Historic review of spate irrigation and its effect on agricultural development

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1. Introduction

The first Yemenis settled in fertile mountain terrain and near wadis; always near water. By about 2000 BC, they were a prosperous nation. Caravan routes to Syria and the Mediterranean, and between India and Egypt, crossed the Yemen and there was plenty of trade in incense, gum and myrhh. But most of all, it seems, using the evidence of the ancient Sabaen engravings, the Yemenis were successful agriculturalists.

Rainfall in this corner of the Arabian peninsula is irregular. To solve this problem, the Yemenis used stone water breakers and weirs. They constructed weirs in every wadi, which achieved two objectives: first, preventing the frequent damage to villages and farms that had previously been caused by violent torrents after heavy rainfall; and, secondly, maximizing the amount of water available for irrigating land during periods of drought.

On the highlands, terraces were built to retain water and keep the land fertile. In dry inland areas, wells were drilled, sometimes to great depths, and the water used for irrigation. Where springs and wadis were situated, tanks and reservoirs were built to conserve the water.

These works helped to achieve significant agricultural development and transformed the Yemen into a green land with rich orchards; at this time it became known to those who lived there as Happy Yemen.

There are widespread remains of ancient irrigation installations still to be seen all over the Yemen. Together with the ancient Sabaen engravings—which illustrate surprising agricultural prowess—they stand as evidence of the technical achievement of those days.

2. Wadis (valleys)

Water flows in all directions from the western highlands in the centre of Yemen. To the west it flows across the coastal plains towards the Red Sea. To the east it flows in the direction of the Empty Quarter. To the south it flows in the direction of the Gulf of Aden; and there are some limited wadis that flow towards the north.

There are many wadis in Yemen, some rich in water and some poor. What concerns this study, however, are the historical wadis on which the old Yemeni civilization was established.

2.1 Historical wadis and irrigation installations

"Historical wadis" refers to those on which the capitals of old Yemeni kingdoms were constructed around 2000 BC. Some of these wadis are now dry, as a result either of desertification or of clay residues. These wadis are Wadi Hadramout and Wadi Arma Al-Meashar in the Kingdom of Hadramout, Wadi Baihan and Wadi Hareeb in the Kingdom of Qataban, Wadi Markha and Wadi Shargun in the Kingdom of Awsan, Wadi al-Gawf in the Kingdom of Maeen and Wadi Adhana in the Kingdom of Saba.

Figure 1 shows the location of the different historical wadis.

2.1.1 *Wadi Hadramout* is considered to be the biggest wadi in the region of Yemen. It extends into the eastern plateau about 420 km in a direction parallel to the southern coast of the Arabian peninsula. The width of the wadi is more than two kilometres. The wadi is dry for most of the year, except when torrents of rain pour in from tributaries, temporarily watering the wadi bed. The most important southern tributaries are Wadi Amd, Wadi Dawan, Wadi Al-Ain, Wadi Rahya and Wadi Bin Ali. Wadi Hadramout is fed by several sources that spring from the Hadramout southern and northern plateaux. The most important sources are Wadi Haynin, Wadi Gacayma and Wadi Aydid.

2.1.2 *Wadi Dawan* is one of the tributaries of Wadi Hadramout. It is a narrow, deep wadi known as Hagrain in the village of this name, and as Al-Kasr between its meeting with Wadi Ain and its end at the head of Wadi Hadramout.

The irrigation establishments are clearly visible and spread over an area of several square miles in the south al-Mashha area. They continue for several miles to the north. The remains appear in the form of hills covered by stones of different sizes spread on the wadi bed and include ruins of falls, openings of drains and remains of main and branch channels. All of these are above the present level of the surface by more than one metre. It is also noteworthy that there are works of clay linking the irrigation establishments.

