

THE INDIGENOUS KNOWLEDGE OF ISFAHAN PEASANTS IN THE EXPLOITATION, STORAGE AND INCREASING THE PRODUCTIVITY OF AGRICULTURAL WATER¹

Siamak Shahabi²

ABSTRACT

Iran is one of the countries which its major parts are in dry and semi-arid areas and continually was faced with drought and dryness. Isfahan province is one of the dry provinces in Iran with the average of 116_{mm} for rainfall. In spite of these natural conditions, the agricultural background in these areas comes back to the very past ages of history. Iranian farmers including Isfahan farmers in order to make use of surface and subterranean water sources created appropriate irrigation methods and raise different types of plants. These methods which were used by farmers from a portion of indigenous knowledge of our country in the agricultured shaped and established by passing time and transferred from one generation to the next one. The study and documentation about this knowledge not only prevents it from extinction but also make possible to integrate it with academic knowledge in order to provide a suitable technology either resolve the increasing demands or exploit the limited ground resources. In this study it has been tried to examine the Isfahanian agricultural indigenous knowledge in the field of exploitation storage and increasing the productivity of water. Major methods which are used in this study to collect the data are including field observation, exploratory interview and tapes and photographs.

Key words: Indigenous knowledge, rural areas, drought, Isfahan, province, agricultural water, subterranean canal.

INTRODUCTION

Iran is considered among dry areas throughout the world with average of 252_{mm} annually. About 65 percent expanse of our country is located in dry and semi-arid areas that average rainfall of them is less than 150mm annually.

1- The article presented here is from a design performed in rural problems research centre.

2- Researcher of Rural problems of research center of Isfahan Agricultural Science & Natural Resources. Address: Isfahan, amirieh shahrake - research center of Isfahan Agricultural Science & Natural Resources - Tel. 0311-7772090. Fax: 0311-7757022. Email: shahabi_siamak@yahoo.com

Since large parts of the country are located in arid regions. Drought periods are more than rainy years. Isfahan is one of the dry provinces throughout the country with average of 116_{mm} rainfall annually. Isfahan average rainfall is less than half of the average of country and one-sixth of the average of world locating in the neighborhood of desert from north, northeast and east and drought of southern areas cause many limitations for Isfahan province(Ibrahimi,1380/2002)(Map1).

In spite of these natural conditions, Isfahanian farmers in order to make use of surface and underground run off created appropriate watering methods and rose different types of plants. These methods which were used by farmers from a portion of indigenous knowledge of our country in the agricultural real in and established by passing time and transferred from one generation to the next one. Indigenous knowledge of each society is a set of culture, skills and techniques about different aspects of life which evolved through trial and errors of people with natural and social environment during long centuries and some of them are really wonderful. Indigenous knowledge of each nation is a part of its national capital that consists of beliefs, values, knowledge and life tools. This is the same knowledge which one day, World nations provide their food from the surrounding environment, provided their clothing, indigenous knowledge of each nation was able it to provide their needs from natural resources without any extinction. So the collection of world indigenous knowledge is a valuable treasure of methods and tools which are examined during the time and will be used in order to develop the nations.

Unfortunately because of oral nature of this knowledge in the one hand and unawareness and little attention of experts to this knowledge in the other hand are caused to increase the speed of extinction rate of it. The study and documentation about this knowledge not only prevents it from extinction but also make possible to integrate if with academic knowledge in order to provide a suitable technology either resolve the increasing demand or exploit the limited ground resources. In this study it has been tried to examine Isfahanian agricultural indigenous knowledge in the field of exploitation, storage and increasing the productivity of water.

METHODS AND MATERIALS

According to the aim of indigenous knowledge studies including present study which is consist of collection, writing and local experiences, knowledge and compilation. We can call these researches "Extractive Research" which deals with study and documentation of people indigenous Knowledge. Most important methods that are used for this research are including:

FIELD OBSERVATION

Observation is the most important and natural research tools that have a high importance in all sciences such as humanities. Field observation is a kind of observation which happens in natural conditions, it means that occurring in the inner of the society. In this method, researcher observes people, behaviours, tools and their function. In this research one part of findings are collected by attending in the field and observation directly.

