



Sustainability of the Irrigation system in Logar province, Afghanistan

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Abstract

Many regions in the world, including Logar province, Afghanistan, are prone to floods and droughts and efficient infrastructure, which will mitigate floods with water collection and subsequent water usage during drought periods along with the decrease of water loss evaporation, for the irrigation purposes are required for the permanent investigation and improvement. The aim of this research is to analyze and prepare inventory of the irrigation system in Logar province, Afghanistan, for the further investigation and development of the applied sustainable water resource programs. The study area is Logar province, which is one of the 34 provinces, located in the South-East of Afghanistan. 90 % of Logar populations are involved in agriculture. Research methods are comparative - descriptive method and review of publications, analysis of statistical data, study and comparison of the different irrigation technologies used by farmers in Logar province. The preliminary results show that there are four types of irrigation systems in Logar: (a) main irrigation canals feeding from the Logar River; (b) secondary subsidiary canals, or irrigation schemes, feeding from the main irrigation canal (a); (c) ancient Karez: underground lateral water channels; (d) artesian nonrenewable groundwater resources, with intensive pumping. There are big water losses in the canals due to the evaporations and old cracked networking facilities. Moreover, intensive water pumping has depleted the underground water resources, which also influenced and shortened the water supply into the Karez networks. Climate Change requires adaption and upgrades of the irrigation system. There are two main trends in irrigation system improvement: one is related to the construction of the big dams, to hold a big amount of water and the next chain of the irrigation channels; another to restore the old, existing ancient karez channels with sustainable small technologies upgrades. India's Paani Foundation is using the second approach now to mitigate the water crisis by combining the old traditional manual build channel with modern managed aquifer recharge (MAR) technologies, supported by the intensive scientific research support (https://www.youtube.com/watch?v=-8nqnOcoLqE&ab_channel=AndrewMillison). Technologies as MAR to support adequate flood-drought management systems combined with the retention ponds infrastructure, similarly to India's Paani Foundation, may provide the sustainable solution to improve the irrigation system in Afghanistan. The further investigation of the sustainable irrigation technologies is required.

Keywords: Afghanistan, Logar, Karez, Irrigation system, water losses.

1. INTRODUCTION

Logar is one of the 34 provinces of Afghanistan, located in the southeastern of the country, Puli-e Alam the center of the province is 65 Km far in the south of Kabul. Having hundreds of villages and Puli-e Alam is the center and capital of the province. As in 2015, the mentioned province had a population in the span of 392045 it is the home of many tribal societies. There are 3 Dams in the province which are located respectfully, Abtak in Khushi, Kharwar at Kharwar and Karomby at Baraki Barak districts, it is mentionable that the construction works of these dams were starting once but because of civil war now the construction works

have been stalled. Inside Logar, there is a river by the name of Logar through the west and leaves to the north of the province and one of the most important assistants of Kabul River. Logar can be described generally as a near and relatively flat river valley in central and south areas. Fig1. Logar is located in the Kabul river basin, one of the major's five river basins in Afghanistan.

