Republic of Yemen
Ministry of Agriculture and Irrigation
Ground Water and Soil Conservation Project- GSCP

Review of:
Traditional Practices of O&M for Spate Schemes in Yemen

Final Report

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Review of Current Practices in Yemen relating to O&M of Spate Schemes by beneficiaries and to make practical suggestions for cost-sharing by the beneficiaries in the O&M costs within the framework of existing Laws to ensure O&M of Spate Schemes by beneficiaries/WUAs after completion

Executive Summary

Background

Farmers have over the centuries developed traditional diversion systems and spate irrigation networks. Temporary ogmas are built using wadi bed material across the wadis to divert the spate waters into the channels leading to fields. As the flow rises the ogmas are washed away, often before the whole command area is irrigated and the flood passes on to lower ogmas; no more diversions are possible until the ogams are rebuilt.

The traditional systems are relatively cheap to build, but require considerable maintenance to remain operative. The construction and replacement of ogmas and distribution of spate flows are communal activities organized by the farmers with the help of a water master. Farmers contribution on O&M are in cash or in-kind, The Bulldozers machines are used to maintain or rebuild these ogmas and the costs are shared on the basis of benefits received and the size of the land.

The modern systems(built by government) are, by contrast, were in the past envisaged to be entirely operated and maintained by the government agencies, since these involved greater commands and larger number of farmers. No cost-recovery system for O&M was ever established for such schemes.

However, with serious constraint of resources faced by the Government since many years, no adequate and timely O&M budgets have been provided for these structures. As a result these are not being maintained either by the government agencies or by the beneficiaries.

The Government therefore decided to transfer the complete responsibilities of O&M of these structures to the beneficiaries/WUAs. The WUAs, in turn have no resources for the O&M of these structures. The existing laws/bye-laws also do not empower the WUAs to collect irrigation fee from the beneficiaries which can be used for the O&M of these structures nor they can impose any fines on the defaulting farmers.

As a result many of the structures built in Yemen with large investments have deteriorated or failed and others are going into disuse or are not giving the desired benefits. The large investments made over these structures may in the near future become sunk costs unless O&M of these is ensured.

On account of above, the donor agencies, and the IDA has given clear indication that they will not finance such schemes unless sustainability of WUAs is ensured and existing Laws/Bye-laws are amended to empower WUAs to collect fee for O&M or impose fines on the defaulting farmers.

The flood water/spates in Yemen, is a major source of irrigation in different regions and agriculture depends significantly on it and on meager rain water in general. These waters are also a significant source for recharging of groundwater. The importance of Spate Structures therefore, can not be overlooked.

An O&M unit was established in Tehama (TDA), Wadi Hadramaut similar O&M units were established for O&M of spate schemes in Lahej and Abyan. However due to many constraints mainly lack of resources over the past many years, no budget was provided for O&M of these structures and these O&M units have virtually become defunct.

Study

For this important issue, a study *"to review the Current Practices in Yemen relating to O&M of Spate Schemes by beneficiaries and to make practical suggestions for cost-sharing by the beneficiaries in the O&M costs within the framework of exiting Laws to ensure O&M of Spate Schemes by beneficiaries/WUAs after completion"* has been undertaken under GSCP.

In addition to the provisions of the TOR, the study also include water rights and maintenance of irrigation facilities with spring sources.

Objectives of the study:

- Review of local customs and traditions for the O&M of spate irrigation facilities and reasons for degradation of these traditions;
- Revival of local customs and traditions, and institutional restructuring with the participation of Local Councils and WUAs established under GSCP; and
- make practical suggestions for cost-sharing by the beneficiaries in the O&M costs by suggesting amendment in the exiting Laws/bye-laws how the O&M of Spate Schemes (in cash or in kind) can be ensured by Beneficiaries / WUAs.

Visits were made to relevant institutions in different provinces and interviews were held with various officials, specialists, members of associations, WUGs and old farmers to identify the current traditions practices of O&M and the system of allocation of spate irrigation water.

Water rights

A study of documents/manuscripts reveal that there were strong customs and traditions in communities about water rights and maintenance of irrigation facilities. In some areas some crops such as palm and vegetables were given priority over other crops. Agriculture Committees consisting of experienced and influential farmers existed in Hadramaut, Abyan and Lahej areas. Irrigation Supervisors were appointed by the beneficiaries and the Agriculture Committee to observe spate water distribution and O&M. . The Irrigation Supervisor was given a part of the agricultural produce or cash.

However after the building of modern structures, the existing water rights and the distribution of shares were disturbed. Many influential farmers misused these modern structures for their

benefits. Non-maintenance of these structures, and inability of the government to take action against these influential farmers led many farmers to abandon the agricultural activities and migrate to cities. All these factors led to the extinction of these customs and traditions relating to the water rights and O&M of irrigation facilities.

Existing O&M Practices observed

(1) In the Directorate of Saber Taiz and some spate structures in Wadi More, the farmers contribute a portion of the agricultural produce (about 2.5 %) for irrigation supervisor and less than 2.5 % in Hadramaut. In other areas lump sum payments of 3000-5000 Rial are made. In most areas maintenance of the traditional spate irrigation systems is still the responsibility of the beneficiaries. As regards the maintenance of modern spate systems, the beneficiaries consider it as the responsibility of the government.

(2) As regards small channels or irrigation systems dependent on streams/springs (some of the springs are even perennial) these facilities are maintained by the beneficiaries, with some exceptions

(3) Contributions of the beneficiaries in the maintenance of traditional facilities are usually in cash or in-kind, animals and in some cases donation of materials (cement and stones) or renting of equipment by some beneficiaries. Sharing of the cost is according to area benefited. In some areas in the mountains the farmers, who pay the largest contributions gets more share of the water and silt.

The role of different agencies in the operation and maintenance of irrigation facilities:

(1) The role of Government:

As indicate earlier an O&M unit was established in Wadi Hadramaut similar O&M units were established for O&M of spate schemes in Lahej and Abyan. However due to constraint of local resources over the past many years, no budget was provided for O&M of these structures and these O&M units have virtually become defunct. Of late the Government decided to transfer the complete responsibilities of O&M of these structures to the beneficiaries/WUAs. The WUAs, in turn have no resources for the O&M of these structures. The existing laws/bye-laws also do not empower the WUAs to collect irrigation fee from the beneficiaries which can be used for the O&M of these structures nor they can impose any fines on the defaulting farmers.

This situation had a negative impact on the operation and maintenance of irrigation facilities leading to the collapse of these facilities. Many of these facilities are at the verge of destruction.

(2) The role of the local authorities:

For the maintenance of modern irrigation structures there are norms for the distribution of Spate Waters and the local authorities receive 30 % of their budget from AFPPF for operation and agricultural services which may include O&M of the irrigation structures.. The

Government is considering restructuring of these provisions and the matter is under discussion with the House Representatives and Council of Ministers to restructure the fund.

(3) The role of WUGs / WUAs and water users:

WUAs:

As mentioned earlier the WUAs, have no resources for the O&M of these spate structures. The existing laws/bye-laws also do not empower the WUAs to collect irrigation fee from the beneficiaries which can be used for the O&M of these structures nor they can impose any fines on the defaulting farmers. In the absence of any support, the sustainability of WUAs established so far is becoming a problem. Further the WUAs / WUGs have no experience of maintaining modern structures and these institutions can hardly play any role.

Water Users:

The crops grown under spate irrigation are generally Sorghum, sesame and a few vegetable which generally have low economic value. The availability of spate is also scarce and uncertain. As a result the farmers are not encouraged to pay their contributions towards O&M of spate irrigation structures

However, there are cases of success. For example in the case of Gail Bawazir and Alrabah WUAs in Shibam district of wadi Hadramawt where the traditional O&M practices are still in vogue and O&M cost are recovered through indirect taxes (at 10%) levied on the agriculture produce. In the case Alrabah WUA in Shibam District and Wadi Al Ain WUA both in Hadramout Governorate some associations have been re-constituted on the lines of the Agricultural Committees.

Strengths and weaknesses of the traditional customs:

The strength depends on the equality and fair distribution of water allocations, maintenance costs of facilities and the speed of resolving conflicts, participation of beneficiaries and their contribution towards maintenance according to area benefitted as well as a sense of ownership by the beneficiaries in these facilities. The weakness is represented by the frequency of maintenance throughout the year, mobilization of all beneficiaries in times of need, fragmentation of holdings, and the traditional cropping pattern with low financial returns.

Laws and regulations:

Article 10 of the Water Law of 2002 provides that Water Users and Beneficiaries associations may be formed for the purpose of involving the public and the beneficiaries of water in regulating water resources or in O&M of water installations. The procedure for the implementation of the provisions of the Law shall set out the purpose and all the detailed rules related to such organizations accordingly.

The draft bylaws were framed by NWRA / MoWE, however, do not provide empowerment for the WUAs to collect fees from the water users or impose fines on the defaulters for the O&M of water installations as envisaged under Article 10 of the Water Law.

Recommendations

General

(1) In the absence of O&M of spate structures, many of the structures built in Yemen with large investments have deteriorated or failed and the large investments made over these structures may in the near future may become sunk costs unless O&M of these is ensured. The Government must pay serious attention to this issue failing which the damage to these structures may lead to heavy losses in the national economy and may be very difficult to restore these facilities. It may be mentioned that the spate irrigation is a significant source of groundwater recharge which is also depleting fast in Yemen.

(2) Provide proper training to the WUAs in the O&M of modern structures to restore confidence in them and amend the draft bye-laws which would empower the WUAs to collect fees from the water users or impose fines on the defaulters for the O&M of water installations as envisaged under Article 10 of the Water Law.

(3) There is need to discuss this important issue in a Workshop where all stakeholders should be invited to develop a clear vision on this issue and to firm up the short-term and long-term measures/steps and the type of amendment required under the bye-lays relating to spate irrigation and in particular on the O&M of Spate structures.

Short-term solutions

- Till such time the WUAs are empowered to assume the full responsibility of modern spate structures, the Government must provide adequate budget for the O&M of these structures at least for the next five years.

- Amend the Draft Bye-laws under the Water Law which would empower the WUAs to collect fees from the water users or impose fines on the defaulters for the O&M of water installations as envisaged under Article 10 of the Water Law.

- Amend the financial regulations so that the fee collected by the WUAs can directly be used for O&M of Spate Structures.

- Provide training to WUAs on the O&M of modern spate structures in accordance with the O&M Manual prepared under GSCP

- Consider creating an organization for O&M with equipments on the lines of Wadi Hadramaut and Abyan and Tuban which would take up the full O&M responsibilities over the

next 5 years and special repairs (see long-term solutions in the following paragraph) thereafter and supervise the work of WUAs and provide them maintenance equipment on rent

Long term solutions

There are two types of maintenance of these Spate Structures: namely (i) **annual maintenance** (which ultimately after 5 years shall be transferred to the WUAs); and (ii) **Major Repairs** which may be necessary in case of damage to the structures and which is beyond the scope of the WUAs.

- Establish a special fund for **Major Repairs** of the Spate Structures for which the following funding sources are suggested:
  - AFPPF;
  - Special Tax on Qat
  - Special tax on tobacco cultivation
  - Part of agriculture produce of crops irrigated by spate

- For the Annual Repairs by the WUAs the following are the sources of funds:
  - Fees from the beneficiaries on the water use;
  - Fines imposed on the defaulting farmers
  - 5 % cost of construction of spate works as per IDA MOUs
  - Initial contribution from AFPPF

Chapter I
INTRODUCTION

1.1- Brief Overview:

Farmers have over the centuries developed traditional diversion systems and spate irrigation networks. Temporary ogmas are built using wadi bed material across the wadis to divert the spate waters into the channels leading to fields. As the flow rises the ogmas are washed away, often before the whole command area is irrigated and the flood passes on to lower ogmas; no more diversions are possible until the ogams are rebuilt. (figure 1,2)

The traditional systems are relatively cheap to build, but require considerable maintenance to remain operative. The construction and replacement of ogmas and distribution of spate flows are communal activities organized by the farmers with the help of a water master. Farmers contribution to O&M are either in cash or in-kind, (figure 3,4) The Bulldozers machines are used to maintain and / or rebuild these ogmas and the costs are shared on the basis of benefits received and the size of the land.

The modern irrigation systems (built by government) were in the past operated and maintained by the government agencies, since these involved larger command areas and larger number of farmers. No cost-recovery system for O&M was ever established for such schemes.

However, with the serious constraint of resources faced by the Government since many years, no adequate and timely O&M budgets have been provided for these structures. As result these are not being maintained either by the government agencies or by the beneficiaries. (figure 5,6,7)

The Government therefore decided to transfer the complete responsibilities of O&M of these structures to the beneficiaries/WUAs. The WUAs, in turn have no resources for the O&M of these structures. The existing laws/bye-laws also do not empower the WUAs to collect irrigation fee from the beneficiaries which can be used for the O&M of these structures nor they can impose any fines on the defaulting farmers.

As a result many of the structures built in Yemen with large investments have deteriorated or failed and others are going into disuse or are not giving the desired benefits. The large investments made over these structures may in the near future become sunk costs unless O&M of these structures is ensured.

On account of above, the donor agencies, and the IDA has given clear indication that they will not finance such schemes unless sustainability of WUAs is ensured and existing Laws/Bye-laws are amended to empower WUAs to collect fee for O&M or impose fines on the defaulting farmers.

The flood water/spates in Yemen, is a major source of irrigation in different regions and agriculture depends significantly on it and on meager rain water in general. These waters are also a significant source for recharging of groundwater. Rains in Yemen do

not exceed 60 days per year and ranges from 200 to 1000 mm per year (figure 8,9) . The quantity of spate water is estimated to about 2 billion cubic meter per year, mostly flows to the Red Sea (741 million cubic m) (figure 10 . However, on account of many spate schemes going into disuse the benefits over the years have considerably reduced. As against the over 80 % of the area being irrigated by spate and stream waters in 1970, it is only about 20 % now.

An O&M unit was established in Tehama (TDA), Wadi Hadramaut similar O&M units were established for O&M of spate schemes in Lahej and Abyan. However due to many constraint mainly lack of resources over the past many years, no budget was provided for O&M of these structures and these O&M units have virtually become defunct.