2.1.3 *Wadi Amd* is one of the tributaries of Wadi Hadramout and is a sandy plane, levelled by a clay layer, formed by the wind. The dust channel carrying torrents from the top of Hareedha is four metres wide, with stones at its banks, following the shape of the city's outskirts. Here the torrents form tributaries, making a network of small streams

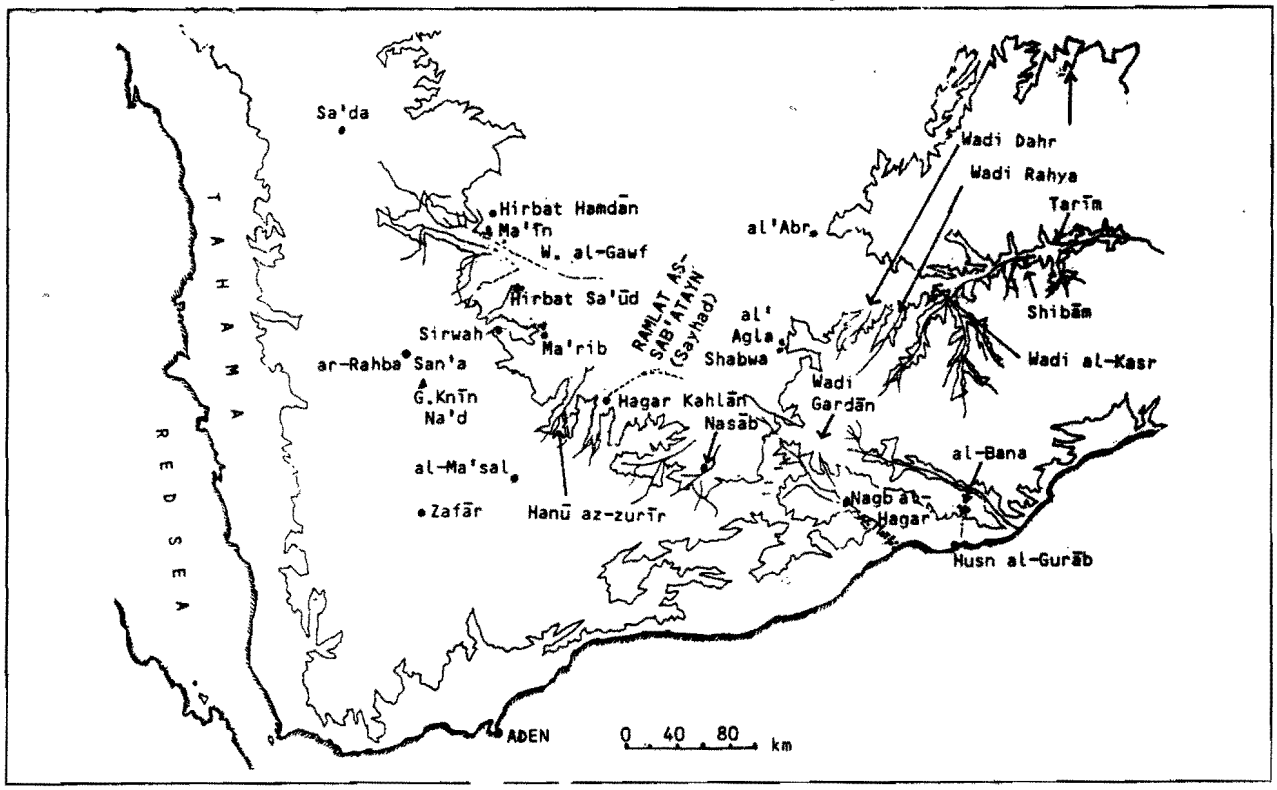

Figure 1 Historical wadis in Yemen

and channels that water the agricultural lands at the top of the wadi. A channel 30 metres wide is still to be seen, despite erosion. There are also the remains of a dam in a V-shape, 3.51 metres wide. This dam has two arms based on two banks built of gypsum. The length of one arm is 63 metres and the other is 40 metres. The distance along the bank between these arms is 85 metres.

It seems that there were three types of irrigation establishment in the wadi:

i. the main feeding channel, with a width of between 20 and 30 metres, believed to have started at a distance of 16 kilometres from the top of the wadi. It widens under the stone dam;

ii. sub-branches at right angles to the main channel, distributing water to fields. Their width is between four and eight metres and they are higher than the surface level by about two metres;

iii. tertiary branches for distribution of water as required.

