

# **Social and Organizational Aspects of the Operation and Maintenance of Spate Irrigation Systems in Yemen**

**(Case Studies from Wadis Zabid, Rima, Abyan, and Tuban- Republic of Yemen)**

*By: Dr. M. Al-Eryani- Water Resources Consultant and Team Leader  
Mohammed Al-Amrani- Consulting Anthropologist and Social Scientist*

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### **Introduction:**

This paper is part of the ground work preparation for the PIM seminar which aims at highlighting the various aspects of the spate irrigation systems.

The paper was prepared by a local consulting firm (Ghayth Aquatech) as one of three papers which deal with the social, financial and legal aspects of spate irrigation systems and the potential role that the water user associations (WUA's) could play in the O&M of these systems in Yemen.

### **Study Objectives:**

This study aims to identify the role which the WUA's could play in the O&M of spate irrigation systems, by assessing the field situation of existing systems. Specifically, it seeks to answer a number of questions regarding the allocation of flood waters, such as: whether the farmers are getting their water shares when it is their turn, the reliability of getting their shares, who actually allocates the water? do the farmers hire somebody to do that? the time period between maintenance works, the extent to which farmers cooperate among themselves to carryout O&M works, ...etc. (see the TOR, annex A).

Although the TOR's proposed a study of only one sample wadi from Tihama and one from Lahej to assess the way in which water is allocated and the equity in this allocation, field work revealed the necessity to expand the study to cover four wadis; namely: two in the Tihama (Zabid and Rima) and two in the southern region (Abyan and Lahej).

### **Study Approach:**

The study entailed field visits for 10 days (17-27 July 1997) followed by 6 days of field visits to W. Bana and W. Tuban to complement the data.

A 31 question "Guide for Interviews" was designed for use in all wadis. The interviewed persons were selected to represent all classes of the local populations (large and small land owners, land tenants, and share croppers).

The number of large land owners who were interviewed was smaller than other groups, as these were not responsive to the interviews, mainly because they are the ones who are most benefiting from the existing water situation. To improve the sampling, each wadi was subdivided into 3 regions: upper, middle, and lower. Thence, interviews were made with farmers from various groups in each region. This approach proved extremely useful and helped interpreting the data and clarifying puzzling issues to the team (at that time). This approach was applied to all four wadis. fifty farmers were interviewed: 20 from W. Zabid, 10 from W. Rima, 10 from W. Tuban and 10 from W. Bana.

The "Guide for Interviews" (Annex B) comprised 31 questions which aimed to assess the farmers' willingness to contribute to the O&M costs, although the TOR's didn't explicitly address this particular point. For this point, a special section of this paper "section 4: Farmers' Attitudes" gives the farmers' responses in percentages. This despite our realization that using "percentages" with such a limited number of interviews is not a fully acceptable, statistically speaking since the small sample may not be fully representation of the population. Never the less, our aim was to emphasize the near unanimous views by the farmers regarding the various issues raised during the interviews. This unanimity was also observed during the group interviews with the farmers and the group discussions with the irrigation staff and technicians in the various wadis. Our approach also included review of previous studies.

## 1) Wadi Zabid

The Hungarian Consultants (TESCO) completed their feasibility study of Wadi Zabid in 1973. In the same year the government issued the decree which established the Tihama Development Authority (TDA), in which one of the tasks of TDA was stated as "carrying out studies and research to define and utilize the surface and ground water resources and to establish the basis for its use" (1).

In order to achieve this task, it was essential for TDA to study the traditional irrigation system, identify its limitations, and decide if it requires modifications or new guide lines/regulation rules to achieve equitable water allocation over the various parts of the wadi. Instead, the TDA concluded that the water allocation system is generally acceptable (2) and it approval the water allocation table of base flow which covers period Oct. 6-15 March as well as the following periods. Thus, we had to study the traditional system, which is still in effect, despite the violations which this system undergoes and which result in many negative effects.

### 1.1) The Traditional Irrigation System

For centuries, agriculture in W. Zabid has depended primarily on flood waters and secondarily on rainfall. Agriculture has been and is still the major source of income for the population. Given that rainfall in Yemen occurs in two seasons (the April-May secondary season and the July-September primary season), it was necessary for the population to organize the irrigation activities which depend mainly on the flood waters flowing from the mountains to the east of Zabid. The regulating rules were devised by the renowned Moslem scholar Sheikh Gebrati some 620 years ago.