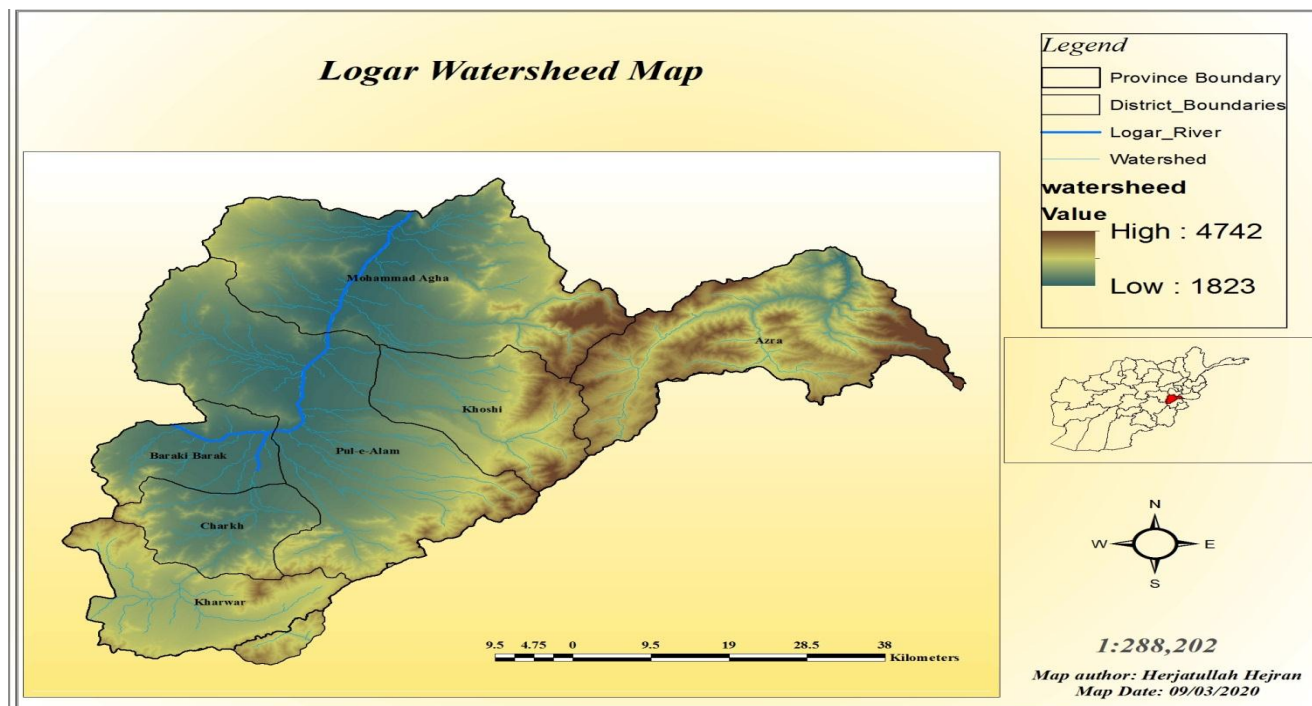


Figure 1: Map of Logar province.

Logar is a province where 90 % of the population is in the field of agriculture. Overall it has 439499.8ha Area, Agriculture and covered land being irrigation is 45017ha, Tillage farmland which irrigates by rain is 22356 Ha, none irrigated land is 82223ha and Grazing locations is 265155ha, As usual, all over Afghanistan especially in this province different kind of irrigation systems is used, the most ancient irrigation and sometimes water supply system is Karez which is much popular at the region, Karez is underground tunnel constructed in-ground by digging the main well of the system and extending underground tunnel in foothills of the mountains. Without pumping tools, this method extracts groundwater gravitationally from the soil. (Abobakar Himat, 2019).

Five types of irrigation systems are in Afghan: the first one is modern surface systems, the second one is traditional surface systems, the third is springs, the fourth is Karezes and the last one is wells. Modern systems make up approximately 10 % of the total irrigated area; Karezes account for about 5%; springs constitute slightly more than 5%; traditional water irrigation systems with intakes from different rivers and riverways account for over 80% (Hafeezullah Hashimi, 2019). And as well as mentioned with Inamullah Safi (Anderson, I. M. 2006; FAO and AIMS, 2004).

In the last decade, there are some improvements in the agriculture field especially the Directorate of Agriculture, Irrigation and Live stocks (DAIL) of Logar province implemented many irrigation projects across the province, in many cases by the financial support of some organization which works with Ministry of Agriculture, Irrigation and live stocks (MAIL), Community Livestock and Agriculture Project (CLAP), Support to National Priority Program 2 (SNaPP2) and On-Farm Water Management Project (OFWMP) this project is working under the bank of Trust Reconstruction fund for Afghanistan, my implementing these projects which provide with improved, reliable, and equitable distribution or the right of irrigation water to increase and improve agricultural productivities and some farm incomes and improve food security. Respectfully, Irrigation schemes, reservoirs, and canals of Karezes and construction of Intakes on Logar River were one of the tasks for Logar DAIL. Besides Logar Agriculture, Irrigation and livestock there are several administrations which we can name as the directorate of Rural Rehabilitation, and administration of sub-basin which were responsible for irrigation water in Afghanistan but now all of them are working under the name of National Water Affairs Regulation Authority. The main reason for implementing and rehabilitation some irrigation canals was to reduce and prevent water losses across the scheme. While there are the transportation and distribution of water inside the scheme, there are many irrigation water losses inside canals because of the distribution and service planning to the

field. (Amir Mohammadi, 2019). Moreover, in many regions the usage of water for irrigation is by Karez and canal system as Logar is located in the semi-arid region there are most losses of water along irrigation canals.