1.2– Justifications of the study:

The experiences of many projects and development agencies working in the field of spate irrigation, revealed that the issue of operation and maintenance of irrigation schemes, after the expiry date of the projects, has been neglected. This has been due to (i) the lack of adequate operational costs for maintenance and (ii) the absence of institutions interested in operation and maintenance of irrigation schemes and the (iii) increased dependency of communities on the state to provide all services, including operation and maintenance of irrigation schemes. .

Non-equitable distribution of irrigation water among the beneficiaries is one of the other factors that have led to the deterioration of irrigation schemes and their total or partial destruction. Thus the issue of operation and maintenance has appeared as an important priority issue for the Irrigation Improvement Project especially the revival of local customs and traditions and its development to address this imbalance with the community participation to ensure sustainability of the irrigation schemes.

1.3– Objectives of the study:

The study aims to fulfill the following objectives:

- Review of local customs and traditions for the O&M of spate irrigation schemes and reasons for degradation / abandoning of these traditions;
- Revival of local customs and traditions, and institutional restructuring with the participation of Local Councils and WUAs established under GSCP; and
- Make practical suggestions for cost-sharing by the beneficiaries (in cash or in kind) in the O&M costs by suggesting amendment in the exiting Laws/bye-laws, of the water law on how the O&M of Spate Schemes can be ensured by Beneficiaries / WUAs.

1.4– Scope and Methodology of the Study:

The study was based on the compilation and review of available studies, surveys and reports concerning various customs and traditions of water rights and operation and maintenance of spate irrigation schemes by government institutions and by international funded organizations and projects. Also visits were made to various institutions including administrative departments in Sana'a under (the concerned ministries, such as Agriculture, Water and Environment), and the Natural Water Resources Authority and the Agricultural Cooperative Union. Visits were also made to the different governorates and wadis to collect different studies and reports and to meet with officials and specialists in the offices of the Ministry of Agriculture and Irrigation, development projects and members of associations and water users groups and large scale farmers as well as representatives of the local authority to identify the prevailing traditions and distribution system in spate irrigation, the water sharing systems and the mechanism of operation and maintenance of modern and traditional irrigation schemes.

These reports and the information gathered were reviewed and analyzed to investigate objectively the prevailing customs and traditions in the operation and maintenance of different spate irrigation schemes such as diversion structures , major channels and / or sub-channels..

Based on the analysis of collected information, some suggestions were prepared on the development of the operation and maintenance in a sustainable manner. Due to the expansion of the study areas and the multiplicity of the wadis that depend on spate irrigation, including Gails, representative areas of the wadis were selected to conduct interviews and gather information from these areas such as Tihama, Taiz, Lahj, Abyan, Ibb, Hadramawt, Sanaa, Hajjah and Al-Mahweet. To gather information from experts and users, guiding questions wre developed with topics for discussion with stakeholders (professionals, members of associations, farmers, etc.).

To know the norm, and old habits in the operation and maintenance of spate irrigation schemes, the study included meetings with elderly farmers and key informants in this regard such as the Sheikhs of the "Shareejs" in Tihama, the Sheikhs of "Alobar" in Lahj and Abyan, and "Alkhail" in Hadramout, etc. There was a special focus on open discussions in an attempt to seeking the important suggestions of farmers' groups on the subject and the problems they face.

Due to the difficulty in covering the operation and maintenance in all target areas, representative focus group discussions were arranged, one group discussion with specialists in each area and 2-3 group discussions with the beneficiaries, representing upper, middle and downstream of the wadis. (figure 11,12,13,14,15,16)

Chapter II
TRADITIONAL SYSTEM OF O&M OF SPATE STRUCTURES

2.1 Traditional Water Rights in Yemen

A study of documents/manuscripts revealed that there were strong customs and traditions in communities about water rights and maintenance of irrigation facilities(figure 17,18). Ibn Muzaffar (during the Rasolate era 1459-1229) as mansions Al Ameer 1361 Hijri (1941) indicated that the norm in the water rights for spate

irrigation in general is "field -to-field irrigation ", with some exceptions of the priority of cultivation of some land on the other which may take precedence in irrigation. . The new lands have the same right of irrigation after the old cultivated land has been irrigated.

In some areas some crops such as palm and vegetables were given priority over other crops. Agriculture Committees consisting of experienced and influential farmers existed in Hadramaut, Abyan and Lahej areas. For performing these tasks Irrigation Supervisors were appointed by the beneficiaries and the Agriculture Committee helped the Irrigation Supervisor in performing his duties. The Irrigation Supervisor was given a part of the agricultural produce or cash.

The volume of irrigation water is agreed to according to habits or customs prevailing in the region. In the Tihama region, the height of water in the field could reach about 2-3 meters. Also the type of crop can affect the volume of water in the field, as grapes and date palm need more water than other crops.

Verwijderd: .

When the first flood is enters the filed, the farmers take measures when to move to the following field when it reach the heel bone of his leg. In the second flood, if it comes after 8-10 days for example, the water goes to the fields that have not irrigated in the first round. When the second flood comes after more than two weeks, water goes to the first field that is planted, as it needs water in this case. In some areas where they have fixed customs, irrigation holes in each field are made based on the need of each field, so water can move to the next field when water overflow the holes. This system is applied for the whole wadi, and if otherwise the system is broken by any one, he gets punished. (figure 19,20)

However after the building of modern structures, the existing water rights and the distribution of shares were disturbed. Many influential farmers misused these modern structures for their benefits. Non-maintenance of these structures, and inability of the government to take action against these influential farmers led many farmers to abandon the agricultural activities and migrate to cities. All these factors led to the extinction of these customs and traditions relating to the water rights and O&M of irrigation schemes. A more detailed discussion of water rights for each region is presented in the following points.

Coastal Areas:

2.1.1 Western coastal plain (Tihama):

Wadi Zabid:

Aldumi, 1982, indicates that in order to provide food for the residents of the city of Zabid, the rules have necessitated control over the Wadi Zabid for the purpose of agriculture and irrigation since the ninth century. Associated rights of water quotas

was set by the name of Ismail Jabarti or what is known as the Al-Jabarti law, which was drafted to resolve violent conflicts between farmers on water at the end of the fourteenth century during the time of the judge Muwaffak Al-din Ali Abu Bakr al-Nashiri, who was the judge of Zabid during the period 1391-1400 in the time of the seventh King Sultan Sharif Ismail Ibn Abbas (1377-1400) and thus the water quotas were set according to imposed dates.

There is also a known dominant custom that do not allow any land to be irrigated twice within 14 days and no new land is to be added for irrigation or any additional channel to be constructed to irrigate new lands. Groups of farmers benefiting from the water of the channel is usually not distributed according to tribal or clan affiliation, but are gathered for taking advantage of the channel. Here, according to the custom, water and the wadi are public property or belongs to God but the secondary canals are owned by who ever benefiting from the nearby fields.

At the present era, and exactly since the seventies of the last century, in order to increase the irrigated area and to exercise justice in the distribution and protection of agricultural land from erosion, the Tihama Development Authority (TDA) had to take responsibility in the distribution of water and other related matters. The Authority has to strengthen the traditional system in water distribution in the sub-channels through the "Aukom" which is known to each farmers under the basis of "field -to-field irrigation ". The water is distributed by Sheikh of "Shareege" (canal specialist) and for each sub-channel, there is a sheikh or a specialist who is usually from the same family and inherited from fathers to sons. This system is still in force.

In Wadi Moore, Irrigation system, as in other wadis, is based on the norm "field -to-field irrigation ", but irrigation system in Wadi Moore is distinguished by irrigation management that is done through what is known to the farmers in the area "Wakeel Al-Aukom" whose function is focused on the organization of channels maintenance when needed through the collection of fees for maintenance and operation and supervise the operation of water distribution to the beneficiaries according to prevailing traditions. For this role, the Wakeel Al-Aukom gets paid by farmers with 2.5% of the grain yield.

It could be indicated that water diversion structures and modern channels were created in the wadi, to ensure fair distribution of water through the wadi with its three parts (upper, middle, and lower parts) through the control of the gates according to the planned tables with dates for this purpose. However, the situation did not go as was desired, due to many reasons including technical and social reasons such as (i) lack of power supply which operates these schemes. In this case, farmers in the upper part of the wadi continue to control water at a time when farmers in the middle and lower parts of the wadi cannot object due to the lack of power and (ii) influence of land owners in the upper part of the wadi (an image of blocked channel (Figure 21,22,23). The prevailing norm "field -to-field irrigation " has become wrongly

understood, as it gives those who are at the upper wadi the right to exploit and expand the cultivation of new lands to provide water for their own rights.

During the implementation of the Wadi Moore project by the Tihama Development Authority, water management in the Wadi is done through two levels of control: the first is a committee of 10 persons elected by the beneficiaries and land owners headed by the Director of Al-Zohrah district and a deputy chairperson who is the Director of Alluhaia district., Both are from large and infleuencial families in the two regions. This Committee is responsible for the distribution of water shares and run the main channels and observe the implementation of important works that make the irrigation system in Wadi Moore effectively managed.

The second level is the control, operation, maintenance and transferring the river path. Each area has a person who monitor the operation and maintenance of channels and regulate the distribution of water shares. When there is a need for maintenance or rehabilitation of the operating channels, the channel observer reports to the committee to make the right decision. Maintenance costs are shared by beneficiaries farmers. In some cases, the costs are shared between the landowner and tenant equally.

Wadi Rima:

According to tradition, known in the Rimaa wadi, the distribution of water to farmers in the wadi is on the basis of recognized equality. Each tribe in the southern area of the wadi has one or more of the gates where their maintenance is the responsibility of the tribe. When there are weak floods only farmers in the upper wadi benefit, but in normal seasons, the majority of farmers in the wadi benefit.

Selfishness and the sense of monopoly, have also led to the wrong understanding of the prevalent norms by farmers in the upper wadi to utilize most of the spate water for their own interests. Trees and sandbags were used to raise water level to be lifted to their fields.

2.1.2 Coastal plain of Hajjah and Al-Mahweet governorates:

Water irrigation in Hajjah and Al-Mahweet governorates is made from field to field according to the norm "field -to-field irrigation " where there are openings called "Hawl". When the upper field is irrigated, the owner of the field open the Hawl to the next field and so on. The owner of the upper field is not allowed to change the place of the Hawl and if the Hawl is changed and has affected the next field, affected yields should be compensated by the owner of the upper field (estimate of loss is made by experienced key farmers). Sometimes, the opening or Hawl is made only in one side of the field to allow for the withdrawal of excess water from the field.

When rain water flow to Almkauiah channel (Aukom), four of armed men are put to guard the water and when land is fully irrigated, shooting is made by the armed men to indicate to Almaaqam owners that the waters have become theirs and therefore the body of the channel is broken to turn water into the main wadi stream. When rain water flows in small amounts in the wadi, it become the share of the first diversion structure . In the case of repetition of the flow of rainwater in the wadi in small quantities, it also become the share of the first diversion structure , even if this repeated flood continue for a full year.

Al-Agel of the area supervises the distribution of water among the beneficiaries according to the size of land owned by each beneficiary. Any one who violates the use of flood water or do not pay the repair costs will be fined by the Agel or to be forwarded to the Sheikh or to the security office in the area in the case of non-compliance. In the Shas Al-Barha Wadi in Khamis Bani Saad Irrigation depends only on the floods water during the rainy season. Here floods often come down with great force that no one can control. Distribution of water in this case takes the course of one field after the other. When there are small streams, as it is the case of this year, distribution is managed by the norm "field -to-field irrigation ". Fields are irrigated from one field to another by a small holes in the end of the field called "Almanaseh".

2.1.3 Southern coastal plain (Lahej and Abyan governorates)

Lahej

(i) Wadi Tuban

During the period August to October, there are three times of floods (once each month). The first flood normally irrigates the fields at the upper part of the wadi next to the first gate and then water goes to the next field and so forth. In the second flood stream Irrigation starts from the next fields that were not irrigate in the first flood. For the third flood, the same way is followed until it reaches the lower part of the wadi. This system goes right in the case of floods abundance during floods season (August-October). However, it is noted that the lands at the upper part of the wadi gets more water than the fields at the lower parts. Because of drought periods in the area in the past years, water did not reach the lower part of the wadi. The number of irrigated fields in the area do not depend only on the amount of flown water, but also on the status of maintenance of the canals and gates and on irrigation water management by the beneficiaries.

In the past, decisions on water distribution, channels maintenance and area to be cultivated were usually taken by the Agricultural Council through a publication announcement accompanied with a letter from the Director of Security. Here, the public announcement was made on the street or in the market by a fluent person accompanied by one soldiers in a carnival with the use of drums to bring as many

people as possible. After a loud reading of the announcement, the paper is pasted on the walls of various building including government buildings. The letter of announcement is also directed to the competent authorities such as the department of justice, the security department, the members of the agricultural council, the sheik of Alubar, and the agricultural extension workers.

Based on the above mentioned announcement, farmers start to clean the lands from weeds, cultivate the lands, raise the Aswams and repair channels. In the case of any damage to the main channels or sub-channels, the Sheikh normally send a person with the use of drum to the affected villages to inform them that they must quickly repair the damage in the channel and that each person has to contribute to the repair of the damage, either by oxen or manual work. In case of rejection by any person, the sheik normally sends a soldiers to take him to the security department where he gets released only after he has paid his share.

The Sheikh of Al-Aubar or the irrigation specialist is responsible for water distribution and regulating the operation and maintenance at the village level under the supervision of the Agriculture and Irrigation Office in the governorate. This irrigation specialist has a good relationship with the Sheikh of the village (Agel) and others. He is assisted by Sheikh Al-Alubar Assistant, who is selected by the beneficiaries, as well as by the agricultural extension agent. In the wadi Tuban, there are about 30 irrigation specialist who supervise the maintenance and operation of water schemes.

The main functions of the Sheikh Al-Aubar or irrigation specialist are:

- Estimates the amount of water that should go in the main channels, allocates water shares and supervises the distribution of water
- Diverts floods water

- Identifies the affected areas that need maintenance , determines the costs of maintenance in the main channels and collects contributions of farmers for maintenance.

Mobilizes workers and equipment for maintenance and distributes the work among them.