EXPLORATORY INTERVIEW

Exploratory interview is one of the methods which are used in this research. In this method, the interviewer explores in the respondent's mind through some kinds of determined subjects and is not limited himself to standard question (Delavar.1380 /2002). In order to collect required data, we interviewed with experts of agricultural Jihad's organization in different parts of Isfahan province and its townships and we used their experience which is gained by working for many years in rural areas. In addition to agricultural Jihad's organization, we interviewed with aware and experienced peasants and they gave very much valuable data to the researcher.

USING TAPES OR CASSETTES AND PHOTOGRAPHS

A cassette player is used to record the conversation and interviews with villagers so that they were concentrated rated and then in an appropriate time were written on the paper. Also to make documentation, a camera is used for some Methods.

DOCUMENTARY METHOD

In this study, documentary method is used to collect some parts of data. This method is one of the easiest ways in social studies and the researcher obtains his necessary data from existing documents such as reports, documents and statistical publications.

RESULTS

In this section, research findings which are including the methods used by peasants exploit, store and increase the productivity of agricultural water, will be explained.

SUBTERRANEAN CANAL AND METHODS FOR INCREASING PRODUCTIVITY OF SUBTERRANEAN CANAL WATER

Subterranean canal has been one of the techniques which were used to provide drinking and agricultural water in dry areas like Isfahan province.

Beside usage of natural underground and surface water like spring, stream and river, well and subterranean canal were most important and artificial forms to exploit from water resources. In this method without any mechanical power and just by gravitational force, the underground waters will transfer to earth's surface. By using this technique it can be possible to collect a considerable amount of underground water and to flow it on earth's surface during the year.

Subterranean canal and its characteristics are as follows: Each subterranean canal contains a main well or mother well ground tunnels, wells and the appearance. The mother well is told to the farthest well toward the source. The mother well in comparison with other wells always is very deeper. The water of subterranean canal is transferred to earth's surface by an underground tunnel. The existing water in the underground layer of earth was led to the tunnel by a mild slope and without using any other mechanical power like electricity power and just by gravitational force. it will flow in direction of underground tunnel. By the reason of this slope, the appearance of

subterranean canal will be located lower than mother well. About the most important conditions for digging can mention to the existence of such permanent underground waters, the steep lands and watery parts of the land which are higher than subterranean canal appearance.

The wells which called "mille" were digged along the tunnel direction. These wells are located in an approximate twenty meters distance from each other. Theses wells are used to evacuate the digged soil and to ventilation of tunnel and to repair. The subterranean canal appearance is an opening where the water flows on the ground (Figure1). After the subterranean canal, every tunnel that transfers the water of subterranean canal to the agricultural lands is called "Haranje" or "Madie". Usually the surfaces of irrigating canals are open. The distance between the appearance and those parts of tunnel where the land is dry and not has water is called dry land or "Khoshkekar" and from here to the mother well where the land is wet is called wet land or "Tarekar". The most important methods to increase the amount and the productivity of subterranean canal water are as follows:

PISHKARZADAN OR NOKANI

There are many different ways to increase the amount and the productivity of subterranean canal water and one of them is "Pishkarzadan or Nokari". When the level of underground decreases because of different reasons Such as drought or not compensate the lost water, this method is very useful. It means that a tunnel will be digged and a well will be added in a direction which nearer to underground resources. This work accomplishes in straight right or left direct. Even it is possible to dig in two or tree sides of subterranean canal. This work causes to absorb much underground water and the water transfers to the main subterranean canal. This factor made them too long during the time.

DIGGING MOTHER WELL AND KAFKANI

One of the other accomplished actions, when the level of underground water decreases, is to make the well deeper and deeper. By digging the mother well, the level which water stops on it becomes lower and this makes the well deeper. Since the floor of well decreases so the floor of tunnels become higher than mother well, it is possible to dig the floor as far as the mother well decreases. This task will make maintain the slope of tunnel toward the appearance of subterranean canal and also flow the water and prevent from remaining the water in tunnels. When the water remains in the tunnel, the walls become damp and therefore collapse.