2. Main Aim of this paper

In this paper, we provide a brief overview of irrigation systems and the situation in Logar province, Afghanistan. As well as we will have some assessment of irrigation projects which has already implemented in this area in last few years by different Local administration and organization (DAIL), (CLAP), (OFWMP) and so on. (See Figures. 2, 3, 4 and 5), next, we consider irrigation systems as well as Karez, Irrigation Associations (IA) and its impact on water management and in time of implementation and maintenance of the projects in districts of the province, the focus of our paper is on irrigation water management and irrigation related problems such as irrigation water losses, distribution of water at irrigation field, rehabilitation and construction of irrigation schemes and canals.

3. Overview of key Irrigation systems in Logar, Afghanistan

3.1. Main Irrigation Canals

River of Logar is one of the key factor and main source of irrigation in this province, from the point it flows inside Logar, starts main canals in Baraki Barak district we can mention here some big canals like Babos, Chalozai, Dehmogholan, Zaqumkhil, and Pul-e Jogi, the main problems in this kind of canals are controlling of water in Intakes area, Local community use a different kind of methods to change the direction of flow into the canals, less of them are recently rehabilitated by Directorate of Agriculture, Irrigation and Livestock (DAIL) of Logar (see Fig.2) which had a positive impact on agriculture production and covered up to 25% extra agricultural land. By implementation of this project now the community or Water User Association (WUA) can catch enough water for the land. As there were some regulation and traditional rule that how to control and catch water from intake and as well as the Afghanistan water law mentions in Article number 37: first if any person who causes financial damage as a result of misuse of the water right, shall also be liable to fine by the law, in addition to compensation. Second, if a breach of water law threatens the downstream community's lives, health and livelihood are considered an offense. By the Law, the offender shall be punished (Afghanistan National Water Law, 2009). But according to the low governance of the current government in the local area, it was impossible to put it in action, all conflicts regarding water issues solve by elders, Mirab, and the local community. They use some traditional ancient regulations for their area, those are so common and well understandable for all because most of the population in this province works in agriculture and do not have enough knowledge about national law and other related law, they just follow common law which we mentioned above.



Figure 2 & 3: Water Intake of Chalozai and Dehmogholan Logar River, Barakibarak District, Logar, Afghanistan.

At main irrigation canals, there is a Mirab system for controlling and management of water. In the past 25 years, the local traditional system is still working well beside the civil war they can do manage water resources and Mirab is also supervising canal and he is in charge of irrigation process in the province or local areas (Inamullah Safi1, 2016). Many of the canals are not constructed and rehabilitated so during one year there are some sediments by flowing of water from the river during flood seasons and some falling of soil to the inside canal by communities which need strong attention, operation and maintenance to clean it, so every year hundreds of WUAs's members or farmers collect by traditional rule and do Ashar system (Ashar is a gathering of the local community or people for doing a job like cleaning of canals) for cleaning the canals, it takes few weeks to clean up the canal from sediments.

3.2. Secondary canals

These types of canals are also called Irrigation schemes, which get water from the main canal and where more than 30 % water losses take place in this type of canals, so for covering more land we need water-saving technology with limited water. If water-saving technologies are applied in farmers' fields more areas can be irrigated with limited water. Such water-saving technologies include the reduction of different transport, operation, delivery, storage, and use process losses. Conveyance loss can be reduced if the lining of canal/distributary/minor through skilled workers and proper lining material is performed (Upadhyaya A, 2016). By using some method, we can reduce water different kinds of losses in an irrigation scheme if we do apply water to the crop according to the required amount of it by using recent irrigation water application method, for reducing distribution losses, the uniform distribution is needed for all location as per requirement, losses of storage can be reduced if the amount of water is applied in the root zone by drip and trickle irrigation. To reduce water and cover more agricultural land several irrigation schemes have been implemented such as lining, which was cause to reduce water losses up to 35% at irrigation schemes Fig.4. Water for the people that are involved in agriculture is a vital resource, and maintaining access to water is very important for poverty reduction in rural and remote areas because when we want to reduce poverty we must manage food security (Heshmatullah Saadi and Reza Movahedi, 2014).