- Resolves disputes that arise between the beneficiaries on water distribution
- Determines the type of crops to be cultivated according to the plan specified by the agriculture and irrigation office
- Determines the area to be planted
- Acts as a link between farmers and other agencies
- Reports about the status of channels maintenance

The main functions of Sheikh Al-Alubar Assistant:

- Acts as a link between farmers and the sheikh of Al-Alubar
- Helps Sheikh Al-Alubar in all of his functions

Verwijderd:

Verwijderd:

The sheikh of Al-Alubar was paid as part of the crop produce for his fee, estimated as Kailah of grain (8 kg of grain) per fedddan. At present, farmers associations, have replaced Sheikh Al-Alubar, as the association provides a maintenance plan with costs to the irrigation council, which consists of 21 members representing the association management, the local council the agriculture and irrigation office, the court , the security department and others. The irrigation council is chaired by the secretary general of the local council This composition have taken advantage from the sultani decree issued in 1950 in this regard.

Irrigation Council meets twice, the first is when distributing water shares in channels and among beneficiaries, and the other to discuss the plan of maintenance of channels and irrigation schemes. The functions of the association is the maintenance of sub-channels while the functions of the local council is the maintenance of irrigation schemes and main channels. The irrigation supervisor is the one who allocates water shares for each channel and defines the type of needed maintenance and costs. Maintenance costs are obtained from the contributions of farmers which is 500 YR/acre and contributions from the local authority and almsgivers donations.

Abyan:

(i) Wadi Ahwar

Distribution of flood water in wadi Ahwar, before unification, was done by water user groups. In each area, there was an entity who is responsible for distributing water shares, operation and maintenance and even improvement of each system, including the channels. The water is distributed to beneficiaries according to the norms agreed between them, and under the supervision of agricultural cooperatives . Farmers pay irrigation taxes for the service provided to them. In this case, all farmers in the wadi get water with justice.

After unification, water users associations have disappeared and the big land owners became the main users who have monopoly over irrigation water, and no one can stop this unfair act as there are no laws or legislations that could help the local authorities to intervene in this respect. Access to water was reflected on the relationship between land owners and tenants in the division of revenue from agricultural land. For those farmers who are dependent on flood irrigation, usually at the wadi upstream, the tenant gets half of the produce, while the other half goes to the land owner. For farmers in the wadi downstream, who are mostly dependent on irrigation from wells, the land owner gets only 25%, while the tenant gets 75% of the produce.

(ii) Wadi Bana

In Wadi Bana Before, the irrigation system was under the responsibility of agricultural cooperatives and the state farms, who were responsible for the distribution of irrigation water to farmers, as well as maintenance, operation and improvement of irrigation schemes. After the unification, the responsibility of operation and maintenance of irrigation schemes was given to the agriculture office in Jaar. The responsible department prepare, each year, an irrigation schedule with the help of representatives from local committees. The role of local committees in water distribution is in the distribution of water to the farmers as well as in solving problems that result from the distribution of water to farmers. The following considerations are usually taken when scheduling irrigation quotas:

- Determination of water shares is estimated based on the quantities that were distributed in the previous season.
- The degree of reliance on floodwater
- The degree of salinity of agricultural lands

Despite these efforts, some land owners do not respect this distribution system which is associated by the absence of laws and legislations to govern water distribution as well as the poor performance of the local authority.

2.1.4 Eastern plateau (Hadramout)

Water rights are well rooted in Hadramout, as in many parts of Yemen, because of water shortage in one hand and the increasing demand on water on the other hand. Beneficiaries have developed a robust system for water distribution on irrigation channels and agricultural fields. Despite the multiplicity and divergence of wadis in Hadramout governorate, irrigation system and water rights as well as maintenance and operation of irrigation schemes are almost similar to a large extent with some differences in names.

When the water flows in the wadi, it enters the main channel (Sakia) and then distributed to the entrances (Alharat) and openings (Albodod) at the same time. The first fields near the openings and entrances are then watered and when it receive sufficient supply, water is diverted to the next fields through openings known as Manaki that are about 45 cm high. This irrigation system is applied for the lands cultivated with annual crops, but for the lands cultivated with perennial crops such as date palm, different Manakis are used with height of 75 cm.

2.1.5 Mountain Highlands Region:

The common water rights in the central highlands, especially in the areas that depend on spring (Gail) irrigation, are similar to that in other areas, with some differences in naming and site specific norms. The dominant system for the distribution of water shares is that, the higher lands receive water first or field-to-field irrigation system. The organization of water irrigation and the distribution of water shares is made by a

selected person, irrigation supervisor, who supervises the distribution of irrigation water. This person is often called "Al-Modawel" who can, sometimes, intervene and determine the priority of irrigation for some fields that need to be urgently irrigated even if this intervention has violated the existing norm, but usually his decision is respected by others.

(i) Ibb Governorate

In Al-Saddah area of Ibb governorate, as selected case study, an old system prevails that rely on water from springs (Gails), which is based on the election of a person named "Al-Modawel" for a period of 2-3 years, sometimes to 5 years, but he can be re-elected again if there is no objection by the beneficiaries. He is selected from the village that has the last irrigated fields. A number of persons (3-5) are also elected to assist Al-Modawel who are known as "Al-Kadeem".

In the case of damages to the channels, beneficiaries are gathered by the use of drums where affected farmers are called to participate in the maintenance specified by Al-Mudawel which can last from one day to several days and is usually done at the end of Autumn season. Each village or group of beneficiaries assigned part of the channel to maintain, but the regular maintenance is done by the Mudawel or his assistants.

Main functions of Al-Modawel (irrigation supervisor):

- Distribution of water shares
- Resolving disputes over the distribution of water shares
- Cleaning channels with the help of Al-Kadeem
- Monitoring of offenders
- Preventing violators, who break the norms, from getting water
- Determining the type of maintenance of the channel

Functions of Al-Kadeem (Assistant water supervisor): -

- Implementing directions of Al-Modawel
- Watching the channel, day and night
- Performing daily simple maintenance and cleaning of the channel
- Collecting the costs of maintenance
- Acting as link between the beneficiaries and Al-Modawel in most cases.

Al-Modawel and Al-Kadeems are getting paid, for their fees, part of the crop produce which is a quarter of the tenth yield in case of maize or barley crops and the eighth of the tenth in case of sorghum and wheat crops. For Qat crop, the beneficiary pays 10-20 bundles, or 3 - 4 thousands Riyals.

(ii) Taiz Governorate

Alakma Wadi in Moazaa district of Taiz governorate was another selected case study where there are some differences in water shares from other wadis. Here, in addition to the conventional irrigation system "the higher lands receive water first", which prevails in Summer season during the abundance of water, there is another water distribution system in the winter when there is water shortage. Here, water distribution is made by consent of all people where Al-Modawel nominates a number of trustful beneficiaries, particularly those who have the knowledge, experience to visit the fields and estimate who worth water first, especially those planting vegetables, regardless of the priorities given in field-to-field system. Al-Modawel, as usual, is elected by people in a general meeting with an assistant called "Al-Motabea".

The main functions of Al-Modawel, in Alakma Wadi, are mostly similar to that in the previous case study, but some extended tasks of Al-Modawel were mentioned in this wadi such as determining the type of crop and land area to be planted by each beneficiary and the amount of water available to avoid any problem caused by lack of water. Mobilization of beneficiaries and workers during large maintenance, was also mentioned. The assistant irrigation supervisor in this area has a different name called "Al-Motabea" who has, more or less, similar tasks to Al-Kadeem in the previous case study.

Al-Modawels and Al-Motabeas usually do not receive any money for their work. Disputes here are concentrated more on channels breakdowns and conflicts over water shares, but are resolved in consultation and consent in the presence of key figures in the Wadi.

2.2 Changes in O&M practices of Spate Structures and Ogmas after modernization of Spate Schemes taken up by the Government

Since ancient times until the last few decades, the prevailing custom in ,the traditional spate irrigation system is that the operation and maintenance is a function of the local community(Figure1,2,3,4) . With the establishment of large irrigation schemes, such as conversion dams and irrigation canals, operation and maintenance of these schemes become the functions of the government for several reasons The most important of which are (i) that the political regimes in the two parts of Yemen were considering this issue as one of the government functions. And (ii) that farmers and even the local community cannot meet the high maintenance costs. This situation has made the farmer from an active participant in operation and maintenance to a passive receiver of this service.

The situation has changed in the last two decades, as privatization and economic reform programs have taken place giving more roles to the private sector and civil society organizations in participating in the ownership of the management and the means of production, and public services. As a result of this, the government started to withdraw from some of its obligation without proper study for the consequences of

this actions, which led to many failures and collapse of many activities and projects including irrigation schemes(Figure24,25,26).

It could be indicated here that the government was unable to establish spate irrigation schemes in all the wadis in the country and, as there are a large number of wadis in Tihama, Abyan and Hadramawt where there are no modern schemes and the traditional irrigation system is still dominant and covers large agricultural areas. The norms and traditions in the operations of irrigation schemes, therefore, did not change as compared to the wadis where modern irrigation schemes were established and the customs and traditions in operation and maintenance and even water shares have changed.

During the last period the government invested heavily in infrastructure projects, including the establishment of modern spate irrigation systems (diversion structures , and irrigation canals ,..... etc) in the most important seven major wadis in the country. Many of these schemes were funded from the local budget or through loans from international donors, particularly the World Bank . The government has assumed the costs of establishing and funding these schemes without any involvement of the community and the beneficiaries in all phases of the project cycle.

A report of the Ministry of Agriculture and Irrigation and the World Bank for the year 2005, pointed out that "as a result of the policy followed, by the government, in implementing operation and maintenance of modern spate irrigation schemes, and neglecting community participation, the low efficiency of the public sector in the maintenance and operation of spate irrigation systems due to insufficient financial allocations for the maintenance expenses, and over staffing in the departments that manage irrigation schemes, many deficiencies that affected the irrigation system and the farmers were observed

These deficiencies include exposure of irrigation systems to damages by the successive disasters, desertification and sand dune encroachment, high salinity of groundwater due to depletion of groundwater reserves and its use in irrigation, and erosion and extinction of local customs and practices that were a source of spirit of partnership that prevailed before the establishment of the new projects. More detailed discussions in each region are presented in the following points.

Coastal region:-

2.2.1 O & M in the western coastal plain:

TDA

The Tihama Development Authority (TDA) is implementing all the operation and maintenance of irrigation schemes in the wadis. The department of irrigation

management, that belong to TDA, performs the operations and maintenance twice a year, once before the rainy season and the second after the season. This includes the varnishing of iron gates with paint and oil, the maintenance of side roads, and the periodical removal of waste, such as branches of trees, from the canals and flood streams either manually or by machines. The farmers here do, not bear any burden in the operation and maintenance works.

During field visit and meeting with specialists in the development of Tehama, officials indicated that the maintenance of canals and irrigation schemes suffer from several problems at the present time and has become obsolete due to lack of financial allocations and the lack of machinery or spare parts, so the channels are destroyed since several years. Its repair, as indicated by specialists from the TDA, would not work because of the lack of justice in water distribution and the weakness of the judiciary and law enforcement.

This situation was reflected on the level of farming income. At the upper wadi cash crops, such as bananas, mangoes, with high water needs, are grown, while in the lower parts of the wadi, farmers rely only on maize and millet with a low market value and low-water needs.

In the traditional system, farmers do maintenance of sub-channels that could bring water directly to their fields. The responsibility of Sheikh Al-ogm (irrigation supervisor) is collecting and organizing the process of building or repair of Aogms and estimating the costs and its distribution among farmers based on land area. He also distributes water to the beneficiaries and identifies which land need water when the wadi flows. In case farmers need heavy machinery, they rented them from the Tihama Development Authority where farmers pay for fuel costs and overtime for the driver.

Sheikh Al-Okom usually get an estimated return of 5% of the produce of each farmer, in addition to that he has the respect of everybody for the services provided. The maintenance costs are called "Tadhmid" and the amount depends on the size of the land, the amount of water needed, location, soil fertility and finally the number of irrigation times. For example, at the upper part of the wadi, the beneficiary contributes a one day's oxen work (2 bulls) for each acre (4178 m2) of cultivated land, while in the middle of the wadi, he contributes half an acre, and tt the lower part of the wadi a quarter of an acre.

A study conducted by the World Bank mission on the second phase of the project, indicates that most of the farmers surveyed (about 70%) do not spend any money to get irrigation water. Some of them pay the costs of repairing the Ogoms to direct the water to their fields. Also it was found that more than 95% of farmers are willing to bear the expenses of operation and maintenance, provided there is equitable distribution of water but 77% of them cannot afford more than 25% of the costs.

Some of the wadis of the Tihama depend on the traditional spate irrigation system, where there are no modern spate irrigation schemes. The distribution of water shares is made through an Aukom agent and the committee that consists of the Aokom agents and headed by the Director of the district. The committee distributes water, resolve disputes and impose sanctions. The Aokom agent collects the costs of maintenance, that usually start at the beginning of rainy season and continue for 1-2 months. The maintenance costs are estimated at 300-500 Yemeni Riyals, but if the maintenance costs are expensive, it is distributed according to land area of each beneficiary. The Oukom agent faces difficulties in collection and distribution of the costs of maintenance and in supervision of activities, so he gets 5% of the produce of the crop of each beneficiary.

2.2.2 O & M in coastal plain areas of Hajjah and Mahweet:

When a channel is damaged, it is divided into several parts and is handed over to each of the formed groups of farmers (beneficiaries) where each group is managed by a leader who lead the group to fix the allocated space by the bulls while the person who has no oxen, do manual work. If anyone refuse to participate, he will be referred to the Sheikh of the tribe, who in turn compels him to pay, with an additional amount as fine for his refusal and to be deprived from irrigation water until he pays his contribution.

In Mahweet, Al-Agel is the one who estimates the costs of maintenance which is distributed between beneficiaries according to their land area. When there is a need to buy materials from the market, someone is assigned to buy and deliver these materials. In the case of the inability of someone to pay his share of the costs of maintenance, the cost is advanced by a better-off person on his behalf.