STORING THE WATER BEHIND THE SUBTERRANEAN CANAL

Continuous usage of underground aquifer especially subterranean canals reduced the amount of water gradually even if it didn't compensate the last water because of drought and it can entail to dry the subterranean canal up.

In order to prevent facing such problems it should be necessary to store running water during rainy seasons in pools which are upper the subterranean canal. This storage has bees used to store the water for the subterranean canal artificially. This water that stored

in the pools directly is used for agricultural activities. For example it can be mentioned to "Azan" pool in "Meimeh". In this pool, not only running water resulting from rainfalls is stored but also additional water is stored in the upper subterranean canals and gradually penetrates in the soil of lower subterranean canals including "Zir asiab" and "Ziarat" storing the water in these pools usually begins day (December) until Esfand(March) (Figure 2&3).

INCREASING THE FLOW RATE IN SHORTAGE OF WATER

The shortage of water causes the amount of water as far as it will be impossible to irrigate the agricultural lands directly by subterranean canal or well. One of the feasible ways is to store the water of subterranean canal or the well in pools. For example in this manner for a farmer who should use the water of subterranean canal for ten hours, the gained water enters into the pool with flow rate $10_{L/S}$ and stores in it and then exits with flow rate 20 to $25_{L/S}$ so that it can be possible to irrigate with appropriate flow rate. In "Kashan" and "Aran & Bidgol" these pools were soiling and in the past they are called "Salakh". Usually they cultivated bamboo around the pool to make shadow and decrease the evaporation of water in the summer.

CONSTRUCTION OF CANAL ALONG WITH SUBTERRANEAN CANAL

In the areas wherever have the proper slope, the subterranean canals were constructed frequently. This work will make the springs of the upper subterranean canal feed the lower subterranean canal. In some areas which subterranean canals are frequently along with wells construct the canal. As an instance, it can be mentioned to the subterranean canal of "Golpayegan", "Khansar" and "Najafabad".

In this township, two large canals were digged at one or two sides of wells. these canals are called "La". These cause to store the water of upper subterranean canal in the lower subterranean canal and to feed the subterranean canal artificially. In addition, when it is raining, these canals obstruct the running water and prevent entering water accompany with sediment and other objects. During the time these sediment and objects cause the subterranean canal becomes full or stop the direction of water into the wells. In order to prohibit collapsing, usually the walls of tunnels will be covered with stone and the ceiling will be covered with planks.

DREDGING OF THE SUBTERRANEAN CANAL

Collapsing of the walls of wells and tunnels, sediments which enter into the subterranean canal will cause that the floor of tunnels become full of mud and slime. This problem not only reduces the speed of water but also it will make those walls of tunnels become damp. Therefore it is necessary to dredge the subterranean canals once a year. Not dredging the subterranean canals in recent years is one of the most important reasons for their extinction. One of the methods to dredge the subterranean canals in townships like "Khansar", Fereidan", "Fereidonshahr" is as follows: Because these townships are located in mountainous areas therefore the sediments are not very much. A person with a sweeper stirs the water. This task moves the mud and slime and prevents to become firm and little by little they will be exited by running water. Also

the speed of water will increase and the subterranean canal will be needed to dredge lesser than before. The subterranean canals have regularly been investigated and if there was any problem, the necessary actions would be done.

KEEPING THE LIMITS OF SUBTERRANEAN CANAL

Commonly there is a limit for every subterranean canal and it should not be digged any other subterranean canal in its limit. Because the water of subterranean canal will reduce and even it is possible to dry it up. Furthermore around the limit of subterranean canal, other activities are forbidden such as arboriculture, agriculture, digging a stream, construction, road construction. Each of these activities will cause the subterranean canal collapse. Also it is necessary to prevent plants like "Khar shotor" and bamboo which growing by itself. Because their roots will destroy the walls of tunnels and wells therefore the subterranean canal becomes fall. According to the local regulations, this limit in Isfahan is 20 meters from two sides.