Figure 4 & 5 Padkhwab-Mazar and Saida, irrigation scheme in Logar.

By implementing these kinds of projects in Logar province the following problems are solved: saved more than 35 % water. Compared to the past, 20% of the surplus agricultural land is now irrigated with water that has been saved, it had played an important role in reducing the conflict between farmers and it has made a positive difference in agricultural production and as well as controversy over land boundaries near to the canals or irrigation schemes. It has often led to major conflicts even some times death issues. Now, with the implementation of these projects, those problems have been solved too. Inside the agriculture sector, however, 93% of the total water supplies are used in the mentioned field, and less than 7% are reserved for other purposes. The management of water in this area and field is therefore important and it has played and plays a critical role in sustainable agricultural growth and development (Heshmatollah Saadi and Reza Movahedi, 2014). For better use of water, the control of water losses and seepages is necessary so the main aim of this kind of projects is transferring water with minimum losses, increasing of irrigation efficiency is the way to save water resources, in Logar province more than 95 % agriculture land is irrigating using the low-efficient surface system. At the recent one half-decade water resources scarcity and more water demand of water because of any reason, it could be growing of population, climate change, and other related problems so water losses in irrigation channels and schemes are the concerns and an issue in water resources management for water-related ministries and organizations, irrigation water losses at an irrigation scheme or canal makes up a significant amount, sometimes these water losses is more than 35 % and some areas that is located in arid and semi-arid

areas are up to 50% of the whole water discharge at intake or in the source of the scheme. Water losses are at unprecedented rates worldwide from water delivery systems. They are made up of various components including physical losses (leakage), unauthorized consumption, and apparent losses (Nourhan Samir, 2017). Leakage accounts for a significant part of the overall water losses often over 70% (Nourhan Samir, 2017). As water is an important resource for humans and the protection of this kind of natural resources is one of the big and main challenges of the 21 century. According to the location of Afghanistan it is located in the arid and semi-arid areas so we can easily say that limitation of water resources and irrigation water are the key factors in the agriculture development in Logar, Afghanistan.

3.3. Karez

Logar river is flowing just inside three districts which are inter into Baraki Barak, flowing to Pul-e- Alam and Mohamad Agha so other four districts Chark, Kharwar, Azra and Khoshi are not able to take water from this river so that is why the use Karez system as well as some parts of the mentioned three districts. Old Karez is a rural Afghanistan water infrastructure that is environmentally friendly and sustainable. Karez is a durable and continuous flow gravity-driven system. (Abobakar Himat and Selim Dogan, 2019). In the past three decades because of war lots of rural infrastructures and water supply systems including Karez received significant harm and some of them became dry and collapsed because of no maintenance and low governance. The main and big threat for this kind of irrigation and water supply system is current drought and digging of well for the irrigation system in a rural area which causes to decrease water table in some places when in summer they start irrigation from Well by using pump Karezes are becoming dry because of the low water table. According to some research, more than 50 % of agriculture production is from the Karez irrigation system in Afghanistan. The average precipitation in Afghanistan is in a year about 300 mm so it will be difficult for agriculture if we do not have irrigation. Karez has some important components which are (1) main well, (2) infiltration part of the tunnel, (3) water conveyance part of the tunnel, (4) open channel at the end of wells, (5) access wells (6) Karez Reservoir, (7) Irrigation Land, (8) Inlet of Karez, (9) Outlet of Karez, (10) Drinking water point (Awkhura), for more details (see Figure 6 and 7)

