TRADITIONAL SPATE IRRIGATION SYSTEM in Al-Hajjareen– Dawan – Hadramut

Spate practical Note


1. Introduction

General

Traditional structures of Spate irrigation are old-style forms of water resources management. They are used in arid and semi-arid regions. Examples can be found in Alghber - Alhajareen valley which is a branch from Doan Valley and is located within wadi Hadramout, Yemen. Traditional structures are established to take advantage of spate water wisely and economically by using gravity. Irrigation practice involves the diversion of hasty spate floods running off from plateaus catchments. Although it usually flows few hours with appreciable discharge, it has recession flows lasting for a few days.

Spate irrigation with traditional structures has several benefits. They manage spate flow for crop production, rangeland, local agroforestry, water ponds for livestock and aquifer recharge. The main crop cultivated in spate irrigation areas is sorghum. Crops are irrigated once or twice per season. Moreover, crops get residual moisture stored in the deep alluvial soils from the sediments deposited in previous irrigation.

Location

Al-Hajjareen is a tributary area of Doan directorate that is situated within the downstream of Doan valley. Its centre Coordinate is 39°E 214224 N 1714018. Doan is one of 30 directorates in Hadramawt governorate within Eastern plateau in Yemen. It is located in south-west of Seiyun city, capital of province, about 100 Km (Asphalt) distance and 800 Kmdistance of Sana'a (capital city). On the other hand, Doan valley is a tributary of wadi Hadramawt. Seeifs a capital city of Doan directorate(Figure 1).

Topography

Alhajjareen area is a part of Hadramout's plateau which lies about 1,000 meters above sea level. This plateau was being crossed by huge valleys (wadis) which were being made by gigantic floods in the past. Valleys' waterbeds are about between 700-800 meter above sea level. Valleys' banks have semi-intense steeps. There are three waterbeds (valleys) called Doan(main), Algabar and Algawo(branches).

Figure (1): Geographic regions [6].
Geology

The Hadramout Wadi is formed by tertiary's formations. It has four geological layers group but its canyons are covered with Quaternary deposits Figure (2). Wadi Hadramout is located in a canyon that is cut through the carbonate rocks of the Hadramawt Group. The vertical sides of the canyon rise 300 m above the top of the Quaternary deposits. The aquifer are approximately 90 km long, 1.5 to 20 km wide and locally more than 100 m thick. It has high transmissivity and good sources of recharge Figure (2). Various large tributaries quickly bring floods from around 22500 km2 over the limestone plateaus to Wadi Hadramawt canyon [6].

Climate

The climate is hyper-arid. It is hot throughout the year with maximum temperatures ranging from 38 °C to 45 °C in summer. Climate data from 1986 to 2005, Figure 3 shows: a humidity rate of 34%, Avg. Max temp. of 36 °C, Avg. Min temp. of 17.5 °C, daily evaporation of 7.5 mm, daily rainfall of 5.8 mm and annually rain fall of about 50mm.

Hydrology

Every season the spates flow through the valleys (wadibeds). Even in dry years of scarcity floods, it has floods flow at least twice. The area has annually two rainy seasons: first during March-April, second during July-August.

From south to north Al-Hajjareen surface water flows into Arabian Sea Basin. Then its water assembles with wadi Al-Ain and wadi Amed to put their water in wadi Al-Masellah Figure 1.
2. Traditional irrigation structures in wadi Hadramout

According to Al-Hajjareen residents the traditional irrigation system in Al-Hajjareen exists since many hundred years. This system was founded by an old civilization that were called Kindah. They were dwellers in the area and depending on spate irrigation. Farmers deducted quantities of spate water from upstream areas by barriers (Aldhameer). The barriers diverted the spate water through main canals, which were built by farmers to convey the flood water under gravity over their lands. Farmers in Al-Hajjareen area still teach their sons the traditional irrigation ways, such as building irrigation structures that helps to control spate water and protect their lands and canals from erosion. However, the new generation has been using modern equipment. They have an apathetic attitude for managing their land in comparison with their ancestors.

Irrigation Network

Spate irrigation networks in Al-Hajjareen area consist of more than 10 main canals that supply agricultural fields with spate water. Every canal diverts spate irrigation water from spate stream (wadi) by masonry or earthy barrier (Aldhameer) which are constructed in the beginning of the canal. The bodies of all the canals are earthy, except parts of the beginnings of the main canal and where farmers control water (Figure 4).
3. Traditional spate irrigation structures in Alhagareen Area:

There is several irrigation structure are used in Alhagareen area, these structures are mentioned as follows:

1- Aldhameer (barrier):
It is a spur-like diversion structure made from stones and rock, which farmers have been burying with spatebed deposits in shape of long piles, in order to be firm. The structures have a deep base that extends at an obtuse angle from the ‘ras al-sygiyah’ (the canal intake) to middle of wadi channel, usually against the direction of the floodwater flow in the wadi. The height of the spur gradually increases from ground level in the middle of valley to 1-1.5 meters at the canal intake. This gradual difference in height is to avoid obstructing the water’s passage, to avoid destroying Aldhameer, and to control the incoming water flow (Image 1).

At the down-stream of valley where it widens out into the agricultural land and the flow spreads out, the valley needs to be closed off completely. Therefore Al-dhamer were constructed across the wadi channel to divert flood water to the main canals. Also the wadi branches are closed off by Aldhameer because they have a small catchment area and flood flow[5&8].

