qing Wen; Iran GIAHS National Committee & Experts Group Members; Supervisors, Authors, Co-Authors and Contributors who their names has been mentioned at the end of this document**, have been outstanding to revive focus and attention on this blessed heritage system, for the people of **Gonabad County** and for the **Islamic Republic of Iran** in general.

Dr. S.H. Kazemi
Director General, APERDRI, MAJ
&
Secretary of I.R. Iran GIAHS National
Committee

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I. Summary Information

Name/Title of the Agricultural Heritage System:

Qanat –based Saffron Farming System in Gonabad, Gonabad, Khorasan Razavi Province, Islamic Republic of Iran

Requesting Agency/ Organization:

Agricultural Planning, Economic and Rural Development Research Institute (APERDRI)- Ministry of Agriculture Jihad (MAJ), Islamic Republic of Iran

Responsible Ministry (public sector):

Ministry Of Agriculture Jihad (MAJ), Islamic Republic of Iran

Contributors:

Local Community, Agriculture Jihad Organization of the Khorasan Razavi Province, Agriculture Jihad Management of Gonabad, Khorasan Razavi Governorate, Gonabad Governor, Saffron Research Institute Center, Seno Village Islamic Council, Khorasan Razavi Cultural Heritage, Handicraft and Tourism Organization; Saharkhiz Saffron Co., Novin Saffron Co., Mizou Co., and all Saffron value chain stakeholders.

Location of Site:

Islamic Republic of Iran, Khorasan Razavi Province, Gonabad City



Geographic Location: 57° 46' to 57° 27' (longitude) and 34° 3' to 34° 54' (latitude).

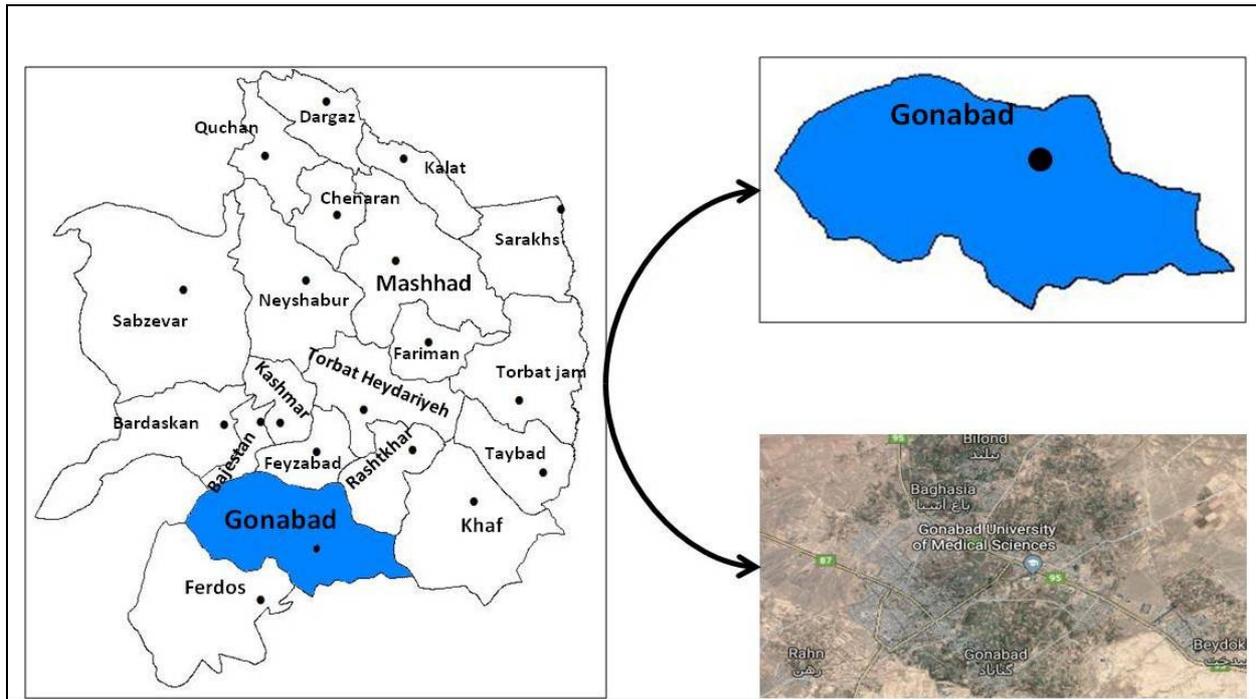


Figure 1- Qanat –based Saffron Farming System Location

Access of the site to Capital City or Major Cities:

Distance of the site to Mashhad City, the center of Khorasan Razavi Province, and Tehran City, the capital of Iran, is respectively 270 Km and 1,091 Km. This access is provided through asphalted road and railway and airport of Mashhad. Considering that Gonabad is located in the route connecting South Khorasan and Sistan & Baluchistan Provinces, this city is of particular importance.

Gonabad is also located in North-South transport corridor (aka Sento Road).

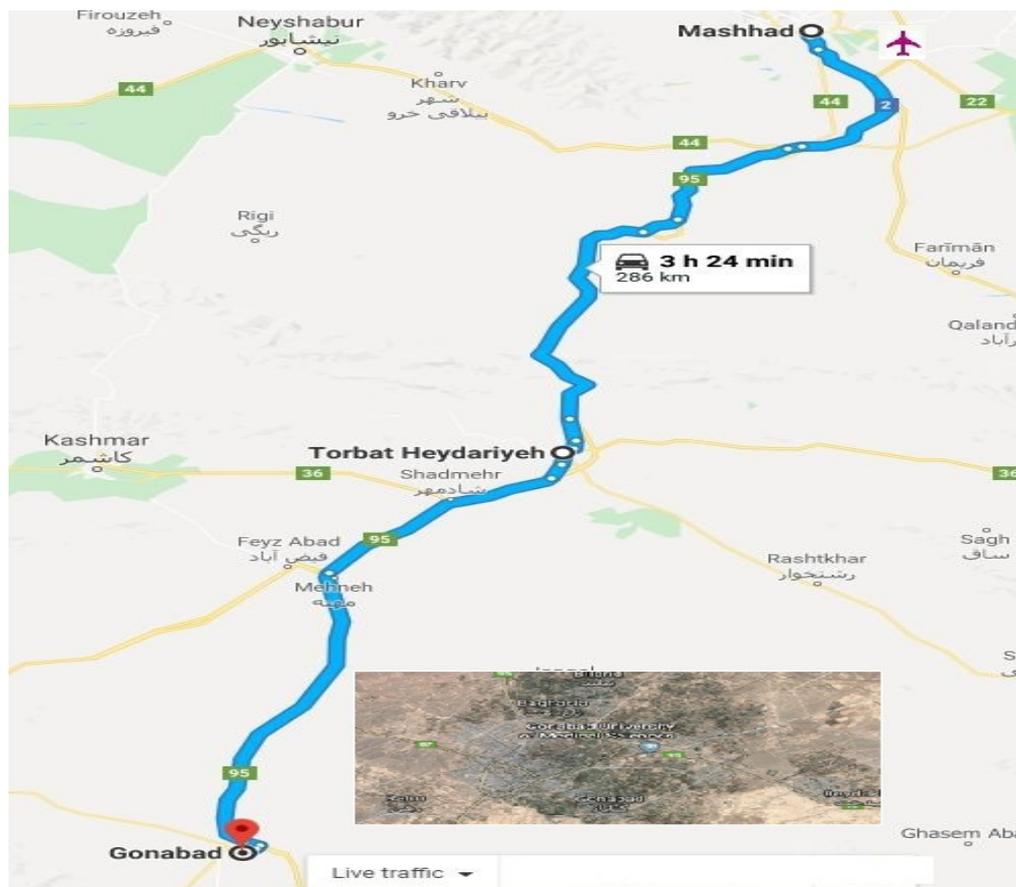


Figure 2– Access Road of Qanat – Based Saffron Farming System

Area of the Site: Area of the region is 5788.79 km²

Agro-Ecological Areas (Farming, Forestry and Aquaculture):

The area hosts plain lands, mountains and forest ecosystems for agricultural activities. Adjacency of Gonabad to Lut and Zangi Ahmad deserts provided the area with unique climate and biodiversity. Area of forests of Gonabad is about 667.5 Km² which represents 7.4% of natural resources of Gonabad and 5.9% of natural resources of Khorasan Rzavi Province. Currently, about 25% of forests of Gonabad is occupied with

Pistachio trees (*Pistacia atlantica* and *Pistacia khinjuk*) with densities varying from 30 to 50 trees per hectare, most of which located at Hengam Mountain. From plant life viewpoint, the area is mostly covered with plants indigenous to dry lands; fauna of the area is mostly covered by Mugworts and Pistachio alongside with other plants such as *Pteropyrum*, *Ephedra*, Fig, annual plants, Alhagi, Esfand (*Peganum harmala*), *Cousinia*, *Hymenocrater*, *Cuminum*, *Ligularia dentate* and Thymes.

Topographic features:

Most of the areas of Gonabad are plain lands and altitude variations are not significant.

Climate Type:

Climate of Gonabad is mostly arid and Semiarid. Gonabad is formed from three major geographical areas of Barakouh, Dashte Gonabad (Gonabad Plain Lands) and Paskelout. Barakouh area has mountain climate with cold winters and temperate summers. Gonabad City is located at the top of Barakouh plateau; it is established on a plain with distance of 24 Km with Barakouh mountain range. Tirmahi (or Zobeid) mountain with height of 2,557 m is the tallest mountain of Barakouh mountain range. Altitude diminishes with light slope from Zobein mountain to Paskelout area of Gonabad. In general, Gonabad City is located at the edge of desert area with arid and semi-desert climate. Compared to Kakhak and Zobeid villages of Barakouh area, Gonabad City has a warmer summer which is similar to summers of Paskelout region. Summer nights are more temperate and maximum temperature may reach to 40 Celsius degrees.

Approximate Population:

According on Population and Housing Censuses 2016, The total population of the city of Gonabad is 88,753, representing 57.34% of the population in the city and 42.66% of the population in the villages. The total number of households is 27607. Trends of growth in population and decrease of population distribution in urban and rural areas has been almost similar. For the first time, during past years the rate of urban population surpassed the rate of rural population. In general, rural population has been decreasing while urban population elevated. As indicated in census of 2011, national and provincial ranks of this city from population viewpoint was respectively 217 and 11. Rate of education at this city was determined 27.85%.

Ethnicity/Indigenous Population:

Most of population of Gonabad are from Aryan race and due to the fact that this area was not occupied by alien races for a long period of time, racial and ethnic composition of its population is mostly intact. Currently, ethnicity composition of Gonabad is constituted from Fars, Turk, Kurd and Baluch people. Language of inhabitants of Gonabad City is Persian with accent of south of Khorasan province which has a resemblance to Dari.

Main source of livelihood:

The main source of livelihood in this area is agricultural activities, mostly farming Saffron, cumin (*Cuminum cyminum*), wheat, barley, grape and almond and mining and creating handcrafts such as pottery, carpet and silk textile weaving and other local textiles. In this city there are 10344 farmer households who work in the agriculture, livestock and horticulture sectors. They use 294 deep and Semi-deep wells , 599 Qanats and 106 springs, which provide 2335.5 million cubic meters of water for agricultural use.

Executive Summary:

Khorasan Razavi province and Gonabad region are part of central Iranian plateau with arid and semiarid climate. Persistence of such climate resulted in water scarcity and poses challenges toward improved food security and livelihood of residents of these areas. However, proper use of water resources supplied from Qanat System and promotion of products with high rate of added value, especially Saffron, created unique opportunity for farmers and residents of the region to improve their livelihood and also created considerable job opportunities. Saffron plays a key role in creating job opportunities, reducing immigration, providing sustainable livelihoods, efficiency and productivity in water use.

Qanat system is a reliable source of water and supports preservation of biodiversity and productivity. The history of the Qanats on Iranian plateau goes back to the Aryans era. Many Qanats, especially in the eastern parts of Iran are from ancient eras. High level of cultivation and production of Saffron in Iran is the main factor in maintaining the global position of Saffron and advantages of our country in this particular field. Low need of Saffron for water compared to cereals, resulted in allocation of more areas to cultivation of this invaluable crop. Atmospheric and climatic conditions made Saffron a major source of income for numerous farmer households. Compared to current magnitude of Saffron farming in Iran, its cultivation was much broader in the past. Currently, most of Saffron farms are located in Khorasan (Razavi, Northern and Southern) Province. According to the Ministry of Agriculture Jaha data, 95% of Saffron is produced in Khorasan, 3% in Fars and the remaining of 2% in the other parts of the country. From quality point of view, Saffron of Iran is unique among products of other countries.

Because of numerous aspects and landmarks such as Saffron museum of Seno Village, Gonabad, Gonabad's Qanats which his marked by UNESCO as a World Heritage Site, historical and monumental village of Kakhak Gonabad, varieties of herbs and animals, Gonabad has numerous values and importance, especially from historical and tourism points of view. One of the aspects of this area is history of Gonabad in production of Saffron.

Flower of Saffron, in its natural beauty and violet, red and yellow colors, gives the city

an astonishing look.

Natural beauty of the region and unique architecture of residence of people which his result of beautiful crops and Saffron flowers are among aspects of the area which promote tourism and eco-tourism. These opportunities can be exploited as valuable economic option for the locals. Another advantage of eco-tourism in these areas is that tourists may act toward promotion of conservation of natural resources and agriculture.

Gonabad hosts considerable areas of farmlands in surroundings of residential areas. Additionally, at the edge of Saffron farms, fruit trees such as almonds, berries and etc. are planted which create unique landscape accessible through a short trip from the city. On the other hand, Saffron flower parts which are disposed as waste, create purple piles of flower parts in corners of alleys and streets of the city. Gonabad's market hosts considerable trade of Saffron flowers and root and the city is crowded with traders and even citizen who has no hand in Saffron trade are even drawn to such interactions. All these created an astonishing local festivity in which all citizens have a part to play.

Numerous small colorful farms of Saffron at the borders of desert, cities build on rich local traditions, unique geographical, natural and agricultural features of the region and crowded Saffron markets are just few beauties of Gonabad. Production of Saffron, the Red Gold, plays a fundamental role in creating job opportunities and income for locals.

Qantas as the main source of water for Saffron farms on foothills and other structures and building used for production of this Saffron are among other factors attribution to promotion of tourism and ecotourism of the region.

The cultivation of Saffron in the Gonabad region is more livelihoods, family and and traditional farming, So the cultivation is not industrial, But over the past years due to the increasing of cultivation area, ground preparation is done semi-mechanized. That is, operations are carried out by livestock and humans and used by medium tractors.

II. Description of Agriculture Heritage System

1. Significance of the Proposed GIAHS Site

One of the most valuable products all across the globe is Saffron of Iran which's eye-catching color, intoxicating aroma and pleasant sweetness is appreciated worldwide. Saffron farming has ancient history in Iran and this country is known as the origin of this invaluable plant. Currently, Iran is the largest producer of Saffron in the world and has over 90% Saffron production worldwide which demonstrates importance and role of "Iranian Saffron" in a global scale. Obviously, Saffron production of Iran has significant importance in global market of this particular product and the market considerably relies on Saffron production and exports of Iran. In other words, any reduction in yield of Saffron in Iran could have a considerable negative impact on global markets and any such reduction may result in elevation of international unit price of Saffron to thousands of dollars.

The special and relative advantages of Saffron, makes cultivating Saffron as superior crops compared with other crops. Some of the benefits include the following:

- Saffron is a perennial crop. This means that, with an onion seeding, more than seven years have not required re-planting and there is a possibility of harvesting the plant several times.
- Saffron is different in terms of planting time and the need for water with other products, that is, the peak demand for water by this plant is right at the time of excess and abundance of water, which coincides with the fall season (November). Also, the planting of this plant is less erosion and less soil nutrient loss.
- The need for light agricultural machinery for planting, and reliance on traditional instruments and manpower.
- Having certain morphological features, such as narrow and fairly thick leaves, is one of the most important factors that make Saffron adapted to arid and semi-arid areas.
- Saffron resistance to climate fluctuations compared to other plants, which is the most suitable product for dry and semiarid climates. The results of the studies show that in general the Saffron plant in terms of drought and frost resistance, It has better conditions to other plants in this County.

Saffron is valuable from agricultural economics viewpoint too; limited need of this plant for irrigation, complex equipment, and skilled workforce of Saffron in combination with its high added value and important role in local economy and livelihood of locals promoted Saffron to place of main pillar of economy of Khorasan.

High quality of Saffron of Iran combined with fertile lands of the region, cheap and available human workforce and strong ties of this particular product with culture and identity of Iran are among important aspects of this product. Considering that Gonabad region has no perennial stream and surface waters of the area are limited to seasonal streams, underground waters are main source of water for agricultural and drinking purposes. Genius of Iranian ancestors in designing Qanats protected these unique structures from hostile agents and environment for millennia and supplied water for over 2500 years.

The studies and research have shown through the historic documents that Saffron has its origin in the Zargos mountain range in Iran (over 4000 years), and then spread worldwide. The main difference between Kashmiri and Iranian Saffron is that of the yield of Stigmas which is about 75%. The size of the stigmas indicates the inherent suitability of the soil and climate for this product. For a long time Iranian Saffron have had excellent standing in the world and it has also had various consumption. Iranian Saffron is mainly organic and has best smell and aroma, with special color and rich in high nutrients.

Some common consumption of Iranian Saffron includes:

- Preparing historical “Royal Food”, drinks and desserts (such as brew tea with Saffron, Saffron rice, Saffron Tah –Chin, Saffron Syrups, Saffron cake, etc.), but also dyeing hair and clothes as well as Persian wooland silk carpets.
- By just physically observing the Saffron its origin can be identified provided it has not been blended with Saffron from various origins.
- The blending is normally done by importers in non producing countries because of the wide disparities in prices: the Iranian Saffron is about 1/2 the price of Kashmiri Saffron due to trade sanctions against Iranian products.
- Persian Saffron has no rival when it comes to its excellent flavor, mesmerizing color and outstanding quality.
- Iran covers about 70% of the world’s 250 tons of Saffron production annually. It is said that classical Persian is the very first language that has the use of Saffron (or Zaferan, as more commonly known aroundIran) registered in the cooking department.
- There are a few points that matter when it comes to the quality of Saffron. For example the age and maturity and the Saffron is a very important point and the mass of style cultivated alongside the Saffron is vital to the quality.
- The Iranian Saffron is made up of the red stigmas which have been professionally cut and separated from the style prior to drying. Stigmas cut this way don’t trap the moisture inside. If stigmas stay attached to the style, it keeps inside up to 30-50% dead weight that it would be paid for it.
- Coloring power is the only measuring tool that can assures of consistent Saffron quality.

There are different types of Saffron that are Cultivate in Iran:

- Sargol: this is considered the top quality, which consists only of the red stigmas of the Saffron crocus. Sargol literally translates as “top of the flower”.
- Pushal/Pushali: this brand is also mostly red stigmas, along with a small amount of yellow style.
- Bunch: a small amount of red stigmas plus a lot of yellow style and possesses lower quality than the two above.
- Konge: only yellow style. This brand has the aroma of Saffron, but barely has any coloring ability.

Also there some differences in Iranian and Non-Iranian Saffron:

- High quality Saffron produced in Iran is exported mainly in bulk to Spain. Then the imported Saffron is mixed and reprocessed with lower grade Spanish (La Mancha) and Portuguese Saffron (safflower which is often sold as “assafoa”) before being packaged in attractive designs. It is then re- exported as La Mancha or Mancha Saffron at higher prices to all parts of the world.
- Persian Saffron threads are all vivid crimson color with a slightly lighter orange-red color on the tips. This indicates that it’s not cheap Saffron that has been tinted red to look expensive
Aroma is strong and fresh.
- No broken-off debris collected at the bottom of container.
- No other yellow or white plant parts mixed in with the red threads.Fresh and current season's threads.
- Saffron threads are dry and brittle to the touch.
- Apart from enhancing the features of dishes magnificently, Saffron also has many medical uses. It is used to reduce a number of health sicknesses, and is used as a remedy to cure insomnia and reduce stress. Saffron is also a useful substance when it comes to weight loss, and fitness since it has an appetite receding effect. It is also of great use in the cosmetics and skin care facility as the various masks.

For Non-Iranian Saffron:

- Spain is producing nearly 1 ton of Saffron annually but is exporting more than 100 tons per year, 20-30 tons of which to the United States alone. Powdered Saffron is more prone to adulteration, with turmeric, paprika, and other powders used as diluting fillers.
- Saffron threads displaying telltale dull brick red coloring which is indicative of age.
- Aroma is musty.
- Broken-off debris is collected at the containers bottom, indicative of age-related brittle dryness.
- Yellow and white plant parts are not separated from the stigmas to add dead weight!
- Have moister trapped inside for adding dead weight.

Even though several thousand years have passed since the innovation of Qanat technology, this method of water transfer and use is still common in some villages and residential areas, agriculture and livestock, and is even the main pillar of cultivation in dry areas. The main factors and conditions that have caused the people to approach the establishment of the Qanats and have caused the sustainability of agriculture production, is the low rainfall in these areas, which usually does not exceed 250 mm per year. Moreover, the desertification of the area and the hinterland of the area by mountains and the lack of permanent rivers, and most importantly, when Saffron is in need of irrigation when other products are harvested, are another reason for the development of Qanat technology in the area. Therefore, the only safe source for watering Saffron is Qanat water

Ghasabe Qanat of Gonabad with about 33 Km. of length and 170 wells is largest Qanat of the world that is marked by UNESCO as world heritage. Mother well of this Qanat is 300 m deep and lengths of its vertical and horizontal excavations exceeds 100 Km. it is estimated that about 70 million cubic meters of soil is moved during exaction of this Qanat.



Figure 3 – Gonabad Qanat is the Deepest Qanat of the World



Figure 4-Traditional Technology Used for Excavating Qanats

Saffron is one of the few agricultural products which is mostly traded in small amounts (gram) rather than large amounts (Kilogram or Ton). Saffron plays a key role in creating job opportunities, immigration reduction, sustained livelihoods, soil and water preservation and efficiency.

From employment viewpoint, studies show that Saffron creates over 70,000 direct job opportunities throughout the year in various areas such as planting, production and processing. There are also other opportunities for about 80,000 farmers to earn money from Saffron trade. About 15% to 20% of annual Saffron production of Iran is supplied for domestic consumption and the remaining part is exported to more than 40 countries all across the world.

In 2016, over 105 thousand hectares was allocated for production of Saffron which yielded about 336 tons of Saffron; this amount represented over 90% of global Saffron production and share of other countries was about 6%. From whole 336 tons of Saffron production the mentioned year, about 257.6 tons was produced in Khorasan Razavi province. With such a production, Iran took first place of Saffron production in the world and India, Greece, Afghanistan, Morocco, Spain, Italy, China and Azerbaijan ranked from 2nd to 9th with respective productions of 22, 7.2, 6, 2.6, 2.3, 1, 1 and 0.23 tons. Area under cultivation of Saffron in Iran, India and Afghanistan was respectively 105,000; 5,000 and 2,000 hectares.

The followings are just few countries with Saffron imports:

Regional Markets: countries in Persian Gulf region including United Arab Emirates (UAE), Kuwait, Saudi Arabia, Qatar, etc.

European Markets: Spain, Italy, France, Sweden, Switzerland, Germany, Denmark, etc.

Other Markets: USA, Canada, Argentina, Taiwan, Japan, China, Hong Kong, etc.

From whole 105,270 hectares area under cultivation of Saffron in Iran, about 82,000 hectares, representing 72% of Saffron farms are located in Khorasan Razavi Province's lands. About 3,500 hectares of Saffron farms, representing 4.3%, are in Gonabad region's lands. Gonabad region hosts about 3% of whole area under cultivation of Saffron in Iran; about 117,000 households of Khorasan Razavi Province are occupied with farming Saffron and about 5,000 persons in Gonabad are in Saffron production and trade.