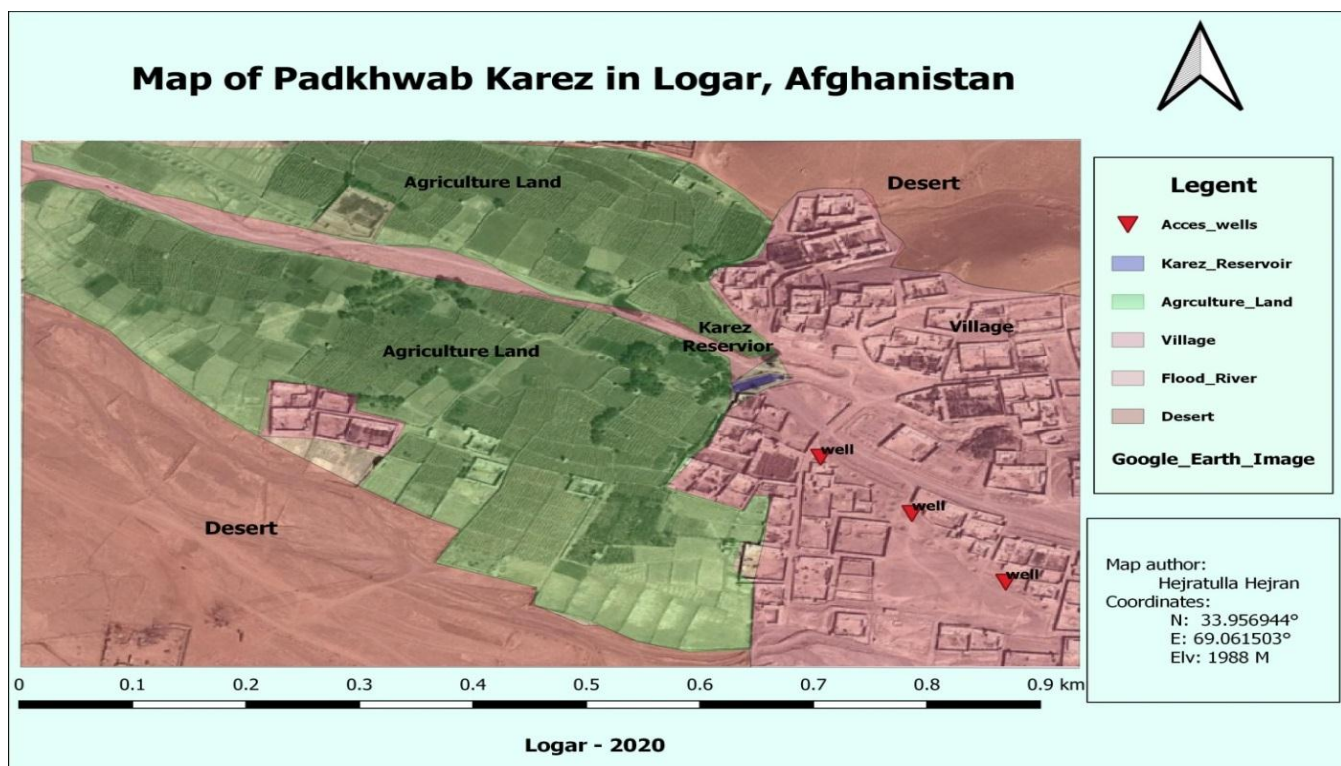


Figure 6: Padkhwab, Faiz Karez irrigation scheme and command area in Logar province Afghanistan.

Karez is an underground conduit with a gentle slope to transport water from an unconfined aquifer to the surface by gravity for irrigation, livestock, and other water supply purposes (Abobakar Himat and Selim Dogan, 2019). In recent years using of deep wells and pumping water are caused of drying some Karez in Logar province, according to Afghan Water Law, digging and construction of Deep Wells should be constructed after getting approval from the related or responsible ministry, according to chapter seven article thirty-eight of Afghan National Water Law: when a person wants to use Deep well for the following purposes like agriculture, commercial, industrial and urban water supply it should be after receiving permit/license by the Ministry of Mines. Shallow wells are not included because it is for drinking and livelihood (Afghan National Water Law, 2009). Low governance and water resources management in Logar, Afghanistan is the cause of increasing illegal digging of a deep well and cruelly drying of Karez irrigation system, this Karez is not just for irrigation purposes some times in many villages it is the best source of water supply for the local community, drinking water for Kochi people (Kochi are people in Afghanistan who have important Afghan animals with them and are not settled in one place. During the year, they migrate from one area to another because of their animals), and livestock water supply purposes. In Logar province, Karez constructs by the local community by professional workers (Karezkan), over the distance between the two wells are different but generally, it is about 25-30m. Karezes are gravity system, enduring and ongoing water, good water quality, a network of water supply in multiple applications, community water management

network, cheap maintenance, minimal evaporation losses, the long service life of pumped wells, acceptable cost, sustainable system, world heritage of water management (Abobakar Himat and Selim Dogan, 2019).