The system was based on "Ala'ala Fal'ala" rule; i.e., priority to upstream then down stream users. In this system the lands of the wadi were divided into 3 regions:

- a) Upper region: comprising the "shrouj" (channels) of Buni, Bari and Jerbah, Mansouri, Rayan, Bogr.
- b) Middle region: comprising the *shrouj* of Mawi, Youssifi, Nassri, Ebri, Jerhazi, Berah, and Jeraeb.
- c) Lower region: comprising the *shrouj* of Shara'abi, Haram and Wadi Al Ain.

Each of these regions is irrigated during certain specified periods of time, and no farmer dares to violate the schedule since the State, over the history of the region, has recognized this system, which remains valid till today despite the violations which used to happen during certain periods of history. In this system, the year is divided into two seasons each of which is further subdivided into certain periods as follows (see Table 1).

Seasons (1): its total duration is almost 5.5 months covering the base flow irrigation period (6 October-15 March) the flow in this season is limited and never sufficient to irrigates the entire wadi. Hence, based on priority rules, the water in this season is allocated to the upper region, expect for the first 5 day which goes to the lower wadi.

Season (2): which spans the period 16 Mar. - 4 Oct. during which the water is allocated to the three regions of the wadi, according to the allocation role of priority to upper users, as follows:

- a) Upper region: receives water for 97 days (16 March-20 July).
- b) Middle region: receives water for 40 days (21 July-31 August). This period is characterized by frequent floods; hence the farmers call it the "forty rainy days".
- c) Lower region: which receives floods for 35 days (1 September-5 October).

Table (1): Traditional water allocation system in W. Zabid during the first season, 6 Tachrien I - 15 Athar (based on a document which describes a judge ruling following a water conflict.)

No. of days	Tachrien I Season (1 Tachrien I= 14 Oct.)	No. of days	Tachrien II Season (1 Tachrien II=14 Nov.)	No. of days	Kanon I Season (1 Kanon I= 14Dec.)
5	Lower wadi	3	Jerbah & Zafri	15	Buni
12	Buni channel	9	Bogr & Rayan	4	Bari
3	Bari channel	2	Bari	9	Mansouri
7	Mansouri channel	3	Mansouri	3	Jerbah & Zafri
4	Jerbah & Zafri channel	7	Jerbah & Zafri		
total 26	excluding the lower days of wadi	total 30		total 31	
No. of days	Kanon II Season (1 Kanon II= 14 Jan.)	No. of days	Shubat Season (1 Shubat = 14 Feb.)	No. of days	Athar Season (1 Athar = 14 Mar.)
4	Jerbah & Zafri	10	Buni	5	Buni
11	Bogr & Rayan	1	Bari	10	Bogr & Rayan
16	Buni	4	Mansouri		
		3	Jerbah & Zafri		
		8	Buni		
total 31		total 28		total 15	

### 1.2) Present-day Irrigation System:

One of the objectives of W. Zabid project, which commenced in 1975 and was completed in 1978, was to increase agriculture production and farmers incomes through the establishment of a modern irrigation network to utilize the flood waters and protect the land from erosion. Hence, the project comprised the construction of 5 diversion structures (three with a capacity of 1459 m<sup>3</sup>/s, one 900 m<sup>3</sup>/s and one 200 m<sup>3</sup>/s). These structures have manually operated gates and they distribute the water as shown in Table (2).

Table (2) components of W. Zabid Irrigation System.

Region	Diversion Structure	Main Channel (Shuraij)	Irrig. Area (ha)	Total Area (ha)
Upper	First	Buni and Bari	1,125	1,690
		Jerbah	565	
Middle	Second	Mansouri	1,080	2,635
		Bogr and Rayan	1,555	
		Mawi & Youssfi	3,310	
Lower	Fifth	Nassri	2,385	7,585
		Ebri & Jerhazi	1,890	
		Berah	1,330	
Lower	Fifth	Jeraeb	250	1,580
		Shara'abi	560	
		Maharaqi & Haram	495	
		W. Al Ain	250	
			Total	14,695
			AlWadi	420
			Total	15,215

### 1.3) The Water Allocation System

When the water flows down the main channel, the first pipe is opened (this is a side opening in the channel) to irrigate a group of fields along the channel bank. Because of the annual accumulation of silt in the fields, the levels of the fields have become higher than the water level in the channels, which forces the farmers to construct temporary dikes across the channel (just past the opening) to raise the water level and allow water to enter the openings and flow to the fields. These dikes are locally called "uqma" (plural is "Ma'aqem").

ch. 1  
water

These *uqmas* are frequently washed away when the floods are strong enough. Once the water enters the group of fields, each field is then irrigated according to its turn (field-to-field) and according to the role of priority for upstream "higher" fields.