*Image (1- A): Aldhameer (barrier)*  
*Image (1- B): Aldhameer (barrier)*
2-Saqiyyat Aldhameer (main canal)

The main body of the Saqyyah is made up of two walls. The outside one is facing the valley and an inside one facing agricultural land.[Image 2]. It contains openings to divert water to nearby agricultural lands called Almarab (farm's canal); however, this canal continues until it ends at Alatheed (canals divider). This canal has an overflow structure, built after 100 meters from Aldhameer on outside wall of Saqyya. It calls MankiSaqiyyatAldhameer (Almansam) (spillway). The Manki or Mansam is constructed beside the canal intake to control overflow water to be back to the wadi.

![Image (2 –A): SaqiyyatAldhameer (main canal)](image1)
![Image (2 –B): SaqiyyatAldhameer (main canal)](image2)

3-Manki SaqiyyatAldhameer (Almansam)

MankiSaqiyyatAldhameer (Almansam) is a structure which exists through the first 100 meters of saqyyatAldhameer on outerside wall. This structure is about 10 to 15 meters long depression in the height of the saqyyatAldhameer wall facing the wadi spatebed ([Image 3]and (figure 5)). The Manki structures is used to control the excess water (overflow) diverted to the irrigation canal. It brings this excess water back to the wadi. The Saqiyaah takes only its safe spate water capacity[5&8].

![Image (3): MankiSaqiyyatAldhameer(Almansam)](image3)
![Figure (5): MankiSaqiyyatAldhameer(Almansam)](figure5)

4. Alrasah (stony wall)

This structure is a stony wall with mortar substance.[Image 4]. Its back usually faces the spate flood channel side and protects the canal from erosion. It exists after the intakes of themain canal (after Aldhameer where the flow is still disturbed).
5. **Alatheed (canals divider)**

This structure is a stony wall which divides the main canal into two canals or more by many dividers (Atheeds). Each divider goes to different directions, and each canal has different bed levels, which depends on the irrigated fields distance from the main canal (Image 5).

![Image 5-A: Alatheed (canals divider)](image)

![Image 5-B: Alatheed (canals divider)](image)

6. **Almarab (farm's canal):**

It is a small canal that extends between farm and canals system (farm off-take) It irrigates the land under a certain slope which takes into account the location and size of the irrigated area. Palm's Marab is the deepest and will get much water. It has a Harah (door). Its maintenance depends on the farm owner himself, so it is out of Alkhyel's recommends. Alkhyel only watches its dimensions (Image 6).

![Image 6 A&B: Almarab (farm's canal)](image)
7. **Alharah and its shapes:**
It controls the quantity of water under aspect of quantity and prevents the driftage. Shape in **Image (7-A&B)** it conveys and controls the water flow from one canal to multi-level canals under aspects of quantity spate. It also prevents the driftage in steep canals.

8. **Fields’ Manki: (surplus outlet)**
These structures control the irrigated water level in the field and field erosion, so it helps canals to get rid of surplus water back to wadibed or to the next low field. This structure is constructed from dry stones or stones with lime or cement mortar (it lines by stones) to protect land soil erosion from higher field to lower field (**Image 8**).

9. **The operation and maintenance practices in wadiDuan**
According to the farmers, each farmer must maintain the branched canal near his farm as Alkhyel (canal supervisor) recommended him. While the main canal takes its enough maintenance by modern equipment, tractor, or loader that finances by Alkhyel from fines, givers, and shares. Following traditional rules and practices, Alkhyel orders farmers to maintain their farm canals and to pay for the maintenance of main canal. **Alsond customs** but Alkhyel push them to organize the times and shifts for irrigation system, which helps farmers in spate water distribution and canals maintenance. The small saqiyya (Almarab), which convey water to farm, should be cleaned by the farmer (**Image 9**). Sometimes main canals are damaged, then Alkhyel collects money from immigrant doners (charities) and repair canals by build stony walls (**Image 10**) or rent tractors (**Image 11**) to repair Aldhameer and any damage in main canals.
10. Conclusion:

Traditional spate irrigation system in Alhajareen consists of more than ten main canals which supply spate water to agricultural fields. In general, every agricultural field has spate irrigation structures start from high level with two important units.

First: the main units which consist of diversion structure (Aldhameer), after that the main canal (Saqiyat Aldhameer), then the canals dividers (Alatheed), then the branched canals, then the farms canal (Almarab).

Second: control units; overflow's structure (Almansam or Almanka) in first 100mm of main canal, stony wall (Alrasah) in one third of the main canal, Alharah and its shapes in branched canals, overflow openings (Al-Mankaa) in the end of canals or between farms.

System in Alhajareen is controlled by inherited traditions and customs, which all farmers know. Farmers must maintain branched canal near their farms as Alkhyel recommended them. Main canal takes maintenance by modern equipment, tractor or loader which is financed by Alkhyel from fines, givers, and shares.

The traditional spate irrigation system in Alhajareen faces big damage problems and sediments as in Damoon and Khedoon. All this system in the area need rehabilitation for agricultural lands and spate structures.

Farmers need awareness about the importance and maintenance of consecrated lands to face future food needs.
11. References:

[6] Lectures of IWRM master which we have studied in Water and Env. Centre – Sana'a Uni. 2010-2011.
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Colofon

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The Spate Irrigation Network supports and promotes appropriate programmes and policies in spate irrigation, exchanges information on the improvement of livelihoods through a range of interventions, assists in educational development and supports in the implementation and start-up of projects in spate irrigation.

For more information: www.spate-irrigation.org.

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