Irrigation of the fields is achieved by narrow channels, around one metre wide, which leave either the main channel or sub-branches at a sharp angle.

2.1.4 *Wadi Armah (or Wadi Maashar or Wadi Al-Atf)* is a small wadi situated north-west of Wadi Hadramout and falls into Ramlat Al-Sabatain. This wadi is considered one of the driest. At the western end are the ruins of the old city of Shabwa, the capital of Hadramout State. The plateau surrounding Shabwa (Al-Goal) is a dry area. This raises the question: considering the city is situated far into the desert, what factors can explain its prosperity which lasted until the end of the 5th century AD?[1]

Unlike the cities located at the edge of the desert, the prosperity of that city must have rested on irrigation. Unfortunately, no ancient engravings exist here to illustrate irrigation establishments and consequent agricultural expansion. Yet such establishments existed. Dr Jacqueline Pirenne says: "Through our observation in the city of Shabwa, and while going up to the plateau that surrounds the site from the eastern side and where the eastern part of the city is located and, in spite of the sand dunes that covered the area, we were able to see the wide canal. Following this canal we reached a wide area located in the north-east that was irrigated by that canal. From above the plateau that surrounds Shawa from the north-west we were able to see a network of channels off-shooting from another wide canal, but it was destroyed in several places. As we went up the plateau we could see, on the western slope, a wide area of irrigated lands."[2]

2.1.5 *Wadi Beihan* springs from the heights of Al-Baidha and Mas'abain. From the town of Al-Rassas it goes to the north-east, where it passes Baihan Al-Odsab. This wadi, which is fed by Wadi Mahr and Wadi Khar, is unusually straight and wide except in some of its remoter areas.

The torrents of Wadi Baihan are brief and irregular. A great part of them flows to the sands of Ramlat Al-Sab'atain. The area of the basin is about 450 sq km and its waters go east, in vain, to the sands of the desert.[3] This wadi was subject to the construction of several irrigation establishments and weirs at the time of the State of Qataban (contemporary with Saba, Hadramout and Awsan). On the other bank of the Wadi (Tamnd'a), the capital of Qataban

State was constructed, known today as Hajr bin Hameed.

The first archaeological excavations in the wadi were undertaken by the American Foundation for the Study of Man in 1950 and 1951. This mission comprised 30 scientists and specialists, of whom one was R. Lebaron Bowen who presented a study on the irrigation system in Wadi Baihan, as a result of his tests on the clay sediments. He also uncovered the presence of a main canal at Hagrain Hameed (Tamnd'a), 1200 metres long. On this canal embankments were constructed for the distribution of water on both sides to lands lower than the canal. Later, other low branch embankments were constructed at the level of the fields that were to be irrigated. These were regular in form, mostly rectangular. They connected with the main canal at right angles.[4]

2.1.6 *Wadi Hareeb* is situated 100 km south of Marib, to the west of Wadi Baihan. They both connect with Wadi Mablaqa in the hills. Wadi Maifa starts from north of Qaifa and 'Al-Awad and ends in the desert of Rub Al-Khali.[5] Wadi Hareeb played a major role in the economics of the old State of Qataban. Archaeological discoveries have shown the remains of irrigation installations and traces of several channels. Those remains are still to be seen, while sand deposits have covered others. Agriculture was not restricted to the environs of the main wadi, but extended elsewhere via its tributaries, Wadis Al-'Ain and Mablaqa.[6]

2.1.7 *Wadi Markha* is situated to the south of AlBaidha within the old kingdom of Osan which was to the south-east of the old State of Qataban and includes territories of Yafa, Lahej, Dathina and Abyan. Osan remained an independent kingdom, after which it followed the Kingdom of Qataban. Later it came within the Saba' and Du-Raydan. Maswara was the capital of Osan.[7]

Archaeological discoveries have shown remains of networks of weirs and channels for irrigation in Wadi Markha.