#### 1.4) Responsibility for Water Allocation

When the TDA (represented by W. Zabid Project Unit) took over the responsibility of water allocation, conflicts over water distribution (which were prior to that a common occurrence which claims several lives every year) disappeared. Among the reasons for disappearance of these conflicts was the heavy punishment which violators received and the supporting role of the local authorities, helping the project unit to enforce water allocation rights, as well as the satisfaction among the beneficiaries who were receiving generally sufficient waters, particularly that most lands were cultivated with traditional crops (sorghum, millet, etc.), which require relatively little irrigation water (2 to 3 irrigations per years) while banana plantations were not so widespread then (about 20 ha in total). This situation continued until the mid eighties when fruit imports were banned and local banana plantations increased. Then water conflicts started to emerge. Since then (and for various reasons), the TDA started to gradually abandon its supervisory role over water allocation.

Traditionally, and until today, the process of water distribution is supervised by a person called "Sheikh Al Sharej" (Channel Master) who gathers the farmers to build "*uqmas*", calculates the costs and charges each farmer proportional to his irrigated area. The channel master also supervises the distribution of water among land lots. He decides which particular piece of land is first to get irrigated when the next flood comes. This process of assigning turns is governed by traditional a rule which prohibits land from receiving flood water more than once in a 14 days period. The area served by each channel (command area) is well defined and known to all farmers and it is prohibited to add new lands to the command area of a given channel or to dig a new channel to irrigated reclaimed land or to irrigate a neighboring land which is not part of the command area.

Also, in all channel, cereals, were the main crop, with more or less equal water consumption.

#### 1-5) Maintenance System

Traditionally, at the beginning of each season the channel master would call upon all the beneficiaries to build the main "*uqma*" at the channel entrance.

This "*uqma*" is commonly made-up of trees, stones, and soil. Each farmer, weather a land owner or a share cropper, would then bring his oxen to work and the cost is proportionally paid by the beneficiaries.

The Channel Master calculates the cost using a system called "*Tadmeed*" system. The term is derived from the word "*Themd*" which is the work force consisting of 2 oxen with a laborer for one day (a laborer gets 500 YR/ day). The system is used to asses the cost of main channel works. The costs are proportioned among the benefiting farmers according to their land areas, quantity of water it needs, its location in the wadi, fertility, and number of irrigations it receives; as follows:

- 1) lands in the upper wadi region: pay the cost of one "*Themd*" per 2 *maads*. This is because the land is fertile, always receives irrigation water, highly priced (1 *maad* is priced at 1 million YR).
- 2) lands in the middle wadi region: pay the cost of one "*Themd*" per six *maads*. This land receives irrigation water more than twice per season.

- 3) lands in the lower wadi region: pay a cost which varies from one part to the other, but generally range from one "Themd" per 10-25 maads. Reason is that this land doesn't receive water except when large floods occur.

It is true that the diversion structures have spared the farmers the exhausting efforts of building the *uqmas* which were washed away yearly. The maintenance department also does large effort in maintaining the entrances to the main and secondary canals. However, the current level of maintenance is generally inadequate, for several reasons (see technical details in the paper on financial aspects of O&M):

- 1) The large sedimentation near the diversion structures and in the channels due to low efficiency of the sluiceways.
- 2) Inadequate finances to properly run the O&M works.
- 3) Inadequate designs at the entrances of some of the main channels (e.g. Rayan channel) where the farmers have to build earth dikes to divert the water to the channel entrances (these works are supervised by the channel master who collects the money from the farmers and pays for the overtime wages and fuel cost for project equipment, especially outside office hours, weekends and holidays; if needed).

In times when project equipment are not functional, the channel master rents private equipment. Those *uqmas* which are located inside the main channel are manually built by the individual (s) farmers(s), each according to his land area. Often the farmers cooperate, by gathering their oxen, to maintain channels or plough land. The channels which directly feed the fields are usually maintained after the harvest and at the beginning of the season.

#### 1.6) Reliability and Equity

The following paragraphs highlight some of the issue and considerations which the farmers, the project technical staff, and the team consider as having an impact on the reliability; and hence equity, in water allocation:

- a) The rule of priority of upstream lands (under the present day cropping patterns): this rule guarantees water to the lands in the upper wadi region, from both perennial baseflow and flood water during the second season (16 March-20 July). It might be argued that this system is fair and equitable under the traditional (cereal) cropping patterns which require limited amounts of irrigation water. However, under today's widespread cropping of banana, which requires irrigation every four days, this system becomes fully to the advantage of lands in the upper wadi region, except in years of heavy flooding when flood water reaches middle and lower regions of the wadi.
- b) Reclamation of new lands in the upper region: some farmers have reclaimed lands upstream from structure No. (1). This land is being irrigated from the baseflow and has consumed most of that water, thereby depriving the lower lands and negatively affecting reliability and equity.
- c) Land reclamation along the main wadi channel (wadi banks/ bed): These lands are locally known as "Golaf" and are estimated to cover some 480 ha. They belong to the large land owners and are "illegally" being irrigated by waters which would otherwise go to the middle and lower wadi regions. It should be noted that the traditional irrigation system prohibits the irrigation of lands which are not included in the table of irrigated lands.
- d) Inaccuracies in the traditional calendars of irrigation: Some of the interviewed farmers believe that the irrigation calendar should be revised, even for the upper region. For



instance, it is found that the main channels of Bogr and Rayan, despite being in the upper region, do not receive any of the baseflow which goes entirely to Buni and Beri channels. Besides, the flood waters which reach Bogr and Rayan arrive before the cultivation season, and even if they arrive in time the length of the allocated time period is insufficient to irrigate all of the lands commanded by these two channels. The same also applies to lands of the middle region, especially areas which are further away from the wadi channel.

- e) *Domination by the large land owners:* The large land owners control the opening/ closure of the main gates during flood peaks, ignoring the regulations which prohibit gate opening during flood peaks in order to prevent entrance of sediment. Frequently, the project staff (operators) are harassed to open the gates. Often, the large land owners would pour sand into the gate control mechanisms to damage it and prevent closure of the gates so that the flood water would continue to flow to their fields. This irresponsible act causes abrasion of the cogwheels, which means higher operation and maintenance cost for the system.
- f) *Ignorance (in the modern diversion system) of the traditional water rights:* The present irrigation system without full account of the traditional water rights. For instance, in the traditional system each channel has its own entrance and a pre-determined quantity of water flow. In the new system, several traditional entrances were gathered into one entrance which draws the flood water into a main channel to be then divided, by special structures, on several channels. This led to frequent conflicts among farmers. These conflicts occur:
- in entrances which feed more than one channel that are served during the same period but have different priority rights.
  - in main entrances near the diversion structures, due to the presence of 2 main channels on the two banks of the wadi which are of the same group of channels but have different priority rights, especially after the flood recedes and baseflow becomes the only source. For example, the lands of AIDoughayshia (structure 2 which serves the lands of Mansouri, Bogr and Rayan according to project design) were to be irrigated from Beri channel and now they are irrigated from Mansouri channel; which is not fair to the lands originally served by Mansouri, Rayan and Bogr channels.

This problem was pointed out by Haydar ( , p.13) who exemplified it by the situation of the farm land block II which is irrigated from channel (I) although its irrigation rights are from channel MSC II. Haydar also proposed that a solution of this problem would have been possible by using traditional methods to quantity the amount of water for such channel.

- g) *Inadequate (small) diameter of feeder openings:* although these pipes were built at the same locations of the old "uqmas", their design ignored the traditional knowledge regarding the amount of water required for each channel. Thus, the openings are too small and can't irrigate the entire command area of the channel, as it used to in the past. For instance, in Rayan channel, four openings were installed at the same locations of the old "uqmas" (called Nadrat Sabeh) and two openings at (Zugar). The channel master informed the team that only the openings at Zugar are adequate and that the four openings at Sebah are too small and they frequently get clogged by sediments. The channel master also pointed out to the need to enlarge the openings on Doughaishia bridge (structure # 2 which feeds the Rayan, Bogr and Mansouri channels) to prevent the frequent clogging of openings.
- h) *Changes in the cropping patterns:* Tihama has been traditionally famous for cereal crops (corn, sorghum, millet and foliage). The production of these crops from wadi Zabid has increased, after the construction of the diversion system, from 21,280 tons in 1975 to

37,170 tons in 1980 and to 46,000 in 1985; an increase of about 116% (AbdelSamad, 19 ; p.99). At the regional level, for example, the area commanded by Buni channel (in the upper wadi region, which is estimated at 855 ha.) was cultivated with corn on some 499 ha (47%), and cotton on 171 ha (20%). But this cropping pattern didn't continue, and banana plantations almost entirely replaced the mentioned crops especially in the upper region of the wadi which is irrigated from structure No. 1, and which is estimated at (1,690) ha (besides the *Gelal* land of about 480 ha) where the banana crop area until the early 80's was less than 20 ha (now it is more than 2,300 ha). It is known that banana requires irrigation every 3-5 days (7 per month). The same change in cropping pattern also happened in the Beri and Jerbah channels.