2.2.3 O & M in the southern coastal plain (Lahj and Abyan): -

The operation and maintenance is the responsibility of the department of agriculture and irrigation. An observer of irrigation for each main channel is to be selected from the same area where he become one of the staff of the agriculture office. He is assisted by a number of farmers in most cases and his is responsible for:

- Supervising the maintenance of the canals
- Helping the irrigation management in the agriculture office to implement irrigation plan
- Monitoring the distribution of irrigation water shares between farmers
- Helping the irrigation management in the agriculture office to resolve disputes between farmers on irrigation water.
- Acting as a link between farmers and related agencies
- Mobilizing the workers and supervise them
- Recording crops that are cultivated and the amount of needed water

According to the results of the survey conducted by the rapid assessment of Wadies, IIP phase II project (paper on water right & irrigation management) project (Paper on water right & irrigation management), the farmers in the upper wadi pay for the maintenance an amount of 5,814 YR/year, in the middle of the wadi 4,043 YR/year and farmers in the lower part of the wadi, pay 12,021 YR/year due to the re-building of their traditional channels.

The survey results also indicate that in the wadi Tuban, collection of fees for irrigation started at beginning of 1996, by the irrigation management in the agriculture office, which is limited to 100 YR/acre for spate irrigation, and 500 YR/acre for irrigation from wells. About 75% is allocated for irrigation management for meeting the costs of maintenance, including incentives for specialists and 25% is supplied to the state treasury. Also it was found that most farmers in the Abyan (66%) do the repair of Ogoms and divert water to their fields and bear the costs of this work. Also all farmers were willing to bear the costs of operation and maintenance provided that equitable distribution of water is made. While about 54% of the surveyed farmers cannot afford to contribute more than 25% of the costs.

Recently a number of water user associations were formed through the help of the European Union. The function of these associations is to distribute water between farmers, and maintenance of sub-channels. While the maintenance of the main channel is still the responsibility of irrigation management. The role of these associations is distinct and all beneficiaries pay 2000-3000 YR/acre for the maintenance of the channels which is received by the association. In some cases, the farmers do not pay as they do not know in advance the quantities of water that will be received when the flood comes.

There are also overlaps in the activities of various agencies responsible for water, namely: The Ministry of Agriculture and Irrigation, National Water Resources Authority, Groundwater and Soil Conservation project and the Field Units. All these parties perform the same work, for example holding field days, or the formation of groups and water user associations, as happened in the Rumaila and duet – Khanfar District.

Case study of O&M in Wadi Toban - Lahj:

The director of the agriculture and irrigation office or the director of irrigation management or irrigation extensionist give guidance to the operators of gates or guards to open or close the main gates during the season, but when no guidance is received, Sheikh Al-Aubar gives this guidance. The gates of sub-channels are the responsibility of the irrigation extensionist and Sheikh Al-Aubar. The gates within the sub-channels, which open to the fields are the responsibility of the beneficiary themselves. The role of irrigation extensionist here is confined to the distribution of water to the sub-channels.

When these traditional sub-channels are blocked by remains of trees or stones, they get removed by the farmer after they get their needs of water in order to allow water to pass to other fields. The size of water in the field normally reach the height of 30 cm.

Through periodical field visits, the irrigation extensionist in the agriculture and irrigation office writes a report specifying the areas and type of maintenance in the irrigation schemes and channels with a proposed budget and the required equipment. The report is given to the director of irrigation for review and then to the director of the agriculture office, who in turn send it to the Ministry of Agriculture. In some cases, the report is discussed at the agriculture office to be approved with the budget and included within the office's work plan to be later on given to the local council instead of the Ministry of Agriculture. Maintenance normally includes:

- Removal of sediment in the channels
- Painting and repair of gates
- Removal of trees from channels
- Collecting and burning of trees and seedlings of Mesquite(*prosopis juliflora*) trees
- Maintenance of flood breakers

Financial expenses spent in the purchase of materials, fuel and wages of workers and supervisors are made under the control of the irrigation supervisor. When the work is done, a progress report is prepared which includes what has been achieved, the difficulties faced and proposals for farther actions.

It is important to indicate that currently financial allocations are insufficient or not available at all. More than that, the leaders of the local authority are not recognizing the importance of maintenance work and what should be done to resolve difficulties.

2.2.4 O & M in eastern plateau (wadis of Hadramawt):

The operation and maintenance in many of the wadi in hadramout, is supervised by a person called "Al-Khail" and some times by deputy on his behalf in his absence. There is a tribe committee known as the agricultural committee which supports the Khail in case of problems with the beneficiaries. The Khail performs following tasks:

- Identify and impose the costs of maintenance for each owner of agricultural land, as one labor work for one hundred Materah (each date Palm equal two Materas). He supervises the maintenance and restores what was destroyed. If the beneficiaries do not comply with the provision of specific labor work identified by Al-Khail, then Al-Khail normally goes to his house and takes the coffee pot or the lock of the door of his house, to remain with AlKhail until the cost is paid.
- Al-Khail was getting paid in the past a wage of two labor work per day but now he gets paid a wage of four labor work per day.

In the past, there were different ways to meet the maintenance costs such as Wakf land by the name of "Al-Dhameer" to be leased for covering maintenance costs, sales of a grass (Alrmam) grown at the edges of Sakia. In the past, when a damage occurred on the main channel or at the entrance of Al-Dhameer, each of the benefiting villagers (men, women and children) were called to work to restore the damage. In this case, one woman or more was left in each village to prepare food, tea and coffee for the workers, while a servant (a boy) in the tribe, takes the food from the villages to the workers.

At present, maintenance is made by modern equipment (bulldozer) where the costs are covered from the output of Waqf land allocated for this purpose, and also from the value of grass that is grown on the channels, as already mentioned. In the event that the costs are greater than the revenue of Wakf land and grasses, the cost is distributed between beneficiaries according to the area of land owned by each of them.

It should be noted that there are different traditions in operation and maintenance of channels or the so-called Al-Dhameer in Wadi Hadramout. For each channel (Dhameer), there is agricultural committee appointed from among the beneficiaries to carry out the following tasks:

- Repair the damaged channels (Al-Dhameer)
- Protects the crops from animals
- Solves problems of agricultural and water among the beneficiaries
- Determines the time of harvest
- Identifies wages of agricultural labors and the rent of camels for plowing
- Identify and collect the costs of repairing the damages, according to the land holdings (Almatirat), namely:

- One acre is about one-third of a hectare = 144 Matirat
- One Matirat is = 15 cm x 60 cm

Arribbah Cooperative Association- Shibam Hadramout

Agriculture cultivation in Shibam area in Hadramout governorate, where Arribah Cooperative was established, dependent only on spate irrigation. Water shares distribution is done according to the prevailing norm "the higher fields gets water first". In most cases, farmers cannot control floods in the wadi due to its strong flow. Therefore, all fields get water in the same time and continue for several days where each farmer gets what he needs and the rest of the water flow to the main channel through several bonds and openings that were built by beneficiaries with support from some donors such as GIZ.

Arribbah cooperative was established in 2004, replacing what was called Arribbah Committee which existed since a long time in the area. The new association consists of more than 100 beneficiaries who form the general assembly with a board committee of 7 members. The Imam of the mosque in Shibam was selected as a chair of the association who was also selected as "Al-Khail" or irrigation supervisor with the functions of:

- Supervising the distribution of water shares
- Mobilizing workers for maintenance of water schemes
- Identifying and collecting maintenance costs
- Keeping the main register of agricultural lands
- Solving disputes between beneficiaries.

A committee was formed which is also called Arribbah committee which help Al-Khail in collecting maintenance costs. The collected costs is locally called "alfarkah" or "Al-Souq". The committee also help Al-Khail when he is incapacitated or when he ia absent.

O & M of irrigation schemes in Arribbah area is organized by Al-Khail who makes field visits, together with labors and *Moalems* (constructors) to the irrigation schemes after the flood flow season to identify damages. When damages are simple, it get repaired immediately, and if damages are huge, its maintenance costs are determined and they search for a source of funding either locally, from the government or from donor agencies. Beneficiaries normally pay their shares of maintenance costs in cash with a receipt from Al-Khail. Labors and Moalems are then hired to do the maintenance. The costs are estimated on the basis of owned land area. Violators are punished by prohibiting them from water or forwarded to the local authority for punishment.

Arribbah cooperative has its own bank account and get its revenues from the sales of mud the is used for house construction, where 50% of the value of sold mud is given to the land owner, 30% for maintenance, and 20% for the cooperative. Al-Khail is paid less than "*Roboa Al-Oshor*" or quarter of the tenth for his work. Recording the flood flow and flood volume as well as the type of crops to be planted is made by a person called "Al-Muhawel" who assist Al-Khail in this regard. When the volume of flood flow is small, it used only for irrigating palm trees.

2.2.5 **O & M in the Mountain Highlands Region**:

In the wadis of Al-Daleh governorate, when there is a large spate, the channel entrances get eroded. Here the users are forced to maintain the eroded channel after each flood. This costs farmers in some cases big amounts of money that is more than what they get from the output of their land.

For each channel (Aubar), one responsible person who is known as "Mokadam Al-Aubar". This person repairs the damage when it occurs, and then distributes the cost of repair to the beneficiaries according to the size of each field.

In the Sana'a wadis, where flood water flow, there are several sub-channels and openings that determine the amount of water passing through them to the nearby fields. These openings and channels are made of mud supported by some stones. In case of destroyed channels or openings, affected farmers estimate the costs of maintenance and do it, then the costs get distributed between beneficiaries according to the size of their land. Usually the owner of the upper fields pay more money than the lower fields, as he is the most benefited from the water.

The function of the water user associations in the area is to introduce modern irrigation methods and have nothing to do with operation and maintenance of the channels or openings of spate irrigation. This has nothing to do with spate ?

In the wadis of Taiz governorate, Maintenance is a periodicall;y done in April of each year and lasts for about a month. Maintenance is usually done when needed. As it is the case of maintenance of irrigation channels in the springs (Gail) system, maintenance of irrigation canals, is made during the flow of flood in the rainy season, the only difference is that the flood waters continue for several hours while the spring water continues in the wadi for most of the year in Wadi Al-Khair in Taiz.

The process of maintenance is made by irrigation supervisor (Al-Musreb) who usually do not receive any money for doing this, but he functions on a voluntary basis. The land tenant, not the land owner, normally pays the maintenance costs.

Case study of O&M from Wadi Alakma - Taiz:
The Modawel (irrigation supervisor) organizes a gathering of beneficiaries in the wadi or any other agreed place to discuss and consult each other on the issues concerning O&M and propose solutions and action plan. The final agreement is written down in a paper with specified fines and penalties for the violators of agreed actions. The agreement is signed by everyone to be committed to its implementation. In case of violating this agreement, the violator is sanctioned and fined as agreed or by involving some experienced or key persons to determine the types of sanctions. The money paid by the violators is used for the maintenance of the channel and is received by the person assigned by the Modawel with consent of the beneficiaries. In case of reluctance by any violator to pay the determined fines, the issue is forwarded to the head/commander of the district.

2.3 The most important problems facing O & M of irrigation schemes:

- Manipulating the traditional norm by farmers in the upper wadi through utilizing irrigation water for most of the time depriving other farmers in the lower part of the wadi. Those influential people also monopolize associations and projects to their own benefits.
- Expansion of agricultural land at the wadi upstream at the expense of agricultural land in the middle and lower parts of the wadi, which is contrary to the followed customs and traditions.
- The farmers near to Aokoms and channels get more quantities of water than distant farmers.
- The big land owners occupy the fertile lands leaving marginal land that is far from the irrigation system for small farmers.
- Many farmers complain about lack of punishing violators of the norms, which leads to leaving sheikh Al-Sharj or distribution specialist without authority or respect from others. In addition to this, there is non-responsiveness/ inability of the local authority in punishing offenders "we cannot apply any penalty on the influential people" (one farmer has pointed)
- The spread of cultivation of crops with high water requirements such as bananas, mangoes, especially in the upper part of the wadi consuming more than three-fourths of the irrigation water,
- Deposition of sediments in the canals and fields that are irrigated more than the fields of other farmers because of unmanaged distribution of irrigation water.
- Lack of maintenance equipment in addition to the high maintenance costs
- Poor efficiency of some channels and openings
- Failures in completing some of the in progress or planned irrigation schemes, and the ceasation of maintenance of existing schemes. (figure 27,28,29,30,31,32,33,34) .
- Erosion of channels, fields and wadis banks by flood water
- Many of the beneficiaries escaping from the payment of maintenance costs
- Crushing and blockage of irrigation openings and channels
- Level of channels become lower than the level of the fields. And The breaching of traditional ogmas have caused lot of erosion of the wadis beds
- Low economic returns from the cultivated crops does not encourage farmers to pay their contributions of the maintenance costs
- Spread of Mesquite (*prosopis juliflora*) trees in the main channels and subsidiary wadis and streams as well as in the main bonds which constitutes a real threat to the main irrigation scheme. (figure 35,36)
- Migration of young people from the area to the main cities because of low income from working in agricultural production. Only a limited range of crops can be produced under the uncertain conditions associated with the spate agriculture. These include Sorghum, sesame and a few vegetable which generally have low economic value.

- The insistence of some farmers to keep the waste in channel gates which are filled during the flood flow. Here, the irrigation management in jaar annually remove about 500,000 m3 of waste from the wadi and channels.
- Lack of building materials and gabions
- Lack of sufficient experience, especially in the operation of the iron gates
- The redistribution of land to its owners constitutes an obstacle in the distribution of water shares and disabling many of the irrigation canals, where the new land owners divide their lands into smaller parts and build their own channels or break existing channels.
- Some farmers refuse or neglect the advice and orders of the irrigation supervisor, which led to damaging many canals and gates.
- Poor planning for the construction of dams and water bonds at the upper parts of wadis with the lack of coordination between the activities of the Ministry of Agriculture and Irrigation, the Ministry of Water and irrigation institutions in the areas of water harvesting.
- Lack of coordination between different agencies working in irrigation activities, including water users to organize the various processes for irrigation.
- Increasing demand for water in the area because of increased population growth on the one hand and availability of low amounts of flood water at about 20-30% according to recent studies, on the other hand.
- Non-existence of technicians and specialists during the season at the gates creates lack of supervising irrigation activities until the end of the season.
- Lack of cooperation of the local authority in the operation and maintenance of irrigation schemes.