2.1.8 *Wadi Shargan* is situated 10 miles beyond 'Adya Hill, south of Mukairas. Its course narrowed after Old Husain village. An old weir was discovered in this wadi. It was built between two rocky heights. The old stone walls are still there but the remains of the western wall cannot be seen. The villages have a drainage system.

There is a lake in the bottom of the weir. This, as Brian Doe said,[8] is due to the speed and quantity of the water flowing in the wadi during the floods. Beyond the lake is the main channel and several of its sub-channels to the western side of the wadi irrigate cultivated lands to the east.

In this wadi 21 inscriptions were found, a number of them in the south of the village and others south of the dam. Some inscriptions refer to the irrigation establishments in the area. One of these inscriptions cited the name wadi (Sh R G N). The archaeologists calculate that the inscription was written in the reign of Saba and Du-Raydar.

2.1.9 *Wadi Al-Gauf* has tributaries starting from the middle heights of the hill of Nabi Shuaib, East Sada and Omshia and to the south the hill of Lawz in Kholan and the hills of Bani Bahlol in the south-east of Sana. It meets the floods of Bani Hushaish and Hamdan north to Arhab and meets the tributaries of Alpuon that descend from the south of the city of Amran and Rayda. Hence, the wadis gathering in Wadi Al-Gauf are Hamdan, Hawth, Midab, Al-Khared, Rada and Shibam. The wadi flows seasonally; some of its tributaries are dry, particularly the northern ones, but the southern ones are always streaming.[9]

In Al-Gauf Ma'een, the historic kingdom, was established and Karma was its capital. Important cities built in the wadi were Baraqish, Kharbat Hamdan, Assoda and Al-Beidha'. The Maecenians constructed a large number of weirs and irrigation channels. Historically, the most important weir is Al-Kharid which was constructed in Wadi Kharid.

2.1.10 *Wadi Adana* is one of the most important wadis of Sheba State where the capital of Sheba was to be founded later. Many hilly tributaries pour into the wadi which passes through a strait among hills and becomes a wide wadi. In this strait the Yemenis erected, in the seventh century BC, the famous Mareb Dam (*see section 3.4*). In the west of Mareb at a point where Wadi Adna separated from Wadi Khashma the city of Sarwah was built as the first capital of the State of Sheba, and here Wadi Sarwah is found. There the Shebians constructed a weir known as Al-Bena on which old Shebian inscriptions were found.[10]

2.2 Wadis far from civilization sites[11]

2.2.1 *Wadi Mawr* is one of the larger wadis which flows into the western plains. It runs only seasonally but its tributaries run continuously. There are many tributaries that join the wadi which springs from the heights of Al-Amshiya near Sada, Washha west of Hashed, Kahlan and Hagya. The major tributary that connects with the wadi in the south is called Wadi Zaa); its floods come from Sawas Hill, Kokaban heights and it streams continuously. Wadi Mour runs north-south until it meets Wadi Zaa and then deviates to the west for about 25 km in Tehama plain. The basin of the wadi is about 7500 km^2 and the length is about 300 km. It flows to the Red Sea north of Al-Lhaia.

2.2.2 *Wadi Surdud* has upper tributaries beginning from Al-Nabi Shoaib and Alhasas, north of Haraz and, from the south, from Al Mohwet gathering in Khamis Bed Saad. It then extends to the strait of Bab Anaka. Its floods irrigate Azaidia, Adahi and Al-Mahgam lands. The most important tributary of the wadi is Al-Ahger which springs from the southern heights of Shebam Kokaban. The wadi runs mostly to the south-west in its upper part and then it inclines to the west towards the Red Sea. Its basin is about 2450 km^2 with a length of about 230 km. It flows into the Red Sea, south of Azaidia.

2.2.3 *Wadi Siham* has a number of tributaries from several springs. Some of these come from the heights north of 'Anes, the peaks of Asod Hill, Walan south of Sana, the south of Haraz and the north of Rayma. The most impor-

tant tributaries are Walan and Doran. Wadi Seham flows into the Red Sea to the south of Hodayda. The area of its basin is about 3200 km².