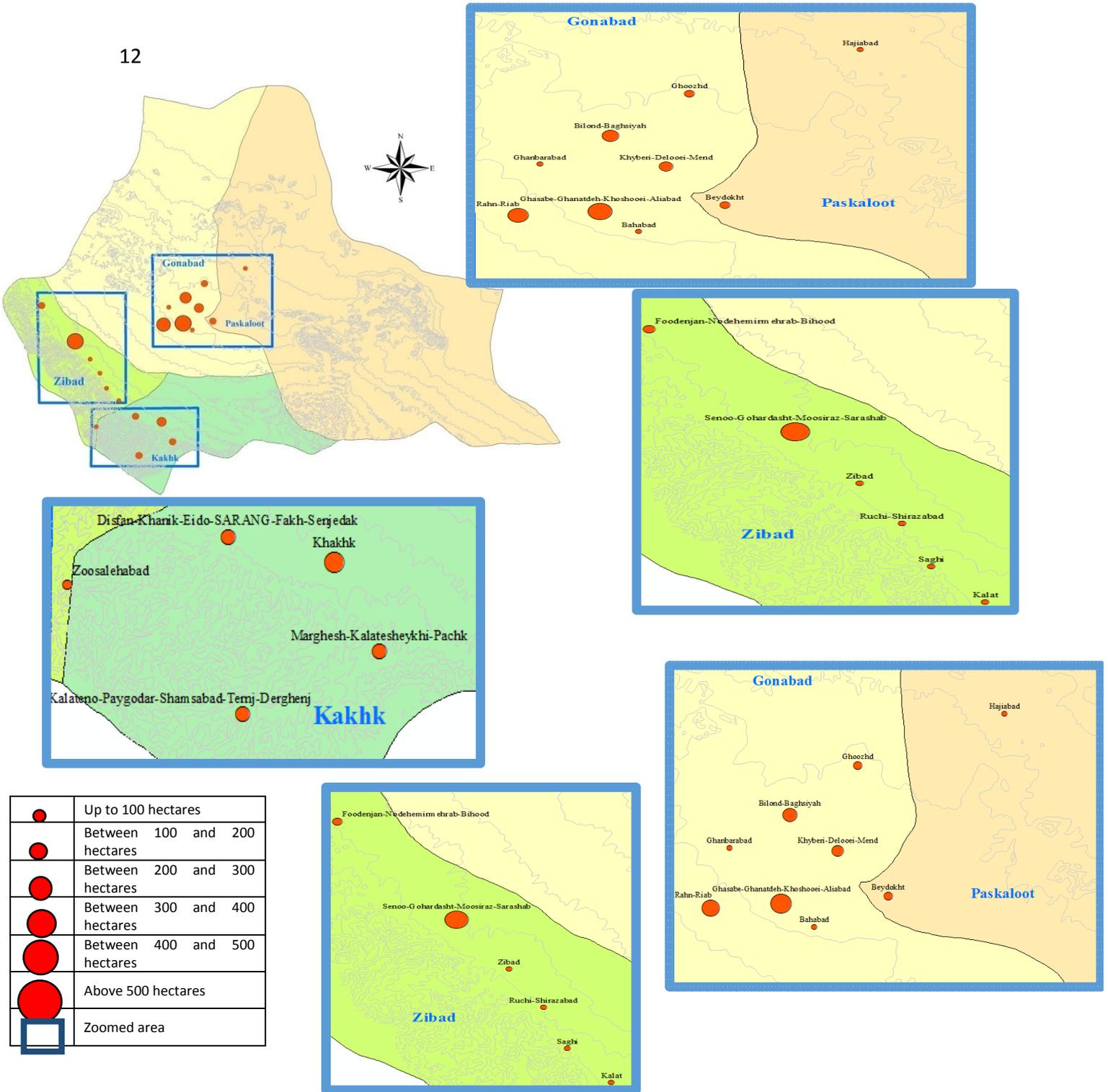


Figure 5 -Land area of Saffron under irrigation with Qanat water



Figure 6 –Saffron Harvested by Farmers

Advantages: In order to prevent the creation of slums, it is necessary to prevent migration of residents of rural areas to cities; therefore, creating appropriate and sustainable job opportunities for them is significantly important. One of the most efficient strategies for this purpose is promoting skills and capabilities of households, particularly handicrafts. To this end, the project for processing, packaging and exports of organic Saffron which is realized using the manpower of the villagers resulted in increased income, elevated occupation and migration prevention.

For many, Saffron is an invaluable heritage from our ancestors with unique strategic importance because its production has been taught and maintained throughout generations. The strategic importance of Saffron and its important economic role, as well as its social implications (such as extensive occupation and preservation of production culture) are among main causes of allocation of considerable farmland area for production of Saffron in Iran which in turn promoted our country to the place of first Saffron producer of the world.

Added value of Saffron which is combined with indigenous knowledge and local skill created an invaluable industry in our country. Considerable cultivation and production of Saffron in Iran is the main factor in maintaining our global position, which is considered as an advantage for the country.

Given that Saffron is cultivated in regions with hot summers, the major environmental and atmospheric limitations are cold winters. Desirable environmental conditions of Khorasan province and other area of the country, considerable cultivation and production, indigenous knowledge and historical background on farming Saffron are known to be among main factors behind maintaining Saffron place in Iran.

Water efficiency of Saffron is significantly higher than other crops which are considered as source of occupation in rural households; therefore, it has a significant role in livelihood of residents of these regions. However, small land ownership, shortage of water and irrigation quality are among the important limiting factors of agriculture in the region, but low water need of Saffron compared to cereals maintains importance of Saffron in the area. This attributes to higher area under cultivation of this crop. The climatic conditions (hot summers & cold winters) made Saffron the main crop in providing livelihood for many farmer families.

Studies show that Saffron has an important role in providing livelihoods for about 70% of its benefactors and about 38% of them gained more than 50% of their income from Saffron trade. During recent years, the trend of Saffron cultivation has shown that it has been highly developed. The area of Saffron farms has been increased over the past 30 years to 70,000 hectares in 2011 which represent a growth of 16.5 times.

It is also noteworthy that 5,000 hectares of Saffron farm has created about 1.25 million man-day of work.

86% of Saffron farmers use Saffron leaves to feed livestock. According to results of research conducted by Kuchaki (Ph.D) and Valizadeh (Ph.D) in southern Khorasan Saffron farms, the mean optional consumption and organic matter of Saffron are respectively 600 g per day for sheep and 272 g for goats, which is economically important.

The followings are factors attributing to uniqueness of Saffron of Khorasan:

Humidity (2.9-7.5%)

Ash content (4.39-19.6)

Percentage of insoluble ash (1.85-98)

Coloring effect (2.307-2.832)

Average length of stamen (stigma) is 28-30 mm

Average length of styles 23-24 mm

Longest and most perfect threads

Exotic taste and flowers

All of the above figures represent high global standards.

Historical Relationship

Origin and Importance

Historically, Saffron farms in the world were originally created by Iranians in the ancient Median state of Alvand and the Zagros slopes 4,000 years ago, and later expanded to other parts of the world. According to historical documents, Iranians have always been the largest Saffron producer ever since. In ancient times, the Iranians, while exporting Saffron to many parts of the world, have introduced the properties of Saffron to the civilizations of Greece, Rome, India, China and the Arab world.

One of the main differences in the Saffron production system in Iran with the registered system of Kashmir Saffron is the source of water. In Kashmir, the water source contains wells and springs, while the main source of water in the Iran system is based on Qanat. This is an innovative Iranian system for the transfer of water from the highlands to the plain. The most

important Qanat of the Region is the Qasabeh Qanat of Gonabad, with a length of 33,133 meters, and a historic date of 2,500 to 3,000 years old (this is designated in UNESCO). There are 599 Qanat Chain with more than 75 million cubic meters of extracted water in Gonabad city.

The other difference between Saffron of Kashmir and Iran is the length of Saffron filament in Iran, due to the type of soil suitable for Saffron production in Iran. Iran's Saffron is distinctly red in color with a light redness of the combination of orange and red. Its aroma is also strong.

Regarding the level of production and cultivated area, the Kashmir region is the largest producer of Saffron in India. While Iran is the largest producer and exporter of Saffron in the world. In addition, the province of Khorasan Razavi and especially Gonabad city are considered as the major region of Saffron production in Iran. Of the 105,270 hectares of Saffron cultivation area in Iran, 86,000 hectares (about 78 percent) are located in Khorasan Razavi province. About 3500 hectares of Saffron cultivation area are cultivated in Gonabad city.

The most significant areas of the world's which Saffron is produced, with the exception of Iran, are as follows:

- Jammu and Kashmir: The history of Saffron cultivation in this region dates back to the first century of lunar history, 1300 years ago (700 AD), which was first cultivated by Iranians. Today, about 1000 hectares of land are under cultivation of Saffron, with a yield of about 3 kg per hectare.
- China: The cultivation of Saffron in China has taken place after the Mongols entered the country.
- Africa: The expansion of Saffron cultivation and the culture of production and consumption of Saffron in this continent have also been carried out by Iranians. The cultivation of Saffron on this continent is limited to the Muslim countries of North Africa (Abrishami, 1987). Nowadays, the proportion of Saffron production in Morocco is higher among African countries.
- Spain: In most western references, the cultivation of Saffron in Spain is related to the period of the Arabian stalactite on the African and European shores of the Mediterranean.
- Greece: Considering the relatively favorable ecological conditions for the cultivation and production of Saffron in this region, the cultivation and production of Saffron appeared to have been noticeable in the past.

Information on cultivated area, yield and the production of Saffron in the world in 2016 as is indicated on Table 1, show that Iran, India, Greece, Afghanistan, Morocco, Spain, Italy and China, Azerbaijan, are ranked first to ninth in terms of Saffron production respectively . The cultivated area of Saffron in Iran is 105,000 hectares, 5,000 hectares in India, and 2,000 hectares in Afghanistan.

Table 1 - Cultivated Area, Yield and Production of Saffron in the World(2016)

Country	Cultivated Area (ha)	Yield (kg/ha)	Production (ton)	Share in World Production (%)
Iran	105270	3.3	336	88.8
India	5707	3.9	22	5.8
Greece	1800	4	7	1.9
Afghanistan	2811	2.1	6	1.58
Morocco	200	3.2	2.6	0.68
Spain	165	14	2.3	0.6
Italy	500	2	1	0.26
China	500	2	1	0.26
Azerbaijan	35	6.6	0.23	0.06

Source: UNIDO

Saffron is a high-value crop which grows best in the Gonabad region. The exact origin of Saffron is not known; however, some believe that it is originated from Asia. Iranians farmed Saffron throughout history; during the Achaemenid period, Saffron was used as a fragrant and aromatic oil, an excellent flavor for the bread used in the kings' court. At the beginning of the rule of Parthia, it was a crop which was exported from Fars to Rome. During the Sassanid dynasty, Saffron was used to kill silkworms to produce silk for woven carpets.

In previous eras, the cultivation area of Saffron in Iran was far beyond the present time.

Throughout the history, name "Saffron" has always been linked with "Iran". Saffron is a product that not only has a specific ecological niche, but has also particular cultural and historical significance. This product has been developed and cultivated in specific regions of Iran with culture of indigenous farmer communities. Historically, it is believed that the Iran plateau is origin of Saffron, and then this plant spread from Iran to other parts of the world. The oldest reference to Saffron in the ancient history of Iran is found in ancient scripts of ancient Greece, where they refer to the Saffron colored clothing of Darius the Great. Historically, in all periods of the Achaemenid, Parthian, and Sassanid, Saffron was cultivated and used in western areas Iran plateau.

During Achaemenids era, Saffron had been used as seasoning of bread and food. Also among the courtiers, Saffron was considered a royal perfume.

Polyn (Greek military writer, 2nd century BC), by relying on scripts of Oedaskunder (336-323 BC), entitled "War Techniques and Tricks", presented list of royal court foods and 63 ingredient favored by the king and royal families (carved on bronze column). In this list, the amount of daily consumption of Saffron is 2 min (each min equal to 498 grams per person).

In the tenth century BC, Persians cultivated Iranian Saffron species. In the margin of the Euphrates River, there was a city called Saffron, which was founded by Sargon of Akkad, the founder of the Akkadian Empire, in 2300 BC. In the thousand years BC, Saffron has been widely

used as a symbol of friendship and aristocracy. According to many researchers, including Alberini (1990) and Wilterhalter and Straubinger (2000), the origin of Saffron is Iran, from which the Phoenicia have taken it to Greece and Rome. Later, 1000 AC, Arabs and Moros have exported it to Spain. According to the national historical sources, it has been documented that Saffron belongs to Iran. These sources mention the primary habitat of Saffron in the Zagros slopes, especially Alvand Mountain. In term of botany, there are a large variety of wild species of Saffron in Iran (8 wild species), including the species *C. haussknechtii*, which is similar to Saffron crop cultivar, and it is believed that crop Saffron is derived from it. This can be a further confirmation of the origin of Saffron in Iran.

Iranians, while exporting Saffron to many parts of the ancient world, introduced its properties to the Greeks, Romans, Chinese, and Sami tribes, including the Arabs, and taught its cultivation method to the Islamic Ummahs of the Mediterranean during 1st-4th centuries AH. It should be noted that Iranian exiled by Muawiyah I have been first to establish Saffron plantation in Levant; then, the planting of Saffron in northern Africa and Andalusia (Islamic Spain) and Sicily (Arabic: *saqlieh*) were popularized, and Iranian tribes like Rustamid dynasty and Banotabari (Persian: "بنوطبری") have played an effective role in the transfer of culture of Saffron growing. Historical documentation reflects the fact that Iranians have had a lot of interest in gold and Saffron from ancient times, so that they distributed *Zarrin* (gold) and *Simin* (silver) coins, along with Saffron, and decorations and mirrors in events, celebrations, festivals, and special occasions, such as weddings and *Eids*, aimed to increase the majestic establishment of these kinds of rituals, for the bride and groom, or prominent figures. At some ceremonies, Saffron was smoked alone or with musk and amber and rose water was sprayed.

Saffron is commonly known as Saffron crocus, which is a genus derived from Iridaceae family. It is a plant with a permanent autumnal flower. Additionally, 9 species of Saffron are known in Iran, which is cultivated. The origin of Saffron is unknown. Some believe that it was originated from Asia. Iranians have cultivated Saffron throughout history; according to archaeologists, the origin of Saffron is the old state of Mede. In the Achaemenid period, it was used to produce aromatic oils, and as a good flavor for breads served in kings' court. Additionally, Parthia exported it from Persia to Rome. During the Sassanid era, it was a common product used to kill silkworm, coloring of fabrics and threads used in carpets. The origin of the Persian word for *za'fran* (Persian: "زعفران") was "زعفرانلاریماکس", which changed to al-Za'fran (Arabic: "الزعفران") due to the development of Arabic language inside the area.

In the city of Gonabad, a historical site called "Saffron Museum" is built in an old monument from Safavi era. In this museum, old tools and techniques, as well as planting and harvesting process of Saffron are exhibited for public. In this museum, customs, traditional instruments and methods related to Saffron cultivation are exhibited.

Currently, this plant grows in countries such as Spain, Australia, India, France, China, Greece, Turkey, Egypt, Iran and Italy. In the past, its cultivation area in Iran was much higher than the current time, and its main area under cultivation was in Khorasan Province, Estehbanat (Fars Province), near Tehran, Kerman and Qom.

Based on the data provided by Ministry of Agricultural Jihad, Saffron is mostly grown in Khorasan province. 95% Saffron is produced in Khorasan, 3% in Fars and 2% in other parts of the country.

Other species of Saffron include:

1. Wild Saffron (*Crocus cartwrightianus*)
2. Jo Ghasem Saffron (*C. Pallasii*)
3. Alameh Saffron (*C. almeheensis*)
4. Purple Saffron (*C. michelsonii*)
5. *Do Galeh* Saffron (white Saffron) (*C. bitlorus*)
6. Zagros Saffron (*C. ancellatus*)
7. Ziba Saffron (*C. speciosus*)
8. Khazar Saffron (*C. caspius*)
9. Gilan Saffron (*C. gilanicus*)
10. Korolkowi Saffron (*C. korolkowi*)

Gonabad's Saffron is produced from several species:

Saffron Dasteh, Saffron Poushal, Saffron Sargol, Saffron Negin

Trend of Saffron Cultivation Area and Production Development

Of the 14300 hectares of arable land in Gonabad, about 3500 hectares are allocated to Saffron production (about 25 percent). Considering the number of farmers and the economic value of Saffron, this product accounted for 40% of the total agricultural income of the Gonabad County. It should be borne in mind that each hectare of Saffron, on average, in the growing period from planting to post-harvest processing, requires 200 to 250 people/day, which according to the level of Saffron cultivation (3,500 hectares), 700,000 to 875,000 people per day Work is being done. Therefore, this product has a significant economic and food security effect in the county. The economic importance and family income share of saffron production is of paramount importance, as saffron growers choose their best and most valuable land, either for easy access or for planting saffron.

97% of the Saffron area is in Khorasan province, particularly in the Gonabad region. Based on data from time series published by the Ministry of Agricultural Jihad, the cultivated area of the Khorasan province in 1973 amounted to about 3,000 hectares, and in 1981, it increased to 4,100 hectares. It was 9,000 hectares in 1987 increased to 21,942 hectares in 1996, and in 2010 increased by almost 67802 hectares in three stages. By 2016, the Saffron cultivation area was 82,712 hectares.

**Table 2- The variation of Saffron cultivation area in Khorasan Razavi Province
(Some years)**

Year	1988	1989	1990	1991	1996	2006	2007	2009	2010	2016
Area (ha)	9300	12600	14800	16900	21942	56592	57062	60036	67802	82712

Source: Agricultural Year Book (1988-2016), Ministry of Agriculture Jihad

Table 3 - Comparison between Saffron Cultivation Area in Khorasan and other Regions of Iran(Some years)

Year Province	2006		2007		2009		2010		2016	
	Area (ha)	%								
Khorassan	56592.20	97	57061.50	97	60035.50	97	67801.70	97	101540	97
Other	1738.83	3	1844.40	3	1900.25	3	2257.37	3	3729	3
Total	58331.03	100	58905.90	100	61935.75	100	70059.07	100	105269	100

Source: Agricultural Year Book (1988-2016), Ministry of Agriculture Jihad

Table 4- Comparison between Saffron Cultivation area and Production in Khorasan Razavi and other Regions of Iran(Some Years)

Year Province	2006		2007		2009		2010		2016	
	Area (ha)	Prod.(T)	Area(ha)	Prod. (T)						
Khorassan	56592.20	178316	57061.50	222163	60035.50	32220	67801.70	229693	82712	276000
Other	1738.83	7780.4	1844.40	8251	1900.25	5680	2257.37	9562	22557	68400
Total	58331.03	186839.6	58905.90	230414	61935.75	37900	70059.07	239255	105269	336000

Source: Agricultural Year Book (1988-2016), Ministry of Agriculture Jihad

As Table 2 shows, Khorasan is the major producer of Saffron in Iran, accounting for about 97% of the total cultivation area in the country. In addition, as Table 3 indicates production declined significantly in 2009 because of the chain of droughts in the same year occurred throughout the country, especially in the Khorasan region.

Contemporary Relation

Multiple Values of Saffron

In this region, Saffron strengthened agricultural and livelihood bases. Additionally, its capacity for tourism and landscape values should be considered, along with its role in the development of food, medicine and other industries which contributed to multidimensional development of Gonabad city, the province and the country as whole. The livelihood of people is such that the participation of all family members, especially women, plays a major role in the production of this crop. Saffron is also used in the pharmaceutical industry for medical purposes and a variety of cosmetic and sanitary products; the Saffron that is processed in food industry has many uses for healthcare purposes.

The development of the Saffron production and processing industry in association with United Nations Industrial Development Organization (UNIDO) has been focused on the Gonabad region. The UNIDO Office has been opened in the Islamic Republic of Iran in 1999 aimed at supporting the industrial priorities of the Government of the Islamic Republic of Iran and in close contact with ministries, public and private bodies, civil and research institutes, as well as the private sector.

UNIDO is a specialized agency that focuses its efforts on poverty alleviation through enhancing productivity growth. This organization helps developing countries and emerging economies in conflict to prevent their marginalization in today's globalizing world. It organizes the mobilization of knowledge, skills, information and technology to advance productive employment, competitive economics, and the healthy environment. The agency has prepared and executed a plant under the below title and objectives:

Investigating and identifying regional capacities for production and processing of Saffron in Gonabad in 2015 covers the followings:

Creating the opportunity to enter new markets by producing new products such as items supplied in the food industry, pharmaceuticals, etc.

Using indigenous and local capacities and resources of the region to produce Saffron and using capacity of Spain and Greece.

In UNIDO, there is a topic called Certification of Product Originality; upon local investigations and specific operations, acquisition of this certificate for Gonabad would be possible which will have an important impact on the marketing and branding of Saffron.

The Agricultural Jihad local office provides training on planting, growing, and harvesting crops to inform farmers about the preparation of Saffron farms, as well as the correct way to weed control and the harmful effects of burning grasses and crops on Saffron farms, along with educational packages. It is also the only research center for medicinal plants in Gonabad, which has helped a lot of farmers in the region with a lot of activities, especially in relation to Saffron.

Saffron has a major role in the livelihoods of about 70% of the region's inhabitants. The share of income of 38% of Saffron growers is more than 50%, followed by 31% share for between 25-50%. This indicates the important role of Saffron in the rural family economy. However, 62.5% of the farmers own less than a hundred hectares of the area, and in spite of the price increase,

the incomes are increased in apparent term; however, instability of prices and outsourcing has led to a non-sustainable income for Saffron growers.

In 2011, the cultivated area of Saffron in Iran was 72162 hectares, of which more than 70000 hectares in two provinces of Razavi and Southern Khorasan (57,000 and 13,000 hectares, respectively). The total amount of Saffron production was 254 tons in the country in 2011, of which 133.5 tons were exported in this year, worth 405 million USD.

In 2016, the area of Saffron in Iran was over 10,5269 hectares from which more than 98,000 hectares was in two provinces of Khorasan Razavi and Southern khorasan (82712 hectares in Khorasan Razavi and 15754 hectares in Southern Khorasan). The total amount of Saffron production in the country in 2009 was 336 tons from which 137 tons was exported with value of 405 million dollars.

An Invaluable Topic for Research

Establishing tourism, cultural heritage, historic landmarks and agricultural sites in association with Agricultural Jihad Organization of Khorasan Razavi Province in Gonabad regions will be an excellent action.

Public and private institutions such as and Department of Agriculture Jihad of Gonanbad, the municipality, the city council, and Islamic Azad University which support Saffron producers and Exporters, especially in organizing festivals and publishing books such as "Saffron, Red Gold of Iran" by Torab Amirghasemi (which provides comprehensive information on this crop) shall be referred as good sources. It is suggested as a need to organize sports competitions at the harvesting season of Saffron.

Saffron has always been a valuable source for researchers; from chemistry to search for new compounds and how they are produced, to biotechnology for beneficial and biologic benefits, to study the therapeutic effects and many other applications. In the past decade, its therapeutic research has been focused on the effect of Saffron on the nerves, and trachea and bronchus, resulting in the treatment of chronic bronchitis and chest discomfort, which has a major role for human health.

Tourism Value

Depending on the micro-climate of the region growth and blooming seasons of Saffron is limited to a short period of 6 to 45 days. Such limited period requires accurate tourism planning so tourist visits the area in blooming season.

The following are examples of activities resulted in increased attention to the Gonabad region: establishment of a specialized Saffron museum in the Seno Gonabad Village, the global registration of the Ghasabe Qanats of Gonabad (Persian: "قنات قصبه گناباد") as the UNESCO world heritage site, the historical and monumental village of Kakhak, with a variety of plants and animals, and its history and importance as a tourist area, and more people's attention to agricultural tourism, especially for the superior regions and the future of a particular crop, i.e. Saffron.

Seno Village

it is one of the villages of Gonabad county, Khorasan Razavi province. This village is located 22 km west of Gonabad on the edge of the mountain range between Gonabad and Ferdows, in a region called "Barakouh" (Persian: "براکوه"). It has temperate climate. Seno Village has become a very beautiful and memorable area due to its geographical place on the slopes of the Siah Mountain and having several small and large mountain springs.

The springs of Seno and Kisou are sights and attractions of Seno Village. The main crop and drinking water of the village comes from two springs of Tengel and Kisou. It should be said that when Tahir, a hydrologist, crossed the area, he told his companions to leave it quicker, and he said in answer to those who asked the cause: "This spring has a lot of water, and if Gonabad was destroyed, it would be by wind or by the flood of this spring."