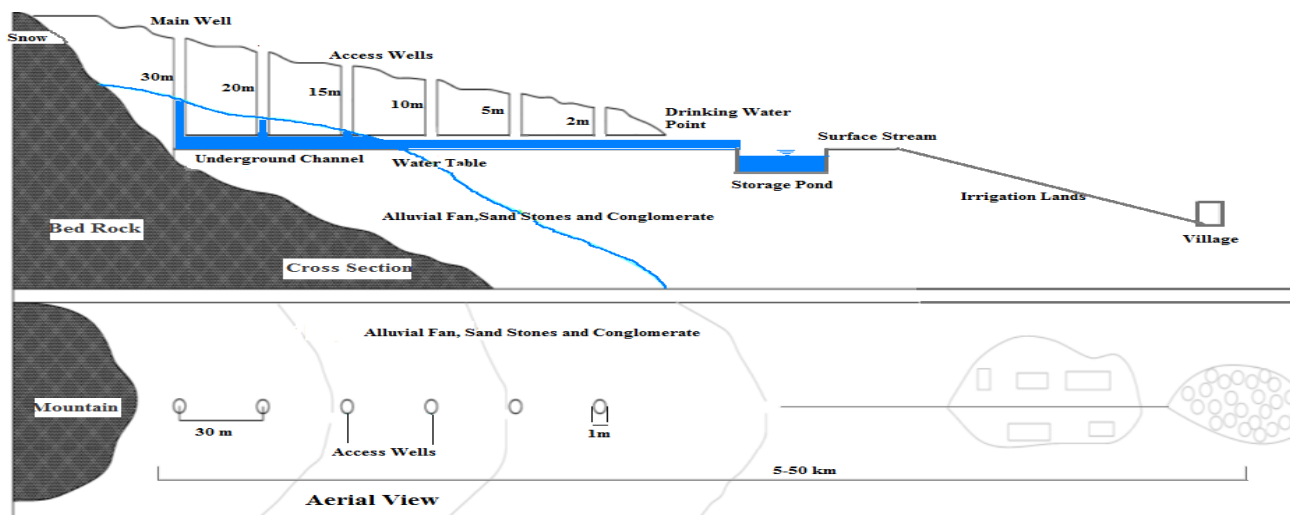


Figure 7: Crass-section and Plan of Karez, Source: Ancient Karez System in Afghanistan: The Perspective of Construction and Maintenance, Abobakar Himat and Salim Dogan, 2019.

During Afghanistan's civil war, in addition to the damage to Afghanistan's economy, development, water resources, infrastructure, and many other important projects, the impact on Karez was immense, and the destruction of many Karez throughout the war. The main reason for harming many Karezes in Logar province was the geographical location because it is located at the south of Kabul and during civil war lots of attacking was done from this site and in response, the government of the time was a force to do operation against them, this Karez was the save place for those who were against the government and they use it as a shelter, by knowing to government some Karez was destroyed for finding the gunmen. But during the last few decades, there were some international and responsible national organizations which they have done maintenance and construction of Karez irrigation and other irrigation systems in Logar and over all Afghanistan. (See Table Number 1st and 2nd)

International Organizations								
DACAAR	ADB	GOC	WB	EU	GTZ	USAID	UNDP	FAO

Table 1: Organizations which were Responsible and main donners for irrigation systems.

National Responsible Organizations			
Ministry of Energy and Water	Ministry of Rural Rehabilitation and Development	Ministry of Irrigation Water Resources and Environment	Ministry of Agriculture, Irrigation and Livestock

Table 2: Ministries which were Responsible for irrigation systems in Afghanistan

By having lots of in 2019 Afghan President Mohammad Ashraf Ghani has issued a decree dividing the ministry of Energy and water into two separate national administrations, the two agencies then operate under the National Water Regulatory Authority and the National Energy Services Regulatory Authority. And as well combined other national administration that they were working at irrigation and water sector but in other ministries, for example, the directorate of irrigation and Ministry of agriculture, irrigation and livestock (MAIL), water is a vital and infrastructural sector of Afghanistan, which has a special place in the reconstruction and economic growth of the country, and National Water Regulatory Authority committed to its healthy management.