2.2.4 *Wadi Rima* comes from Doran Anes, Hamam Ali, the north hills of Otoma, north of Wsab and the south of Rayma. Its course runs among the hills of Swab and Rayma. It descends to Bani Sawada, Almashrafa, then Algaroba and Al-Husainiya of the Zaranik lands. This wadi flows into the Red Sea. It runs discontinuously and is affected by the quantity of seasonal rainfall. The area of its basin is about 2540 km² and it is more than 250 km long.

2.2.5 *Wadi Zabid* is second to Wadi Mour in area: its area is 4500 km² and it runs continuously. It has many tributaries including Alodain wadi of Ana, Sahol north of Ib. These streams meet in a strait between the hills of ras and Wsab. It irrigates Zabid and flows into the sea in Alfaza. It has a length of more than 250 km.

2.2.6 *Wadi Nakhla* is situated to the south of wadi Zabid. It springs from the heights in the north of Taiz and flows to the Red Sea north of Al hokha.

2.2.7 *Wadis Rasyan and Moza*: Wadi Rasyan is situated to the south of Wadi Zabid. It has a basin of about 1750 km². It reaches the Red Sea north of Maha port. Wadi Moza is situated to the north of Wadi Rasyan and joins the Red Sea. It has a basin of about 1300 km². These two wadis spring from the heights of Saber near Taiz.

2.2.8 *Wadi Tuban* is one of the major wadis in Yemen. It springs from the heights of De-sofal, about 50 km north of Taiz. It flows south-east to the low ground of the Aden Gulf. The basin of this wadi is mainly fed by three other wadis: Akan, Warazan and Bela, which all join Wadi Tuban in the south at the village of Wahat. Tuban splits at the village of Zayda into two branches known as Wadi Al-Kabin—which flows to the gulf of Aden near Ashab city—and Wadi Asageer, whose floods end near the village of Al-Imad before getting to the sea. Together, these wadis form the Tuban Delta. In this wadi there is a continuous stream that reaches the Delta and three springs irrigate Al-Hussaini and Al-Arays gardens. The area of its basin is about 7150 km².

2.2.9 *Wadi Bana* springs from the heights near Yarim. Its most important tributaries are the wadis of Hasan and Sohayba which join near Bataiys forming Delta Abyan. There is a continuous stream in Wadi Bana which reaches the Delta. It flows to the Gulf of Aden 50 km from the village of Sheikh Abdulla.

2.2.10 *Wadi Hagr* gets flooded by rainfall in the southern region, Shabwa, and the west of Hadramout Governorates. It has a continuous stream and flows to the Arabian Sea near the village of Al-Hussein.

2.2.11 *Wadi Maifa'a* gets its waters from the rain that falls on the middle area. Some of its most important tributaries are Wadi Amaqeen, Wadi Habban, Huda and Cardan.

3. Irrigation in Ancient Yemen

The study of historic irrigation in the south of the Arabian Peninsula is particularly interesting, because of the great role played by irrigation in the development of agriculture there. History books are not always sufficient for such research and care and concentration are needed to discover what the different theories are.

We would like to thank those archaeologists who studied this subject and left for us the results of their efforts. Valuable research on the principles and mechanisms of watering was carried out.

First of all the archaeologists came Abu Al-Hasan Al-Hamdani, the Yemeni writer whose life spanned the end of the 9th century and the beginning of the 10th century AD. In his book on irrigation establishments, Al-Iklil, Abu Al-Hasan devoted a chapter to the Yemeni dams in which he described what he saw of the remains of the great Marib dam.

Caton Thomson's English mission visited Yemen in 1937 and carried out excavations at the old city of Hurayda. The results were published in a book called *The Tomb and Moon Temple of Hurayda (Hadramout)*, Oxford, 1944. A chapter of this book was devoted to irrigation in Wadi Amd, one of the tributaries of Wadi Hadramout. This chapter is highly valuable, because it is the first research on the principles of irrigation in Wadi Hadramout.