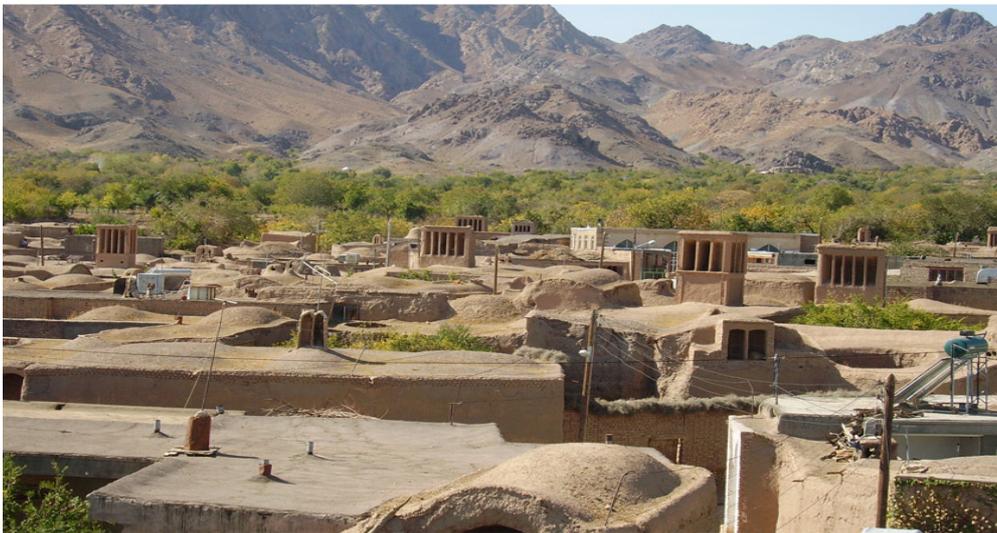


Figure 7- A view of the Seno Villgae with the Gonabad's most water spring

The first Saffron museum in the Seno historical bathhouse is welcoming tourists. More than 90 percent of the Seno people livelihood is from Saffron Red Gold (Saffron). The Saffron farms with beautiful violet flowers, and with pristine nature and dense trees, staring at the eye. The village of Seno, which you will see people who are lush and lively, people who every year fall in the hands of the smell of Saffron perfume, even houses and Their alleys smell of these precious wrists.

The people of this village plan their lives on Saffron and each year in November, they are ready to take a Saffron, whose name and reputation is global. The Saffron Museum of the village of Seno established in June 2012 as the first specialized Saffron Museum in the building of one the old bath is located in the Safaviyeh period and in an area of 180 square meters. In this museum, old tools and gadgets, and how to plant, plant, harvest and after harvesting Saffron flowers are public view, so that visitors can closely monitor these natural-scale stages.

Seno has more than 1,500 years old in the city of Gonabad and the most visited villages of Khorasan Razavi in terms of enjoying historical and natural attractions.



Figure 8- Saffron Museum in Gonabad, located at North East of Iran

Historical Monuments

The ancient monuments and works, as well as historical stories around this village, date back to more than 1500 years ago. In the village of Seno, 20 monuments have been identified so far that only seven water mills have been registered in Iran's national monuments list. The most important historical monuments in the village are historical buildings, including the house of Mohammad Hassan Ghahremani, Ghahremani's house, porch of Mansel Mirza Ahmad Hosseini's house, the historic tower of Hesardeh (Persian: "حصارده"), the fortress of Sarasiab (Persian: "سرآسیاب"), the water storages (Persian: "آب‌انبار") and the old bath of the village. The mosque of this village also has a long history and unique architecture, which unfortunately has been destroyed over the past years.



Figure 9- One of the Ghasabeh Qanat of Gonabad Outlet

Customs and Rituals

People of Seno Village have traditionally different customs in Nowruz, weddings, Muharram, and so on; but, what is distinctive in this regard are rituals associated with the Seno spring, due to the special sanctity that water has with the Persians and Muslims and have still remained among people. Every year, in April, the ceremony of *Balghourpaziis* held at the Seno spring. At this ritual ceremony, all people in the village gather at the spring, where the tombs of one of the village's elders, slaughter (or *zebh*) a sheep, and cook and distribute *Balghour* (or Bulgur) among the people praying for this great blessing. Another ritual is a ceremony of lighting *Asa Cheragh*. At this ceremony, the people who have vows (or *nazr*) are gathering in the water source of the spring, and light cotton balls in number of their vows, and distribute their products such as almonds, raisins, etc. among the people as *ajil moshkel gosha*. Local games are also very important among the people, and the most important of these games include *galbazi*, *kabedi*, *kolah hasoubak*, *ghalehbazi*, etc.

Ghadiri Bread: is one of the great traditions of the Seno Village, which is survived from ancient times. These breads are distributed among the villagers by the owners of the endowment (or

vaqfi) lands, which are baked at the *Eid of Ghadir Khumm*. The original owners of these *vaqfi* lands have been from our past generations, who have been deeply ingrained, and given the notion that the rewards of good work are of particular importance to people's happiness, they have made this initiative, and at times when there was no communication and bread at a price of the life, they informed people of this auspicious day and made them happy.

At 8km east of the village towards the Gonabad city, there is a large, beautiful and intact plain which is the habitat of several hundred hectares of a vegetation called "Rivas" (or Rhubarb), which locals call "Rivaj".



Figure 10-The Rivas Plain

This area, known as the Rivas Plain, is one of the most beautiful views of the desert region. The Rhubarb plant of the Seno village is considered to be an organic and unique species in Iran. Due to the warmer nature of the Seno Plain than the foothills, the Rhubarb of this area has wider leaves, and flowers earlier. This beautiful view reaches its peak as rhubarb flowers in *Ordibehesht* month (May), which can be considered an attractive tourist area.

Ghasabeh Qanat of Gonabad: is one of the most important tourist attractions in the area, which has been estimated, by the efforts of domestic archaeologists and the findings of pottery in the Qanat, dating back to Achaemenid period. This Qanat has been constructed with the guidance of its makers in such a way that, for many years, has been protected from natural and unnatural enemies. It has provided 2,500 years of water to the area. Ghasabe Qanat is one of the most important tourist attractions in the region, which by estimation dates back to the Achaemenid period.

The French Henri Goblot is one of the people who spent many years of his life on research on the Qanat; he praises this structure in a book titled “Technical Qanat for Water” and referred to it as the most engineered Qanat structure of the world.

This Qanat with length of 33,133 meters is about 2500 to 3000 years old. Several broken potteries and ceramics were recovered from this historic aqueduct, dating more than several hundred years old. Considering several kilometers of length and a depth of 350 meters, and digging many wells along the channel of the aqueduct as well as limited facilities, construction of this Qanat was known to be of supernatural nature. The Greek historian, Yolie Boyos also mentioned presence and application of Qanats in desert and salt pan between land of Medes and Parthia (Khorasan) in his scripts. Aside from legends and myths, potteries found in main branches and mother well of the Qanat and their comparison with the Achaemenid temples shown that this Qanat may originate from Achaemenid era. In some of the ancient writings, it is mentioned that the Qanat of Gonabad has 70 kilometers and depth of the mother well is 500 meters. However, according to results of conducted studies, total length of its 8 branches is 33,133 meters and the depth of mother well is 340 meters with total of number of 405 shafts. It estimates the debit of the Qanat in the past was up 600 liters per second, but its current rate is about 150 liters per second. The United Nations Educational, Scientific and Cultural Organization, UNESCO, in 2016, registered the Iranian Qanat as World Cultural Heritage. 11 Qanats were listed in the regions of Khorasan, Yazd, Kerman, Isfahan and Markazi provinces. The age of these Qanat are from 200 to 2500 years. The Qanats of Gonabad, as the deepest Iranian aqueduct, which is reaching 350 meters in depth, is one of the well-known Qanats.



Figure 11-The old Ghasabe Qanat of Gonabad



Figure 12-An Outlet view of the old Ghasabeh Qanat

Tak Meidan: is a village of Kakhak district of Gonabad County in Khorasan Razavi province, a high mountain village located in the rural district of Kakhak. The village has good orchards and fertile lands. It is beautiful and very cozy, and located next to the *Foroud Arg* and has beautiful attractions, especially in the summer.



Figure 13-The Tak Meidan Village as a tourist destination

Importance for Urban and Rural Economic Reform and Environmental Structure

The Gonabad County, considering the agricultural situation, is especially important for the cultivation of Saffron, which is also evident in the other cities of this region. Income from the sale of products by Saffron producers is spend in the county, in addition to the investment in the cities, and, in the long run, the economic cycle leads to an economic balance of the region, the protection of the productive regions, and the tendency of young people to continue their production, and consequently, development and sustainability, which will improve the structure of the city, the region and the Saffron farms with the goal of productivity.

2. Characteristics of the Proposed GIAHS Site

Saffron of Gonabad is appreciated as one of the geographically important products of Iran. This region and Iran have highest share and rank in in production and exports of Saffron and quality our Saffron in known to be the highest among other countries. Saffron product of Iran, particularly those produced in this region, is unique in the world. Additionally, it is economically viable because Saffron continues to yield for at least seven consecutive years. Having a product of a high standard and relying on indigenous and traditional agricultural method, with the long history and existence of small-scale farmers, have high role in livelihoods of the population, which is considered among the criteria of JIAHS.

i. Food and Livelihood Security

Diversified Product Cycle

In areas such as Iran and especially Khorasan, due to lack of rain and arid climate, the Saffron residues (fodder) is used as a livestock feed in the autumn and winter. Since Iranian cultivated lands are used to feed human beings, livestock feed has always been in trouble. Therefore, this product can be recommended as an alternative to providing part of the livestock needs.

If the value of each kilogram of Saffron residues is equal to wheat straw of 1000 IRR, the value of forage production will be 87 billion IRR. The figure is significant.



Figure 14-Using dried Saffron leaves for feeding livestock

(86%)

Animal Diversity: The excellent nectar and herbal properties of Saffron flower helps bee farmers to produce high quality honey during the blooming season of Saffron; they place beehives near Saffron farms during the season which results in elevation of quantity and quality of honey produced from Saffron nectar. The rodents such as mice, porcupine and rabbits prefer Saffron bulb because of its sweet taste; so these rodents breed and survive in these areas, and thus the life cycle is also in progress in these ecosystems.

Food Source

From nutritional point of view, Saffron is an invaluable product which is obtained in a small amount from Saffron plant. Saffron is used as a spice, seasoning and coloring agent that reduces fat and cholesterol. It has sedative, appetizing, antispasmodic, anti-cardiac and anti-cancer, memory enhancing and blood pressure reducing properties.

The plant is used to treat asthma, skin diseases, eye diseases, urinary tract infections, jaundice, early menstruation, flatulence, stomach pain, and anemia. Saffron helps digestion and strengthens the stomach and is used as a painkiller for gingivitis, especially in gum pain. Saffron is used in various types of foods. It is not only important in the food habits of people in the Gonabad area, but also is commonplace in the food culture of all parts of Iran and used in many different ways.

Medicinal and Health Enhancing Properties

Application of Saffron is not limited to its use in foods as color or spice. It has an increasingly uncharted use in pharmaceuticals, cosmetics and medical industries. Recent scientific studies confirmed the Iranian traditional belief that Saffron is one of the most effective treatments for depression.

In fact, there has recently been a great deal of hope among medical scientists regarding natural depression treatments using magical powers of Saffron. In addition, Saffron plants have an effect on the nerves, and trachea and bronchus, resulting in the treatment of chronic bronchitis and chest discomfort, which has a major role for human health. It is also used to treat blood disorders, heart palpitations, colds, fever, hysteria, smallpox, shock and spasm. Saffron is one of the most valuable spice and medicinal products in the world.

In the book entitled "An Introduction to Saffron of Iran", Professor Mohammad Hassan Abrishami points to carpet weaving girls who use the Saffron as coloring agent in their yarn, and says that they are smiling and happy while exiting from the workshop because of the contact to Saffron.

Steady consumption of Saffron has many properties such as increase in the vitality and happiness. This is a colorful and expensive herb and has unique properties to treat many mental and physical illnesses. Doctors help the patient recover the disease by administering the appropriate dosage of Saffron. Nutrition experts say Saffron is very effective in increasing sexual virility. Among its medicinal properties, it could be referred to its effects on diseases such as Alzheimer's, depression, kidney stones, and so on.

Saffron is known to be an effective painkiller with positive properties for treatment of gum disease, cramps and neuropathy as well as enhancing sexual performance. It also has potent anti-cancer, sedative, memory enhancing, heart disease control and atherosclerosis, cholesterol lowering properties and its effect in treating insomnia, depression, spasm, Alzheimer's, burns and rheumatism, respiratory diseases, colds, coughing, retinal detachment disorders due to aging are well appreciated.

Treating skin diseases with Saffron:

- Effective in brightening the skin.
- Playing an effective role in eliminating contaminations and insolubility on the skin.
- Eliminating dark spots caused by sunburn
- Skin rejuvenation and cleanser

Livelihood Security

Khorasan Province, and especially Gonabad, is the major areas of Saffron production in the country. In this area, water shortage and low water quality is a major limiting factor for agricultural development. In contrast, Saffron is an exceptional plant in the region that is resistant to drought, and is considered a valuable and worthwhile product, due to the shortage of water.

Its growth period is from late September until April when other crops require high water consumption. But afterwards, Saffron does not require water and does not compete with other crops for use.

This encourages farmers to develop Saffron cultivation, as well as a stable and profitable job for about 400,000 people in the region.

Qanats in the Gonabad region play an important role in livelihood and economic development in the region. These *Qanats* have played two main roles for the people of the region: provide water requirements for about 9777 hectares of agricultural land and drinking water for people living in the area.

Saffron is considered to be the most expensive agricultural and medicinal product of the world. Its resistance to drought, low water need, high maintenance capacity, resistance to corruption, capacity for job opportunity creation with high income, capability in adding foreign-currency value, especially in Khorasan province (particularly in areas with limited industrialization and development projects, such as Gonabad) production and development of this plant is highly regarded as a strategic product essential for food security, rural development, and reduction of rural-to-city migration in the region. Among all agricultural products in the county, about 3,600 hectares is allocated to Saffron with harvesting rate of approximately 10,800 kg of Saffron yield valued over 450 billion IRR. This accounts for 35 percent of the revenue from the total agricultural income of the city. According to surveys, each hectare of Saffron requires 200 to 250 workers annually for planting, harvesting and separating the flowers. With area of 3,600

hectares, it requires 756,000 man per day. Therefore, this product has a significant economic and food security effect in the region.

ii. Agro-biodiversity

Gonabad Geographic Status



Figure 15- A schematic of farms in the city of Gonabad

With an area of about 5788/79 km², Gonabad is located at 57° 46 to 57° 27 (longitude) and 34° 3 to 34° 54 (latitude), and limits to Mahvalat and Rashkhar, Kashmar and Bajestan from north, Ferdows and Bajestan from west, and Khaf from east, and Qaynat from south in Khorasan province. The average altitude of this county is 1105 meters. Its center is Gonabad, 282 km from Mashhad. Based on the latest administrative divisions of the country, it has 2 districts of Central and Kakhak, 4 rural districts and 125 villages inhabited.

Remnants (including soil masses, and pebble and stack masses and ancient sites) reveal the settlement and human life dating back to prehistoric times in this area. However, Gonabad is one of the oldest Iranian cities, which has been considered by the rulers of the Achaemenid period due to its place in strategic region. The Ghasabe Qanat of Gonabad, which some attribute its construction to Bahman, Esfandiar's son, indicates the prosperity of this area in ancient times. On the other hand, in the traditions of Shahnameh (A poem book containing Ferdowsi's epic poems), Gonabad has been an epic arena in the mythological period, and some areas of it have also been named in this epic work. At beginning of Islamic period, the city was called "Jenaid" (Persian: "جناید"), and according to writings of historians and geographers, it has a special importance and reputation. Due to the fact that it is located on the road of southwest of Khorasan, and it ultimately extends to the Chabahar port, the city is therefore very important. Meanwhile, the city of Gonabad is located at the intersection of Zabul-Zahedan and Yazd-Kerman to Mashhad main roads. The area of Gonabad is about 32.1% of the province and 1.170% of Iran.

Extensive Local Biodiversity and Indigenous Species in the Ecosystem of Saffron

Variety of Agricultural Products in the Area

In the county of Gonabad, there is more agricultural diversity in the mountainous areas; for example, the diversification of crops in the historical and important village of Tak Meidan in the rural district of Kakhak of Gonabad. Unlike the city of Gonabad, which follows the climate of arid regions, this village has a relatively temperate mountainous sub-climate. Because of the mountains, the highest precipitation in the county is seen in the village, so that the village is the most important drainage basin of the Kalat Dam, and supplies the water resources of the lower villages such as Zou Saleh Abad, Kalat and Mohammad Abad. Irrigated and rain fed orchards which grow a variety of crops and fruits such as walnuts, almonds, apricots, plums, cherries, sour cherries, apples, guavas, peaches, pears, hawthorns and cucumbers, are added to the beauty of this small paradise. The village has long been known for the quality and quantity of its walnuts among the people of Gonabad and Ferdows. Agricultural products include Saffron, wheat, barley, lentil, chickpea, beans, peas, millet, potatoes, onions, garlic, tomatoes, green cucumbers, watermelons and melons, turnips, beets, corn and alfalfa. Sometimes they are grown in terms of whether there is drought, or as much as the needs of the household. The agricultural and drinking water of the village is provided through the spring and the *Qanat* upper the village. There are 9 streams of *Qanat* in the village of Tak Meidan.

There are some several hundred years old trees of walnut, apple, almond, berry, willow, and *Pistacia atlantica*. There are also three water mills in the northern valley of the village leading to the village of Zou Saleh Abad, and also in Tengel Kalat, which indicates the prosperity and having large water resources.

Table 5- Main Agricultural Products in Gonabad County(2017)

Product Name	Cultivated Area(Ha)	Production(Ton)
Saffron	3500	10
Cotton	450	1103
Sumac	1050	162
Wheat	800	2240
Barley	2000	5800
Pistachio	6500	4400
Poultry and Fish Meat	-	12975
Red Meat	-	2159
Eggs	-	1962
Milk	-	58130

Source: Ministry of Agriculture Jahad

Indigenous Plant and Animal Species of the Region

Plant and animal species in the historical and important village of Tak Meidan in the Kakhak rural district of Gonabad are as follows:

The vegetation of the region follows the growth pattern of the steppes of *Artemisia annua* and *Astragalus*. This composes a huge part of the regional vegetation, along with other rangeland plants such as: *Lactuca scariola* (Persian: “گاوچاقکن”), *Zannichellia palustris* (Persian: “یالاسبی”), *Phlomis fruticose* (Persian: “گوشبره”), *Acantholimon* (Persian: “کلاهمیرحسن”), *Acanthe phyllum bracteatum* (Persian: “چوبک”), *Ferula assa-foetida* (Persian: “آنغوزه”), Poppy (Persian: “شقایق”), *Lemna* (Persian: “عدسک”), *Paracaryum rugulosum* (Persian: “چشمکبک”), *Verbascum* (Persian: “گلماهور”), Tulip (Persian: “لاله”), *Apiaceae* (Persian: “خارزنبابا”), Spear Thistle (Persian: “کنگر معمولی”), Artichoke (Persian: “کنگرفرنگی”), *Cnicus benedictus* (Persian: “خارسفید”), *Rosa persica* (Persian: “ورک”), and *Geranium molle* (Persian: “شمعدانیوحشی”). In addition, medicinal plants include: Chicory (Persian: “کاسنی”), violet (Persian: “گلبنفشه”), *Descurainia sophia* (Persian: “خاکشیر”), ziziphora (Persian: “کاکوتی”), thymes (Persian: “آویشن”), English lavender (Persian: “اسطوخودوس”), Viper's bugloss (Persian: “گلگاوزبان”), Broadleaf plantain (Persian: “بارهنگ”), *ferula* (Persian: “کما”), *Ferula gummosa* (Persian: “باریجه”), Common sage (Persian: “مریمگلی”), *Ferula assa-foetida* (Persian: “آنغوزه”), yarrow (Persian: “گلپومادران”), and Ziziphus (Persian: “کنارکوهی”), which are found in plenty in the region.

Due to its high ecological diversity, the village accommodates a large number of mammals and wild birds at its optimum level and hosts them efficiently. The wild mammals and reptiles include: Urial sheep, goat, red fox, wolf, jackal, wild cat, Pallas's cat, heyna, matern (Persian: “سمورد رختی”), rabbit, pika, Indian crested porcupine, Long-eared hedgehog, Brandt's hedgehog, as well as various types of snakes such as Spotted Wipe Snake, cobra, Rattlesnake, Pseudocerastes, Braid Snake, and Echis, and salamander, and Iranian spiny tailed lizard. The birds include: Partridge, See-see partridge, Common nightingale, Common blackbird, Finches, Magpie, crow, Chough, Sylvia warblers, Wagtails, golden eagle, Common buzzard, Northern goshawk, Levant sparrow hawk, Kestrel, owl, etc. (according to the Department of Environment of Gonabad).

Table 6-Statistics and information of medicinal plants of the Gonabad County(2017)

item	Plant Name	Cultivated Area (Ha)	Production (Ton)	Yield (Ton/Ha)	Irrigated	Rainfed
1	Cumin(green)	350	105	0.3	50	300
2	Rivas	5000	850	0.85		*
3	Tarragon	1	1.5	1.5	*	
4	Mint	2.5	37.5	15	*	
5	Sour Tea	1.5	1.3	0.85	*	
6	Paper Pumpkin(Cucurbit)	1	0.2	0.2	*	
7	Coriander	2	2	1	*	
8	Black Caraway(Nigella Sativaa)	2.5	3.75	1.5	*	
9	Dill (disambiguation).	2	30	15	*	

Rhubarbof Seno Plain: This area, known as the Rivas Plain, is one of the most beautiful views of the desert region. The Rhubarb plant of the Seno village is considered to be an organic and unique species in Iran. Due to the warmer nature of the Seno Plain than the foothills, the Rhubarb of this area has wider leaves, and flowers earlier. This crops grown in the Binalud Mountain Range. In addition, it has the first rank of production, cultivation area and yield per unit area of the province. During the spring, this plant grows in the mountain range, along rivers and areas with stagnant waters, and its thick leaves are used as feed. It proliferation is usually done by planting in the seedbed and then moving to the field, or through the cultivation of fresh seeds. *Rivas or Ribas* (or Rhubarb) isa genus of perennial plants in the family Polygonaceae, with aerial stems and leaves containing acidic materials, which is used as an edible plant.

Therapeutic Properties: Rhubarb has a cool humor, and a variety of vitamins and minerals. For all members of the body, it is considered to be a very nutritious food, and it has an amazing and miraculous effect. It is astringent and useful for strengthening the stomach and liver. It is useful for febrile and anorexia patients and treats jaundice, obsession, weakness. (Department of Plant Products Improvement, Department of Agriculture Jahad of Gonabad)



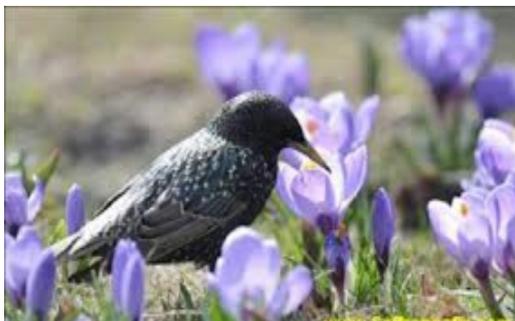
Figure 16- The rhubarb plant as a souvenir of the Seno Plain

Plant and Animal Species of Protected Areas of the Region

The prohibited hunting area was established since 1997, and became a protected area in 2006. The area is 120719 hectares, located at west of Gonabad and southeast of Bojestan. The vegetation of this area includes *Haloxylon*, *Pistacia atlantica*, Milkvetch, *Zygophyllum*, *Acantholimon*, *Calligonum*, Tamarisk, *Teucrium polium*, yarrow, ferula, Liquorice, Caraway, Chicory, *Ziziphora*, Barberry, Broadleaf plantain, thymes, and *Eremurus*. This area is a habitat for animals such as sheep, deer, whole, goat, boar, panther, wild cat, rabbit, hyena, European goldfinch, Grey-headed goldfinch, Eurasian siskin, Red-fronted serin and Horned lark.



**Figure 17- The various bird species of the region
(European goldfinch, Common buzzard, Common rock
thrush)**



**Figure 18-The animal species of the region
(Deer, bee, golden eagle, ram and ewe)**

Hengam and Eftekar which regions with total area of 99,710 hectares are marked as wild animals protected area of Gonabad.

These regions are among the most important desert habitats of Iran in which hundreds of goats, sheep, rabbits, foxes and wolves, leopards, deer and thousands of birds such as Partridge, see-see Partridge, Pigeon and Sandgrouse are living in the plains. The Eftekar region's significance is because of existence of an endangered species called Asian cheetah.