STORING THE WATER INTO THE SUBTERRANEAN CANAL

Having a permanent flow during the year is one of the flows of subterranean canal. This issue will cause to waste much amount of water when there is no agricultural activity and therefore the amount of underground water will reduce. Also it is not possible to dam inside or outside of the subterranean canal. Because by this task, the level of water will increase thus the walls of tunnels will become damp and will collapse but in some of these subterranean canals which has resistant wall, it is possible to dam inside of it and store the water there.

One of the popular examples for these dams is the dam of "Vazvan" subterranean canal in "Borkhar & Meimeh". This subterranean canal has 2 kilometers length. At the distance of 1500_m from the mother well, there is a dam. The height of tunnel is around 6_m. There are five holes in the dam. In the early Azar(December) they will be closed by mortar and until Farvardin(April) the water will be stored behind the dam. In farvardin, the highest hole will open the lower the level of water, the more holes will open. The water that stored behind of dam, not only cause to become full the tunnels but also will full all apertures and the level of water will considerably increase in surroundings wells. This amount of water is sufficient for 4 to 5 mounts from beginning of usage then the water of subterranean canal will be naturally used. The water had been exited from the holes with much pressure and without any control. In 1366(1988) Meimeh Jihad organization closed all of these holes and by plumbing and installing a 6 inch gave valve prevented to waste much amount of water.

KEI OR AN OPEN SUBTERRANEAN CANAL

In areas near "Zayanderood" river like "Ghohab" and "Baran" or "Zarinshahr" to use the surface run off, "Kei" has been used. The author of the book "Nesfejahan fi Tarife el Isfahan" in page 105 writes: Kei is not frequent everywhere. It is possible in a land that its water is near to earth's surface and there is not need to dig a well. for making a Kei , it should began to work in a lower land toward higher and dug a creek and went ahead. This method is opposite of subterranean canal. By going further, it becomes deeper and

the water will increase. In deep depth the water seeps out and flows a creek. In some cases it becomes greater than subterranean canal. They can be large or small, long or short. This action is called Kei and is frequent in "Ghohab" (Hosseini Abari, 1379/2001, 152).

Kei is used in land which its aquifers are located in upper layers of land and in swampy lands. Where the land was impenetrable and had a little slope, the level of water of river has been rose. Kei has been dug from where the water flew on the ground and like an open canal or creak was led to its source, the further it moves forward, The deeper it becomes. Gained water will transfer to the lower lands by canals and farmers use it to agriculture. Additional water was absorbed by the land and was fed lower Keis.

Both subterranean canal and Kei have an equal characteristic that is an underground source, but in spite of subterranean canal, the canal of Kei is on earth's surface. This is the reason why Kei is also called open subterranean canal. Kei is operating like drainage and collects the seepage from surroundings lands and get ready these lands for agricultural activities. In recent years many wells were dug in these areas. The unmethodical use of pumps to extract the underground waters and recent droughts were caused to decrease the level of aquifer therefore there is not Kei any more like past. Many of them are destroyed or are turned into a dump. Growing moss and bamboo were common difficulties which they had. Turning into a march caused that the water became smelly.

STORING THE WATER BY A POOL

Using pools in order to store the water for agriculture and animal husbandry is a method that developed in recent years. The water of these pools will provide from different ways. Using the running waters in rainy seasons is one of them. In central areas of Isfahan drain the pastures and lead the gained water into the pools by canals and then consume it. Some farm lands have a steep surface and there is a pool in the lowest point of farm land. In rainy seasons, the running waters which hasn't been absorbed by the land, stored in this pool and then are used for agriculture. Running water lead into the pools by small creeks which are made in the surface of farm land. In some areas of Isfahan like "Baran" and "Varzaneh" which irrigate the farm lands by well because of drought, the number of these wells decreased. The farmers store the water of several wells into a pool. This water has much pressure and is more appropriate for agriculture. The more and the faster water Transfers to the farm land, the more it is prevented to waste water.