The American Foundation for the Study of Man that visited Yemen from 1950 to 1953 comprised thirty specialized scientists, including F. B. Albright and R. Lebaron Bowen. This mission recorded the results of its study in the form of several valuable scientific researches. One of these is the study conducted by Bowen on *Irrigation in Ancient Qataban*.

Bowen studied the origins of irrigation in the wadis through his analysis of the amount of silt gathered in the ancient fields. He also wrote about the different irrigation establishments.

In 1959 the Ministry of British Colonies sent Mr G. Lankester Harding to carry out a survey of remains and historical sites in a number of protectorates. He studied 39 historical sites and published a book entitled *Archaeology in the Aden Protectorates* (London, 1964). When discussing the mains of Wadi Dow'an, a tributary of Wadi Hadramout, he wrote of the irrigation in that area. His research complements that of Caton Thompson.

Modern excavations have added a great deal of information concerning the origins of irrigation and its systems. The French archaeological mission presented to us models of irrigation systems in Shabwa, the capital of the kingdom of Hadramout, in Wadi Hadramout and in the area of ancient Awsan.

The joint Yemeni-Soviet archaeological mission is still presenting us with a good deal of information on irrigation and its systems in the tributaries of Wadi Hadramout.

3.1 Types of irrigation

There were several types of irrigation, the most important of which is under study in this paper: spate irrigation. But

it should be mentioned that Yemenis did not water the lands from torrents, but also depended on irrigation from springs, wells and water from tanks, the construction of which was their speciality.

3.1.1 *Spate irrigation.* The irrigation systems using torrent waters basically consisted of building dams and canals. Watering lands was carried out according to the following steps:

(a) diverting the torrent waters in the wadi into a canal (Al-'Abr);
(b) making sub-channels from the main canal (Sawaqi) which control the discharge of water, through drain outlets, in small or large quantities as needed; and
(c) distributing the water through smaller channels to the agricultural area that needs to be irrigated.

3.1.2 *Irrigation by torrent waters.* Torrent waters in Yemen are quite heavy, especially in the mountainous areas that receive large amounts of rainfall. The water, in mountains, gathers in cracks in the rock layers. This water then comes out in the form of springs. The paths of these springs may be diverted to direct the water to agricultural areas.

3.1.3 *Direct irrigation (rainfall).* Some of the Yemeni lands receive rainfall directly, especially the mountainous areas. This provided the incentive to transform these heights into terraces.

3.1.4 *Irrigation by wells.* The use of wells comes second, for irrigation purposes, only to spate irrigation. The use of wells is a very old tradition in the Arabian Peninsula and in Yemen in particular. There are many Saba'ean engravings showing wells and the buckets used to get water from them.

3.2 The first irrigation

When did irrigated cultivation begin? Answering this question is not simple, especially when we have little but a few stones left of the first irrigation establishments.

It is worth mentioning the viewpoints of some of those who discovered these irrigation establishments. Caton Thompson says: "The irrigation system in South Arabia is not known by archaeologists, and it is difficult to fix a date without a certain evidence shown by a remain. Continuous repairs of dams and weirs, stone obstructions, canals, branches and the incorporation of ancient works with modern ones throughout the generations has effaced clues that might point to the date of this irrigation system."

Through his study of the amount of accumulated silt in the ancient fields which he dated between 1000 BC and 300 AD Bowen said that the silt sedimentation at the bottom was the first thing to occur in Hagrain Hameed (which is located six miles south of Tamna'). He believed that watering activities in the Baihan area went back to 3000 BC and might be older. He also clarified that there was a settlement at that time.

These hypotheses prevail and will prevail until another study of stratification can prove otherwise, or another study of plant be carried out in these areas. Achieving this might clarify many ambiguities and answer many questions.