2.5 Proposed solutions to improve performance:

- When an irrigation channel is established, all obligations and commitments for maintenance are written and signed by all beneficiaries, including sanctions for the violators.
- The sanctions could involve deprivation of water and doubling the fines and sanctions. Here the local authority is encouraged to contribute a portion of the costs and help in seizing offenders and in cooperating with Al-modawel
- Any action taken must be presented to the beneficiaries and taking the prior approval
- Determination of the economic situation of beneficiaries and assisting them in establishing main irrigation structures
- Awareness creation and training

2.6 The role of different parties in the O&M practices;

2.6.1 The role of central Government:

As indicate earlier an O&M unit was established in TDA, Wadi Hadramaut and similar O&M units were established for O&M of spate schemes in Lahej and Abyan. However due to constraint of local resources over the past many years, no budget was provided for O&M of spate structures and these O&M units have virtually become defunct. Of late the Government decided to transfer the complete responsibilities of O&M of these structures to the beneficiaries/WUAs. The WUAs, in turn have no resources for the O&M of these structures. The existing laws/bye-laws of the water law also do not either empower the WUAs to collect irrigation fee from the beneficiaries which can be used for the O&M of these structures nor allow them to impose any fines on the defaulting farmers.

This situation had a negative impact on the operation and maintenance of irrigation facilities leading to the malfunctioning / collapse of these facilities. Many of these facilities are at the verge of destruction.

2.6.2 The role of the local authorities:

The local authorities receive 30 % of their budget from AFPPF for for developmental purposes as well as for operation and agricultural services which may include O&M of the irrigation structures.. The Government is considering restructuring of these provisions and the matter is under discussion with the House Representatives and Council of Ministers to restructure the fund. Additional to that there is contribution from local authority amounting to 15% towards the construction cost of medium and small schemes after signing the tripartite agreement between the local authority , WUAs and GSCP. However farmers are not happy with the local authority behavior

Abd Allah mansion " The role of local authority is so weak and their role focused only on how to collect money"

2.6.3 The role of WUGs / WUAs and water users:

2.6.3.1 WUAs:

As mentioned earlier the WUAs, have no resources for the O&M of these spate structures. The existing laws/bye-laws also do not empower the WUAs to collect irrigation fee from the beneficiaries which can be used for the O&M of these structures nor they can impose any fines on the defaulting farmers. In the absence of any support the sustainability of WUAs established so far is becoming a problem. Further the WUAs / WUGs have no experience of maintaining modern structures and these institutions can play hardly any role. additional to that the reputation of associations is not so good from bad experience of exciting association

Verwijderd: <sp>

2.6.3.2 Water Users:

The crops grown under spate irrigation are generally Sorghum, sesame and a few vegetable which generally have low economic value. The availability of spate is also scarce and uncertain. As a result the farmers are not encouraged to pay their contributions towards O&M of spate irrigation structures

However, there are cases of success. For example in the case of Gail Bawazir and Alrabah WUAs in Shibam district of wadi Hadramawt where the traditional O&M practices are still in vogue and O&M cost are recovered through indirect taxes (at 10%) levied on the agriculture produce. As in the case Alrabah WUA in Shibam District and Wadi Al Ain WUA both in Hadramout Governorate, some associations have been re-constituted on the lines of the Agricultural Committees.

Chapter III
Strength and weaknesses of the Current Maintenance practices

The review of customs and traditions prevailing in the spate irrigation in the wadis and areas that do not have modern irrigation schemes, or those that existed before the establishment of modern schemes, showed some of the strengths and weaknesses of the prevailing norms in this regard, which could be summarized as follows:

Strengths: -

- The existence of equitable distribution of water conservation and water rights
- The selection of irrigation supervisor (Sheikh Al-Shareej or Al-Ogom agent) who is characterized by chasteness and integrity.
- Equality and fair participation in maintenance according to the size of each cultivated land.
- The quick speed and fairness in resolving disputes
- The presence of a systems of penalties that is applicable to everyone and is administered by irrigation supervisors (sheikhs Al-shareej or Al-Aubar agent ..) and the beneficiaries or to be referred to the concerned government agencies in rare cases.
- The documentation of traditional norms on water rights and maintenance of irrigation schemes
- The costs of maintenance is assumed by all without discrimination, taking into account the particular circumstances of each person where contributions are paid in cash or in kind.
- The circumstances of disabled, absentees and insolvent who are unable to bear the costs of maintenance, are well taken into account as the costs are paid in cash for those who can afford while beneficiaries contribute to the costs of those who are incapacitated or insolvent.
- Simplicity of local communities with easy access to all beneficiaries and good mobilization for maintenance activities especially when using drummer or advertising people in the weekly markets to raise any related issues.
- Religious impetus and moral deterrent, had, directly or indirectly, played a role in the respect for traditions by people.
- The existence of sense of ownership of the water schemes by the beneficiaries and lack of free riders
- Each group of beneficiaries are responsible for the maintenance of Ogmas or part of the channels that they directly benefit from

Weaknesses:

- Irrigation schemes were primitive in its nature with rapid destruction and damage as it is being built using stones and mud and trees remnants.
- The frequent maintenance that is needed throughout the season in many of the wadis as a result of the flow of floods and the destruction of irrigation schemes.
- Mobilizing all beneficiaries for maintenance in the specific timing is becoming now more difficult than it was in the past.
- There are no specific programs and plans for maintenance with no timely cost allocation and mostly things are dealt with based on the common saying "what appeared it will be dealt with".
- No efforts are paid in collecting specific amounts of money to be placed in a special fund to be used for maintenance of irrigation schemes when needed.
- Most of the contributions to the maintenance are in-kind and cannot have continuity in modern irrigation schemes, where there is a need to purchase materials (cement, iron, paint, etc.) and rent equipment (bulldozer, etc.) from the market as well as the need for qualified staff.
- The fines collected from violators either go to the affected people or to the hands of the persons who solved violations, but are not used for the maintenance of schemes.
- The operation of irrigation schemes require high electrical energy and high technical skills that are constantly needed in these schemes.
- Change of cropping pattern and the introduction of crops with high water requirements is not consistent with the traditional irrigation schemes and therefore do not conform with the prevailing norms in irrigation operations including the distribution of water shares.
- Fragmentation of land holdings and thus each field need a separate channel or irrigation openings.
- The low economic returns from agricultural production with weak marketing networks do not encourage the continuation of using traditional norms.
- The limited agricultural land that benefit from irrigation schemes.

The customs and traditions of water shares distribution as well as operation and maintenance of large and modern irrigation schemes, including diversion structures, channels and sub-channels built by the government in the various wadis of Yemen, has mostly disappeared and no longer working, due to several reasons, that include:

- The Government had sponsored the establishment of these schemes and used to be responsible for its operation and maintenance.
- It is difficult, for the community, to operate and maintain these modern schemes as a result of the complexity and high costs of operations and maintenance and there is a need for high technical skills for operation and maintenance.
- When channels and bonds were established, it were merged together in a smaller number of channels or bonds which negatively impact the mechanism of water shares distribution and maintenance of canals and Ogoms (bonds).

- The expansion of agricultural land and cropping pattern at the upper wadi has affected water rights in the middle and lower parts of the wadi, which led to the reluctance of farmers in these areas to do maintenance.
- Change of cropping pattern and the spread of crops with high water requirements.
- Migration of some farmers, or shifting their activities to other areas
- Lack of violations seize agencies in the government and the growing influence of powerful people in the wadi areas.

All of these and other factors led to the degradation and loss of traditional customs that prevailed in the organization of irrigation issues. In addition to the short period since the establishment of modern irrigation schemes and taking the responsibility of all maintenance and operation of these schemes by the government, as well as the newly establishment of water user associations with little experience and the influence of Sheikhs and the weakening of the government role, all have not enabled the beneficiaries to develop reliable traditions in the management of different irrigation operations.

Chapter IV
Review of Legal & Institutional Aspects related to O&M of Spate Structures and their Enforcement

4.1- Legal and institutional Aspects related to O&M of spate irrigation:

The Laws related to maintenance and operation:

By reviewing the laws and regulations on water in general and irrigation in particular, as well as the law of the local authority and other laws and regulations, it was found that the issue of maintenance and operation of irrigation schemes has received a modest attention. This report, will address the group of articles and items of the laws that are directly or indirectly related to the spate irrigation or with regard to water user associations in the water law, and the law of local adminstartion as well as orders and administrative decisions, which were presented below : -

4.1.1 The Water Law: -

The law aims at the development and rational exploitation of water resources, as well as good maintenance and operation of its schemes as indicated in Article (3) of the Water Law No. (33) for the year 2002.

In article (10) The law refers to the formation of associations and groups, committees, aimed at community participation in management and operation and maintenance of water schemes. The law authorized the National Water Resources Authority, in coordination with the local authority to form committees of water basins to contribute to the regulation of water as indicated in Article (11).

Chapter (3)- Article (25) indicates "Without violating the provisions of this law, the law gives the Ministry of Agriculture and Irrigation and its institutions the task of running, organization and rationalization of water used for irrigation according to the general water plan of water resources and irrigation policies in coordination with the beneficiaries and the relevant authorities.

As indicated in paragraph (3 A and B) of the same article "the functions of the Ministry of Agriculture and Irrigation is the establishment of water schemes with the operation and maintenance of these schemes to take advantage of rainfall and flash floods and to plan for protection from floods including the demolition and breaking of some channels when needed, as well as to refine the wadis and general channels and monitor the flow of rainwater and floods and control irrigation water uses and its schemes. Also the preparation of a number of demand indicators of irrigation water for

the short, medium and long terms, as indicated in the paragraphs (5.6) of the same article.

In Chapter (2) of the Law under the title of preservation of water resources, article (48) indicate "The Government represented by the Ministry (the Ministry of Water and Environment) and the relevant agencies, provides support and facilities necessary for farmers to encourage them to use modern irrigation methods and purposive techniques that achieve savings in water use, rationalization and increase production as well as establishing water schemes to take advantage of rainfall and floods and to achieve its sustainability through the maintenance and operation in coordination with the concerned local councils and the beneficiaries, paragraphs (1) and (2). As indicated in paragraph (4) to "support and encourage grass-roots efforts in the management of water resources and conservation".

No mention in the Water law on the penalties and sanctions for breaking the customs and traditions of spate irrigation systems as is the case with drilling of water wells or pollution of wadis streams etc. In Chapter (2) of sanctions, article 70 of the law indicates about the penalty incurred for throwing waste in the wadis stream in order to hold the water and impede its flow or reclamation or expansion of agricultural land, or any other schemes that impede the flow of flood water. This can be understood and applied to flood water irrigation. The law also did not refer to the fines and penalties that must be borne by the violators of the spate irrigation systems. However, this deficiency can be overcome through making these provisions in the bye-laws of the Water law.

4.1.2 The bylaw of the Water Law:

The draft bylaw, which was approved by the Cabinet in the first half of 2011, aim to implement the provisions of the law in the organization and management of water, including proper maintenance and operation of water schemes and the involvement of users to manage and protect and preserve these schemes as indicated in Chapter (2) Article (3).

The article No. (8) pointed to the possibility of forming associations and water user groups to involve them in the development, operation and maintenance of water schemes. The Articles 9-21 identified the organizational forms of popular participation in the management of water resources through federations, associations and groups of water users as well as to water basins committees and included the goals and tasks of these formations, with the maintenance of floods streams and public irrigation canals as indicated in Article (13).

Article (37) Chapter (3) indicates under the heading "sectoral uses of water" that the task of operation and maintenance of water schemes and regulation and rationalization of water use for irrigation is one of the functions of the Ministry of

Agriculture and Irrigation in accordance with the law of the local authority and the plan of water. In item (G-1-A) confirmation of the same article as was mentioned at the beginning of Article 37 with adding that "strengthening the role of the beneficiaries to participate in the planning, financing, management and operation and maintenance of these schemes"

As Paragraph (7) of the above article indicates "the functions of the Ministry of Agriculture and Irrigation also to take preventive measures on the risk of floods, including streams and the refinement of public channels. In the third part of the same article "the Ministry of Agriculture and Irrigation may contract with the private sector to study the investment and management, construction, operation and maintenance of water schemes for irrigation purposes". In addition to that the duties of the Ministry is to determine the costs of services associated with irrigation in coordination with the Water Resources Authority. What can be understood from this paragraph, is the determination of the fees for the operation and maintenance of irrigation schemes as mentioned in paragraph (9) of the same article.

Control measures have focused on the drilling of wells and water pollution only without addressing the various aspects of irrigation, such as taking hold of water and the infringement of irrigation schemes as well as issues related to operation and maintenance.

In Chapter (8) of the bylaw under "fees" the bylaw authorized the National Water Resources Authority to get the fees, including water rights registration fees, fees of water user for commercial purposes and fees for the protection of water resources from pollution as indicated in Article (88). The bylaws did not mention the fees that can be obtained for the operation and maintenance of irrigation schemes. It did not mention also the possibility to spend part of these fees on the operation and maintenance of irrigation schemes, either for doing studies and research on water or in the follow-up of offenses and limiting the random water drilling as indicated in Article (89).

4.1.3 Local Authority Law No. (4) for the year 2000:

The Law authorizes the local authority represented by the administrative units, the implementation of development projects, management and control as indicated in Article 14 - G:

Article 19 of the Law referred to the study and approval of projects and the supervision and control over the work of district local councils and shall exercise several functions such as that related to financial affairs and the development of revenue as it is in paragraph (6) or is related to the implementation of water policies and the protection of water basins as mentioned in paragraph (14) or for establishment of cooperative societies in all of its forms and supervise the cooperative

activities and the coordination of cooperative plans and programs as indicated in paragraphs 19 and 20, and finally maintaining service schemes to ensure its safety and operation as mentioned in paragraph (25) of the same article. And to perform many disciplines, including what indicated in paragraph (12) in the development of water resources and encourage the construction of dams and water bonds and its protection, and what indicated in paragraphs (13) and (14) in encouraging the establishment of cooperative societies of various kinds and supervision of cooperative activities and coordination of plans and programs. In addition to proposing organization rules for the contribution of citizens in the establishment and maintenance of basic services projects funded by them or with their participation, as indicated in paragraph (18).

It is clear from the above articles that the local adminstration law has no direct explicit provision that address the O&M of spate structures / irrigation facilities.

4.1.4 The Law of Associations, NGOs and the Law No. (39) of 1998 on Associations and the Cooperative Unions: -

Through a review of these laws, there was no mention of maintenance and operation except of what has been mentioned in general. But it is possible to find in these laws some articles that can be used directly or indirectly on water user associations until the issuance of new by-laws or the modification of the current by-laws.