- i) *Shortfalls of the agriculture policy*: In 1984, a ban was issued on fruit imports. However, with this ban, there was no clear policy on what fruits should be grown locally? and farmers were left to decide on their own without any regulations to prevent abuse of water rights. High value crops were then introduced to the wadi and conflicts over water started to emerge again. The main benefactors from the new situation were the large land owners who practically took all the water on the basis of the traditional priority right for the upper lands.

This led to violation of existing irrigation systems so that the surplus water in the period 18 Mar.- 28 July became a subject of competition between farmers in the entire wadi. This conflict has not been resolved yet, though farmers in the upper region have confiscated the water by virtue of their lands' location. Interviews with small lands owners (1/2-10 ha), share croppers, and tenants of *waqf* land (land put in religious trust) stated that large land owners in the upper wadi region use force to take water to their lands and that the large land owners have abandoned the old system so that there are lands which haven't received water for the past four years and wouldn't receive water except in exceptional floods.

- j) *Land tenure and agricultural relationship in the region*: The objective of rural development projects is to fight backwardness and poorness in the rural areas, and improve the standard of living of the rural population where most of the country's population live and depend on agricultural activities. However, it appears that the project implemented in Wadi Zabid didn't do much to poorness and did little to improve the standard of living of the majority of the population. This is attributed to several reasons. One main reason is that these projects were not accompanied by economic, legal, social and political measures to protect the poor who by far constitute the majority of the wadi's 65,000 residents who work mostly in agriculture.

Lacking these measures, the state of equity and justice deteriorated, especially given the wadi's widespread occurrence of large land holdings. Although there is a general scarcity of statistics on land holdings, the study carried out by the Hungarian consultant (TE SCO) in 1973 revealed that 7 families own some 4,282 ha (about 47% of the private land in the wadi which was estimated at 9,000 ha). The per family holdings for these 7 families ranged for 216-1,800 ha (Noaman, 1989).

The TDA (1983) estimated that large holdings account for about 36% of the total land area, while 18% is small holdings and 46% is land in religious trust *waqf* (15% is government *waqf* and 31% is family *waqf*, which is land put in religious trust under management by the family itself). These numbers, match the numbers given by Abdel Jawad (1984) as follows:

- 46% *waqf*: 31% (5,300 ha) private *waqf* and 15% (2,600 ha) government *waqf*.
- 36% (6,000 ha) large holdings owned by 25 families.

less dependence on cash crops for collection  
impact of water control  
of p. 99.

- 18% (3,000 ha) small holdings owned by 2,000 families.

It is believed that the pattern of land holdings described in TESCO's report is more reliable, though it is also believed that large holdings in the wadi have increased in number and area over the past 20 years.

Interviews with the farmers revealed that the large land owners get most of the water and deprive the lands in the lower wadi, which has led to desertification of that land and forced owners to sell out to large owners. Since 1962, many new large owners have emerged. The former Central Planning Organization (CPO) highlighted this point by mentioning in one of its reports (CPO, 1983) that "TDA officials state that W. Zabid project benefits only 5 individuals or even less, and because of this project the land holdings of these individuals have increased from 5,000 to 15,000 ha). This situation becomes more clear when examining the system of sharing of land produce among the land owners, tenants/share croppers and owners of water wells/pumps in wadis Zabid and Rima (Table 3).

It is worth noting that farmers cannot directly lease waqf land except through certain families and individuals who sub-lease the land to farmers. In this regard it is also noted that the number of tenants in 1983 (1,560) was more than the number of share croppers (516) (Abdeljawad, 1984).

The lack of a law that regulates the relationship between owners and farmers has led the large land owners to change the sharecropping arrangements, especially after the expansion in banana production.

#### 1.7) Consequence of Inequity in Water Allocation

- 1) desertification of many lands which are in the lower wadi region, and encroachment by sand dunes; which devastated many families and forced them to sell land to the large owners, led to desertion by share croppers to the cities in search of job opportunities. The same also applies to small land owners in the middle wadi region.
- 2) change in the status of many small land owners in the middle and lower wadi regions from land owners to sharecroppers because of:
  - a) water scarcity in these regions due to illegal diversions by upstream land owners which in view of the weak role of the state and lack of regulations for the relationship between the sharecropper and owner, forces the small owners to sell to the large ones, or to desert land and switch to a sharecropper in another land; or even to look for a different job for living.
  - b) the unfair policy by the Agriculture Credit Bank (in financing well pumps, for instance). The bank requires the farmer to contribute at least 50% of the fund. Of course, many of the small land owners do not or can't afford this self financing of 50%. Hence the bank facilities mainly serve the large land owners and community leaders. The large land owners have exploited this situation by purchasing pumps and providing water to the small land owners for half of the crop. In addition to getting half of the crop they also decide the crop which the farmer can grow. The result is that the big farmers are getting richer and the poor ones are getting poorer.