With an area of 30,000 hectares, this hunting prohibited area is located at east of Gonabad. Since 1996, the area is marked as a hunting prohibited area. Most of the area is covered with hills and its vegetative life includes species such as *Haloxylon*, *Pistacia atlantica*, Milkvetch, *Zygophyllum*, *Acantholimon*, *Calligonum*, Tamarisk, *Teucrium polium*. The region also hosts mammals such as sheep, deer, goat, foxes, wolves, hyena, and caracal, and such birds as Partridge, see-see Partridge, kestrel, Sandgrouse, Bearded vulture, and vulture. Another indigenous plant is the *Pistacia Atlantica* or wild pistachio. These wild trees are a symbol of strength and tolerance, with over 1000 meters in height.



Figure 19-The plant species of the region (Seno Village of Gonabad County)



Figure 20-Tulips in the plains of Seno Village in Gonabad County

Various Animal Species

Due to plant diversity, the area also has many animals, including sheep, deer, eagles, hawks, partridge, pigs, boars, wolves, cheetahs, snakes, jackals and foxes.

Mammals: Of nearly 190 known mammal species in Iran, 7 species are definitely present in the region. However, most observed species are big-sized species either active at night or day, which characterize with profiles and prominent identifier features; that is while their presence in the region is certain. Deer, Long-eared Hedgehog, rabbits, foxes, wolves, wild cats, and jackals are among such mammals that have been observed in the region. The rare species of Urial ram and, leopard, and Pallas's cat are also found in the area, which are unique in country and the world.

Birds: Based on surveys, 31 bird species have been observed in the area. Some of them, such as the Black-bellied sand grouse and Bustard laying their eggs on the ground, while others use shoots like larks and Red-headed bunting, and some of them use holes in the sandy walls and drains.

Reptiles: Reptiles, such as amphibians and fish are poikilotherm and take their required heat from the environment. 12 species of reptiles, including one species of turtles and 11 species of reptiles, belonging to six families, have been identified. (Department of Environment of Gonabad).



Urial ram and ewe



Urial ram



Common rock thrush

Figure 21-Various animals and plants species



Figure 22-The Hengam Protected Area

Ecosystem Performance

Protecting Biodiversity in the Ecosystem

Hengam Protected Area: The area was declared as prohibited hunting area since 1996, and its term was extended to 5 years in 2003. Its vegetation includes *Haloxylon*, *Pistacia atlantica*, Milkvetch, *Zygophyllum*, *Acantholimon*, *Calligonum*, Tamarisk, *Teucrium polium*. The region is an animal habitat for mammals such as sheep, deer, goat, foxes, wolves, hyena, and caracal, and such birds as Partridge, see-see Partridge, kestrel, Sandgrouse, Bearded vulture, and vulture.

Geographical Location: The Hengam Mountain is located at 35 km southeast of Gonabad, between N3405 to N3415 latitude, and E5815 to E5905 longitude. The highest points of area are located in the Kalat Mountain, with altitude of 1800 m, and in Kalateh Zardvand, located on the border of Gonabad County and Qayen with the altitude of 1945 m. Its area is 416 km². The Hengam Mountain is limited from west to the Gonabad-Qayen asphalt road, from the east to the Gisour plain, south to the non-asphalt road to the Kaboutar Kouh-Abas Abad and from the north to the non-asphalt road of Chah Payab.

Geology, Pedology and Vegetation: Hengam Mountain is located in an eroded relatively high to high area with numerous deep valleys, consisting of shale and sandstone, with a gradient of 40 to 90%. In some places, such as the lumbar wall and the *kalateh ahan*, there are igneous outspreads such as granite. Given that it is a mountainous area with high slope, there is no evolved soil, and the slopes are often bare and without soil cover. In some places, there is found a very shallow, limestone and non-uniform soils of Lithic Leptosols. On the slopes of the hills and the middle to low slopes, and where there is no stone cover, there is a thin layer of light soil with a high percentage of pebbles and alkaline pH, which is the habitat of pasture plants with dominance of *Artemisia sp.* and *Pistacia atlantica* trees.

The arable lands and orchards, which have been established in the Qanats of the region are also the result of alluvial gathering in the small *bandsar* (or dam) of the lower reaches of the Qanats called "Bandecheh". After digging the *Qanat*, the boundary of the river, which usually has a pebble bed, is selected, are considered for construction of embankments for spring floods by blocking the river. With long-term sedimentation, alluvial fine and fertile soils are developed which are suitable for agriculture and horticulture. Thus, by developing and completing *bandchehs*, a *Qanat* desert or farm is created. The main crops and fruits of the region's farmers include: wheat, barley, millet, kitchen-garden products, pomegranate, berry, fig, apricot and almond.

In terms of vegetation, the area is mainly covered with arid species, including *Pteropryum aucheri*, *Ephedra sinica*, tulip, *Ficus carica* L. subsp. *rupestris*, *Pistacia khinjuk*, perennial plants, Alhagi, Esfand, *Cousinia farimanensis*, Hymenocrater (Persian: "دوايشخعلی"), *Lkivistique officinale*, *Ligularia dentate* (Persian: "زلفپيرزن"), and thymes, and with dominance of *Artemisia sp.* and *Pistacia atlantica* trees.

History of *Pistacia atlantica* Forest of the Hengam Mountain: Hengam Mountain is a summer pasture area for livestock farmers of the Ostad Village. This village is located at 35 km of Gonabad at the west of the Gonabad - Qayen Road and beyond the mountain range. Considering animal husbandry as main occupation in the region, livestock wells and existing *Qanats* are used as livestock water resources. In the first half of the year, the farmer move their livestock to the mountain ranges and return to the village during the cold season.

In the past, not long ago, there were natural forests of *Pistacia atlantica* trees in most regions of Gonabad County, whose remnants, as individual and scattered trees, are now seen especially in the southern and southeastern heights of the city. At the beginning of the twentieth century, with increasing population and the need for fuel, the *Pistacia atlantica* trees have been cut in large number, and almost extinct in most places. Except in certain areas for obvious reasons, including religious issues and personal property, a part of this forest is survived which is called *Siah Dareh*, due to the existing *Qanat of Siah Dareh*. In fact, the owners of this *Qanat* have prevented the people from invading the region to cut the trees for production of coal; that is why this natural forest remains intact even now. There are about 30 streams of *Qanats* and springs in the Hengam Mountain, between *Kaboutar Kouh* in the west and *Siah Dareh* in the east. However, often settlements are not inhabited, and most of them are faced with water shortage, destroyed or being destroyed. (Department of Environment of Gonabad)

Helali Protected Area: Since 1997, it has been announced as a prohibited hunting area, and has been converted into a protected area in 2006. With an area of 120719 hectares, it is located in the west of Gonabad and southeast of Bojestan, and in fact, between these two cities. The Helali protected area is a mixture of mountainous, plains and hills. According to De Martonne climate classification, it has an arid and desert climate with hot summers and cold winters. In the study of the flora of this region relying on the existing flora, 318 plant species were identified. These species belong to 205 genera and 53 families. Most species belong to Asteraceae, Poaceae and Brassicaceae, respectively with 53, 30 and 26 species. The geographic distribution of species in the area showed that most species (56.3%) belong to the Iran-Turanian region, and according to the history of destruction in the region, 14.1% are the species of multi-regional, cosmopolitan, and semi-cosmopolitan plants. Therophytes (47.5%) and hemicryptophytes (26.1%) are among the most important biological forms of the region.

Vegetation: Haloxylon, *Pistacia atlantica*, Milkvetch, Zygophyllum, Acantholimon, Calligonum, Tamarisk, *Teucrium polium*, yarrow, ferula, Liquorice, Caraway, Chicory, ziziphora, Barberry, Broadleaf plantain, thymes, and Eremurus.

Wildlife: sheep, deer, whole, goat, boar, panther, wild cat, rabbit, hyena, European goldfinch, Grey-headed goldfinch, Eurasian siskin, Red-fronted serin and Horned lark.

Soil and Water Protection

A suitable soil for Saffron is one with crust, loessy, low density, good drainage, organic (non-chemical) fertilization, and at high altitudes than other lands. Traditionally, bedding is preferred because of good drainage for Saffron cultivation.

Precipitation: Three meteorological stations with long-term data series were considered to predict the average amount of rainfall.

Table 6-The average precipitation of various meteorological stations in the region (mm)

Station	22 Sep-22 Oct.	22 Oct. – 21 Nov	21 Nov- 21 Dec.	21 Dec – 20 Jan	20 Jan –19 Feb.	19 Feb – 20 March	20 March –20 April	20April – 21 May	21 May – 21 June	21 June – 22 July	22 July – 22 Aug	22 Aug – 22 Sep	Annual
Gonabad	1.3	8.4	20.2	23.2	29.8	34.3	36.8	10.9	1.1	0.0	0.0	0.0	166
Bajestan	1.39	5.5	23.2	26.1	35.1	32.9	33.7	14.7	0.02	0.0	0.0	0.0	172.6
Kalat	0.8	10.6	42	46.7	60.9	63.1	53.5	8.1	5.3	1.7	0.0	3.3	296

Source: Iran Meteorological Organization

As shown, the highest rainfall occurred at Kalat Station (63.1 mm) at the highest elevation during February 19 and March 20. Also, the average monthly precipitation for other months (except for September 22 to October 22 and April 20 to May 21) is greater in Kalat, indicating monthly precipitation at higher elevations is more than in lower ones in Kalat. Gonabad has an average annual rainfall of about 166 mm, which illustrates it as a semi-desert, semi-arid, and arid area where underground water is considered as the main source of water for agriculture.

Temperature: The average annual temperature in the highlands is less than low elevations. The average annual temperature is 15.1 and 16.4°C respectively at the Gonabado and Birjand stations; but at Kalat Station it is 12.2 °C, due to the difference in height of 600-700 meters between the Kalat and other stations.

Evaporation: Based on Gonabad station data, the average annual evaporation rate is about 3002 mm. Evaporation is varied as a function of temperature variation.

Suitable Climate for Saffron: Saffron is tolerant to a hot and cold weather conditions, and is sensitive to cold and high humidity. In similar areas of Gonabad with an annual precipitation of 200-200 mm, yield is possible only with double irrigation. The province of Khorasan, particularly Gonabad and Qayen counties, are the most suitable area for the growth of Saffron.

iii. Local and Traditional Knowledge Systems

Knowledge System

Qanat System Knowledge

Qanats are more than just a way of using groundwater. They represent a unique and integrated system whereby sustainable management of land, water, and agricultural biodiversity is attained through a wide use of the indigenous knowledge and wisdom.

The importance of Qanats to arid regions has been well established and they maintain their importance in these regions to date. Qanats were the only means of water supply for several centuries, and they contributed to the forming of civilizations in these harsh climatic conditions. In fact, what has been termed 'the Qanat (or Kariz) Civilization' manifests unique social, cultural, economic and political characteristics and the knowledge of how to live in deserts.

The 'Qanat civilization' emerged in the Central Iran watershed, particularly in areas where the following prerequisites existed:

1. A desert surrounded by high mountain chains, leading to accumulation of relatively extensive groundwater reservoirs.
2. Limited rainfall, low humidity, and distance from sea coasts.
3. The absence of permanent rivers and other surface water sources.
4. Limited rainfed agriculture and the dependence of irrigated agriculture to qanat.
5. Sustainable use of the aquifers.
6. Poor vegetative cover, low share of animal husbandry in the economy, and prosperous handicraft industry.
7. Scattered villages and urban settlements.

The qanat technology has spread from Iran to the east (Central Asia and China) the south (Arab region and North Africa) and the west including into the new world (Peru).

The qanat of Jopar, near Kerman city, which is associated with the worship of *Anahita* (the water goddess) is estimated to have existed as far back as 1200 BC.

Qanats were in common use in Iran during the Achaemedian period (c. 625 BC) and the technology was then transferred to Egypt, North Africa, Spain, Cyprus, Sicily, and other countries. In 500 BC, qanats were recorded in Egypt, in 750 AD in Madrid, in 850 AD in the south of Algeria, in 1520 AD in Los Angeles, in 1540 AD in Chile, in 1780 AD in Turkmenistan and from 120 BC to 1475 AD qanats prevailed in China.

Historical records show that in the Parthian period (205–212 BC), qanats were deliberately destroyed in certain strategic points by the defending kings to hold back Roman occupation. *Tabbari* also discloses some facts about qanats in the times of the Sassanides, though the actual location has not been mentioned. In the year 828 AD, the Abbasid Caliph built a garden near Baghdad which was irrigated by qanats.

In books remaining from the Iranian scientists of the early Islamic period, including Haseb Karaji living in about a thousand years ago, the principles of the earth's gravity and flow of surface are discussed, which shows that at that time they had the knowledge of underground waters (*hidden water*). Inclined horizontal wells gradually replaced vertical wells for bringing water to the surface

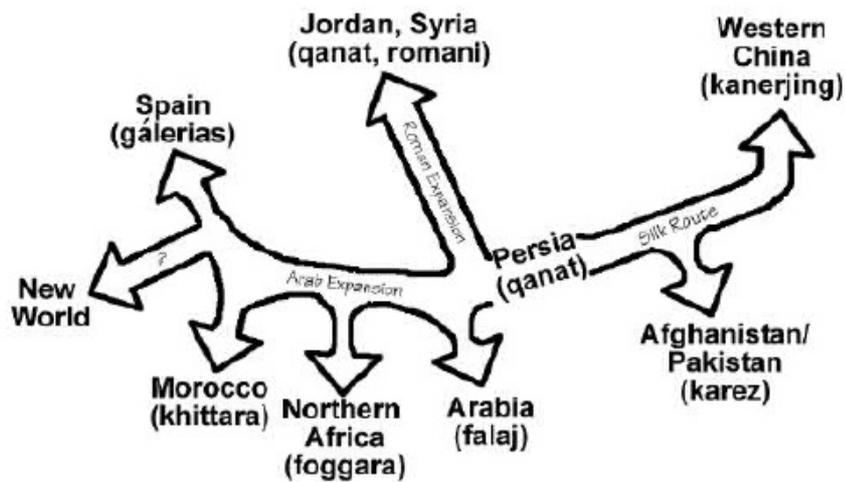


Figure 23- Qanat Technology Originated from Iran

Qanats first appeared in the mountains of Kurdistan in western Iran, eastern Turkey, and northern Iraq more than 2,500 years ago. The earliest report of a *qanat* system is chronicled on

a tablet narrating the destruction of the *qanats* which provided water to the city of Ulhu (modern Ula), located at the northwestern end of Lake Urmia by Sargon II in 714 BC (Laessøe 1951). Soon thereafter, Assyrian cities, particularly those located on the upper Tigris River, relied on *qanats* for drinking water. Then, the capital city of the Medes, Ecbatana (modern Hamadan) was watered by *qanats* as was Darius's capital city of Persepolis (Forbes 1955; Goblot 1963). Under the Achaemenids (550–331 BC), when Persian rule extended from the Indus to the Nile, *qanat* technology spread well beyond the confines of the Iranian Plateau. To the west, *qanats* were constructed from Mesopotamia to the shores of the Mediterranean as well as southward into parts of Egypt and Arabia. They became particularly important sources of water in the foothills of eastern Iraq, the Syrian Desert, and the Hadhramaut. In Yemen and in Oman, *qanats* are locally called *falaj* (plural: *aflaj*). *Qanats* are gently sloping subterranean tunnels dug far enough into alluvium or water bearing sedimentary rock to pierce the underground water table and penetrate the aquifer beneath. Water from the aquifer filters into the upper reaches of these channels, flows down their gentle slope, and emerges as a surface stream of water at or near a settlement. *Qanats* are generally constructed on the slopes of piedmont alluvial fans, in mountain basins, and along alluvial valleys. In these locations, this groundwater collection system has long brought water to the surface and supported settlement in regions where no other water technology would work. *Qanat* technology were developed through centuries of trial and error, gradually turned into an integrated well-established irrigation system and became one of Persian's unique knowledge system, backbone of the agricultural civilization and a vital part of the society's culture up to present time.

The structure of a *qanat* is simple. It consists of a horizontal tunnel (*Kooreh*) running through an incline with many chains of vertical wells (*Millehs*) that form air passages allowing for required operations such as excavation and dredging (see figure 1). This forms the basic pattern of *qanats*, but from a structural point of view they can be divided into different categories based on location (mountain/plain/desert), length of mother well (*madarchah*), the number of the vertical tunnels or the distance between mother well and the mouth of the *qanats* (*mazhar*). *Qanats* are synchronized with the climatic conditions of the region. If average annual rainfall is heavy, the length of the *qanats* is shorter and the mother wells are not deep. Where rainfall is scarce, the length of *qanats* increases and so does the depth of the mother well. The depth of the mother well and the length of *qanats* in mountain regions are shorter than those in the plains.

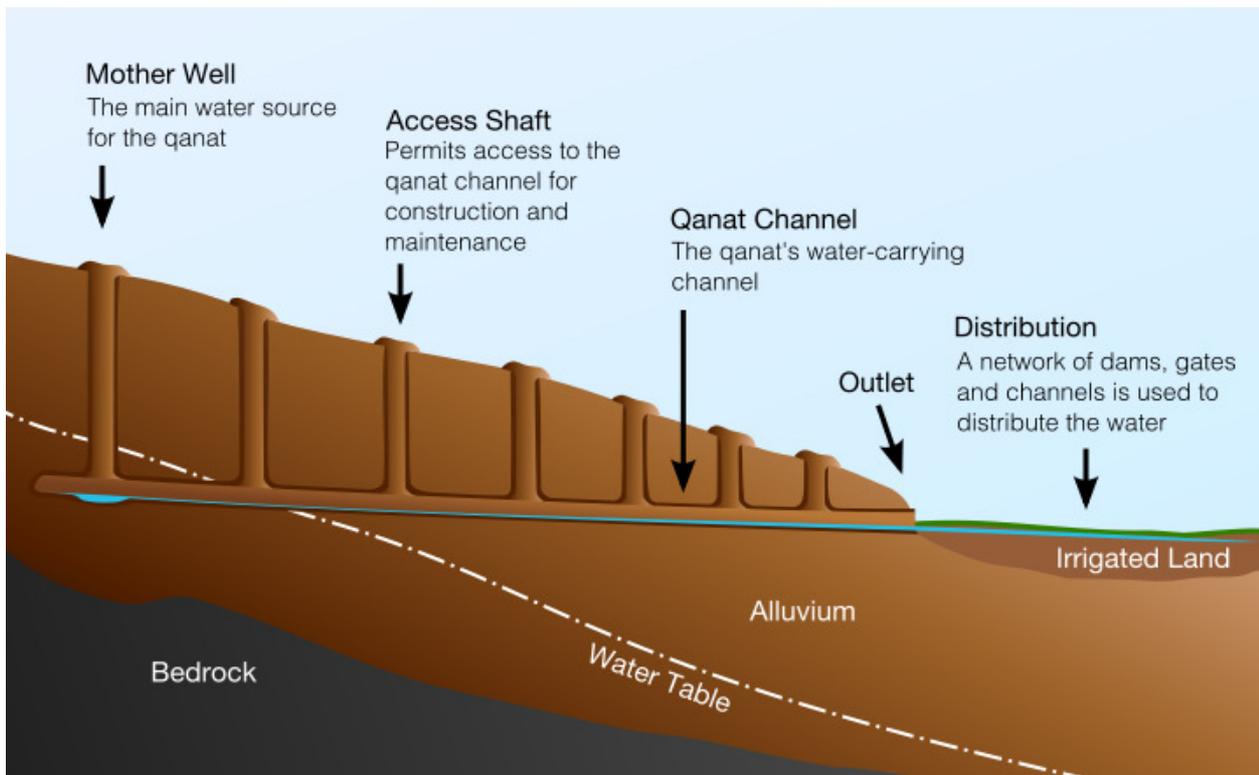


Figure 24-Vertical view of Qanat

Planting Knowledge

The relationship between natural and human factors in the planting environment: A very suitable climate is not the sole reason for the excellence of Iranian Saffron, but because of the rich heritage of indigenous knowledge and skills in the cultivation of this crop.

Economic, social, and cultural diversity of the local community is mixed with the history of cultivation and growing Saffron. The production technology and use of local knowledge-based methods have provided for the growth of Saffron production in these regions. The Saffron growers of Iran know the best manual methods of Saffron production. For example, the yield is harvested at night or early morning, and thus, it keeps its aroma.

Their placement under the direct sunlight reduces the quality of the yield. Various parts of the provinces (Razavi, North, South Khorasan) each have a variety of key features according to their local knowledge of Saffron.

Color: Torbat Heydarieh, Khazari, Ferdows, Zir Kouh Gharbi, Qayen, Birjand, Gonabad, Sarayan;

Aroma: Ferdows, Gonabad, Qayen, Khazari, Zir Kouh Gharbi, Sarayan, Birjand, Torbat Heydarieh; and

Taste: Sarai, Ferdows, Birjand, Khazari, Zir Kouh Gharbi, Torbat Heydarieh, Gonabad, Qayen.

In Iran, cultivation is based on family work and on small farms, and it is only dependent on indigenous traditions and low levels of technology.

Preparation of the Land: Generally, Saffron grows better in fertile soils with moderate texture, loamy, sandy loam mixed lime. Most Saffron cultivation areas in Khorasan, including Gonabad, use two traditional and mechanized methods for Saffron cultivation. In the traditional system, the ground is plowed in the spring which is repeated again after 10 to 15 days.

If the ground is uneven and unlevelled, the farmers use the cutting disc and the level, and then after two weeks the land is plowed in two directions perpendicular to each other. Before the third plow, about 40 to 80 tons of fertilizer (completely dry and decayed organic fertilizer free of weeds) is applied, but some of them use half of this amount after the third plow. The other half is used to sow bulbs in the sand or after the first irrigation. Then the land in semi-mechanized systems is divided into several basins with different parts from 40 × 10 to 100 × 10 meters. The ground is plowed with horizontal grooves during autumn and before planting. During the spring again, the land is plowed to provide for degradation of materials with solid bounds, and weed control. After using the fertilizer, it is grooved with a width of 25-20 cm, the gap between the grooves in each basin is used to plant Saffron bulbs.

Selection of Saffron Bulbs: Saffron is divided into several categories according to the type of bulb. The amount of bulbs used depends on the size of the bulbs selected. Saffron bulbs are cultivated from 3 to 10 tons per hectare. Healthy bulbs are selected with intact buds.

Saffron Cultivation Time: Saffron bulbs can be planted from late May to before October. Saffron bulbs must be taken out of the old land within two weeks and planted on new land.

Planting Density: The planting density has a significant effect on the productivity of the crop and the yield. If the density is reduced, reaching the maximum bloom may be delayed, and

continue for seven years. Traditional farmers in the region use an average of 1.5 to 3 tons of Saffron bulbs per hectare.

Saffron needs nutrients such as nitrogen, phosphorus, potassium, calcium and low-consumption elements such as iron, copper, Magnesium, and so on. (Ghadamyari)

Saffron cultivation is usually carried out in two ways: cross planting, row planting or spot seeding. Currently, with increasing mechanization and planting tools, row cultivation is used for planting Saffron with distance of 20-25 cm.

Growing Knowledge

Saffron Irrigation: Saffron irrigation depends on the weather conditions of the area, but is usually starts in early November. If the weather is warm, irrigation will be delayed.

Irrigation is carried out after 10-15 days since planting, followed by second one after 4 to 5 weeks after the first irrigation.

During this period, if no water is fed to the soil, the soil surface remains soft and allows the flowers to easily come out of the soil. Third irrigation is usually done after flowering.

Irrigation intervals are every 12 to 24 days. Usually, the number of irrigation in the province is 3 to 6 times, depending on the air condition and water quality.

Fertilization: Approximately 15 tons of degraded fertilizers (completely dry, decayed and free from seeds and weeds organic fertilizer) are used per hectare per year to maintain fertility. In addition, 100 kg of nitrogen, 200 kg of ammonia phosphate and 50 kg of potassium fertilizers are added to the soil.

Caring Knowledge

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In rural communities which are the main source of Saffron, livestock are considerably integrated to complete production chain and agricultural productivity. Thus manure, one of livestock byproducts is used by farmers as fertilizer for their fields, especially in Saffron farms. On the other hand, favorable amount of rainfall especially during winter which coincided with growing season of Saffron has positive impact and provides essential elements required for

production of Saffron. In past eras, rubbles from ruined houses and buildings known as “Shoureh” were used in Saffron farms because of their rich mineral content.