If we ask about the size of area irrigated by torrents, Dr Jacqueline Pirenne said, upon viewing Shabwa city from the air in a helicopter, "The aerial view enhanced what we had seen of irrigation canals. The cultivated areas are quite wide, considerably exceeding the present fields surrounding the city. They even extended to an area which nowadays is desert."

The area once irrigated by Ma'rib Dam has been estimated at more than 5000 hectares, according to expert studies and by the evidence of aerial photographs taken of the area before the new dam was constructed.

3.3 Engravings and Irrigation

Archaeologists found a good number of Sabean inscriptions depicting irrigation and watering activities. These inscriptions also inform of agricultural terminology and the names of equipment and tools, such as the engraving in Repertoire 4069 which was found in Wadi Dura south west of Nisab (which is 300 km north-east of Aden). This engraving tells us about preparing an irrigation installation in Wadi Legam. Another inscription was engraved on a rock south-east of the village of Ber Anakhel, situated at the juncture of Wadi Dura and Wadi Mkhyla, in the place known as Amkdad. The engraving shows clearly organized agriculture.

The inscription of Amra mentioned in Repertoire 3856 was found at the foot of the mountain Barha. The owner of this inscription is called Ghalb Ben Dosan. It shows how agriculture was organized, the terraces and the digging of wells for irrigating the fields.

3.4 Irrigation installations

Archaeologists have found the remains of weirs in different parts of Yemen but no comprehensive report has been published. A short history of Yemeni weirs appears in the second volume of the book by Abu-Alhasan Al-Hamdani (Al-Ikleel).[12] Unfortunately he covers only the Al-Goaf region and the Western Plateau.

Al-Hamdani listed 26 weirs, the most important of which is the Mareb Dam. This is believed to have been the first to be constructed in Yemen and is very famous. He recorded his observations of his visit to Mareb. It was considered a major engineering success in irrigation in South Arabia built in the 5th century BC and it brought prosperity to the people in Al-Goaf through agriculture. It was destroyed around 575 AD, and those it had helped to support scattered.

4. The tanks

As we have seen, the Yemenis were able to control the flood waters in wadis through weirs and distribute it to agricultural lands through irrigation channels that still exist.

They were also able to preserve rain water in drier regions by digging huge tanks into the rock and lining them with non-porous material such as marble. The tanks were mainly used for drinking water and household use. Many of them were built on fertile heights such as the heights of Ib Province. Many of these tanks are still in use, but their

water is no longer fit for drinking.

There are still remains of some very old tanks such as the ones at Hesen Al-Gorab where the famous old port of Kana was situated. But the greatest concentration of tanks was found in the city of Aden. At the time of the British occupation, in January 1839, more than 50 tanks were recorded in Aden.[13] This reflects the size and importance of Aden as a port long ago.

The tanks were built over a substantial period, as the populations of the cities grew. The differences in construction were noted by the British architects, Norsi and Belhi, in their book, *Aden Tanks: A Historical and Archaeological Survey*.[14] Some experts believe the Aden tanks were built in the pro-Islamic period.[15] This is supported by their similarities to the Hesen Al-Gorab tanks.

One tank remains of the group believed to have existed outside the garden of Wadi Tawilah. It is circular and this is considered to be typical of the shape of the original tanks. It is also believed that the tanks each had a smaller tank acting as a filter at the entrance. Many of the tanks are connected by channels along the course of the wadi. (See figure 2.)

A description of the Tawilah tanks was written by Solt, who visited Aden in 1809. He said that there were many beautiful, but now ruined, tanks, three of which at least were very deep and 80 feet wide, dug into the solid rock and lined with marble.[16]

British archaeologists mentioned a tank at the entrance of Wadi Al-Khsaf. On the hill in the north-east of Wadi Atawilah there is a small tank still present.[17]

The tanks remained safe following the British occupation of Aden. Two tanks in Wadi Alaydros, cleaned in 1847, were described in the book on Aden tanks by Norsi and Benhi.[18] One of them was circular, situated at the head of the wadi, with a diameter of 406 feet, a depth of 10 feet and a capacity of 546 300 gallons. The other had a diameter of 406 feet and a capacity of 99 000 gallons. There are no remains now of these two tanks in the wadi.