STORING THE WATER TO CONSUME LIVESTOCK

In desert areas, people dug a pit to store the water in order to use in the summer for their livestock. These pits are called water reservoir. The stages of these methods are as follows: At first they make a pit in the ground and then cover its walls with a plaster made of clay and straw. For this purpose selected a soil which the percentage of its clay is high and its permanent is very low. The floor of this water reservoir is covered with mortar. In some areas, the walls of these pits cover with mortar. The running water stores in these water reservoirs. These water reservoirs have ceiling in order to prevent

to evaporate the water. In addition the water of these reservoirs is used by stockbreeders.

In recent years, agricultural organization helped to feed the water reservoir. In mountainous parts of desert areas, there are springs which approximately eight months of year have water but their water was little and they attracted less attention. Especially during the summer which noon didn't travel to the desert, they completely wasted. In recent years, the water of springs leads to water reservoir by polyetilin pipes which are very long even at the distance of 12_{KM} and then uses. In some areas, these water reservoirs will full by tankers.

In mountainous areas of desert townships and in some parts of mountain, there are water reservoirs. Since the land of these areas is stony, the water can be stored and there is usable during the year. Filling the holes increases the capacity of storage. Nomads of "Semirom" county dig pits to feed their live stocks. These pits will be full with rainfall. Usually in early year or in the time of childbirth, the herd transfers to the top of the mountain and make use of theses wells. When they finish, the herd transfer to the down of the mountain and drink water of springs and rivers.

CONSTRUCTION OF DAM IN PASTURE TO PROVIDE WATER FOR LIVE STOCKS

In pastures with steep lands, because of low permeable, the water flows. The owner of pasture moves the soil by spade and makes crescent- shaped walls which have 15_{cm} height in direction of water flow. In first and second years, these walls can not keep the water but by passing time, they will be coated with sediments resulting from rainfall. These walls don't let flow the rainfall. The owner of pasture feeds their live stocks for 2 to 3 months with the use of this water. There is no need to provide water from wells. This task will help to preserve the plants of pasture.

IRRIGATING IN NIGHT

Horticulturists irrigate their gardens during the night to prevent evaporating of water.

JUG IRRIGATION

Jug irrigation is one of the methods which has been used in the past in desert areas of isfahan but now it is forgotten. Jug irrigating has been mostly used in truck forming (like water melon and melon) and in arboriculture. This method has a main influence on preventing from evaporating. In this method when a tree has been cultivated, several jugs which are full of water put in the next of it. The gradual leak of water from these jugs will cause to grow the roots of tree. These jugs were shoddy and didn't keep the water cold. Because they were used jugs for a long time, they were full of moss therefore the water of these jugs has been smelly. In some areas, the half-cooked jugs have been used. Usually the farmers were investigated the jugs occasionally. By make use of this simple method economized water consumption.

In recent years, some farmers used this method in other forms in truck farming and arboriculture. For example one of "Borkhar" township farmers made a ting hole in a

large soft drink bottle and put it next of a melon bush. After 4 to 5 days, he fills the bottles the water of these bottles was absorbed by the soil and is used by the bush. In "Ardestan" township, an owner of pasture cultivated almond tree and used dry-farming method. He put a 4 kilos can to irrigate them gradually.

ARRANGING THE UNDER AGRICULTURAL LAND WITH WATER RESOURCES

In the past, that groups of farmers who had a limited water resource like a subterranean canal or a well, in raining seasons cultivated a land which has no need to irrigation (these land were far from the subterranean canal). In the summer they would cultivate a land which is near the subterranean canal so that the direction of water decreases. In this manner, they arrange the cultivation and irrigation of land and minimized the washing of water and made the outmost use of their water.

DAM CONSTRUCTION IN DIRECTION OF WATER

One of the oldest methods has been to make use of dam on permanent or seasonal rivers. The water which is stored behind these dams not only is directly used for agricultural activities but also causes to feed the land artificially (Figure 4&5).