Weed Control and Grooving: Weeds, by competing with Saffron, reduce crop yields due to water and food and sunlight shortage. In addition, Saffron planting and harvesting can create disturbances and host a number of diseases and insects. Field weeding is essential whenever weeds are grown. In Saffron farms, the first weeding is carried out after the second irrigation which causes the weed elimination of the Saffron field. Saffron flowers are emerged in loessy soils, and farmers must loosen the soil using shovel, plowing, cultivator and other local equipment for soil this purpose and elimination of solid and hard soil. The weeding is performed manually during the first irrigation in late October.



Figure 25-The application of organic fertilizer in a Saffron field in the Kakhak rural district of Gonabad

Ripened Fruit: The fruit color is green before it ripen (with the exception of the red variety, of which the leaves and the fruit are red from the beginning), and depending the variety, it becomes yellow, red, greenish-yellowish, red pink, black Purple, and so on. The time to ripened fruit varies from one cultivar to another, which is 84 days to more than 130 days. (Qedamiyari)

Pests and Important Diseases:

Most important pests of Saffron in proposed site and in Iran are Rodents (e.g. mice, porcupines, and rabbits), mites and white worms that they all attack Saffron bulbs when it is cultivated. In none of above-mentioned pests, engine oil cannot be useful for pest management. In some parts of Iran Saffron production, we have reports on Trips attack to leaves in late winter. It is not challenging and due to restriction in chemical application for Saffron farms, only natural repellents like pepper (*capsicum*) or *mentha* extract, being used.

Several methods have been used to combat this pest including mechanical operations and the destruction of nests around the farms or the use of smoke to escape the rats around the farms. In the past, to create smoke, a burner was used to incinerate the burner to combustible materials such as oil or engine oil. The burning of the burner caused the smoke and led the smoke into the hole, the rats escaped from the place, and thus the Saffron Corms were protected from attack of mice. Nowadays, instead of the old burners, new natural gas burners are used, and smoke are created by burning sulfur near the nest of mice, and the rats run away. This operation does not cause any harm to the soil and water because the smoke is spread in the air. In this way, without the use of chemicals or killing mice, this pest is being fought.

In different parts of proposed site, like Seno farms, producers have focused their resources on the health and safety of the food products by producing a strategically precious product, organic Saffron, according to the domestic eco system as well as the agricultural and the socio economic conditions. They are working under supervision of European companies like BCS and have Europe organic label. And supervisors constantly monitor water, soil, product, and socio-economic condition of production system to ensure organic production regulations are fully complied. You can reach the documents at www.mizou.co

Harvesting Knowledge

Cutting and Collecting: The harvesting method depends on the weather condition at the time of irrigation. Generally, Saffron flowers bloom about 2 to 3 weeks after the first irrigation. Hot and cold weather can endanger the flowering process, but it is also facilitated by relatively cold shadow shelter.

The flowering takes 15 to 20 days, and the harvesting period is 10 to 15 days. The time to pick flowers is usually early morning before dawn. For easy handling and preventing damage, it is best to pick flower when it is in the bud stage. In this way, flower blossoms are gradual. After harvest, the sepals are separated from the stamen and the ovary, and then transported. The flowers do not accumulate because they are easily damaged, and the quality of Saffron might incline

The average economic harvest from the third year onwards is 10 kg per hectare. The Farmer of 2013 has harvested 25 kg dried Saffron per hectare. 1kg of Saffron flower produces on average 3mithqal of dry Saffron. 1Kg is between 2200-2000 Saffron flowers. 1 hectare of Saffron produces roughly 270 man-day work per year.

Drying and Packaging: After harvesting flowers, the sepal and stamen are manually separated. Separated stamens are packed in 10 grams packages, which each is wrapped up by a narrow thread.

In other ways, after drying, the red parts of the stamens are separated by scissors from the yellow section, which in fact is the Saffron considered of a good quality.

Drying the Saffron is carried out in the shade or in a dry and warm room. The plant parts which are separated are placed in the fabric for about 20 days to reach about 10-15% moisture.

Another method that is not popular is to dry Saffron under the sun or heat. Drying under sunlight takes about 3 to 5 days to maintain a good moisture content of 8 to 10 %; in this method of radiation exposure, the color changes effect the product's value.



Figure 26 -A Saffron field ready to be harvested



Figure 27-The Saffron ready to be harvested



Figure 28-The flowers, or blooms, which are harvested in Gonabad



Figure 29-A basket of harvested Saffron flowers



Figure 30-The Saffron flower (sepal, bud, violet leaves)



Figure 31-The steps of separating of Saffron parts and wastes

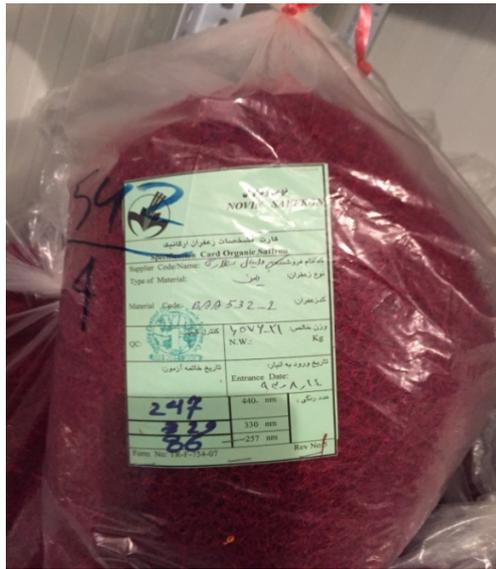


Figure 32-The sepal and stamen of Saffron ready to be separated



Figure 33-The product of Saffron

Local and Indigenous Experiences

.It should be noted that this product is planned in the Gonabad region as a main source of livelihood or family farming and its cultivation is not an industrial process; but during the last 10 to 20 years, the cultivation has been carried out through a semi-mechanized process most of which was carried out using livestock and medium-sized tractors.

Cultivation of Saffron using Qanat water has long been prevalent in the Gonabad region. This important agriculture has been based on the water supplied from the Qanats and the canal systems. By relying on knowledge, technology and experiences acquired from their ancestors and using indigenous knowledge of the region, peasants have tried to improve Saffron cultivation and plantation. Since the Gonabad city is located in an arid climate with limited water sources, surrounded by two deserts, our ancestors realized that water needed for agriculture and horticulture had to be supplied through excavation of Qanats. Because of droughts and scarcity of water, the general approach of peasants and farmers of the region took an efficient approach for using water and growing plants with limited need for water. So they selected crops whose growth period was aligned with atmospheric precipitation.

A) Preparation of the land for planting this precious product is carried out in particular; the land selected for farming Saffron should not be used for cultivating Saffron before. After selecting the high quality land, it is irrigated in the second half of October. It should be noted that the selected land is completely leveled and before the irrigation, manure is distributed on the land based on financial capability of the farmer and needs of the land. Leveling the land is carried out based on experience of the farmer using shovel.

B) The farmers believed that bulbs should be harvested from good and suitable land and dried; then after cleaning the bulbs and removing overlays, the bulbs were ready for planting process.

C) Generally, depending on the soil texture, after 4 to 5 days and as the farm is in proper condition, farmers called their family members and started to plant as a group under direct supervision of farmer experienced in planting operations. During the planting process, usually there were persons with two bulls and planting tools such as plows, jowls, etc. who performed planting operations and planted rows of bulbs. The plant has been cultivated in rows from the old. At the beginning of the planting operation, elders and experienced farmers gave necessary training to the younger ones. Then planting operation was performed after prayers and distributing candies. The planting time could be varied depending on the soil texture and experience of the farmer. The depth could change, but the depth of planting was usually between 10 and 15 centimeters. The rows were 20 to 25 centimeters apart so harvesters of flowers can easily move between rows and avoid destroying plants. Some farmers believed that they had to enter the field with bare foot to produce least pressure on the ground and Saffron bulbs; they also tried to avoid bringing sheep or heavy agricultural equipment to Saffron fields.

D) Immediately after completion of planting process, farmers charged with walking the bulls dismantled the plowing device and used Malleh as secondary leveling tools. With great care, the Malleh operation was done on the newly planted ground. Benefits of this operation are including:

Maintaining soil moisture up to the time of irrigation, this is commonly known as Zaj Ab in the second half of December.

Laying bulbs into the soil and reducing the volume of air around the bulbs

E) Plots of the farm were based on the previous plan designed farmer, immediately after the Malleh operation was done. This operation was performed by a tool called a Panjeh, and two more people are required: a more experienced person to do a Pajneh guide and determine the boundary path, and the other person should be physically capable to be able to pull the soil towards the boundary of plots. At the same time, the water transfer path to the farm, which is called the local term "Jouy" was constructed.

For planting the bulbs, they first strengthen the land using organic fertilizers. Then, they irrigate the soil, and wait a few days for reduction of the soil moisture content. Then on a pre-planned day, the farmer and his people (in traditional farming) move to the farm, along with two asses and plowing equipment (*gavrouni* (Persian: "گاورونی")), and bags of cleaned Saffron bulbs. The yoke (*joq* (Persian: "جغ")) is fasten to the neck of the donkeys and the plough is connected to that, and the initial plowing operation begins. Primary plowing is aimed to prepare the ground. Some people were doing the first plow two days ago, so they would not be too busy on Saffron seeding days.

After the initial plowing is complete, the process of planting Saffron begins when the soil is completely plowed. First, the farmer puts firewood on top of the plough, so that when the blade moves forward, the soils are spread on both sides and create the space necessary to plant the bulbs. After the first groove was created in the ground, or in other words, it was stretched (or *kesh*), one person, while holding a bucket or a container filled with Saffron bulbs, moved along the *kesh* and seeded Saffron bulbs in a way that they were taught. (The distribution of bulbs should be such that at least there is one bulb on each *vajab* interval). The workforce inlays the bulbs into the grooves.

They will continue to do so until they reach the end of the groove. On the way back of the donkeys, the second groove is created right next to the first groove, and work force repeats the process as before. This work will continue so that the work ends. Obviously, the farmer's estimate of the amount of Saffron bulb required should be correct, because if the estimate is incorrect, the bulb may run out and the land will remain half-finished. The vice versa also holds true, because if the bulbs get too much, they will not be required and lost, because the planting of bulbs is standard in terms of number, which, if it is low or high, will affect the fertility of the land.

When the planting is finished, the farmer begins to level the ground and partition it. He should try as much as possible not to walk on the newly planted ground or to dig deeply into the ground, as bulbs may be damaged. Saffron bulb is planted in August. The above can be done within one day and even half a day, and therefore, as stated above, it does not take much time for the farmer. About three months later is when harvesting the Saffron is begun, few flowers will emerge on this land, but next year the amount of land fertility will increase, and in the following years more and more. In the old days, Saffron field could have Saffron yields for up to ten years. After ten years, the land is exhausted and must remove the bulbs from the ground in

one of the two above mentioned ways and plant them elsewhere. Farmers, of course, might plant lentils and peas in order to avoid this problem.

The second stage, which is called "Caring", does not lead to much trouble for the farmer. The hardest thing at this stage is to ensure that the mice do not tunnel in the ground and do not eat the bulbs. The next job that should be done in this stage is to irrigate the soil. The Saffron land is only irrigated twice per year: once before emergence of the flowers in late September every year, and once again after the completion of flowering. The first water is to loosen and *randeh zani* the soil.

Randeh zani is to scratch the surface of the earth aim to help the flower emerge from the soil. The surface of the earth is very hard and solid due to the fact that the hot sunlight is mooned for months, so flowers cannot push out this solid layer. Therefore, the farmer will scratch the surface of the soil to allow the flowers to come out of the ground. The second irrigation is called "Zahechi water" (Persian: "آبزهچی"), and as it was said, it is performed after the emergence of flowers from the ground. The old people believed that there was also a third natural irrigation that was good for the land, and that water was given to the earth during the winter and when snow and ice covered the surface of the Saffron field. The water is mixed with ice, which is called *yakhou* i.e. ice + water, and penetrates the Saffron bulbs and strengthens them. It also destroys the mice.

The operation of *randeh zani* is another operation which is performed in Caring stage. For this purpose, it is utilized such equipment as pitchfork, pickaxe. The person(s) who perform the work are said to be *randeh zan*. It can be said that at the Caring stage, the hardest thing to do is *randeh zani*, because it's very happening that an elderly woman has to do it alone, while her children are in Tehran and Mashhad, and she must find someone to do this work, which sometimes is a dilemma. Many young people who live in cities go to the village to help their mother or father in the season of *randeh zani* as it is a very hard work.

Fertilization is another matter which is considered during the Caring stage. It is to apply organic (manure) fertilizer to the Saffron field. This is not a matter of urgency and the farmer can bring the fertilizer to the ground from April to the first irrigation. Saffron field almost every year needs fertilizer like animal manure, and in the old days, when cows and sheep were high in number, much of the fertilizer production was transferred to the Saffron cultivated land. The process of transferring manure as fertilizer to the soil was called *khak kashi*, which included several donkeys carrying manure filled in bags on their back to the destination.



Figure 34-Extracting the Saffron bulb using pitchfork

The harvesting operation of Saffron flowers which is usually carried out at dawn, is performed using in traditional wicker baskets that are produced as household handicrafts. Also, suitable plastic baskets and handbags are used to collect harvested Saffron flowers. Proper containers for keeping stigmas separated by workers are completely clean and made of ceramic, melamine or metal. After drying Saffron stigmas, they are stored in white cloths in a dry area. Since the past, Saffron farms are worked by minor famers in a completely traditional way for livelihood. Because of this, products of this region have higher quality compared to products from large mechanized farms. Jobs and household income from Saffron farms are based on production of at least 6 kg of dry Saffron per hectare through traditional farming and using human workforce and agriculture machineries for plantation, plant growth and harvest.

Table 7- Comparison of the commercial value of Saffron in the traditional and industrial systems

Traditional					
Planting		Cultivation		Harvest	
Activity	Man/day work	Activity	Man/day work	Activity	Man/day work
Land preparation and plotting	40	Mechanical pest control	6	Picking flowers	60
Animal fertilizer	10	Animal fertilizer	4	Removing stigmas	120
Removing previous Saffron bulbs	100	Crust breaking and grating	22	Drying stigmas	10
Bulbs skinning and sorting	20	February weeding and plowing	18	Other	2
Planting and covering	50	Other	2		
total	220	Total	32	Total	192
Industrial					
Planting		Cultivation		Harvest	
Activity	Man/hour work	Activity	Man/day work	Activity	Man/day work
Land preparation and plotting	16	Chemical pest control	3 hours	Picking flowers	60
Animal fertilizer	5	Solution spraying	3 hours	Removing stigmas	120
Removing previous Saffron bulbs	24	Crust breaking and grating	4 hours	Drying stigmas	8
Bulbs skinning and sorting	40 men	February weeding and plowing	18	Other	2
Mechanized planting and covering	8	Other	2	Drying with heater	20%
Other	5 men				
Total 53 hours of tractor operation and 45 man/day planting work per 1 hectare		Total 10 hours of tractor operation and 20 man/day cultivating work per 1 hectare		20% dried mechanically and 45 man/day harvesting work per 1 hectare	

Table analysis:

In traditional system employment and per capita income of the village is increase which in turn increases stability and prevents rural migration which is an important socioeconomic factor

A producer is not concerned with product harvesting and constant production and supply increases economic power of a family

Limitation in production and a balance between supply and demand creates a favorable market conditions and therefore a profitable production for the farmer

Production costs are lower in the mechanized method but it's not well established due to the micro-production and traditional farming of Saffron on the other hand increased growth of Saffron cultivation and large Saffron farms have led to concerns over harvesting and product quality

Stable production of Saffron is only achieved by its traditional method and one of the reasons behind the success of this product is micro-production and small, family farms.

Introduction of traditional planting, harvesting and Saffron harvesting equipment:

Plow or Miner: An agricultural tool for digging, plowing and plowing a land that has a blade or heavy steel blades that is pulled by four-legged, especially bovine ass on the ground. This tool, with a sharp tip and back inside, is tied to the neck of the livestock and plows it with it. The wooden iron cow, which has been used centuries ago, is still used in some parts of the world.



Figure 35-Plow the ground with a plow to plant Saffron

Corms

Leveler: The desired land of Saffron planting decreases as a result of the yield of bedding. For this reason, the leveling of the ground and also to maintain the adhesion of the kernel to the bedding, as well as to prevent the soil from being wasted, after planting, they will dry the soil. For this purpose, a leveler is used. Trowel forms into different shapes and dimensions. A small trench may be a board made of wood that is used to flatten and block the soil on the ground. In traditional bay, Iranian rubble is used as a putty and roller, usually can put one, two or three times on the ground. In any case, the last direction to pull the trowel should be in order to do irrigation of the earth.



Figure 36- The farmer is leveling after planting Saffron

Tools for creating Borders: A flat wagon with a wooden handle that pulls a string and takes one person and blurs a person in the threaded line. In local terms it is also referred to as a pawl.



Figure 37- Tools for creating a border

Tools for Breaking Soil (ChaharShakh): For breakdowns, after the first irrigation of Saffron is used. Usually, 6 teeth are used manually for cracking Saffron fields. There is another one that seeks for livestock like an ass or cow, and a crackdown makes it easy



Figure 38- Farmer Breaking the Saffron Farm with ChaharShakh(First Photo) and another tool for breaking the soil(Second)



Figure 39-The farmer is breaking the soil with three branch plows, and livestock

Harvesting the Last Year Saffron Corms: During the old days, the operation of harvesting the Saffron Corms was carried out by a clam. But nowadays, Corms operations are made by mechanized vehicles such as tractors, and workers harvest certain corms by special equipment.



Figure 40- Harvesting Saffron Corms

Water and Soil Management

Gonabad region has no perennial stream and its surface water sources are non-perennial rivers. Precipitations, surface and ground water sources are limited in the area mostly dependent on precipitation in mountains. Most of foothills under higher grounds with sharp slope experience floods caused by streams of higher grounds. Penetration of snow waters into ground water reserves in southern areas promote availability of water sources which are used for agriculture and household purposes.

Table 8-Ground water sources of Gonabad (per two million m³)

Sources Year	Wells		Springs		Qanats		Total water sources	Total discharge (mcm)
	No.	Discharge	No.	Discharge	No.	Discharge		
1969	27	3	7	3	137	59	171	65
1981	202	24	-	*	314	40	516	64
1985	153	14	22	6	270	40	445	78
1991	136	21.9	21	5.7	144	40	301	67.9

As demonstrated above, more than 67.9 million m³, about 40 Cm or approximately 59% of the water is discharged through Qanats. Therefore, Qanats have great importance in supplying water, both for agriculture and drinking water in the area.

Most Qanats have quality water. Since Saffron is susceptible to salinity and incompatible with waters with high amounts of EC, there is a direct relationship between Qanat and Saffron production. Qanat is a safe and steady source of water supply for Saffron farms. In Gonabad region, Qanats are used for supplying of the water from November to mid-December. Usually, farmers perform weeding before irrigation and mechanically remove common weeds such as Brumous in Saffron fields. First irrigation interval (خاک آب) have a significant effect on growth, quality and quantity of Saffron flowers and stigmas. So Saffron farmers try to get the maximum water they can give to Saffron farms. Gonabad water quality is one of the components affecting Saffron development in the region. Majority of Gonabad's water sources which originate from Qanats have high quality with an EC of 500-2000 dS. Because of the fact that Qanat water travels more than 30 km from the mother well to outlet of the Qanat, it is filled with beneficial minerals and has an important effect on quality and quantity of Saffron production. According to farmers and experts, because of quality and rich mineral content of Qanat water, need for fertilizers in Saffron farms is minimal which resulted in production of healthy and organic products in the region.

About the mining activities in the region, there are two types of mines in the area, located in mountainous regions and very far from the farms. These mines include mining rock which used for buildings, and another mine is Bentonite. Because of high altitude, these activities do not have any effects on soil and water and they are extracted and send the extracted mines out for processing outside the region.

Also there are very strong legislations for these activities and the miners have to obey the environmental aspects of mining which sets and monitors by the government agencies like the Environmental Department, IMT Ministry and MAJ.

Different published studies in last 10 years (Keramati et al. 2007., Momeni Damaneh et al., 2015., Rooki, et al., 2017) on quality of water (drinking or agriculture) never indicated any sign of water pollution with engine-oil or it lookalikes.

Table 7-Comparison of the Gonabad Drinking Water Parameters with National Standards

MeanParameters	Gonabad Drinking Water	National Standard	
		Optimum	Limited amount
Cl (mg/lit)	0.57	0.5	0.0 – 2.8
pH	7.56	7.5-8	5 – 6.9
EC (μ S/cm)	1840	*	1500
Turbidity (NTU)	0.33	≤ 1	5
Hardness (CaCO ₃ mg/lit)	268.6	*	500
TDS (mg/lit)	901.65	*	1500

*not mentioned in national standard (Source: Keramatiet.al., 2007.)

In another study, groundwater quality in aquifer of Gonabad basin, Khorasan Razavi, investigated for a 5-year period using multivariate statistical methods and artificial intelligence. Graphical methods and classification of underground water quality show that the type of water is mainly that of sodium sulfate. Spatial distribution of water quality using multivariate statistical R-mode model states that water quality in this basin affected by two factors. The first factor, salinity and water hardness in plain, is the linear combination of Ca²⁺, Mg²⁺, Na⁺, SO₄²⁻, Cl⁻, TH and EC. The second factor is the combination of HCO₃⁻, CO₃²⁻ and pH which indicates water alkalinity (Table 8 and Table 9) (Rooki., et al., 2017).

Table 8- Water samples quality parameters from Gonabad basin in 2006

Column	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Cl ⁻	HCO ₃ ⁻	CO ₃ ²⁻	SO ₄ ²⁻	TDS	EC	TH	pH
N	25	25	25	25	25	25	25	25	25	25	25	25
Mean	21.8	0.44	5.56	8.59	18.14	2.8	0.16	15.48	2264.8	3594.9	707.2	8.18
SD	8.6	0.59	4.9	5.55	10.63	0.82	0.26	8.58	1058.45	1680.1	473.9	0.25
CV	0.4	1.34	0.88	0.65	0.59	0.29	1.59	0.55	0.47	0.47	0.67	0.03
Min	9	0	0.7	1	3.3	1.6	0	2.9	691.7	1098	90	7.7
Max	36.8	2.1	16.2	21.4	39	4.6	1	32.9	4107.6	6520	1580	8.6
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µs/Cm	mg/l CaCo ₃	-

Table 9- Water samples quality parameters from Gonabad basin in 2011

Column	Na ⁺	K ⁺	Ca ²⁺	Mg ²⁺	Cl ⁻	HCO ₃ ⁻	CO ₃ ²⁻	SO ₄ ²⁻	TDS	EC	TH	pH
N	25	25	25	25	25	25	25	25	25	25	25	25
Mean	18.3	0.6	6.8	11.3	18.6	3.7	0.3	14.6	2301.5	3652.3	906.2	8.2
S.D	8.4	0.84	5.6	7.7	9.8	0.9	0.4	8.4	1032.7	1639.2	540.8	0.3
C.V	0.46	1.4	0.82	0.68	0.53	0.24	1.3	0.58	0.45	0.45	0.6	0.04
Min	3	0	0.9	2.2	3.6	2.2	0	3.6	705.6	1120	210	7.7
Max	35.7	2.3	18	27.1	41	5.8	1	32.2	4025.7	6390	1980	8.6
Unit	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	µs/Cm	mg/l CaCo ₃	-

Since Qanat has a rich cultural and social background, stringent laws are in place to protect Qanat irrigation system and prevent its pollution and destruction in different areas of Iran, including Gonabad (Hosseini and Jahandideh, 2016). Also, the latest Qanat water quality analysis in Gonabad (2016) is shown in the below figure..