5. Conclusion

We have seen how enterprising and creative the Yemenis were in using all available means to irrigate the land. This led to the prosperity of the old Yemeni civilization.

But eventually the agricultural prosperity broke down. Political disputes such as the war between Sheba and Hadramout at about 800 BC prevented the proper maintenance of the weirs and channels. When big floods followed, the already cracked weirs were irretrievably damaged. Gradually, previously cultivated lands turned to desert and most of Yemen's population scattered and emigrated to other parts of the Arabian peninsula. Soon, too, the trade route changed from the landway between Yemen and Asham to the sea route through the Red Sea, causing the decline of much trade.

Lastly, it must be suggested that preserving and restoring the old irrigation installations should be a priority for the officials in Yemen. Using international aid to maintain and repair these may improve Yemeni agricultural prosperity yet again.

And encouraging archaeological research in all respects of the Yemeni civilization and facilitating the task of those interested in studying them will promote awareness of history, and help develop a sense of national pride.

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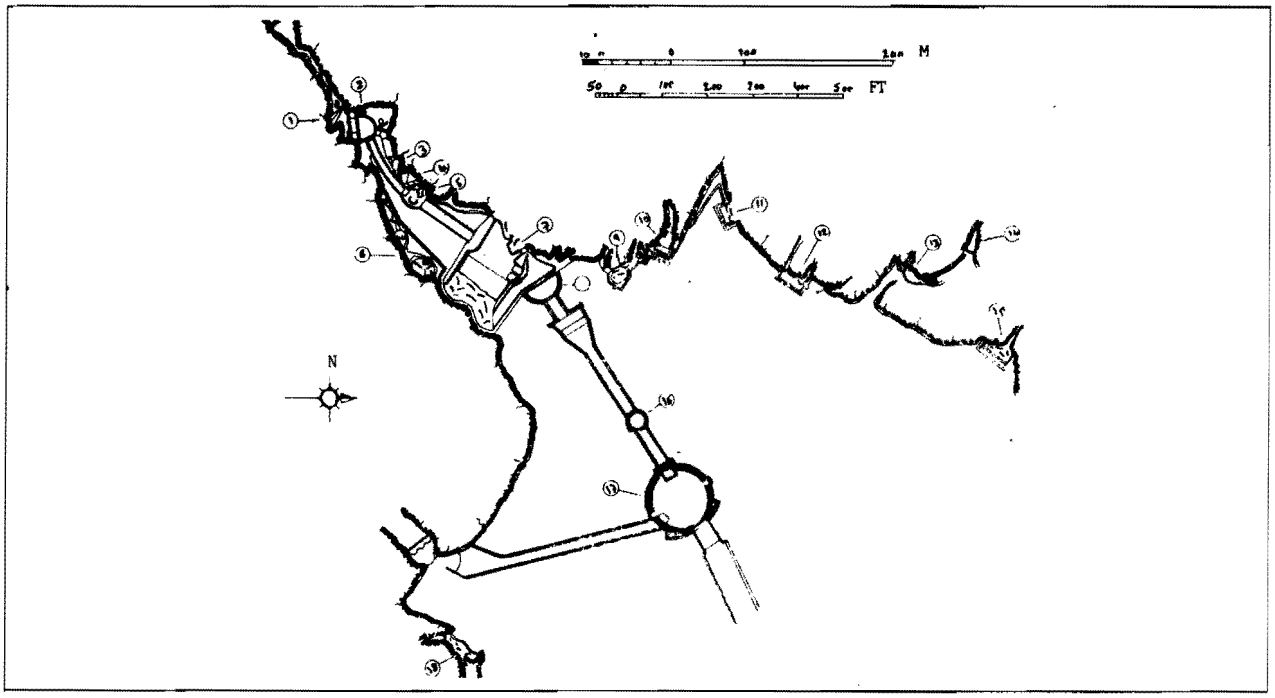
(Figure 2 Atawilah Tanks)



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