INTEGRATIVE CULTIVATION OR CULTIVATION WITH AN AWNING

The farmers who live in central and desert areas of Isfahan, Cultivate two or three crops altogether to apply the utmost use of their water resources for example, the farmers of central parts cultivate corn, Cantaloupe and tomato altogether. At first they harvest cantaloupe and then tomato and in the end the corn. The farmers of desert areas plant watermelon or melon with cotton. Of course this kind of cultivation is possible in small farm lands and none mechanized. There is not possibility to use this method in large mechanized farms and at all is not economized. In "Khor and Biabanak", there are many palms. Sunflower, beef, turnip, wheat and barley were cultivated together with palms. Every one of them shades on the other one. This action causes to prevent evaporating.

THE CULTIVATION OF GRASS

One of the methods which is current among farmers "kashan" and "Aran and Bidgol" township is cultivation of grass in their gardens. Thus they use two purposes irrigation for both trees and grass. Nothing the grass makes a shadow and prevents evaporating but also it can be uses to graze the livestock.

USING ANIMAL FERTILIZER

In this method, some crops like onion, the seed is cultivated with much amount of animal fertilizer. The number of irrigations can be reduced by the water which stores in this kind of fertilizer. This fertilizer causes to increase the output of crop. This method will be used in the cultivation of trees. In this manner that the surface of land will be covered with this fertilizer so that to prevent evaporating. this fertilizer also helps the trees to grow better. In another method, large pieces of animal fertilizer will be thrown in the irrigational water. These pieces prevent evaporating of water entirely.

USING STRAW AROUND THE TREES

When the water was not sufficient, the horticulturists covered the surface of the land with straw. This caused to keep the humidity of soil.

KEEP THE WEEDS OF GARDEN

During drought periods, the horticulturists don't weed. These weeds prevent to evaporate.

CULTIVATION IN SEDIMENT RESULTING OF TORRENT

In the area of "Khor and Biabanak", when the torrents settled in fields, pits or in front of dams and the land is still humid, the peasants will cultivate water melon in this land. When the weather was getting warmer and the watermelons grew, they cover them with grass. This keeps the bushes from drying. However these gained watermelons are small, they are very sweet and delicious.

THE CULTIVATION OF TREES ON STEP LANDS

In mountainous areas of "Semirom", "Chadegan" and "Fereidan" which it is impossible to agriculture in steep lands, the villagers dig creeks. These are vertical toward the land. In basin part of these creeks, they plant fruitful trees like peanut, walnut, sumac and vine by dry farming. In this method, they dig a canal with one-meter depth. They put a side the surface soil, this soil is appropriate for cultivation. The under soil is white and will be used beneath of slope. Then they cover the floor of pit with high-quality soil and cultivate the tree seeds in it. However this method has been common in the past but in present time, the agricultural organization helped to develop it more scientific and mechanized (Figure 6&7).

CULTIVATION IN A PIT

In north and east-northern parts of "Kashan" and "Aran & Bidgol" there is an area which is well-known to "Bandrig". This area has a range of sandy hills. "Bandrig" has about 120_{Km} length and about 20_{Km} width. It begins around "Qom" and along "Aran & Bidgol", "Kashan" and "Ardestan" stretches near the "Yazd". Because these hills are sandy, so they don't absorb the rain water. The rainfalls gather in surroundings lands. This water is not joined to aquifer. So the level of underground waters is high in this area. In the following there is a method which based on it the peasants would cultivate watermelon by dry farming technique.

There is a pit downward of hill with an area of 100 to 500 square meters (Figure 8&9). This pit is dug to 2 meters depth and its grit is kept around the pit. Of course the floor of pit made up of grit. The sandy walls are operated as a windbreak. These prevent the running sand to pour in the pit. Dry bushes are put around the pit or desert plants are cultivated to prevent the sand to pour in pit more. Newly the screen is used to prevent entering animals that may injure the watermelons. These pits have died and even they are mentioned as marriage portion in bride's matrimonial deed.