4.1.5 Decisions and administrative orders:

- Presidential Decree No. (5) for the year 1996, on the restructuring of the Ministry of Agriculture and Irrigation touched on the general tasks of the ministry, including what was indicated in paragraph (19) of the tasks of the ministry. This indicated "the establishment, operation and maintenance of irrigation schemes and regulating their use." In the article (13) paragraphs (12,14,18) indicated that the tasks of the general directorate of irrigation: included: (i) the organization and implementation of training courses for maintenance and use of irrigation systems; (ii)establishment and restoration of water for agricultural use; and (iii) periodic inspection of water schemes and follow-up the level of its operation and maintenance. Also there was indication for the follow-up of maintenance of heavy and light equipment as well as periodic maintenance of these equipment,
- In the Administrative Decision No. (6) for the year 1990, the Tehama Development Authority "An irrigation committee was formed in Wadi zabid and Wadi Rimaa, where the acting chairperson of the committee could be the one responsible about operation and maintenance in the wadi. The tasks of the committee included:

- solving the problems brought to them and making recommendations for the distribution of irrigation water as well as maintenance of water schemes.
- proposing the role of farmers in the process of maintenance of irrigation systems and encouraging them to improve the irrigation process.
- In 1996, The Director of agriculture office in Lahej issued an administrative order number (14) for the year 1996 called the "bylaw of irrigation in Lahej governorate" which was approved by the local council in the governorate.

4.1.6 The Sultanate Decree for regulating the spate irrigation in wadi Tuban- Lahej governorate:

The organization of irrigation in Wadi Tuban was fortunate to have the issuance and application of legislation since the early times. The Sultan of Lahej had issued in 1950 a decree number (1) known as the law of the "agricultural council and agricultural court". It contained many important provisions that could be used even at the present time, including the membership of the Agricultural Council from the local authority and representatives of the land owners, farmers, and even the sheikhs and key figures in the Wadi as consultants. The Council has a number of tasks including: the organization of irrigation, the distribution of irrigation shares, the distribution of lands between small and large farmers, the organization of leasing and share cropping, dividing the wadis, operation and maintenance of irrigation schemes, the organization of the differences on Al-Aubars and wadis, establishing a special fund, the imposition and collection of fees, as well as penalties and fines on violators and other tasks.

The Council meets twice a month, and in the season meets twice a week (Monday and Thursday of each week) or when needed. The decree has (3) chapters, the first is the formation, and the functions of the Council, the second is the persuasion, the compensation and the Treasury of the council, and the third is the agricultural court. The law also has 4 sub-chapters which provide for the tribunal set up, purchase and sales of agriculture, land rent and penalties.

With regard to maintenance and operation, paragraph (4) In Chapter (2) that the cost and type of maintenance is estimated by a person assigned by the agricultural council where the costs are distributed to beneficiaries according to the return of the land. The costs is handed over to Sheikh Al-Aubar with two others selected by the Council in consultation with the beneficiaries to supervise the expenditure, the work and prepare accounts. As indicated in Chapter (2) of the Decree (persuasion of compensation) in items (4 and 5):

The Decree also noted the financial resources of the Council which are returns from fees, penalties, fines and donations.

In the violations chapter a provision in the decree above, there are clear provisions in this regard that the violator shall be the aggressor and specific fines, including cash or equivalent to what is cultivated in the land or to be imprisoned from 10 days to 3 years. In other cases, payment of fines and imprisonment is done at the same time.

4.2- The level of Adherence and Enforcement of the legal & Institutional aspects related to the O&M of Spate Structure:

4.2.1 Water Law /2002

- Some laws are recent and have not been circulated or widely consulted. With respect to water law, many of those interviewed during field visits do not know about this law and its contents "we did not hear about the law of water, but if there is a law that is reinforcing customs and inherited traditions and promote the equitable distribution of water as in the past, we welcome it and are ready to apply it" indicated by the farmer Hussein in Tihama.

> As indicated by the farmer Hussein in Tihama "we did not hear about the law of water, but if there is a law that is reinforcing customs and inherited traditions and promotes the equitable distribution of water as in the past, we welcome it and are ready to apply it".

These laws do not contain many important issues about the spate irrigation, such as determining the fines and penalties for offenders and to identify aspects of the fees and disbursements as in other subjects referred to laws such as groundwater, wastewater and other.

- Water Law do not regulate water rights and justice of water distribution with no promotion of prevailing customs and traditions. "If it promote the customs and traditions, and achieve justice in the distribution of water and control offenders, it is good and we will positively deal with it. But otherwise we do not need it" indicated farmer Joyoub Mohammed.

> As indicated by the farmer Joyoub Mohammed "If it promote the customs and traditions, and achieve justice in the distribution of water and control offenders, it is good and we will positively deal with it. But otherwise we do not need it"

- Water Law pointed to the possibility of the formation of groups and associations, committees or associations of water users in general, but did not refer to the formation and strengthening the role of irrigation water user associations in general and the spate irrigation in particular. Also it did not

specify the roles and functions of different agencies (the beneficiary, associations, government institutions) in the operation and maintenance of key installations, whether Ogmas or channels or sub-channels.

4,2,2 The bylaw of the Water Law

It emphasized the responsibility of the Ministry of Agriculture and Irrigation in the operation and maintenance in coordination with other irrigation schemes, but no attention was given to the spate irrigation schemes. Also no mention about the fees that can be obtained for the operation and maintenance of irrigation schemes and the possibility of spending part of these fees on the operation and maintenance of irrigation schemes.

4.2.3 With regard to the local authority the following was noticed:

- The law did not refer directly and clearly to any of the functions of the local authority in the maintenance and operation of development projects and services.
- The law did not refer to the fees obtained from the violations practiced in spate irrigation channels, such as bridging or non-acquisition of water share.
- The law did not refer to the distribution of part of these fees or income obtained by the local authority in the maintenance and operation.

4.2.4 With regard to Law No. (39) of 1998 on Associations and Unions:

This law had been prepared before the establishment of the Ministry of Water and Environment and the restructuring of the Ministry of Agriculture and Irrigation and even before the establishment of Water User Associations, so no reference in the law to the role of the Ministry of Water and Environment in this aspect and the new role of the Ministry of Agriculture and Irrigation or water user associations. However, the law has mentioned the other associations, such as fisheries, housing and craft. It is therefore important that we can take the main outline of the law and try to adapt it in line with developments in the establishment of water user associations. It is important here to note that this law has allowed the establishment of the Federation of Associations where water users are in urgent need for such a union.

Although the law (39) of 1998 did not refer to the privacy of many water user associations, as it is in Article (67) on the resources of associations that can be obtained from the fines imposed on violators of the irrigation systems. Also it did not indicate the importance of identifying a specific percentage of surplus profits for the maintenance and operation as is followed in such associations. But it can adapt some of the articles, edit or add to it when there is difficulty to issue new law for establishing the federation of water user associations.

4.2.5 Bylaws of associations:

Through a review of the Statute of irrigation water user associations, the following were observed:

- The operation and maintenance was marginal and was not included as one of the main objectives of the Association, which resulted from imbalanced reference to other related laws and the standard format used for the local association. No mention about the operation and maintenance of irrigation schemes only under the item of the participation of Groundwater and Soil Conservation Project ... etc.. "With the support of its members with various modern techniques and irrigation methods (modern irrigation systems, maintenance and operation, ... etc.)."
- Also no mention is there in the functions of the management platform on the operation and maintenance despite the mention of the many other tasks such as maintaining groundwater, training and raising the productivity of crops etc., except what is mentioned in Article 21, item 9, on the establishment or re-rehabilitation of rainwater harvesting schemes.
- No mention to the fines that can be obtained from the violators of spate irrigation uses.
- It did not include the financial resources of the association fees for water use which is annual or seasonal.
- It did not indicate the possibility of establishing a special fund or account for maintenance and operation with identification of its resources.

4.2.6 Tripartite agreements:

1- Groundwater and Soil Conservation Project (GSCP):

Tripartite agreements, adopted by GSCP were prepared and signed by the field unit of the Groundwater and Soil Conservation Project (GSCP), the local development council in the district (local authority), the cooperative societies or the Agel of the area or the village. Tripartite agreements are also adopted by s the Sana'a Water Basin Project, the irrigation development program and the Social Fund for Development and others. The focus here will be on the agreements of the Groundwater and Soil Conservation Project and the irrigation development program.

In these agreements, especially the agreements of the implementation of spate improvement works and water harvesting projects, there are clear indications about the operation and maintenance that the GSCP project contributes to its creation as stated in the following items: -

- For the implementation of spate improvement works and water harvesting projects, it is clearly stated in Article (4). "The second party (the beneficiary) is obliged to fulfill his obligations as set forth in Annex (3) of the agreement. He must also do the management, operation and maintenance of the project." In items (9,10, and11) of the

Annex (3) of the agreement, there are indications for the second party in the operation and maintenance costs, to provide the required data and to adopt any developments in the operation and maintenance of the project. The agreement also indicated that the field unit is to perform periodic field visits to the project site and to monitor compliance of the beneficiaries on maintenance and operation.

- For the agreement on the implementation of improved irrigation techniques projects, the Agreement indicates in item (11) that the obligation of the field unit is to carry out training courses for beneficiaries to clarify the technical issues related to operation and maintenance of improved irrigation systems.
- According to the tripartite agreement, the roles of the local authority is to (1) Ratify the contracts, the beneficiaries usually pay for ratification of contracts, (2) to contribute to the payment of the beneficiaries contributions that is estimated as 15% of the costs of irrigation schemes of which 5% as the contribution of farmers on maintenance and the 10 % is from the construction costs.

4.2.7 Irrigation improvement project:

The agreement on works, transport and support that is signed between the WUA and the implementation unit of the irrigation improvement project:

There are many goals of this work of which the most important is the delegation of responsibility for operation and maintenance of irrigation schemes to the water user associations, and the strengthening of the capacity of the associations to carry out the functions of operation, maintenance, repair and improvement of main irrigation schemes. In Article (4) of the Agreement the association is to assume full responsibility in the operation and maintenance of irrigation schemes handed over to them. In the Agreement also under the title "delegation of operation and maintenance responsibility" "the project is to deliver the management of the operation and maintenance of irrigation schemes to the water user associations in the area, while the association accepts to assume full responsibility for operation and maintenance of the scheme". The project is to assist the association in the routine maintenance of the schemes during the next two years after the handing over with providing technical advice and equipment.

4.2.8 Decisions and administrative orders:

Based on the field visits and the review of decisions taken and administrative orders, it was clear that there is relatively high level of the implementation of decisions when there is availability of adequate and timely financial resources as observed in Tehama, Lahej, Abyan and Wadi Hajar - Hadramout. Many claims of the costs of maintenance of irrigation schemes were reviewed by the specialists in the agriculture offices, and some associations. For example, the agricultural office in wadi

hajr, at the end of 2011, is claiming 32 million Yemeni Riyals for the maintenance of all irrigation schemes.

However, the level of implementation of other laws is weak or do not exist, especially the water law except what is mentioned on associations.

Chapter V
Current Status of the Maintenance of different types of Spate Structures

5.1- Status of the maintenance of different types of spate structures

Maintenance of large irrigation schemes before the year 1990:

During the development period that took place in Yemen before unification, especially after the 1962 revolution in northern Yemen, which actually began in the early seventies of the last century, the Tehama Development Authority TDA (1971) was established. The TDA focused its work in the construction of diversion structures and irrigation channels in the four wadis of the Tehama. This was followed by construction of dams, water reservoirs, and irrigation channels in many different areas. The government, represented by the Ministry of Agriculture and Irrigation and its other agencies, have assumed all the different costs of construction, operation and maintenance of these schemes.

The situation was not significantly different in the southern governorates before unification (1990), as the government has sponsored the establishment of many irrigation schemes in the main wadis in Lahej, Abyan, and Hadramout. The government has also assumed the costs of maintenance and operation, as the case in the northern governorates. However, it must be noted that some irrigation schemes, especially in Al-Arais conversion dam was built by the British before independence on the same place of old structures. The case was the same in other areas such as Hadramout

Operation and maintenance was done by the departments or sections that belong to the Tehama Development Authority or other development authorities and offices or agricultural cooperative societies in the southern governorates. Annual plans were prepared, discussed and approved by concerned specialists in these institutions then referred to funding by the Ministry of Agriculture and the Ministry of Finance in the two parts of Yemen as mentioned earlier.

The maintenance of these schemes was made periodically at the beginning of each season and when necessary. Also the maintenance and repair & maintenance of equipment was done before the start of the irrigation schemes. During the seventies and eighties until the beginning of the third millennium, there were funds from international organizations especially the World Bank for assisting in the maintenance and operation of such schemes. Other agencies, such as European Union, in the past few years, have provided assistance for the maintenance of the main channels in

some of the wadis of Tihama. Thus, the operation and maintenance of these schemes is still the responsibility of the government, which was strengthened by the provisions of the laws and resolutions affirming the government role in this regard.

The main reason for assigning this role to the government is that the government role is to do the construction, operation and maintenance of infrastructure in various areas, not only in water and irrigation. In the mid-nineties of the last century, there was changing role of the government after the restructuring of the economic sector and the reconsideration of the government's role by giving part of its functions to the private sector or civil society organizations. This what applied to the irrigation schemes despite the fact that, until now, the government still operates and maintains most if not all irrigation schemes. Several reasons are behind this role of the government, notably that the beneficiaries and in particular societies, water user groups and farmers as individuals are not able to taker this burden due to lack of sufficient technical experience, and the high cost of operating and maintenance for poor farmers.

Medium spate irrigation schemes built after 1990:

In the past, the government was focusing on establishing large irrigation schemes and often funds these schemes through loans from international organizations. After the unification the focus was shifted to constructing medium or small-scale schemes to benefit farmers in specific areas with easy operation and maintenance that can be managed by users. However, poor planning and lack of vision of what should be done and what priorities are led to establishing many of these schemes in areas that are not suitable on the one hand and with weak design and construction on the other hand. These established schemes also need constant maintenance that is not affordable by the beneficiaries and do not encourage the beneficiaries to contribute to the maintenance. In addition to that, there was lack of clarity about the maintenance and future sustainability of these schemes.