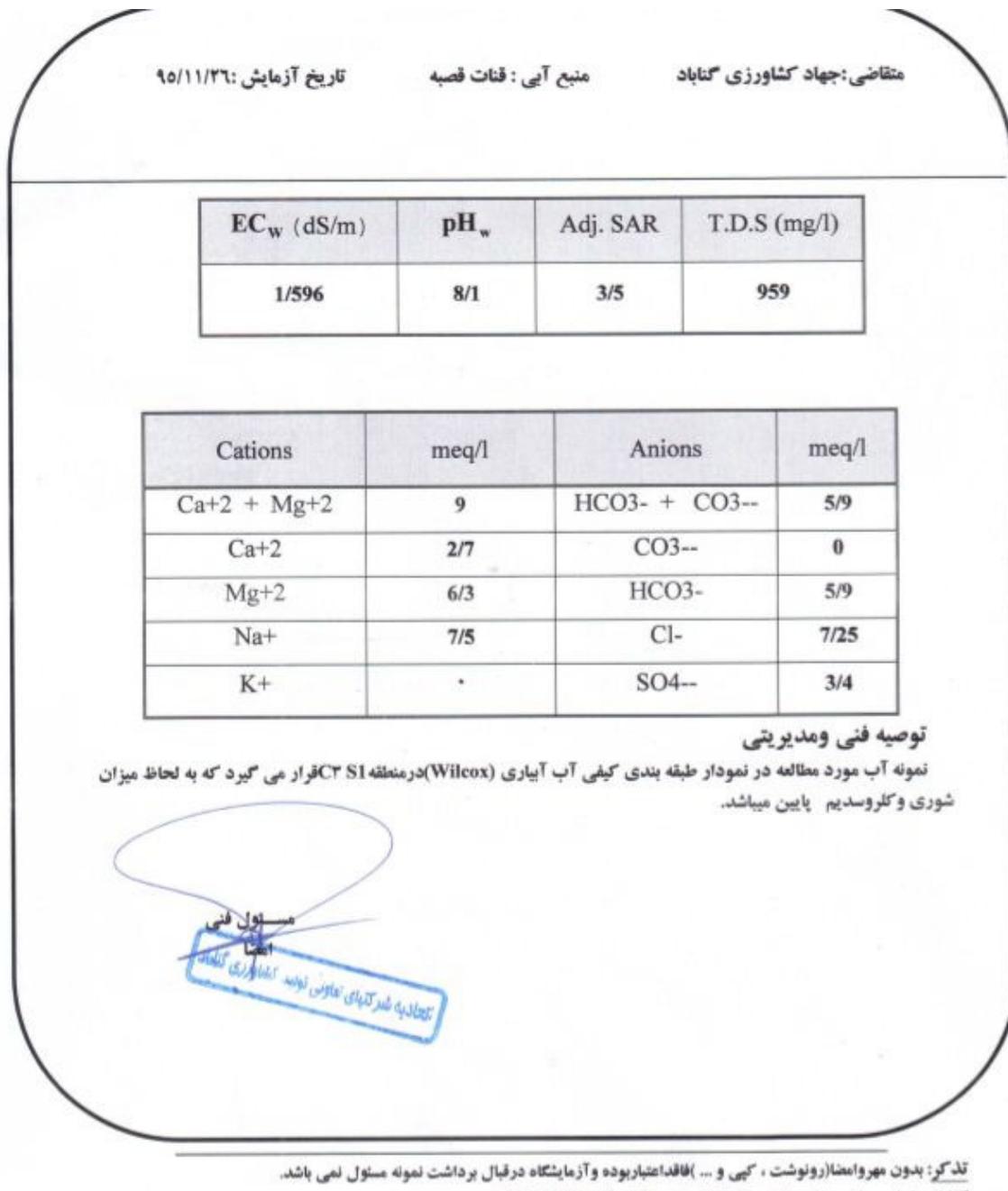


Figure 41- The latest Qanat Qasbeh Water Analysis(2016)

System Technology

Specific Technology of Qanats of the Gonabad Region:

From the morphological viewpoint, the Qanat is an underground duct that draws water from a water table or higher water resources to high ground. In fact, the Qanat includes a series of vertical wells, which are connected under the ground through a low gradient tunnel.

It has been interconnected by a gradual and gradual tunnel.

The first well is referred to as the main, or parent, well. The well is usually located inside the underside of an alluvial cone to the underground water surface. The opening of wells are located at intervals of about 20 to 200 meters in a line between the drainage area of the groundwater and irrigated land.

Qanat is one of the most important and amazing man-made structures for water supply system which has been capable of supplying water for over 60,000 villages all across the country. Gonabad has more than 599 Qanats with annual capacity of 126 million cubic meters that are developed to meet most urgent needs of communities residing in areas with limited access to water resources.

In this particular water extraction system, water is extracted without any help and expense and only using gravity force. Because of structure of Qanat and its shaft system, supplying water from Qanats are much cheaper than wells. Water supply from Qanat is permanent and does not interrupt during emergencies of cultivation and sensitive situations. This water sources is long-lasting and steady and irrespective of consumption, water is always flowing. Kariz (aka Qanat) has many advantages and we just covered few of them here. Qanat has several advantage as water supply system; first of all, the major part of the water channel is located underground and as a result, water loss due to evaporation and penetration in the soil is minimized. Secondly, the system is powered by gravity without the need for any pump; and third, underground water is renewable. The third advantage brings numerous benefits.

From the beginning of the invention of the Qanats, the determination of the time and the equitable distribution of water among the shareholders were carried out by Mirab and with a clock or cup tool. The water clock consists of:

1. cup (minute measure)
2. A pot full of water.
3. Small stones or chips
- 4- Human calculator or Mirab
5. The place where was the Cup House, and the Mirab was permanently settled there.

A cup is a small bowl with a stanchion in the middle of it and a few degrees or a numerical mark in its inner body that is placed on large boiler full water. First, in order to determine the precise timing of the use of Qanat water and the equitable sharing of the water, this technology was invented, but later they found other uses including to determine the longest day, the longest night, night and day equality, and the determination of religious times during the Islamic period.

This water clock is at least two thousand years old and has been used since the beginning of the construction of the Gonabad Qanat. The management of this water clock was accomplished

by at least one person at the day and one person at the night, and the time (minutes) was calculated based on the number of cups filled with the number of chips or rocks as well.



Figure 42- Water Clock

IV. Cultures, Value Systems and Social Organization

Agricultural culture and value system

Cultural and Symbolic Meanings of Saffron

In our country, the value of Saffron is more than a plant. Saffron and its blossoms in the spring are a symbol of beauty and youth. The freshness and beauty of Saffron blossoms provide the city of Gonabad to become as a haven in the heart of the Binalud desert plains and as a symbol of beauty and happiness, freshness and liveliness. One of Gonabad's most prominent symbols is the Saffron fields in the harvesting season, where there are seen violent patches of Saffron leaves.

Saffron in Persian Literature

The Saffron plant is indigenous to Iran and India, and it would not grow naturally in Arab countries. The Persian word for the Saffron plant is *korkom* (Persian: “کُرکُم”), which is pronounced in the Middle Persian in the form of *kurkum* (Persian: “کُورکوم”).

The Iranian poets who have been mentioned Saffron, include: Ferdowsi, Nasir Khusraw, Salman Savoji, and Nizami Ganjavi. Ferdowsi (a thousand years ago) wrote a poem about Saffron in the *Shahnameh*.

Salman Saviji (seven hundred years ago) has written about Saffron in the book “Jamshid and Khorshid”:

Nasir Khusraw (hundred and fifty years ago) has mentioned Saffron in description of a part of the Achaemenid Apadana Palace.

Nizami Ganjavi (eight hundred years ago) mentioned Saffron in the story of “Khosro and Shirin” in description of ingredient of *Faloudeh Shirazi*.

Indigenous Food Culture

Saffron is a fragrant and natural flavor and color, and delivers a special flavor to foods. It is warm in humor, and is commonly used in Iranian cuisine as a joyful material. It is used extensively in foods (especially with rice), sweets, cakes, ice creams, drinks and so on. Haji Mohammad Ali Baruchi described as the cook of Shah Isma'il in his 929 AH book “*Tabakhi*” various receipts of many Iranian dishes and ancient *halva*, in which it was used Saffron.

Saffron has been used for its beautiful color, flavor and exceptional taste from long time ago. In recent years, the use of Saffron has increased with the tendency of the community to consume natural supplements, rather than chemical and synthetic types in foods.

Today Saffron is very common in technology and industry, and various factories in the food industry use Saffron in the production of sausages and margarines. Dairy factories use it to make varieties of butter, cheese and other manufactured products. In some factories, Saffron is used in the preparation of various types of cake powders and in a variety of desserts. Saffron is also utilized as a natural and healthy flavoring agent in some hot and cold drinks such as Saffron sauce, Saffron tea, Saffron milk, jelly, ice cream, chocolate, candy and sweet, cake and muffins,

breadcrumbs and so on. Saffron is an essential part of the receipts for some soups, seafood, rice and poultry, and is also used to make desserts and beverages. In many cultures, Saffron is a valuable spice that many people like to taste. And they like its flavor and color.

In Iran, it is not possible to make many foods without seasoning it using Saffron, including those with Saffron chicken. Saffron also has an important role in the preparation of many types of traditional Iranian cakes and sweets such as *Sohan of Qom*, *Masghati of Shiraz*, *Halva of Yazd*, *Bread of Kermanshah*, *Ranginak of Khuzestan*, *Date Cookies of Lorestan*, *Qottab*, etc.



Figure 43-Saffron Tea



Figure 44-Saffron used in various desserts



Figure 45- Use of Saffron in Tah Chin and Cooked rice

Saffron in Celebrations and Festivals

The culture of the people in this region comes from more than three sources:

1. Religious rituals
2. National customs and rituals, such as Nowruz and *sizdah-bedar*, and *shab-e yalda*, or Yalda Night, which has a very ancient history in this area.
3. Local and traditional venues such as the wedding party and the *hanabandan* ceremony in the public bathroom, the *Kharman* celebration, the autumn celebration of the breeding season of the sheep and the harvesting of Saffron, which is one of the most important celebrations in the region.
4. **Thanksgiving for Saffron harvesting in Gonabad:** The purpose of this thanksgiving ceremony is to introduce Gonabad as an independent brand in the production of Saffron. Every year, after a month of work and effort in Saffron farms, the hardworking people of this area, for the sake of this beautiful and worthwhile blessing, celebrate one full day in the village.



Figure 46- Thanksgiving for Saffron harvesting in Gonabad

5. **Foam Ceremony:** The "Foam" is a sweet type that is obtained by "stirring" the water of "Soap Plant (Chubak)" and sweetening it. To prepare this local pastry, they have slaughtered some "boletus" or "buck" (which is a root of a desert plant) and how many times they boil in water, and because it is bitter, they change it and boil it again. They repeat so much that it gets bitter and does not have any flavors. Allowing this water to cool, then they pour it in a large container that is better to crumble. Men and young people, with a handful of thin pods of pomegranate trees called "Bazzog", combine this fluid to a similar degree to the foam, but this should be done in a cool environment, and usually the chest will continue with a specific song until the "foam" becomes stiff. Then add some grape juice or sugar syrup or sugar powder gradually to the foam to give it a good blend and make the "foam" sweet. When the "foam" is prepared in any direction, they pour it into sacks and pour it into a peppermint of walnut, almonds, pistachios and fennel seeds (fogs) and eat it with fingers. The "foam" thus obtained is sweet, delicious and aromatic that much can be eaten. Before they "sweat" the foam; for fun and recreation, they occasionally rub somewhat of it, and since this "foam" does not have a flavor and odor, it does not hurt anyone. This action is a laugh and a tool for fun. Sometimes, in snowy nights, believing that it is happy, they put some "foam" on the snow. "Foam" is one of the most beautiful and delicious winter activities, especially nightfall or Yalda (the longest night of the year), which is common among all the people of Khorasan province, but in the villages where the weather is cooler, people are more likely to attend the ceremony.



Figure 47- Foam Ceremony

Medicinal Culture

Saffron belongs to the Lily family and has been used extensively since thousands of years ago. For a long time, it was used as a cure for cough, cold, stomach illness, insomnia, uterine bleeding and heart disease and bloating. Saffron has always a special place among our Iranians, and its taste and aroma are always reminded of Persian original dishes. Saffron is a plant that has a medicinal effect in many cases and has a positive effect on the treatment of certain diseases.

Saffron has anti-cancer effects and acts as an anti-tumor agent and eliminator of free radical. Based on medical research, it has been proven that antioxidants in Saffron have anti-cancer properties. According to the results of this study, the use of Saffron seems to prevent the occurrence of carcinogenic gene sequences and has a significant effect on the repair of damaged DNA molecules.

Saffron consumption is effective in preventing depression. According to today's research, Saffron has anti-depressant properties, while traditional medicine has also attributed Saffron to the joyful and laughing properties. The use of Saffron in food and drink at least one cup of Saffron tea for relaxation is recommended. Saffron is an enhancement of the mind's focus and is effective in preventing Alzheimer's and Parkinson's disease. Saffron is effective in treating neuropathic pain and low back pain.

Saffron Byproducts and Industries

Saffron is widely used in perfume and fragrant industry as well as in dye industry. Saffron gives food a special aroma and color, and therefore it is common in the food industry, such as sausage, in confectionery such as cake powders, in pharmaceuticals such as antidepressants, in textiles such as silk fabrics, in the manufacture of (alcoholic and non-alcoholic) beverages and as a natural flavoring agent in the dairy industry and etc.

Dye: Saffron is a plant with purple, red or yellow color. Saffron dyes are used in textile industries, such as silk fabrics and carpet yarn as well as in some old buildings. In Iran, Saffron dye is sometimes used to write prayers.

Perfume industries: Saffron has a sweet odor due to its Safranal substance. The essential oil of Saffron is used in the formulation of many precious fragrances, and because of the increasing tendency of the world to apply to natural smells, Saffron essential oil is used widely. In the valuable book of "An Introduction to Saffron of Iran", Professor Mohammad Hassan Abrishami points to carpet weaving girls who use the Saffron as coloring agent in their yarn, and says that they are smiling and happy at the exit from the workshop because of the contact to Saffron.



Figure 48-Industrial processing steps of Saffron



Figure 49- Various packages of Saffron

Social Organization

Women Participation in Cultivation and Harvesting

This place that reflects the role of women beyond formal culture, as the role of women becomes more pronounced at the time of cultivation. Women are at all stages apart from their usual activities working along with their families; perhaps, because Saffron is more than a commercial commodity and has come into the family structure, and they usually manage and coordinate family in these days. In all stages of cultivation of Saffron in Gonabad (planting, Caring, harvesting), the presence and participation of women is well seen. In early November each year, with the arrival of the first flowers of Saffron, Gonabad will announce the arrival of a new occasion in the city. The masses are preparing for a nearly twenty-day activity that will involve a very intensive work with participation of all the social classes. A few days later, Gonabad's Saffron flowers are ready to be harvested. All people who directly or indirectly benefit from the economic benefits of Saffron flowers come in contact with it. Some families do not mainly sell Saffron products as wholesale, they consider it as cash and keep it at home so they can be easily converted into money when needed in the market. This is also done under the management of women throughout the year. They take out a few batches of Saffron from the warehouse for sale when they need it. Therefore, many retail transactions in Gonabad are managed by women. The people of Gonabad are divided into four categories in dealing with Saffron:

- 1- Those who themselves cultivate Saffron flowers, and in these days, they perform the stage of separating sepal and stamen (stage of separation) in addition to harvesting flowers, and then experience economic benefits.
2. Those that do not cultivate Saffron flowers and do not harvest, but are in the flower market, and after buying the farmer's yield, enter the stage of separation and economic profits.
3. Those who do not have Saffron flowers and who only help farmers in the separation stage and get paid.
4. Those who do not enter this cycle, but during these days, involve in a way in changing atmosphere of the market, nature, and even change in the social interactions of families, and as a result, they are acting differently.

In less than a month, Saffron flowers will emerge every day, which should be harvested immediately, and at last two days before drying, they should pass the separation stage. Therefore, the work speed needs the cooperation of all the members of family and also relatives and friends.

During the harvest, all families are involved and work is not done only by male members. According to an old pattern, all family members go to the Saffron field at the early hours of the morning before the warming up of the air, when the yield is still in bloom form. The harvest takes several hours. Everyone moves in a row and manually picks the flowers. Then they come home and perform the separation stage. If there are many flowers, two approaches will be to follow. Part of it is sold in the city market, which is now very hot. A remaining part is also packed in about two, three, or five kilograms packages, and is distributed among the neighbors who did not grow themselves to carry out the separation process and then earn their wages.

However, what is important in the narrative of harvesting a high-profit agricultural product for cultural studies is the existence of many private small-scale landlords, which has made the meaning of the "action" unique to these products both in qualitative and quantitative terms. In term of quantitative, the small-scale ownership increases the total area of cultivation and more families enter the special customs of Saffron growing, and on other hand, qualitative term means that all the members of the family's mental and physical components are affected, as everyone in every age is assigned a task regardless of gender, of whom a certain activity is expected.

Assisting in harvesting, collecting and packaging fresh Saffron yield and arranging them to dry are among the tasks performed by women in the region. The reception of all family members during work is also their regular duty. As shown, some families is only helping major farmers in the separation stage. Establishing such relationship, and sending flowers to the doors of the neighbors' house and bargaining for the acceptance of multi kilograms of Saffron flowers and their separation is usually done by women of both families.

Handicrafts is mostly made by women in Seno Village of Gonabad, which helps the household economy. The handicrafts include carpet weaving, texture, sewing of traditional clothes and so on.



Figure 50- Participation of rural women in the harvest of Saffron

Cooperatives, Exporting and Producing Organizations

In Gonabad, there is a Union of Rural Cooperative Enterprises, and farmers are able to become a member, participate in and contribute to the agricultural activities of the Department of Agricultural Jihad, and benefit from various facilities in addition to receiving training in the field of planting, Caring, and harvesting crops. The training include preparation of Saffron farms, how weeds are weaned, and the harmful effects of burning grasses and so on. Also, the Herb Medicine Research Center in Gonabad, with many activities, especially in Saffron, has helped a lot of farmers of the region.

Covered cooperatives in Gonabad include 15 producing cooperatives, which account for 95% of the agricultural and orchard lands of the county, covering wheat, barley, cotton, pistachio, Saffron, with total membership of 5000 members.

8 rural unions and 15 production cooperatives are operating under Gonabad Cooperation Office and the BETKA system acts as mediator which purchased about 64 tons in 2017. In addition to Gonabad, there are different companies and factories. For example, Zarrin Saffron East Company has an international Saffron exchange and operates in Torbat Heydarieh; numerous farmers, investors, merchants and exporters are among subscribers of the company. Activity such organizations in Mashhad is common; these organizations have their activities focused in industrial parks and process Saffron products. Khorasan Union of Saffron Exporters with more than 52 members, including Novin Saffron, Mostafavi Saffron and Sahar Khiz Saffron that are among most reputable Saffron producers is another example of such organizations.

- Saffron cooperatives and their affiliated organizations include Saffron producing unions (private, more than 25 years history)
- Distributors: Saffron Distributors Association (Private, over 6 years of experience)
- Saffron Exporters Union (Private, more than 10 years old)
- International Saffron Exchange (private, over 5 years old)

Mizou Co. Organic Project

The project of Mizou Saffron, Gonabad, which is being implemented with the participation of all farmers, villagers and the Islamic Council of the Seno Village, is considering its long-term vision, creating an Eco Village in Seno, aiming to produce organic Saffron by improving the way cultivating, producing, processing and using indigenous knowledge with a historical background based on the use of biological elements and the use of renewable farm inputs.

With the support of the traditional knowledge available in the region, it introduces a new model of sustainable development and innovative rural entrepreneurship in which the development of climate-intelligent agriculture is designed around three basic axes: production sustainability (quantitative and qualitative), adaptation to ecological trends in Environment, long-term adjustment and long-term relief effects of environmental degradation trends. This is the largest internal control system (ICS) of the country and the first project to produce organic Saffron in the world.

In order to empower rural women, especially women headed by households, a workshop on training and production of Gelim (traditional carpet) and weaving was initially trained and then provided with suitable tools and materials for carpet weaving and knitting in the home. Outside

the harvesting season, and Saffron processing, to make economic activities and thus earn a decent income.

Another advantage is the identification of all organic Saffron farms covered by the project, which is 1780 pieces and totally 450 hectares and includes 700 farmers. The identification card of each piece contains information such as geographic characteristics of GPS and Auto Cad maps and Google Map, and the owner's and farmer's details, precisely, the plan and amount of irrigation, the type and amount of organic and biological inputs, as well as the plan for land cultivation and cropping pattern Farmer application and other reports.

Also, with the establishment of the ICS internal control system, the management of the group of Saffron farmers as a systematic and purposeful organization based on the concept of win-win, based on standards and practical agricultural practices, has had a significant social, environmental and economic impact in the region. This group of farmers Organic Saffron, ICS is organized and managed by the manager and internal inspection team and a number of experts and agricultural specialists and agro-ecology experts.

Impacts such as improving the ecosystem of the region and improving the level of soil and water health and the entry of biological elements in the production cycle, as well as stopping the migration from village to town and, of course, reversing the return of the village to the return of many villagers to their farms and their homes caused by Increasing motivation and increasing the income and value added of the product and allocating it to farmers, as well as increasing the level of health of farmers and their families through the elimination of chemical inputs, which led to a reduction in the rates of chemical toxicity.

Saharkhiz Saffron Co.

The company has a history of 85 years and runs from cultivation to domestic and foreign business. The company manufactures processes and packages various types of Saffron products. Getting the best taste and quality award in 2017 for Saffron Negin, Saffron Tea and Pistachio Saffron, and in 2018 for Saffron, Saffron Candy, Saffron Infusion , Green Tea, Cinnamon, Green Tea, and etc. from the International Taste and Quality Institute (iTQi) is a success of this company.

Saharkhiz Co. also has a 100 hectare Saffron Farm. Its next seven plan is to achieve 10 kg/ha production. The company covers 450 farmers' households and covers a total of 400 hectares of farms. All of these services are carried out through a contract between the company and the farmers. Participation in farmers is under way in various forms:

1- As a public corporation, a large part of the farmers in different parts of Khorasan Razavi are shareholders. Participation also includes the land of the company and the land of the farmers and the land of other cooperative companies willing to cooperate. The overall management of the farms is with the company and the farmers' association. The company trains farmers and provides the farmer with organic support and provides the necessary support. Finally, it purchases 30% more than the market price of the farmer.

2. In this new system, the company participates in profit and loss with farmers. Another type of cooperation is with farmers who have water and land but do not have the ability to make costs for production, which the company pays for costs.

3. Another kind of cooperation is between the company and the centers related to the extension and education of agriculture, which is carried out with the participation of the Agricultural Organization

4- Assign a place for direct referrals of farmers without a contract for selling their product.

Novin Saffron Co.

It is a family-owned, enterprise in the food industry; founded in 1992 and noted for our high-quality products & innovation. Since the very beginning, the Company has been keeping a high profile as a specialized, innovative, honest, serious and prominent producer and exporter on the world trade scene for high-quality and differently-packaged Saffron and for services based on customer satisfaction. One of the Company's important activities is its cooperation with international and important scientific centers such as Chiba University & Mashhad University of Medical Science in proving and expanding medicinal uses of Saffron which have been followed by astonishing results.

Setting up the world's greatest unit for the hygienic processing and packaging of Saffron in clean room conditions, designing and producing over 400 kinds of packages in different languages and with different nations' tastes, making wide-ranging scientific researches, producing tens of by-products from Saffron and exporting them, conducting extensive marketing research and exporting to the five continents are parts of the activities of this production unit.

It exports to more than 25 countries as: Spain, Italy, Sweden, France, Switzerland, Germany, Belgium, Bosnia, United Kingdom, Austria, USA, Canada, New Zealand, South Africa, Hong Kong, China, Singapore, Japan, South Korea, Kuwait, Bahrain, Qatar, Oman, Saudi Arabia, United Arab Emirates, Turkey, ...

Novin Saffron is the world's Saffron producer which holds ISO 14001, ISO 9001, ISO/FSSC 22000, HACCP Standards, ISO 10002, ISO/TS 10004 which has the first ISO/IEC 17025 accredited Saffron laboratory, which holds the Health Apple Certificate awarded by the Ministry of Health and FDA and which has for several times been selected as the country's model exporter and producer, the country's top product, the country's model R&D and



Figure 51-Saffron Associations and Awards

The effects of Qanat on Gonabad's local social and cultural organization: Gonabad is part of the Qanat civilization. Qanat civilization is known for its small-scale landowners, handicrafts and commerce. In a society where production and economic factors with high standards are formed, people are calm and have a calm morality.

In similar areas of Gonabad, where *Qanat* play an important role as a source of water, a particular social organization has been formed, which is called *Qanat civilization*. Within the boundaries of the Qanat civilization, the division of water is usually controlled by the small-scale owners. There is a large number of villagers and *Qanats* in this territory. There is a system of micro ownership and common issues tied with *Qanats* (repair, protection, dredging, etc.) that require a specific organization.

This organization was created by the water dividers and stewardship. In the past, when there were no formal offices, these people played an important role in managing the city.