On the floor of pits, some holes were dug with 120_{cm} depth and 40_{cm} radius as far as to reach to the water (Figure 10). Until 20 to 30_{cm} before the surface of land. This pit was full with a mixture of dry grit and bird fertilizer or chemical fertilizer. Usually each pit was full with 3 kilos bird fertilizer and 1 kilo chemical fertilizer. The method of mixing is as follow:

A 30_{cm} layer of grit and then a layer of fertilizer were poured. Rest of the pit was full with the mud. The watermelon seeds were cultivated in this muddy layer. 7 to 8 seeds were cultivated but after they sprouted and in the first stage 3 to 4 saplings were cut and in the second stage, when the saplings were grow and the possibility of their destruction is very low, just one sapling was left and the others will be cut.

The cultivated seeds of watermelon grow by the humidity of mud and their roots move downward in the soil so that to reach the aquifer. For this reason, the roots of watermelon may penetrate until 2 to 2/5_m depth. This was made possible by sandy land of this area. Dry bushes of "suf" (a kind of plant) are put among the bushes to keep the soil. The branches of water melon bushes wear in these plants. this causes to reserve the bushes against sever desert winds. These winds can't dry or eradicate them.

The watermelons are cultivated in early spring and will be harvested in middle of summer. The period between cultivation and harvest, the farmers don't have any work to do except they should weed a few times. Since it's too hot in desert, they begin to harvest from dawn until sun appears. These watermelons are large, sweet and juicy. When the harvest finished, after a while these pits will be filled with running sands. In order to recultivate, it is necessary to evacuate the pit.

TO MUDDY THE WATER OF CREEKS

One of the actions that farmers do to decrease the permeable of the ground is mudding the water of creeks. When the under cultivation lands of grain increase, the water should pass across a longer direction. This method is used in areas which its soil is sandy and as locals say this soil is "light". Therefore this soil has a high permeable. Some persons pour the soil in to the water and muddy the water. The mud settles as a layer and covers the floor and the wall of creek. The soil is called "Laye khak" (layer soil). This kind of soil has high percentage of clay and it was gathered near the dams of rivers. The other use of this method is that live stocks don't drink this water any more.

DIGGING A WELL TO PROVIDE THE WATER FOR LIVE STOCKS

The Nomads of "Semirom" use spring water for their live stocks when the springs dry up, they dig a well there and provide the needed water of their live stocks.

MOVING LIVE STOCK OR DECREASING THEIR NUMBERS

When stockbreeders who live in desert areas of Isfahan can not provide the needed water for their live stocks. They will transfer them to the pastures. If this was impossible, they would sell some of them.

CONCLUSION

Iranian farmers and especially Isfahan succeeded to create appropriate techniques for irrigation. They could make use of water resources (surface and underground) and also reared many kinds of plants. These methods which were used by farmers from a part of our indigenous knowledge in agricultural realm. They formed during the time and evolved and transferred from one generation to another one.

According to the gained results, in dry areas like Isfahan one of the techniques which are used to provide drinking water and agricultural water has been digging a subterranean canal. In this method without any mechanical power and just by using gravitational force, the underground waters transfer to earth's surface. This technique makes it possible to gather a considerable amount of underground waters and flow them on the ground like natural spring during the year. There are different way to maximize the amount of water and productivity of subterranean canal. They are including "Pishkarzadan", digging a mother well, storing the water behind the subterranean canal, increasing flow rate in dry periods, construction of canals a long with subterranean canal, dredging the subterranean canal, keeping the limit of subterranean canal, storing the water into the subterranean canal.

In addition of subterranean canal, Kei or open subterranean canal has been one of creative methods by Isfahan farmers. They also constructed pool, water reservoir and dams on rivers and in the pastures. To prevent evaporating of the water, they cultivate the grass, use animal fertilizer, keep the weeds and use straw the trees.

The farmers used creeks and jug for irrigating. They irrigated the land during the night. Integrative cultivation, cultivation sediments resulting from torrents, cultivation of trees in steep lands, these are various kinds of cultivation which can be mentioned.