3.4. Deep wells

Deep wells: due to the increasement of the population and returning refuge from neighbor countries the demand for agriculture is more than last few decades, so the water for agriculture is limited and surface water is not enough, in Logar province, there are using of solar pumping system from deep wells which caused to extend the land for agriculture but the main problem is getting downing of the water table and drought of Karez systems.

4. Irrigation Association (IA)

In 2012 by the Ministry of Agriculture, Irrigation and Livestock (MAIL) a guideline was established which was based on paragraph five of Article 11 and Articles 18 and 22 of the Water Law, aims to regulate the formation, registration, strengthening, and operation of irrigation associations, to maintain the traditional and desirable Mirab water system, which is a cultural heritage of the country for better water management has been established to irrigate agricultural lands.

4.1. Objectives of the procedure

(1) Explain the conditions of how to form, register, strengthen, and operate irrigation associations. (2) Organizing and managing matters related to the formation, registration, activity, and strengthening of irrigation associations. (3) Arranging water affairs for irrigation, operation, and maintenance of irrigation networks.

4.2. Conditions for creating an irrigation association

Irrigation association is created under the following conditions: (1) Members of the Irrigation Association should represent all relevant management areas. (2) Members must own land or water rights in the area of management. (3) Members must be physically present in the management area.

4.2. Structure of Irrigation Association

(1) The Irrigation Association consists of the General Assembly (all members of the Association), Mirab, Chekbashi or Chekbashiha, Secretary and Treasurer. (2) The Irrigation Association shall be elected for three years or more without regard to religious, ethnic, linguistic, and gender discrimination of residents and members who have agricultural land or water rights, as stated in the relevant statutes. (3) Ordinary meetings of the General Assembly of the Irrigation Association shall be determined in accordance with the relevant statutes. Main and key persons in an irrigation association (see Figure 8).

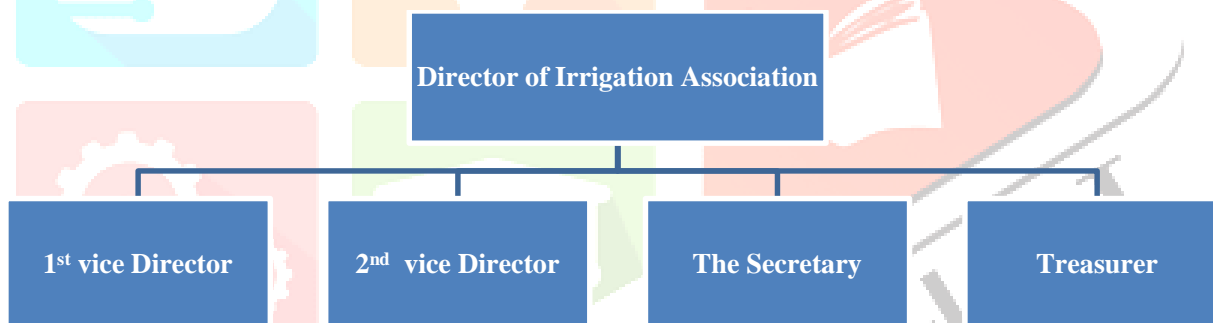


Figure 8: the key persons in an irrigation association in Afghanistan.

4.3. Competencies of Irrigation Association

The Irrigation Association has the following competencies: (1) Preservation and provision of water rights in the relevant areas. (2) Ownership and control of irrigation networks in the area covered. (3) Participate in making important decisions on water resources management, including protecting the interests of users in water user associations, sub-councils, and maritime areas. (4) Participate in the decision-making of governmental and non-governmental institutions to invest in the rehabilitation and development of irrigation networks in the relevant areas. (5) Use of the collected fees, for the purpose of performing the responsibilities them, is included in article eight of this procedure and other items that are included in the statute of the association. (6) Apply for and use it in emergency assistance in crop and natural disasters.