**Table (3): Agriculture Production Relationships according to the source of Irrigation Water**

Source of Water		Sharing of the crop				sharing of the cost (seeds, harvest and zakat)
		Land owner	Farmer (share cropper)	well/pump owner	tenant	
Ground Water	1) When there is no land tenant	1/4	1/4	1/2	---	in proportion to the shares in the crop. Sometimes the zakat is paid by the land owner and owner of the well/ pump
	2) When there is a land tenant	1/6	1/6	3/6	1/6	as above
	3) When the land is rented from waqf (govern. waqf)	The farmer gets all the crop				tenant is re-imbursed for all costs
	<ul style="list-style-type: none"> <li>land is rented for a fixed annual sum</li> <li>when the lessee is a different person then the farmer (farmers is sub-lessor)</li> </ul>					
						proportional to the shares
Wadi Water	1) when there is no land lessee (middle person between owner and farmers)	2/3	1/3	--	--	As above
	2) when there is a land leasor	1/3	1/3	--	1/3	As above
	3) when the land is rented from waqf or from any other owner for a fixed annual rent paid by the tenant.	the rent	1/3	--	1/3	As above

*separate waqf waqf*

## 2) Wadi Bana (Abyan Delta)

### 2.1) Current Irrigation System

The current irrigation system in the delta of Abyan is an extension of the traditional system which is based on priority of upstream land (*Arda'a* system). In the fifties when the British administration was preparing for the Abyan Delta Cotton Project, it sought to preserve that system without change.

Hence, before it began constructing the diversion weirs and irrigation network, it worked to solve the water conflicts in the wadi. For this purpose, a water allocation agreement was drafted on the basis of traditional rights and was signed by the Fadhli and lower Yafee tribes. Then the network, comprising the Batais weir and the diversion and secondary channels were built, with channel capacities designed to meet the water shares and priority rights. Subsequently, the weirs of Haijah, Dew, Makhzan, and Garaeb were built. It is worth pointing out that the British, who built the weirs, didn't build internal irrigation network (except in upper Batais region). Hence, the irrigation method is field -to -field.

The Abyan irrigation system comprises the following structures:

- a) Batais weir: with capacity of  $130 \text{ m}^3/\text{s}$ , of which some  $60 \text{ m}^3/\text{s}$  is transferred to:
  - Batais main channel (which receives 100-120 cm of water measured on the staff gauge) and which has priority.
  - Mikelan main channel, which receives 130-150 cm.

Surplus water is diverted to Shagat Ba Omar (7,000 ha of arable land).

- b) Haijah weir: which receives water only when the flow at Batais exceeds  $60 \text{ m}^3/\text{s}$  and after Shagat Ba Omer is irrigated. Its water share is estimated at  $30 \text{ m}^3/\text{s}$  distributed on priority basis on Ahboosh, Jabalaen, Feesh, Nashr, Hawaship. Surplus water from this weir is diverted to Abr Johaisah (up to  $5 \text{ m}^3/\text{s}$ ) and the rest is directed to the wadi to irrigate the lands of Ras AlFanh and Daeo weir.
- c) Daeo weir: this structure receives surplus water from Abr Johaisah and AlFanh. Its share is  $58 \text{ m}^3/\text{s}$  distributed according to priority on the channels of Daeo, Nashairah, and Nukhailah. An earth dike is needed to raise the water to the level required to irrigate the command area of this weir, otherwise the water flows to other lands, especially at low flows. But when the flow is large enough then the dike is washed away and the water flows to Al-Makhzan weir.
- d) Al- Makhzan weir: this weir receives surplus water from Daeo weir. Its allocated flow is  $36 \text{ m}^3/\text{s}$ , distributed on Qaryat, Bashehara, and Jawl channels. Like the Daeo weir, the operation of this weir requires an earth dike to raise the water to irrigate its command area.
- e) Al-Uqm weir (Uqmat Al-Sadah): this earth structure receives surplus water from Al-Makhzan weir. It irrigates the lands of Khamlah, Afeni, Beish, Jaolah, Kawr. However, when the flow is high, this structure breaks and the water flows to Al-Jaraeb weir, then to Al-Semah weir which also serves as retaining structure for groundwater recharge. This structure (uqmat Al-Sadah) can only be broken by orders from the prime Minister.