Despite the above mentioned constraints, there are many schemes that have been completed and benefited a large number of farmers in different regions. Some mechanisms for maintenance and sustainability of these schemes was considered by Irrigation Improvement Project, the Groundwater and Soil Conservation Project, the Social Fund, the Agricultural and fisheries Fund, and other related agencies. Through the review of agreements made by these projects, special items related to the commitment of beneficiaries on the maintenance of these schemes were noticed. However, the maintenance costs for these types of schemes, especially large and medium and often small schemes were rather beyond the ability of the beneficiaries. And this has often led to their reluctance to carry out maintenance. Nevertheless, for the traditional structures, whatever its size, and where the government did not interfere in establishing these schemes, periodical maintained by the beneficiaries was often made. The main reason for this is the low costs of maintenance which is

mostly in kind (animals or manual work). In rare cases, the purchase or provision of certain materials or equipment for O&M purposes was made which usually fit with the economic conditions of farmers., This was indicated by many the beneficiaries in the various regions.

Maintenance of small spate irrigation schemes:

The situation for small-scale schemes is not different from the status of medium-size schemes as many of these schemes have been established whether by the beneficiaries or by the Government or by various organizations, including the Agricultural and fisheries Fund, the Social Fund and other agencies. These schemes, especially traditional schemes are maintained in the same system of maintenance referred to earlier. Here some examples of maintenance can be sited such as the case of the irrigation schemes in the Gail Bawazir in Hadramout governorate. Gail Bawazir Association was established in 1966 as a multi-purpose association working through contributions by the beneficiaries. Maintenance and operation is covered by contributions from the output of the beneficiaries , in addition to what is being collected from the beneficiaries, which is about 5% of the sales of agricultural produce. This system lasted until the mid-nineties of the last century and then transformed to the sell of water to the beneficiaries with 500 YR/hour of which part is used for maintenance of irrigation schemes. It was also noticed, from the review of a number of correspondence and documents, that the Association was searching funds from the government for the maintenance of parts of the canals or ponds.

Although the reviewed functions of the Association do not refer to the maintenance of irrigation schemes, but the list of reported achievements of the Association referred to a number of activities in the maintenance of irrigation schemes in addition to the completion of some studies, made by the association, for maintenance with its budget. The Government and some donor organizations (GIZ, etc.) made overall maintenance of many of the channels based on claims made by the beneficiaries in the area. In the agreement between the Agricultural and Fisheries Fund, there is an item that oblige the beneficiaries to do the maintenance of the scheme after it is handed over to them.

5.2-Reasons behind the poor maintenance of spate irrigation schemes:

There are many difficulties facing the maintenance of spate irrigation schemes, these are listed as follows:

For large-scale schemes:

- Lack of commitment to equitable distribution of water shares according to the prevailing norms.
- The influence of powerful people and the no punishment of offenders
- The low economic returns of agricultural products

- Lack of a sense of ownership and proper utilization of the schemes by many farmers
- The low efficiency of some irrigation schemes
- The large size of irrigation schemes with the difficulty of its operation and maintenance by the beneficiaries, as there are technological difficulties with high costs of operation and maintenance.
- The financial allocations, made by the Ministry of Finance, for maintenance and operation are usually inadequate and comes at inappropriate times after the end of the maintenance period
- Administrative bureaucracy and lack of understanding of maintenance and operation requirements in terms of time and size.
- Lack of understanding of the importance of maintenance of irrigation schemes and its risks by many actors, especially the local authority.
- Lack of clarity of roles for the different actors such as the central government, the local authority and the beneficiaries, including associations and water user groups.

Chapter VI

Potential Government Policy relating to O&M Spate Structures

6.1- Government support to O&M of spate irrigation schemes:

The issue of the operation and maintenance is not the only great headache for the beneficiaries but also for the professionals and decision makers due to the risk of damages to these schemes and the difficulty of restoring these damages and the high costs of operations. The Government has, in the past and even the present time, taken the responsibility of all operation and maintenance which was reflected in the issuance of various laws and legislations that suggest that this activity is a function of the government.
Although the situation has slightly changed in the past few years, when part of the role of the government in this regard was shifted to the civil society organizations and the private sector, due to severe constraint of the government resources which led to poor maintenance of irrigation schemes.

The review of several literature and meetings with the beneficiaries and officials in the concerned ministries and local authority, the following conclusions were observed:

- Keeping in view the importance of operation and maintenance of irrigation schemes especially large diversion structures and main channels, this could be possible by establishing a special department within the ministry that would supervise and follow-up the operation and maintenance through preparation of annual plans and programs with the short-and medium-term maintenance of irrigation schemes. The department could also seek funding for this purpose, perform staff training and capacity building as well as to study the possibility of expansion and consolidation of some of the channels or schemes and contribute to emergency operations during floods.
- The local authority, should take the responsibility of operation and maintenance of medium irrigation schemes and irrigation sub-channels through the agriculture offices and the agricultural development projects.
- The cooperative associations, the water user groups and the beneficiaries should bear the costs of operation and maintenance of small irrigation schemes and the secondary sub-channels that serve a number of beneficiaries.
- Each farmer should bear the cost of maintenance of canals and openings in his field.
- Government whether central or local government, must provide support to the water user associations in maintenance and operation through assistance in training of their members and in bearing part of the maintenance costs with gradual transfer of responsibilities to the associations and beneficiaries.
- For this purpose, pilot areas of selected schemes should be established for helping the community in the formation of groups and water user associations and in capacity building enabling them to gradually take over responsibilities of

maintenance of these schemes, The study of this experience in the pilot areas can be replicated to other areas.

- In special cases and certain areas, the private sector could be contracted to carry out periodic maintenance of irrigation schemes where this experience could be studied and replicated to other areas.

6.2- Support in terms of equipment of O&M:

- As the maintenance of irrigation schemes is a daily activity, especially before and during the flood season, it requires the availability of a numbers of maintenance machines ready for use and to be continuously maintained and inspected from time to time. These equipment should be with agriculture offices or development authorities and projects until the private and cooperative sectors take this role.
- Some equipment can be rented from the market when needed by the associations, groups or agriculture offices and development agencies.

The type of support needed by the beneficiaries, as ascertained from them through interviews can be summarized as follows:

- Support with heavy equipment to re-habilitate and maintain old spate irrigation schemes.

> "We do not need financial support because it goes to the hands of powerful people". As indicated by Al-Hashidi

- Technical support, awareness creation and training of farmers on how to establish associations and maintain the structures
- Assistance in the establishment of a special fund for operation and maintenance where its resources could come from the contributions of the beneficiaries, the fines imposed on violators, water use fees, donations, subsidies and other sources. In principle, the government can contribute 30-40%, the local council 40-50%, and farmers 10-20% This fund should be under the supervision of associations or Wakil Al-Aukom. Farmers contributions could be gradually raised and thus government's contribution reduced for the maintenance of large schemes and main channels, while maintenance of sub-channels are to be farmers duty.
- Financial support must be directed to the farmers needs and used / released , under the supervision of the associations and the local council.
- Helping associations and irrigation councils in building their institutional capacity so that they can play the roles assigned to them.
- To complete the establishment of channels to make water reach all farmers.
- To rehabilitate wadi banks and protect land from erosion
- To ensure easy access to equipment and maintenance materials

6.3- Possible amendments to laws and regulations:

Amendments that must be included in the by-laws of the Water Law: -

- Specific provisions for water rights of spate irrigation and irrigation from Gails
- Provisions for how to resolve conflicts and disputes over water rights and violating irrigation canals
- Special provisions on operation and maintenance of spate irrigation and irrigation from Gails
- Regulations in the by-law that characterize spate and Gail irrigation with associated rights and duties
- To include in the by-law the management and operation of irrigation canals and the spate irrigation schemes and responsible agencies.
- Fines and fees that must be collected by WUAs from spate irrigation and use for O&M of spate structures
- The entity authorized to collect the financial resources in spate irrigation to be deposited into a special account and also the mechanism of using these resources.
- To establish agricultural courts to take immediate decisions at the level of wadis or basins against violators
- Clear provision of the fees imposed on the operation and maintenance and its sources
- The type of fines and sanctions on violators of spate irrigation and irrigation by Gails
- Items and articles that refer to irrigation by Gails, its rights and the maintenance of its schemes
- Specific peculiarities of the different types of associations such as drinking water, irrigation networks, spate irrigation and other types of associations.
- Formation of water user associations should be at the district level not basins level
- To give the Ministry of Agriculture and its offices clear power in the formation of water user associations as compared to that given to the NWRA

Amendments to be made in tripartite agreements:

- The local authority should, at the outset, assume the contribution of farmers in maintenance costs of spate structures.
- Farmers contribution must be taken from the imposed fees on the agricultural products market in the area to be used for maintenance of irrigation schemes
- The Agriculture Offices in the Governorates should provide sufficient number of engineers and technicians to do field visits and supervise the progress of O&M work (in Lahej – only one engineer for 15 districts)
- The contribution of the beneficiaries should not exceed 5% of their production or the cost of maintenance
- Protection of the wadi banks should be O&M costs
- The importance of having a special unit of operation and maintenance in the Agriculture Offices in the Governorates

6.4-The role of the local authority in O&M of spate irrigation schemes:

The local authority, now and in the future, must play a big role in the operation and maintenance of irrigation schemes, including schemes that depend on Giuls and springs as it constitute the backbone of the economy of these areas and that many of the population are depending on them. The central government must provide at the beginning with education, training, material and financial support to the local authority/WUAs to enable them to assume this role gradually and in selected pilot areas.

In order to perform this role, local authorities need capable and flexible administrative cadre. Financial and material incentives must be provided and a spirit of competition and innovation must be encouraged with less bureaucracy, corruption and the introduction of modern management techniques for local authorities. The main functions of the local authorities in operation and maintenance of irrigation schemes could be as follows:

- To contribute to resolving disputes between beneficiaries
- To supervise the distribution of water shares
- To participate in the supervision of the maintenance in general
- To help in controlling and apprehending offenders
- To search for funding for maintenance and expansion and renovation
- To contribute to the maintenance of medium and small-scale schemes
- To contribute to the maintenance of sub-channels for large-scale schemes
- To participate in issuing of legislation
- To identify damages during floods and storms
- To implement emergency work during flooding disasters
- To establish an O&M unit within each district to deal with the above

Chapter VII
Lessons learned and Recommendations to achieve a Sustainable O&M Practices of Spate Schemes

It should be noted that institutional governance is not only inadequate with regards to the issue of maintenance, but also these institutions lack technical developments for

future needs. These institutions, mostly focus in their management on short-term and temporary solutions. During the institutional building of these institutions, the deficiencies based on the following important **lessons learned** should be taken care of:

- For the Spate Diversion Structures constructed under various projects, the beneficiary contribution is not actually paid by the beneficiaries themselves. Instead, it is paid on their behalf by the Local Authorities. The beneficiaries therefore do not develop a sense of ownership in these structures;
- In view of the above, the beneficiaries do not care to maintain these structures in spite of the Tripartite Agreements signed with them in which they agree to operate and maintain these structures, For example the spate structures constructed under LWCP in Shabwa, or Dhamar or Taiz are not being maintained by the beneficiaries nor by the beneficiaries. The Gates of Al Moharamiya Spate Diversion Strcture (constructed at a cost of US$ 180,000)_ on Wadi Behan in Shabwa have rusted and become totally inoperative beyond repairs because no one cared to apply even the oil/grease to its moving parts;
- Further, the Government have transferred the O&M responsibility to the beneficiaries without establishing beneficiary organizations to take over this huge responsibility. In November 2009, the Ministers of MAI and MWE clarified that the spate structures have to be maintained by the beneficiaries and that no financial support (except for the training) would be provided to them and they will have to stand on their own. It is logical that without ant financial support on empowerment these beneficiary organizations can not stand on their own;
- These organizations not only lack technical knowhow relating to O&M of spate structures, nor they have financial resources to discharge this responsibility;
- The Water Law or its by-laws do not empower these organizations to collect any fees or fines from the beneficiaries which can be used for O&M of these spate structures;
- Although the design of modern spate diversion structures is based on equitable distribution of water, the influential farmers usually located in the beginning of the command area consume major share of the spate water depriving the other beneficiaries. The Government at the same time is unable to enforce rule of law and ensure equitable distribution of spate waters;
- These tail-ender farmers do not receive spate water for a number of years. As a result they loose interest in these structures and are not willing to share the O&M responsibilities;
- Tribal conflicts are one of the major constraint towards smooth O&M of the spate structures and neither the government nor the local authorities are able to resove these conflicts. For example Canal Gates on spate diversion structure A;I Salim on Wadi Behan (constructed at a cost of US$ 135,000) are lying closed since 1998, because of some tribal conflict. Although the matter was brought to the notice of Governor many times, no action has been taken;

- Government is paying little attention to this important issue of O&M of spate diversion structures on which large sums have been spent and many of these structures have either gone into disuse and many more are likely to follow suit if this issue of O&M is not tackled soon
- The scio-economic issues, such as the relationships between land owners and their partners (Al ajeers) and between the Sheikh and the farmers, is very important and effective in establishing associations and in encouraging farmers contribution to the cost sharing of O&M of spate schemes.
- Protection of Wides bank and the field against the water flue is so important to encourage beneficiaries to contribute to the maintenance of water schemes.
- When there an effective role played by local authorities, farmers find it easy to solve their problems and this situation limits the interference and monopoly of powerful people.
- It was also found that the right establishment of farmers associations with the prevalence of transparency and accountability is very important for the sustainability of O&M of spate schemes.
- When self initiative and sense of ownership of irrigation schemes prevails and encouraged, a positive role is played in O&M of these schemes.

In order to take its role in maintaining the schemes and ensuring their sustainability, the following issues as general principles of operation and maintenance must be taken into consideration:

- The operation and maintenance must be an integral part of institutional education of any development program. Institutional tasks must contain operation and maintenance of schemes, machinery and equipment of the institution.
- The organizational structure of any institutions, must include a department or division of operation and maintenance with efficient and skilled staff.
- Planning and program development process for operation and maintenance must be made at early stages of the project.
- There should be a clear mechanism for operation and maintenance, with specified responsibilities.
- Financial and material means of operation and maintenance must be made available on time.
- Operation and maintenance responsibility must be complementary between the various institutions, whether governmental or community based.