4.4. Duties and Competencies of the MAIL

The Ministry of Agriculture, Irrigation, and Livestock has the following responsibilities towards irrigation associations: (1) Awareness of farmers and farmers about the provisions of establishing irrigation associations. (2) Cooperation in establishing irrigation associations, which includes the following: (1) Launch Advisory Process. Facilitate and organize initial meetings. (2) Facilitate the selection process of Mirab, Chekbashi, or Chek Bashiha, Secretary and Treasurer. (3) Distribution of sample forms containing the appendices of this procedure and the necessary guidance for its proper home. (4) Provide information on the progress

of the registration process to applicants upon request. Guidance of registered irrigation associations in order to raise awareness and increase their capacity, in order to actively participate in the management of water resources and water regulation in the farm and training and introduction of new technology. (5) Preparation and arrangement of guidelines and appendices related to pursuing the process of participatory principles in water resources management and water regulation on the farm. (6) Provide technical training on the implementation of irrigation projects and the maintenance of irrigation networks, financial and administrative management, and other activities that require specialized skills.

4.5. Responsibilities of Irrigation Association

Irrigation Association has the following duties: (1) Choose Mirab and Chekbashi or Chek Bashiha. (2) Prevent water losses. (3) Prevent the illegal use of water in accordance with the water law. (4) Prevent any kind of activities contrary to Articles 5 and 6 of the Water Law, which will reduce the quantity and damage the water quality. (5) Monitoring the fair distribution of water to farmers in accordance with water rights. (6) Cleaning of water pipes, canals and removing obstacles caused by floods in the flow of water, in order to prevent the destruction of the irrigation system and agricultural lands. (7) Continuous protection and maintenance and efficient use of irrigation networks under the auspices of the association. (8) Measure and record the amount of water flow inside the irrigation canal or scheme. (9) Participate in the identification, service, implementation, and monitoring of irrigation projects. (10) Follow-up and implementation of the plans of the Ministry of Agriculture, Irrigation, and Livestock in the absence of water and drought. (11) Obtaining and collecting the rent of water transfer services for agriculture and maintenance of irrigation systems according to the statute of the Irrigation Association. (12) Continuous contact with the Water Users Association and participation in the time of decision making related to water resources and use of planning for agriculture. (13) Moreover, some other duties and responsibilities which is giving during the implementation according to law.

5. Surface and Ground water

Groundwater is the main water supply source for Logar region and for its residents but in past two decades the usage of groundwater is extremely increased by digging deep wells, covering more agricultural land and incensement of the population in the urban and local area, as well as this, has led to a large pest, which has greatly damaged the Karez and springs in the Logar area, while groundwater use has increased and there's no system to recharge it, and locals community are ruthlessly using groundwater in a non-professional way. In the Logar sub-basin, the groundwater recharge rates or water tables are estimated based on the groundwater level growth in wells close to the River of Logar (Najibullah Sadid, 2020).

More over-irrigation from surface water is also decreased in a rural area and it causes lack of irrigation water so farmers need to irrigate the land, to find enough water for irrigation they need to dig deep wells.

6. CONCLUSION

Logar is one of the most important province in the southeast of Afghanistan for the Afghan government because of geographical condition, near to the capital, having enough agriculture production, a good assistant river for Kabul river which includes the current province in its territory and easy to implement lots of agriculture projects. Besides all in this province, there are many kinds of rules and regulations that how to use irrigation water, and how to distribute it among farmers and the local community. Before 2020 there was a different kind of organizations that were responsible for the water sector in all over Afghanistan but since 2020 all the responsibilities just belong to one administrative which is called national water regulatory authority. And the most common irrigation system that is using inside the Logar province are main canal irrigation system, secondary canal irrigation system, Karez system and also we can say that Karez is using for water supply tools as well, and it is a useful and very friendly system in remote areas where there are no canals that are received irrigation water from the river which is flowing inside this province, by using this system the maintenance and recovering of it is not much expensive and the final one is deep wells pumping irrigation system which recently used more than last decade but caused of drying Karez system and as well as decreasing of the water table in step area. All the above systems and maintenance of them are not expensive. By having more responsible administration there implemented several types of irrigation projects by different organization like we can say intakes on the river of Logar, rehabilitation of irrigation schemes, cleaning off some main irrigation canals, and recovery and maintenance of some active Karez irrigation system. All these activities caused to decrease conflicts among the sector of agriculture and to prevent water losses among the irrigation canals and

irrigation schemes. Besides all the above improvements for better management of water resources in Logar, there are registered water user associations for better implementation of irrigation projects and water management in the agriculture sector. This association has four key persons that are most responsible for the selective area and they are the director, first vice president, the secretary, and treasurer. The whole responsibility of this structure is issued and showed by some regulations that have already exist in the regulation of making an irrigation association.

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