Impact of Saffron on Urban Structure of Gonabad

In general, Qanats impose significant impact on structural aspects of urban and rural areas; such impacts may be found even in this era.

Traditionally, when a Qanat is active in a city, water canals pass through large houses owned by important and influential people and then smaller houses would benefit from the water. Finally, it would pass through houses without any access for houses. Thusly, Qanats not only impacted physical structure of cities, but also they affect social structure of rural and urban areas.

The followings are aspects of importance of Saffron and Qanat in physical texture of the area: The region, its residential and farmland areas, Qanat debit rate, size and area of Saffron farms have diverse topographic and textural features because of climate and microclimate of the region. Zobeid and Kakhat villages are established on foothills.

V. Landscapes and Seascapes Features

Important Aesthetical Aspects and Landscapes

Saffron farms of the area are mostly built on sloped plane in form of small terraces which gave the area astonishing view. Area of Saffron farmlands of Gonabad's neighborhood exceeds 2,000 ha. These areas have highest quality, best access and most irrigation. During the harvest season, aerial view of the region stunning.

Landscape of purple flowers of Saffron at dawn creates velveteen scene over the lands. Considering that Saffron farmlands and Qanats supplying them are owned by minor farmers, narrow pathways are developed in surroundings the lands that creates interesting view. Violet, red and yellow composition of Saffron flower makes view of the city even more attracting.

Natural landscape and residential areas accompanied by farmed lands provided and excellent opportunity for tourisms; especially, Saffron farms have unique potential for promoting tourism and ecotourism. This can be interpreted as a valuable and economic privilege for livelihood of locals. Another value of ecotourism may be found in preserving natural and agricultural resources.

Considering that residential areas of Gonabad are surrounded by farmlands, unique views of these landscapes are accessible by a short trip. Additionally, depots of Saffron flower wasted parts create colorful picture in alleys and streets of Gonabd and contrary to any other waste, soothes mind of visitors. Saadi Street of Gonabad is the center for Saffron flower and root and activity of traders in this marketplace attracts attention of tourists. The city engages each and

every citizen in atmosphere created by Saffron business, even those who have no economic interaction with this product. Just like a local tradition and festival, everyone have a role in this business.

Rural areas occupied by farmers have the following features which may contribute to promotion of ecotourism:

- ✓ Colorful landscape of numerous but small farms in desert's nearby;
- ✓ Local traditions are inspired by geographic, natural and agricultural aspects of the area which is attractive for local and foreign tourists;
- ✓ One of the unique features of the area is local market of Saffron, the red gold which plays an important role in promotion of occupation and income of locals;
- ✓ Quants which are main source of water used for agricultural activities, especially Saffron farming are among structures which have tourism significance.



Figure 52-Saffron Farms Landscapes

III. Action Plan for the Proposed GIAHS Site Analysis of Strengths and Challenges

a) Strengths

- Due to more knowledge of people around the world and the importance of Saffron nutritional and nutritional values, the demand for this product has increased more than in the past.
- Appropriate marketing and exhibitions, and high added value of Saffron, which guarantees to increase the sales of Saffron.
- The success of local farmers due to the support of indigenous knowledge and traineeship from their ancestors and the use of scientific advisors for agricultural advocates.
- The passion for farmers and farmers who own and retain their own small land.
- Available and affordable human resources and dependence of Saffron on native human resources due to being traditional

b) Challenges

- Inadequate knowledge and low technical knowledge about pests, diseases and weed control, because of the incidence of diseases that have not had a history in the past, and there are new strategies.
- Length of the land idle period
- Droughts and the limitation of rainfed cultivation due to low rainfall and soil texture (sand) are among other factors that have led to a heavily dependent on Qanats
- The financial weakness of the farmers, which will force them to sell their products to intermediaries.

Proposed policies and strategies

- Increasing public awareness
- Protecting the biodiversity/agriculture and ecosystem
- Protecting experiences, technologies and agricultural traditional knowledge
- Economic development of GIAHS site
- Protecting the GIAHS site landscapes
- Protecting and improving cultural activities in GIAHS site
- Developing community-based rural tourism

Predicted actions to implement Policies and Strategies

Predicted action plan based on all stakeholders opinions are displayed in Table 9 in detailed.

MOA= Ministry of Agriculture Jihad

PBO= Plan and Budget organization

ICHHTO= Iran Cultural Heritage, Handicrafts and Tourism Organization

DOE= Department of Environment

MOIA= Ministry of Internal Affairs

MSRT=Ministry of Science, Researches and Technology (Universities and Affiliated Research Institutes)

MOP= Ministry of Power

MOIMT= Ministry of Industry, Mines and Trade

MOH= Ministry of Health

MOC= Ministry of Culture

MORUD= Ministry of Road and Urban Development

LOC= Local Communities

RIO= Related International Organization

IRIB= Islamic Republic of Iran Broadcasting

Table 9-Action plan for the GIAHS site: " Qanat – Based Saffron Farming System"

Funding Organization	Cost Estimate (Million IRR)	Executive Organization	Year	Plan	Results
PBO LOC RIO	800	LOC MOA MOP MSRT ICHHTO RIO	1	<ul style="list-style-type: none"> ✓ Identifying regions specific for Saffron farming ✓ Determining Qanat users that farm Saffron ✓ Making an educational feasibility study to introduce the site and its importance 	1) increase public awareness
PBO LOC RIO	1000	LOC MOA MOP MSRT	1	<ul style="list-style-type: none"> ✓ Monitoring droughts and consequences of low supply in Qanats ✓ Monitoring rural immigration pattern and shortage of work force ✓ Optimizing Qanats and improving their water productivity 	2) Analysis of threats and obstacles
PBO LOC RIO	800	LOC MOA MSRT DOE	1	<ul style="list-style-type: none"> ✓ Identifying biodiversity ✓ Providing required nutritional resources for the wild life when there is shortage 	3) Actions required to preserve agricultural and ecosystem biodiversity of GIAHS
PBO LOC RIO	1500	LOC MOA ICHHTO MSRT IRIB	1	<ul style="list-style-type: none"> ✓ Documenting and collecting local know-how ✓ Extending traditional farming tools ✓ Establishing a Saffron Museum and its associated local culture 	4) Preservation of experiences and traditional agriculture techniques and know-how
PBO LOC RIO	2000	LOC MOA ICHHTO MSRT	1	<ul style="list-style-type: none"> ✓ Developing the culture of tourism and eco-tourism during Saffron harvest times ✓ Introducing the unique natural vistas of the red gold of the desert 	5) Actions required for economic development of GIAHS
PBO LOC RIO	1000	LOC MOA ICHHTO MSRT IRIB	1	<ul style="list-style-type: none"> ✓ Identifying and documenting natural vistas and introducing them to tourists and target group ✓ Maintaining and preserving these vistas 	6) Actions required for preservation of GIAHS vistas
PBO LOC RIO	1000	LOC MOA ICHHTO MSRT MOC IRIB	1	<ul style="list-style-type: none"> ✓ Identifying, recording and documenting cultural activities including old proverbs, stories, legends, games and tradition in social activities, cuisine and dialects 	7) Actions required for preservation and improvement of cultural activities in GIAHS
PBO LOC RIO	500	MOA MOIA LOC	1	<ul style="list-style-type: none"> ✓ Forming special Saffron work group in the city and establishing multiple committees to work on and enhance GIAHS 	8) Actions required to enhance cooperation and contribution to carry out the aforesaid actions

PBO LOC RIO	500	LOC MOA MSRT	1	<ul style="list-style-type: none"> ✓ Forming evaluation committee for the site activities under supervision of local experts 	9) Monitoring and evaluation
PBO LOC RIO	5000	LOC MOA MOIA ICHHTO IRIB	2	<ul style="list-style-type: none"> ✓ National Saffron day with approach of preserving Qanats and broadcasting from the provincial and national IRIB 	1) increase public awareness
PBO LOC RIO	200000	LOC MOA MOP MSRT	2	<ul style="list-style-type: none"> ✓ Identifying deteriorated Qanats ✓ Prioritizing non-refundable government grants with the approach of repairing and restoring Qanats. ✓ Preserving Genetic reserves of the regional Saffron as an ancient heritage 	2) Analysis of threats and obstacles
PBO LOC RIO	1000	All stakeholders	2	<ul style="list-style-type: none"> ✓ Forming strict regulations to prevent anything threatening biodiversity (changing the occupancy of lands, breaking down land ownership, use of chemicals, over issuance of hunting license) 	3) Actions required to preserve agricultural and ecosystem biodiversity of GIAHS
PBO LOC RIO	3000	LOC MOA MSRT	2	<ul style="list-style-type: none"> ✓ Providing local know-how to researchers for scientific validation of local expertise. ✓ Establishing model farms in research centers according to traditional experiences and monitoring them 	4) Preservation of experiences and traditional agriculture techniques and know-how
PBO LOC RIO	10000	LOC MOA MOIMT MOH	2	<ul style="list-style-type: none"> ✓ Establishing Saffron processing plants and preventing sales of raw Saffron by providing suitable packaging and preventing wholesales ✓ Performing quality tests and providing appropriate health codes for the products in order to prevent frauds 	5) Actions required for economic development of GIAHS
PBO LOC RIO	5000	All stakeholders	2	<ul style="list-style-type: none"> ✓ Providing the necessary background to implement current regulations and forming new regulations to preserve vistas including prevention of desolation, overgrazing, preserving water sources such as Qanats, springs, seasonal and permanent rivers, beautification of villages and improvement of rural roads while preserving the authenticity and traditional texture 	6) Actions required for preservation of GIAHS vistas
PBO LOC RIO	5000	All stakeholders	2	<ul style="list-style-type: none"> ✓ Holding local traditional festivals ✓ Promoting a sense of national motivation to develop sustainable agriculture and food security of rural regions 	7) Actions required for preservation and improvement of cultural activities in GIAHS
PBO LOC RIO	1000	All stakeholders	2	<ul style="list-style-type: none"> ✓ Developing cooperative companies and support funds, NGOs, local farmer's market, holding administrative session at site 	8) Actions required to enhance cooperation and contribution to carry out the aforesaid actions

PBO LOC RIO	500	MOA	2	✓ Using experts to determine strengths and weaknesses of the action plan	9) Monitoring and evaluation
PBO LOC RIO	5000	MOA MSRT	3	✓ Holding national Saffron conference and using the opinions and knowledge of experts based on local know-how in form of articles or reports and inviting agriculture producers and developers	1) increase public awareness
PBO LOC RIO	150000	LOC MOA MOP DOE	3	✓ Continues decrease in precipitation in the region and lack of any snowfall during growth of this product is a threat to production and its economics that must be prevented by correct management of water (piping of streams) and suitable water feeding ✓	2) Analysis of threats and obstacles
PBO LOC RIO	1500	LOC MOA DOE MSRT	3	✓ Preserving natural resources and developing livestock and pastures balance plans to preserve the biodiversity of the region	3) Actions required to preserve agricultural and ecosystem biodiversity of GIAHS
PBO LOC RIO	3000	MOA IRIB	3	✓ Selecting model farmers with the approach of applied traditional know-how and extending this knowledge by face-to-face or documentary methods	4) Preservation of experiences and traditional agriculture techniques and know-how
PBO LOC RIO	10000	LOC MOA ICHHTO	3	✓ Constant planning and investment to attract foreign tourism and establish required infrastructure according to the general culture of the region	5) Actions required for economic development of GIAHS
PBO LOC RIO	1000	LOC MOA	3	✓ Participating famers in persevering and maintaining vistas and utilizing incomes derived from them as motivation	6) Actions required for preservation of GIAHS vistas
PBO LOC RIO	2500	LOC MOA MOC ICHHTO	3	✓ Promoting regional and local festivals, gatherings, contests including local games and sports, poetry and story telling with regional dialect, cooking contests and etc	7) Actions required for preservation and improvement of cultural activities in GIAHS
PBO LOC RIO	2500	LOC MOA MOC ICHHTO	3	✓ Providing the means for participating of celebrities (directors and investors) to further the financial and research objectives and encouraging the public to participate in activities available at the site	8) Actions required to enhance cooperation and contribution to carry out the aforesaid actions

PBO LOC RIO	800	All stakeholders	3	✓ Initial evaluation of programs and directives to achieve the future scope of the site by the selected organization and choosing best practices	9) Monitoring and evaluation
PBO LOC RIO	5000	LOC MOA IRIB	4	✓ Allocating independent budget for the site and funding to preserve and maintain water sources and educating the users to increase productivity in farming	1) increase public awareness
PBO LOC RIO	5000	MOA in corporation to other stakeholders	4	✓ Forming executive directive for GIAHS and establishing sustainability regulations by considering threats such as droughts and rural immigration	2) Analysis of threats and obstacles
PBO LOC RIO	2000	MOA DOE ICHHTO	4	✓ Preserving ecosystems and biodiversity	3) Actions required to preserve agricultural and ecosystem biodiversity of GIAHS
PBO LOC RIO	5000	LOC MOA	4	✓ Promoting workshops, classes and centers for learning and extension of agriculture to transfer local know-how to other farmers, promoting camps and conferences for farmers of other regions in GIAHS	4) Preservation of experiences and traditional agriculture techniques and know-how
PBO LOC RIO	5000	LOC MOA MSRT MOIMT ICHHTO IRIB	4	✓ Amending quality methods of processing (storage, packaging, processing plant, Safranal and Crocin extraction with state of the art systems) ✓ Planning to restore old farms, consulting with local tours to develop tourism culture of the region ✓ International promotion of natural vistas and attracting international tourism	5) Actions required for economic development of GIAHS
PBO LOC RIO	600	LOC MOA ICHHTO IRIB	4	✓ Facilitating ease of access for tourists to natural vistas considering the limited window of Saffron harvest and emphasizing this to both tourists and farmers	6) Actions required for preservation of GIAHS vistas
PBO LOC RIO	2000	LOC MOA ICHHTO IRIB	4	✓ Promoting local contests regarding micro culture of Saffron, involving the education department in preserving this valuable heritage and as this product is harvested by the family students should be free for few hours per day to assist their family in harvest	7) Actions required for preservation and improvement of cultural activities in GIAHS
PBO LOC RIO	1000	All Stakeholders	4	✓ Participating users in planning and getting their opinions, technical conferences with research center and university and exchanging opinion between researchers and university	8) Actions required to enhance cooperation and contribution to carry out the aforesaid actions

PBO LOC RIO	500	Relevant public bodies in cooperation to LOC	4	✓ Providing seasonal reports of inspectors to the specialized workgroup	9) Monitoring and evaluation
PBO LOC RIO	3000	LOC MOA ICHHTO IRIB	5	✓ Holding harvest festival and Saffron thanksgiving tradition throughout the site as a public culture (Saffron thanksgiving tradition is held each year in Gonabad after harvest)	1) increase public awareness
PBO LOC RIO	40000	MOA	5	✓ Guaranteed purchase of Saffron based on quality	2) Analysis of threats and obstacles
PBO LOC RIO	1000	LOC MOA DOE	5	✓ Planting plants that develops pastures and prevent soil deterioration to prevent damage by wildlife to GIAHS	3) Actions required to preserve agricultural and ecosystem biodiversity of GIAHS
PBO LOC RIO	50000	LOC MOA MOIMT	5	✓ Attracting investor for branding and/or industrializing valid local experiences and know-how	4) Preservation of experiences and traditional agriculture techniques and know-how
PBO Locals& Related International Organization	500000	LOC MOA MOP MIA MORUD	5	✓ Developing main roads to adjacent provinces, repairing and dredging Qanats and constructing diverting dams and streams covering canals	5) Actions required for economic development of GIAHS
PBO Locals& Related International Organization	1000	LOC MOA MORUD ICHHTO	5	✓ Developing access road to tourism destinations, providing the opportunity for harvest by tourists	6) Actions required for preservation of GIAHS vistas
PBO Locals& Related International Organization	6000	LOC MOA MOC IRIB	5	✓ Using the rural capacity as the location for shooting films, making regional quarterlies regarding site news, establishing local radio, holding annual exhibitions	7) Actions required for preservation and improvement of cultural activities in GIAHS
PBO Locals& Related International Organization	2000	LOC MOA MIA	5	✓ Using every available political, social and public capacities to further the objectives	8) Actions required to enhance cooperation and contribution to carry out the aforesaid actions

PBO Locals & Related International Organization	100	All stakeholders	5	✓ Reflecting the results of the workgroup to be analyzed by research institutes	9) Monitoring and evaluation
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Appendix 1: Tables

Table A 1-The wild plants of regional rangelands

Scientific Name	Persian Name	Uses	Plant Type
<i>Halotis Pilosa</i>	دانهشور	Medicinal–Fodder	Perennial
<i>Suaeda sp</i>	سیاهشور	Fodder -Medicinal–Protective	Perennial
<i>Astragalus gasdianus</i>	گون	Industrial–Medicinal–Feed– Fodder–Protective	Perennial
<i>Eryngium noeanum</i>	زول	Medicinal—Fodder–Protective	Perennial
<i>Amygdalus Lycioides</i>	تنگرس	Medicinal–Industrial–Fodder– Feed–Protective	Perennial
<i>ConvolvulusLeicalyc</i>	پیچک	Fodder–Protective	Perennial
<i>Achillea millefolium</i>	بومادران	Medicinal–Fodder	Perennial
<i>Acanthophyllum sp</i>	درمنه	Industrial–Protective–Medicinal	Perennial
<i>Centauria virgata</i>	گلگندم	Aggressive	Perennial
<i>Lris songarica</i>	زنبق	Fodder–Protective	Perennial
<i>Peganum harmala</i>	اسفند	Medicinal–Protective	Perennial
<i>Alhagi camelorum</i>	خارشتر	Fodder–Protective–Medicinal	Perennial
<i>Alriplex leucoclada</i>	سلمهتره	Fodder	Perennial
<i>Ebenus stellata</i>	بادلنگ	ProtectiveFodder -	Perennial
<i>Farula Foeticla</i>	کما	Fodder	Perennial

Table A 2- The Wild Mammals

Scientific Name	Persian Name	Scientific Name	Persian Name
Canis Lupus	گرگ	Hystrix indica	تنشي
Felis silvestris	گر بهحشي	Capra aegarua	كلوبز
Gazellu subgutturosa	آهو	Sus scrofa	گراز
Vulpes vulpes	روباه معمولي	Ovis orientalis	قوچوميش
Lepus europaeue	خرگوش	Panthera pardus	پلنگ وحشي

Table A 3- The Wild Birds

Scientific Name	Persian Name	Scientific Name	Persian Name
Alectoris chukar	كَبَك	Accipiter nisus	قَرَقِي
Grus grus	دَرَنَا	Aquilaheliaca	عَقَابشَاهِي
Chlamidotis undulata	هُوْبِرِه	Aquila chrysaetos	عَقَابطَلَايِي
Athene noctua	جَغْدَكُوچَك	Falco cherrug	بَالَابَان
Bubo bubu	شَاهبُوف	Falco peregrinus	بَحْرِي
Pica pica	زَاغِي	Falco Pelegrinoides	شَاهِين
Columba Livia	كَبُوتَرچَاهِي	Falco Subbuteo	لِيل
Sturnus Valgaris	سَار	Falco tinnunculus	دَلِيجِه

Table A 4- The Wild Reptiles

Scientific Name	Persian Name	Scientific Name	Persian Name
Eryx Jaculus	كُورمَار	Varanus griseus	بَزْمَجَهَبِيَابَانِي
Testudo horsfeldii	لَاكِيشْتَاَسِيَايِي	Coluber ravergeri	مَار پَلَنگِي