It should be pointed out that there is another irrigation system which serves the Maseh lands (western delta). It comprises primary, secondary, tertiary and quaternary canals.

## 2.2) The Water Allocation/ Distribution System

Four canals branch out of Batais main channel. These are:

- Arshan canal, which commands 1,061 ha
- Fathli canal, which commands 409 ha
- Hertli canal, which commands 1,066 ha
- Ben Jumailah, canal, which commands 412 ha

These canals receive water from the main channel according to the rule of priority of upstream lands. The canals always receive some water, especially in the main season (June-Sept.). The irrigation from a following flood is usually resumed at the point where irrigation ceased in the last flood (though this rule is nowadays not respected).

Usually the July to August floods irrigate the lands in the upper delta. Hence, these lands are usually irrigated every year, and surplus water in this season goes to lands in the mid-delta. The rest of the delta is irrigated in the summer season.

## 2.3) Water Allocation/ Distribution

There are two irrigation systems in the delta: the modern system in the west and the traditional system.

The network in the west was funded by the Kuwaiti fund. It serves some 4,510 ha through 4 channels. The irrigation department operates the main and secondary canals while the tertiary and quaternary canals are operated by the irrigation inspectors with participation of the farmers. The network doesn't include field-to-field irrigation.

The traditional system comprises primary and branch canals and it includes field-to-field irrigation.

The interviewed farmer indicated that they do not get water on time when it is their turn. They reasoned this to delays on the part of the irrigation department in cleaning and preparation of the main and branch canals in time to receive the flood water. Another reason is the lack of a supervisory entity (such as the cooperatives, which existed till the 90's), as well as the frequent violations of the irrigation schedule which used to be enforced in the past, and the diversion of water to the farms of the community leaders more and above their shares.

Water allocation is the responsibility of the irrigation inspector who is a government employee responsible for monitoring the adherence to the priority rights and irrigation schedule so that the farmers will not illegally divert water from one canal to the other.

In the past, the irrigation system was subdivided into three levels:

- 1) External irrigation which deals with water distribution from the weir to the main canals. The O&M at this level is the responsibility of the government (local irrigation department).
- 2) Internal Irrigation: which entails the monitoring of the branch canals. Its operation and maintenance is also the responsibility of the government.
- 3) Sub-internal (field) Irrigation: which entails monitoring of the canals which draw water from branch canals to the fields. This is the responsibility of the farmers.

This system remained in effect from the 50's through the early 90's. The inspector's task was to:

- decide the area to be irrigated.
- organize the irrigation process in the internal canals as per recognized customs.

- inform the irrigation department on the readiness of the lands for irrigation, since the regulations forbid the delivery of water to un-ploughed land.
- notify the head of the internal irrigation department (when the land is ready for irrigation), who in turn informs the Head of the external irrigation department. The latter then instructs the guards to open the channel gates
- do the "Tadamed" calculations. That is calculates the irrigation fee due by each farmer based on the irrigated area (which used to be about 1 Dinar per feddan).

#### 2.4) Equity in Water Allocation and Reliability of the Modern System

It may be generally stated that equity in water allocation lasted until the 90's with farmers getting water when it is their turn, and water reaching the lower regions in a naturally variable way (due to natural fluctuations in rainfall).

Interviews with the farmers and technical staff of the irrigation department revealed the need to review the irrigation policy as a whole, revise the priority system, and the need also to get back to the pre-reunification system of irrigation. The farmers and technicians believe that the main problems with the current system are:

- 1) The priority system is unavailing and doesn't serve agriculture, and alternatives must be devised to replace it. The reason is that it gives the upstream lands the "lions-share" of water and deprives the downstream lands. Upstream lands receive water in the two rainy seasons plus baseflow. This has deprived entire areas of water for several years, while if the system is modified it could receive one or two waterings per year (e.g Jabaleen and Ahboosh areas which used to get 2 waterings per year in the past).
- 2) Inadequacy of the branch canals relative to the command areas: the old irrigation network (Batais canal and Mikelan in particular) has a limited number of branch canals relative to the command area. Indeed, some branches have a capacity of only 1 m<sup>3</sup>/s which is only adequate to deal with flood waters which last for a limited number of hours. The result is that not all of the ear gets irrigated.
- 3) The limited number of regulators on the branches. This has forced the farmers to use the field-to-field irrigation method which is not a flexible method that allows protection of rights. For instance, when a field is irrigated from the first flood it becomes impossible to irrigate an adjacent field, from the second flood, without having to let the water flow over the first field.
- 4) Limited capacities of the tertiary and quaternary canals in the so called "new irrigation projects" (or the western W. Bana reclamation project which commenced in 1971 and was completed in 1981) which is irrigated from Hajjah and Daco weirs. This in addition to the many defects in these structures.
- 5) Lands which are irrigated by traditional system (by earth dikes, like Sadah and Semah dikes) where there is no irrigation network constitute a burden on the irrigation departments and on the farmers, because of the large amount of earth works and hence the difficulty of irrigating it. These lands also do not receive their share of water except perhaps once every four years.
- 6) Changes in the cropping patterns: cotton tobacco and peanut have been the leading crops in Abyan delta, while the area of banana plantations has never exceeded 150-200 ha since the 50's till 1994. And no farmer dared to expand his banana area because of the strict regulations. However, since the mid 90's, this situation changed drastically towards