General trends of the proposed solutions:

Before talking about any solutions or remedies to the issue of irrigation schemes in general and the spate irrigation in particular, general trends of policies in agricultural irrigation must consider the following topics:

- Identify roles and responsibilities in operation and maintenance of irrigation schemes whether it is the function of the government, as indicated in the laws and regulations or the role of beneficiaries, as indicated by many decision-makers or there is a need for change in laws due to lack of government budget.
- It is important to focus on the establishment of small and medium-scale schemes with simple and easy maintenance costs, and in areas identified by studies not by the wishes of people.
- At present time attention must be given by the government for the maintenance of existing schemes that lack maintenance, as any damage may result in heavy losses to the national economy.
- Protection of the wadi banks, as it is important for the Government to intervene in this area with the study of the needs and interference in the establishment of irrigation schemes as well as encourage the beneficiaries to do the maintenance work.
- Attention to be given to the formation of associations on a sound foundations to restore confidence and create awareness among the beneficiaries with amendment of existing laws and legislations to be in line with the current circumstances and new changes.
- Developing a clear vision through a national strategy to deal with the issue of irrigation or modify existing strategies which include available trends, the short, medium and long term plans and programs.

Recommendations

General

(1) In the absence of O&M of spate structures, many of the structures built in Yemen with large investments have deteriorated or failed and the large investments made over these structures may in the near future may become sunk costs unless O&M of these is ensured. The Government must pay serious attention to this issue failing which the damage to these structures may lead to heavy losses in the national economy and may be very difficult to restore these facilities. It may be mentioned that the spate irrigation is a significant source of groundwater recharge which is also depleting fast in Yemen.

(2) Provide proper training to the WUAs in the O&M of modern structures to restore confidence in them and amend the draft bye-laws which would empower the WUAs to collect fees from the water users or impose fines on the defaulters for the O&M of water installations as envisaged under Article 10 of the Water Law.

(3) There is need to discuss this important issue in a Workshop where all stakeholders should be invited to develop a clear vision on this issue and to firm up the short-term and long-term measures/steps and the type of amendment required under the bye-lays relating to spate irrigation and in particular on the O&M of Spate structures.

Short-term solutions

- Till such time the WUAs are empowered to assume the full responsibility of O&M of modern spate structures, the central Government (through the Agricultural & Fishery fund or the Ministry of finance) must provide adequate budget for the O&M of these structures at least for the next five years.
- Amend the Draft Bye-laws under the Water Law which would empower the WUAs to collect fees from the water users or impose fines on the defaulters for the O&M of water installations as envisaged under Article 10 of the Water Law. For example, in Indian State of Andhra Pradesh, a Law has been enacted linking the water charges collected by the Revenue Department and the distribution of water charges for Operation and Maintenance works. An another landmark decision has been take by issuing orders for apportioning the water tax collected among the Farmers' Organizations for the Operation and Maintenance of the irrigation systems. The Act also empowers Farmers' Organizations to levy a fee to achieve the objects of the Act and for performing its functions. All the members are mandated to pay the amounts as decided by the General Body of the Farmers' Organizations. In addition, the WUAs can collect contribution from their members.
- Amend the financial regulations so that the fee collected by the WUAs can directly be use for O&M of Spate Structures. This could also be proposed and facilitated by the Irrigation Sector of MAI.
- Provide training to WUAs on the O&M of modern spate structures in accordance with the O&M Manual prepared under GSCP and related projects under the supervision of MAI and NWRA.
- Consider creating an organization for O&M with equipments on the lines of Wadi Hadramaut and Abyan and Tuban which would take up the full O&M responsibilities over the next 5 years and special repairs (see long-term solutions in the following paragraph) thereafter and supervise the work of WUAs and provide them maintenance equipment on rent.
- The funding of the above activities should be provided by central government through the Agricultural and Fisheries Fund.

For spate irrigation associations and groups of water users:

- Healthy preparation for the formation of associations away from the powerful and influential people with independent contracted management to be under permanent control and auditing. This could be made in collaboration between MAI and NWRA.
- Operation and maintenance of spate irrigation schemes must be one of the main objectives of the formed associations.
- The functions of these associations must contain clear terms in the operation and maintenance of the schemes especially during the preparation of plans and

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maintenance schedules, including the provision of budgets and the rehabilitation of equipment.

- The tasks of operating and maintenance must be entrusted to special people or specific management levels such as division of operation and maintenance of irrigation schemes and equipment.
- There should be an internal statue and mechanism of action which is clear and specific and contains the following topics of operation and maintenance:
    - Determine the share of each channel of water
    - Coordination and distribution of water shares on channels
    - Supervising the distribution of water on channels
    - Implementation of regulations on water distribution and maintenance
    - Develop detailed plans for operation and maintenance and identify costs and access to it and prepare the required equipment.
    - Establish a schedule and assign responsibilities for operation, maintenance and implementation
    - Penalizing offenders and negligent with periodic evaluation of the work.
    - Organization of other operation and maintenance works
    - Regular recording and documenting information on the different channels and schemes in a special register
    - Assign an agent or supervisor for each channel or group of channels called the agent or the irrigation specialist or irrigation supervisor, as is the case in the prevailing traditional norms of sheikh Al-aobar or Al-Ogom agent with the following functions:
        - Monitor the status of irrigation schemes throughout the year
        - Periodic inspection of schemes and determine the damages and types of maintenance
        - Reporting on any developments occurred on irrigation schemes and agricultural land in his area.
        - Communicate with the owners of agricultural land, the local authority, associations and administrators as well as his counterparts in the other channels.
        - Estimate the costs of maintenance
        - Mobilize workers and equipment operation and maintenance
        - Supervising the maintenance process
        - Identification of offenders and the type of violations and report them.
        - Supervise any activity undertaken by farmers in his area, especially in their channels and crops.
        - Ensure that all beneficiaries have received water in time and quantity.
        - Commutate information and orders from the local authority and associations to the leaders of groups and water users, and vice versa.
        - Investigating the reasons for not contributing to the maintenance costs and maintenance operations.
        - Preparation of periodic reports

- Attend meetings called by the association and the local authority and other agencies.
- Recording of data and information about the various schemes that are under his supervision.
- Keeping the various books and registers of costs, damages, violations, accounts, beneficiaries, problems, difficulties etc..

Long term solutions:

There are two types of maintenance of these Spate Structures: namely (i) **annual maintenance** (which ultimately after 5 years shall be transferred to the WUAs); and (ii) **Major Repairs** which may be necessary in case of damage to the structures and which is beyond the scope of the WUAs.

- Establish a special fund for **Major Repairs** of the Spate Structures for which the following funding sources are suggested:
  - AFPPF;
  - Special Tax on Qat
  - Special tax on tobacco cultivation
  - Part of agriculture produce of crops irrigated by spate

- For the Annual Repairs by the WUAs the following are the sources of funds:
  - Fees from the beneficiaries on the water use;
  - Fines imposed on the defaulting farmers
  - 5 % cost of construction of spate works as per IDA MOUs
  - Initial contribution from AFPPF

- Spate irrigation must be given parallel attention as groundwater irrigation from wells
- Develop proper plan for the building the capacity of the local authority (administrative councils) and associations to play their role in the operation and maintenance of irrigation schemes and the gradual transfer of these schemes to the responsibility of these entities.
- Introduction of agricultural crops and cropping patterns with viable economic return.
- Training and awareness creation in various fields
- Review and re-consideration of some of the gates and vents that farmers complain from its inefficiency.
- Focus on the concept of integrated management of the water basin, especially after the construction of dams in the highlands.
- Review of the various laws to include clear items in operation and maintenance of spate irrigation schemes and identify fees on the use of water and the imposition of fines on the offenders and legalizing the establishment of the agricultural fund mentioned above.

- Framing norms of operation and maintenance of spate irrigation schemes in the laws and legislations particularly the local authority law, the water laws and other sanctions and penalties in this respect.
- Legislate the formation of special groups, societies, associations and water basin councils, as well as the federation of water users with clear texts for spate irrigation groups and water user associations.

Resources that could be a source of funding for operation and maintenance of spate irrigation schemes:

There is a large number of sources that can fund operation and maintenance of irrigation schemes as it benefit directly or indirectly from these schemes. These sources could include the following:

- Fees and contributions of the beneficiaries for water uses (the Islamic religion prohibits sale of rain water). But this fees can be added with the zakat, or as a percentage of gained profits.
- Fines from violators of the agreed norms or regulations
- Direct government support and donations, etc..
- A certain percentage of the Agriculture and Fisheries Fund.
- Taxes from the wholesale markets for the sales of agricultural products in each region.
- A proportion of Qat taxes as Qat growers benefit directly or indirectly from floods irrigation.
- A proportion of cigarette taxes as tobacco benefits from spate irrigation
- A proportion of agricultural production as irrigation is the backbone of agriculture in Yemen.
- Percentage of agricultural products exports as most of these products depends on spate irrigation.
- Percentage of the sales of water bottling factories

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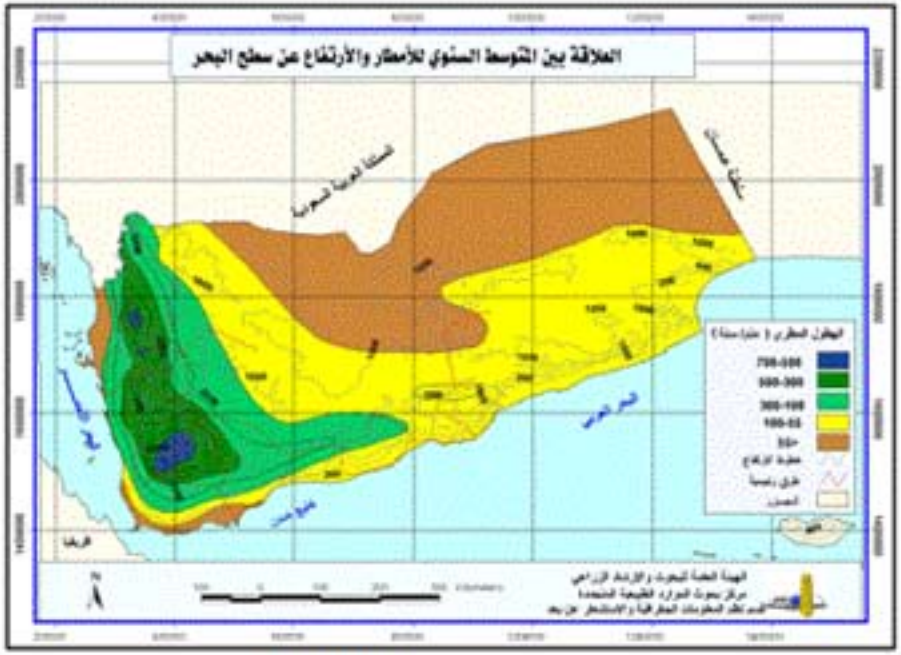

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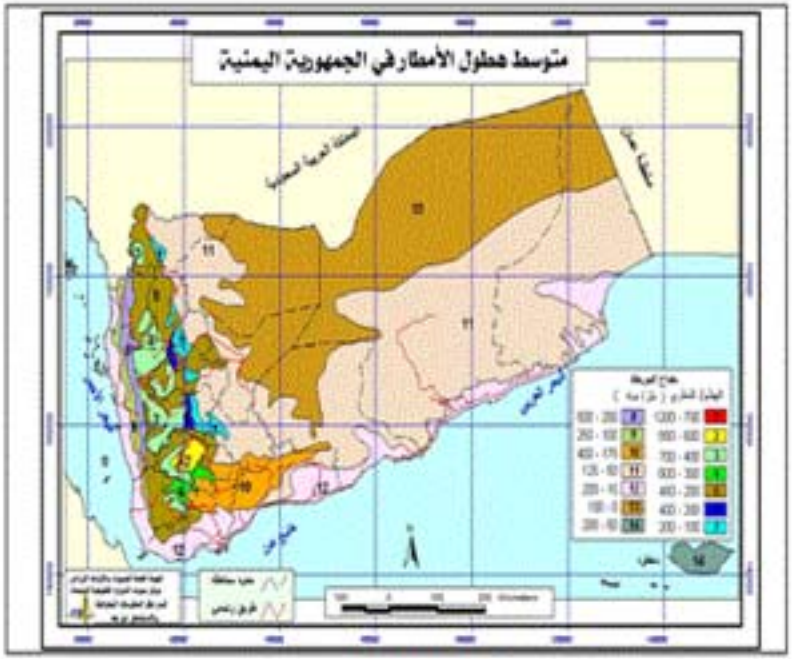

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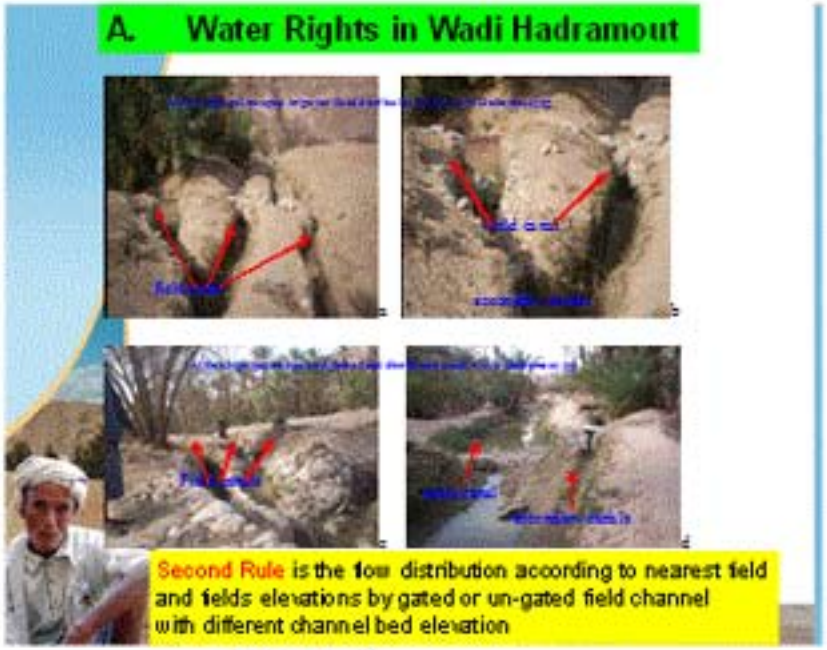

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