Appendix 2 : Maps



FigureA 1-The map of administrative divisions of Islamic Republic of Iran

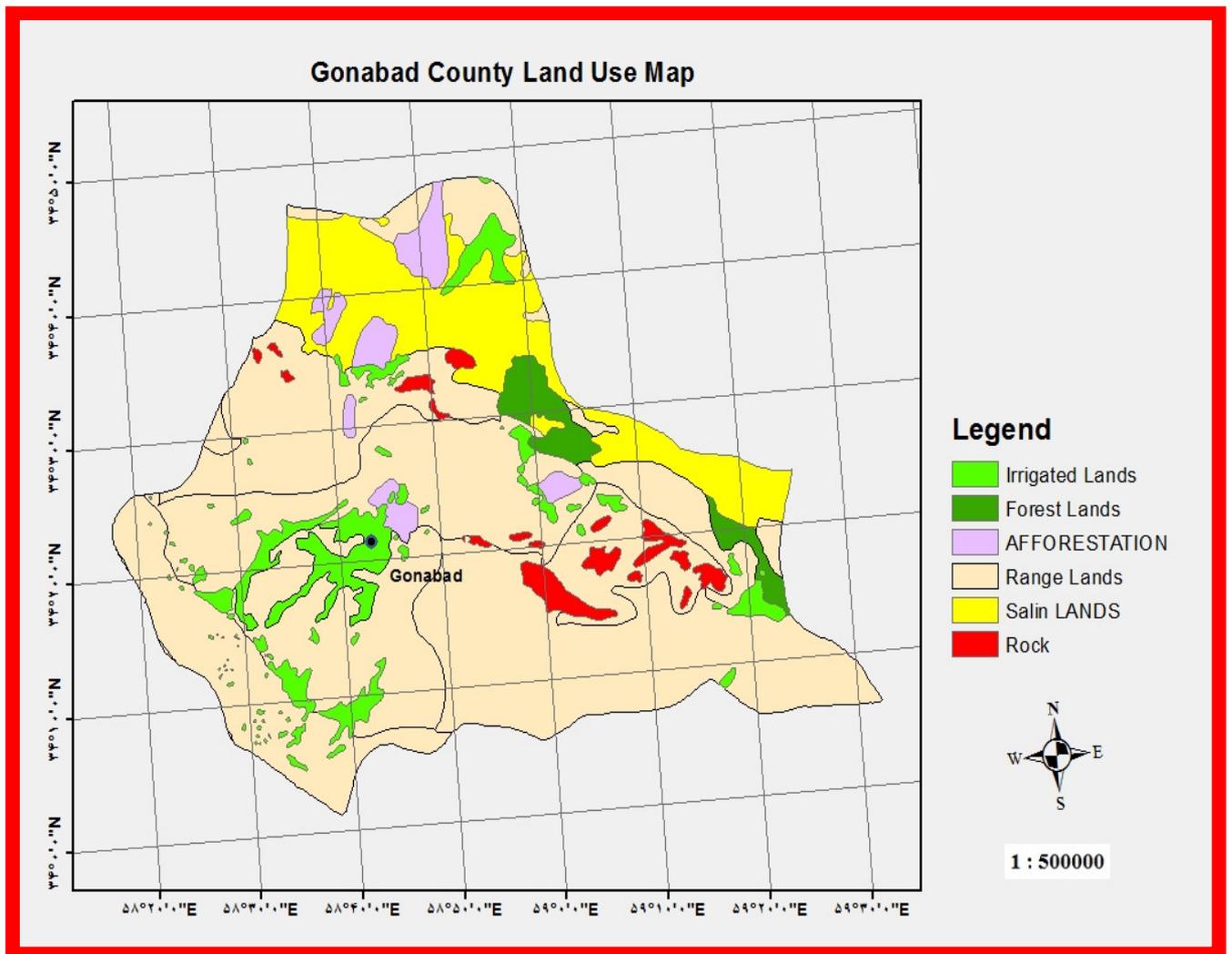


Figure 3-Gonabad County Land Use Map

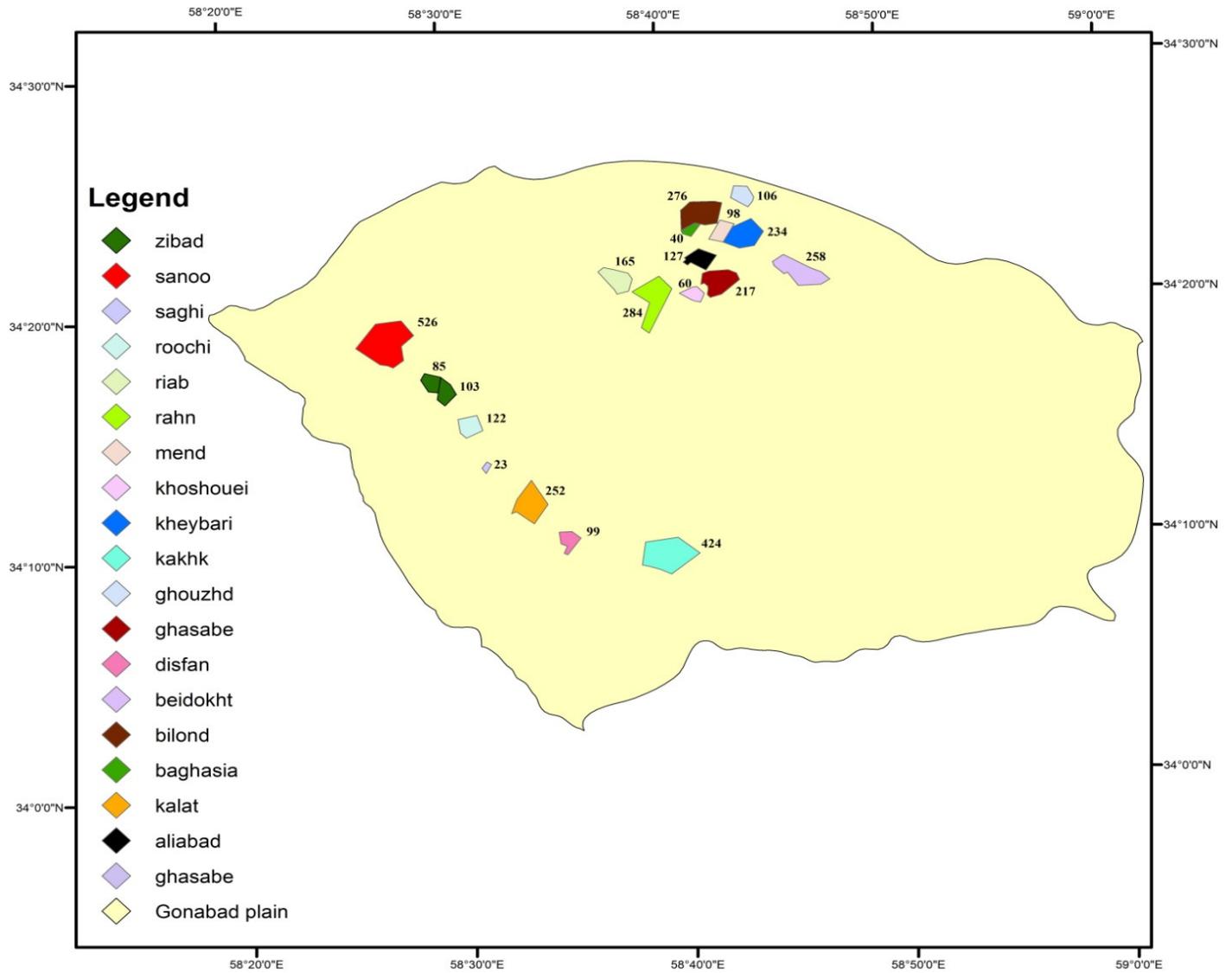
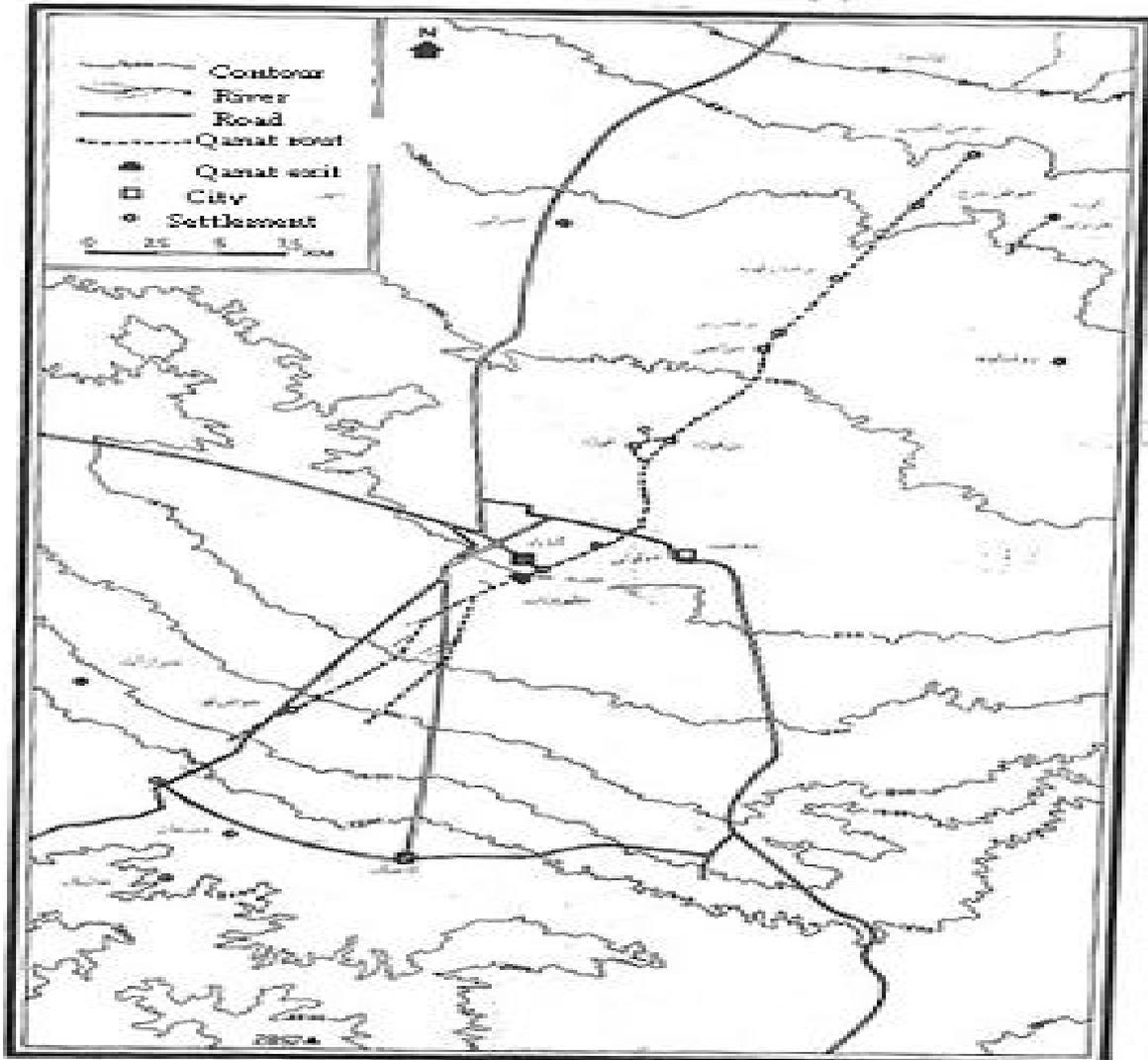
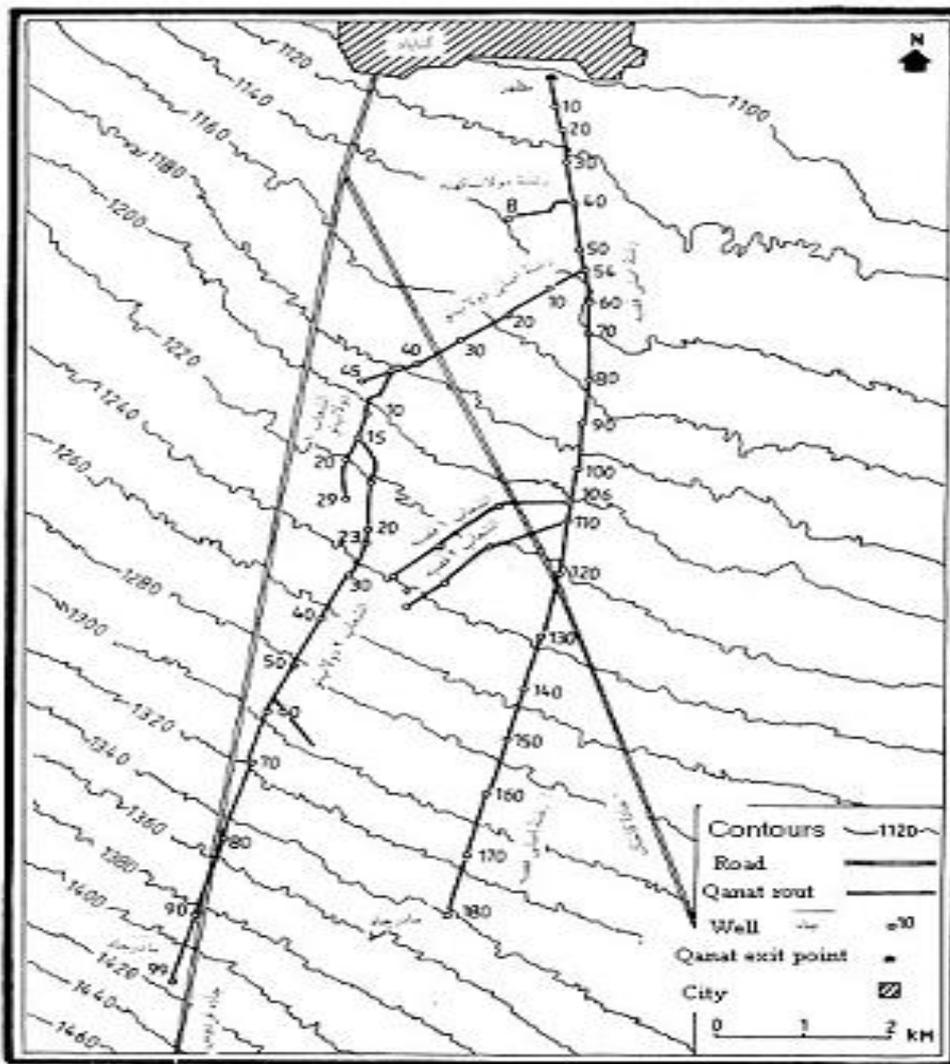


Figure 4-Areas under cultivation of Saffron in Gonabad Land Use Map

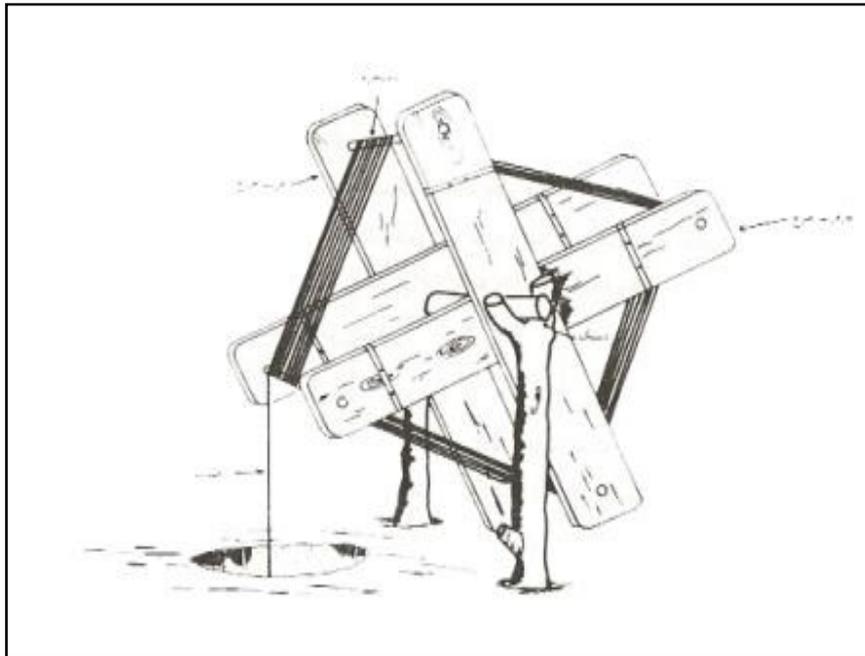
Appendix 3: Photos



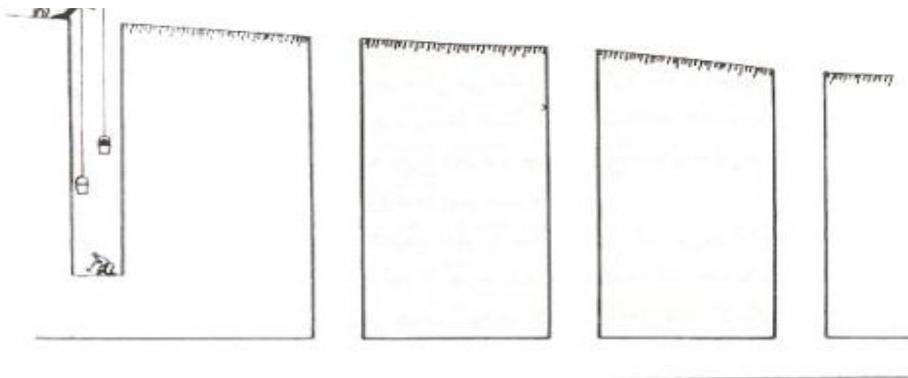
FigureA 5-Past Rout of the Ghasabe Qanat of
Gonabad



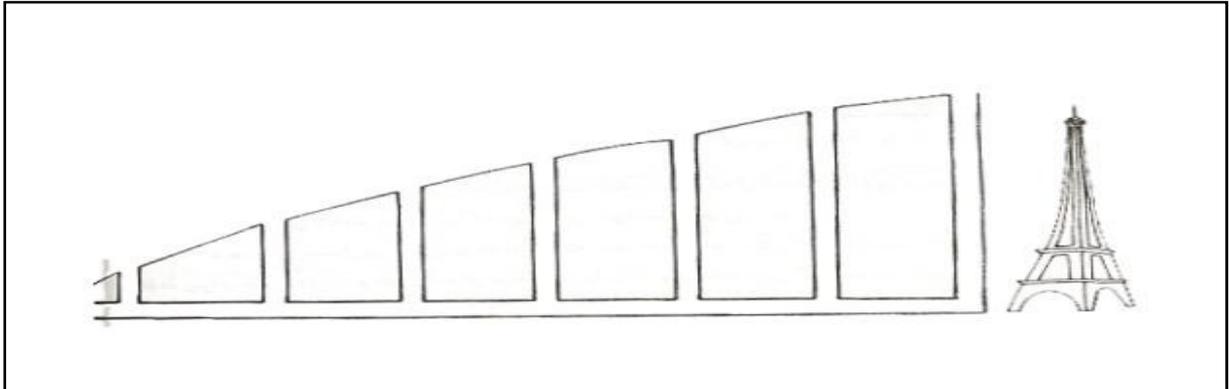
**FigureA 6-The current route of the Ghasabe Qanat of
Gonabad**



FigureA 7-The water wheel with two buckets for extracting materials



FigureA 8-The water wheel with two buckets for extracting debris



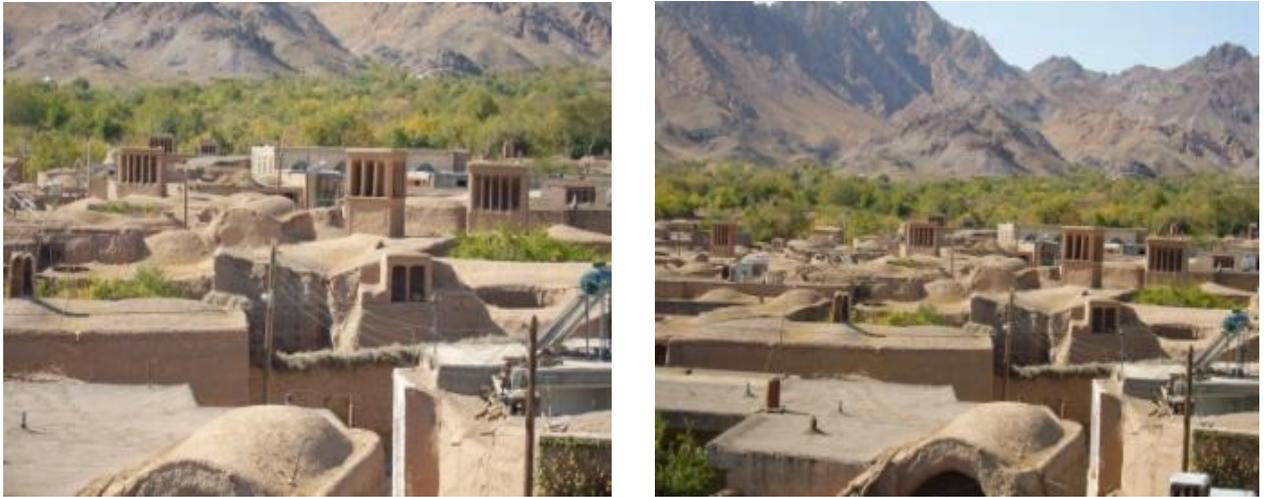
FigureA 9-Comparison of Eiffel tower height with depth of mother well in the Ghasabe Qanat of Gonabad

Name: Ghasabeh Qanat
Location: north Slope of *Siah Kouh* (southwest of Gonabad)
History: 2500 years
Number of wells: 427
Depth of mother well: 300m
Length of canals: about 33km]

[Mother well; wells; Qanat canal; opening of Qanat (or *mazhar Qanat*); agricultural land;
underground water streams]



FigureA 10-Qanat as symbol of Iranian civilization



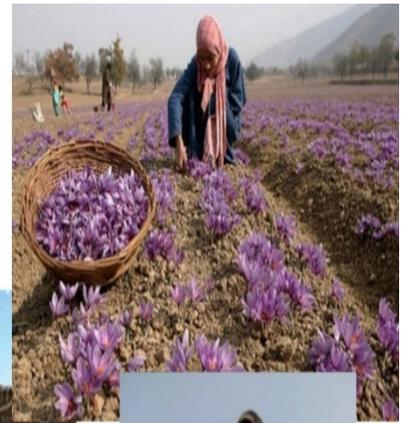
FigureA 11-The view of the Ghasabeh area of Gonabad



FigureA 12-The entrance of the historical Ghasabe Qanat of Gonabad



FigureA 13-Ghasabe Qanat of Gonabad marked as a historic landmark



FigureA 14-Saffron Farms and Processing Units

List of Proposal Authors and Contributors
Qanat–Based Saffron Farming System in Gonabad

No.	Name	Designation	Affiliation	Role
1	A. KianiRad(PhD.)	Assistant Professor (Agricultural Economics)& Research Deputy	APERDRI	Scientific Supervisor & Editor
2	J. BehzadNasab (PhD.)	Assistant Professor(Geography and Rural Planning))& Head of Agro-Industries and GIAHS Research Group	APERDRI	Supervisor & Research Team Manager
3	M.R. Motevalli Alamouti (MSc.)	Senior Researcher	APERDRI	Author
4	S. A. Mousavi (MSc.)	Senior Researcher	APERDRI	Co-Author
5	S. Joafshan Vishkaei (MSc.)	Senior Researcher	APERDRI	Co-Author
6	H. Ataei(MSc.)	Senior Researcher	Gonabad County Agriculture Jahad Management	Co-Author
7	J. Emami	Expert	APERDRI	Contributor
8	M. Mazrooei(MSc.)	Head of Organization	Khorasan Razavi Agriculture Jahad Organization(KRAJ)	Contributor
9	N.G. Salehi(MSc.)	Deputy of Organization	Khorasan Razavi Agriculture Jahad Organization(KRAJ)	Contributor
10	H. NaghibiHossni(MSc.)	Manager of Horticulture Department	Khorasan Razavi Agriculture Jahad Organization(KRAJ)	Contributor
11	M.A. NabiPour(PhD.)	Former Gonabad Governor	Governorate	Contributor
12	H. Ghorbani	Current Gonabad Governor	Governorate	Contributor
13	A.R. Hoseinzadeh(MSc.)	Manager	Gonabad County Agriculture Jahad Management	Contributor
14	R. Esmi(PhD.)	Horticulture Expert	Khorasan Razavi Agr. Organization, (KRAJ)	Contributor
15	S. Rezaeian(MSc.)	Assistant Professor	Khorasan Razavi Agriculture Jahad Organization(KRAJ)	Contributor
16	A. Moazeni(MSc.)	Horticulture Expert	Gonabad County Agriculture Jahad Management	Contributor
17	N. Ghafuri(MSc.)	Technical Deputy	Gonabad County Agriculture Jahad Management	Contributor
18	H. Radaei(MSc.)	Assistant Financial Officer	Gonabad County Agriculture Jahad Management	Contributor
19	G. Koshafar(MSc.)	Head of Technical Officer	Gonabad County Agriculture Jahad Management	Contributor
20	M. Rezaei(MSc.)	Expert	Gonabad County Agriculture Jahad Management	Contributor
21	A. Sedaghat(MSc.)	Manager of Farming	Gonabad County Agriculture	Contributor

No.	Name	Designation	Affiliation	Role
			Jahad Management	
22	A. Arasteh(MSc.)	Expert	Gonabad County Agriculture Jahad Management	Contributor
23	H. ZareHosseini(MSc.)	Horticulture expert	Gonabad County Agriculture Jahad Management	Contributor
24	M.R. Zarei(MSc.)	Manager	Zibad District Agriculture Management	Contributor
25	D. Hoseinzadeh(MSc.)	Manager	Kakhk Zibad District Agriculture Management	Contributor
26	Y. Gheisari(PhD.)	Head of Saffron Research Station	Gonabad County Agriculture Jahad Management	Contributor
27	A. Ghorbani(MSc.)	Head of Program and Budget	Gonabad County Agriculture Jahad Management	Contributor
28	Ms.M. Shamshirkesh(MSc.)	Land expert	Gonabad County Agriculture Jahad Management	Contributor
29	A.R. Saadatfar(MSc.)	Head of Public Relations	Gonabad County Agriculture Jahad Management	Contributor
30	A. Sazvar	Head of Logistics	Gonabad County Agriculture Jahad Management	Contributor
31	M. Hashemi(MSc.)	Head of Security office	Gonabad County Agriculture Jahad Management	Contributor
32	A.R. Samimi	Services	Gonabad County Agriculture Jahad Management	Contributor
33	M.A. Jafari(MSc.)	Deputy of Governor	Governorate	Contributor
34	A. Safari(MSc.)	Manager of District	Governorate	Contributor
35	M. Nabizadeh	Dehyar (Village Manager) of Seno	Governorate	Contributor
36	M. Zolfaghari	Village Islamic Council Member	Governorate	Contributor
37	A.Sadeghian	Village Islamic Council Member	Governorate	Contributor
38	D.Kazemi	Village Islamic Council Member	Governorate	Contributor
39	H. Kaveh(PhD.)	Head of Saffron Research Institute	Torbat Heydarieh University	Contributor
40	A. Vatandoost	Manager	South of Khorasan Agriculture Organization	Contributor
41	Ms. N. Sadat Taghavi(MSc.)	CEO	Mizou Saffron of Gonabad Private Company	Contributor
42	Ms. S. Seraj(MSc.)	CEO	Gonabad Persian Yaghout Chinnan Private Company	Contributor
43	G.R. Karimi(MSc.)	CEO	Mashregh Zamin Zarin Saffron Private Company Torbat Heydarieh	Contributor

No.	Name	Designation	Affiliation	Role
44	F. Saharkhiz(PhD.)	CEO	Saharkhiz Group Private Companies	Contributor
45	R. Bayasteh(MSc.)	Executive Manager	Saharkhiz Group Private Companies	Contributor
46	Ms. N. Anvary(MSc.)	Commercial Manager	Saharkhiz Group Private Companies	Contributor
47	M.A. Shariati Moghadam(MSc.)	CEO	Novin Saffron Private Company	Contributor
48	Ms. A. AliMardani	Export Manager	Novin Saffron Private Company	Contributor

I.R. Iran GIAHS National Committee

- Ministry of Agriculture Jihad (MAJ):
 - ❖ Agricultural Planning, Economic and Rural Development (APERDRI)- Secretariat
 - ❖ Bureau of International Affairs and Specialized Organizations
- FAO Representative to the Islamic Republic of Iran
- Cultural Heritage, Handicrafts and Tourism Organization
- Environmental Conservation Organization
- Iran Trade, Industry, Mine and Agriculture Chamber (NGO's and Local Community Representatives)
- Iran UNESCO National Commission
- Ministry of Science, Research and Technology
- Ministry of Industry, Mining and Trade
- Ministry of Interior Affairs
- Iran Agriculture Bank
- Islamic Republic of Iran Broadcasting

Experts Group Members, MAJ

- APERDRI
- Horticulture Department
- Crop Department
- Soil and Water Department
- Livestock Products Department
- Agricultural Research, Education and Extension Organization
- Forest, Range and Watershed Management Organization
- Fisheries Organization
- Iran Rural Cooperatives Central Organization
- Nomad Affairs Organization
- Rural and Nomad Women's Agricultural Activities Office