Figure1: Subterranean canal appearance



Figure 2: Azan pool



Figure 3: Azan pool



Figure 4: Sohe dam



Figure 5: Sohe dam



Figure 6: The cultivation of trees on step lands



Figure 7: The cultivation of trees on step lands



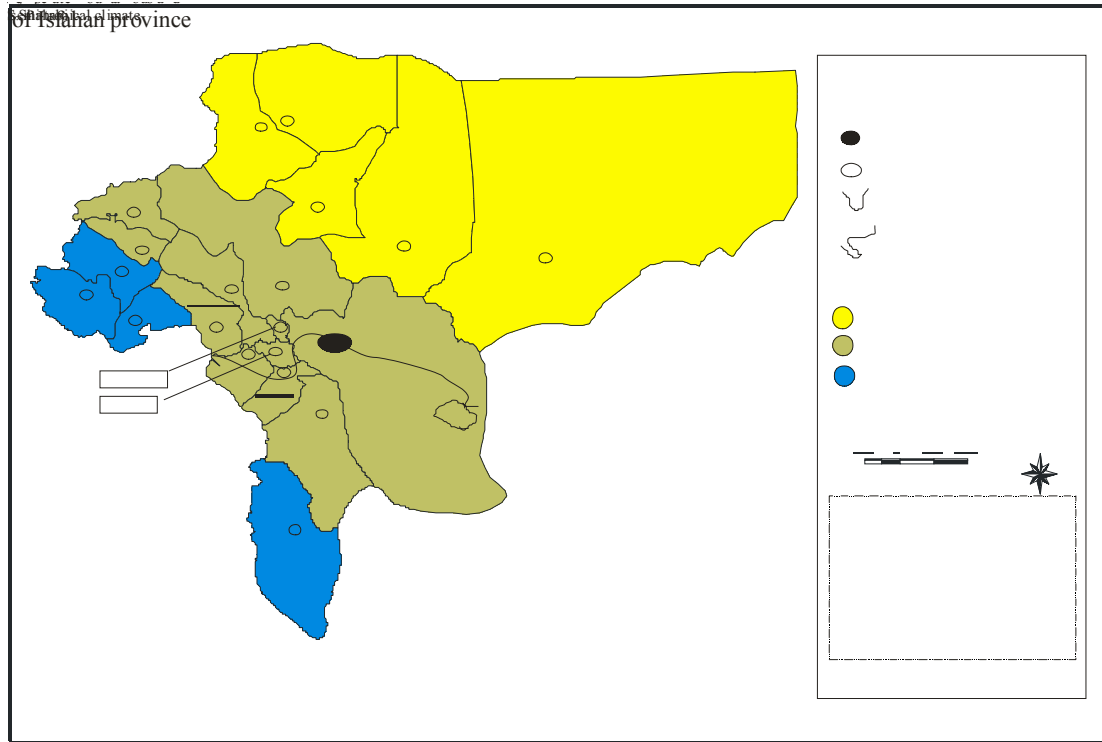
Figure 8: The cultivation in a pit in Band rig



Figure 9: The cultivation in a pit in Band rig



Figure 10: Digged pit for cultivation in a pit



REFERENCES

1. Ebrahimi,P. (1380). Investigation and evaluation of supply management and demands of drinking water in drought conditions (Isfahan), environment and water magazine, 48-49:43-52. (In Farsi)
2. Hosseini Abari,H.(1379). Zayanderood from the source to the swamp, Goha publication, page 167. (In Farsi)
3. Delavar, A.(1380). Practical and theoretical principles of social and humanities studies, Roshd publication. Page 432. (In Farsi)
4. Emadi,M.H. and Abbasi, A. (1377). Indigenous knowledge and permanent development of villages: an old view in a new area, village and development magazine, 2(1): 17-45. (In Farsi)
5. Yaghobi, J. and Zare, H (1379). A glance on indigenous knowledge, jihad monthly periodical, 230-231:51-55. (In Farsi)