expansion of banana plantations in Batais region (20-40 ha), Daeo region (80-120 ha) and Akmat AlSemah and Dehl Ahmed (about 20 ha).

- 7) Deterioration of the weirs and destruction of some (especially those washed away by the 1980 floods). The command areas of these structures are now irrigated using earth dikes and gabions for flood diversion.
- 8) There is a large number of benefactors (6,500 households) who were dismissed from the land they used to farm before re-unification. These farmers are now working as tenants or daily laborers. This has indirectly resulted in concentration of the land holding and greater control of water by large land owners.
- 9) Frequent violations of the irrigation schedule by some beneficiaries, especially the local powerful figures, especially that no punishments are given anymore. Violations include: construction of illegal dikes, breaching of dikes, theft of wooden logs from the diversion gates. Also some influential farmers get orders from local authorities (directed to the irrigation department) to grant them repeated irrigation of their land.
- 10) Until today, there has been no replacement to the cooperative societies which used to act as a mediator between the benefactors and the government. The agricultural cooperatives used to take the responsibility for the sub-internal irrigation works. This includes the construction of *uqmas*, clearance of branch and field canals, ploughing of member's lands. The costs are recovered from the crop:

## 2.5) Methods of Maintenance

The irrigation department in the delta carries out many of the operation and maintenance tasks in the main and branch canals. These works include maintenance of concrete structures, earth dikes, earth bunds around the fields, flood protection works, etc. The irrigation department also carries out works outside the main and branch canals, which are the responsibility of the farmers but which are needed because of the lack of irrigation network and the complete dependence on field-to-field irrigation. Example of these works are:

- a) *Sawagat*: which are irrigation ditches, 40-50 m long, dug in the fields and necessary to deliver the water to the fields.
- b) *Etwaf*: short irrigation ditches which irrigate in two directions/sides.
- c) *Sawaed*: which irrigate the command areas of Nasherah canal, Um Sulaibah & Makhzan canal, etc.
- d) Cleaning/desilting of some quaternary canals in Daeo, Jabaleen and Ahboosh mountain for these works. the cooperative used to pay the cost of fuel and oil the equipment.

Nowadays, because of the large work involved in these activities and the closure of the agriculture equipment rental stations, besides the stopping of collection of irrigation fees and the widespread violations of the irrigation programs and the disintegration of the agriculture cooperatives; for all of these reasons, the irrigation department is nowadays not doing any maintenance works at the "sub-internal" level.

This has deprived the lower and middle delta region from water. Interviews with farmers have indicated that some areas have not had any maintenance works for five years.

The maintenance period is divided into two sub-periods May-June and Sept. - December. Maintenance works are either manual or by machinery rented either from the irrigation department (for cost of fuel and wages of the driver) or from the private sector.



Interviews with farmers and technical staff of the irrigation department indicated that the maintenance works, (nowadays after the irrigation department has stooped activities at the third "sub-internal level") take three forms:

- 1) in areas where there are still agriculture cooperatives (there are 3 such cooperatives: Derjaj, Ruah and Hesn, but only Derjaj is still active) the cooperative coordinates with the irrigation department to provide equipment for maintenance works. The cooperative pays for the fuel and wages of the driver while the farmers pay proportional to their farm areas.
- 2) coordination among individual farmers, at the channel level, who delegate one of them to contact the irrigation department for equipment rental. They divide the cost equally among themselves.
- 3) by cooperation among a group of farmers who delegate the largest land holder among them the responsibility of follow-up and collection of contributions from the others, each as he can and not proportional to his area.

As for the accounting aspects and number of laborers or equipment, results of the interviews indicated that this will depend on the type of works needed and the involvement of the irrigation department. The procedure is usually to get one of the farmers to organize the works (rent equipment and hire laborers) and collect shares.

The irrigation inspector is usually the person who supervises the maintenance works at the main and secondary channels' levels. Specifically, his duties include:

- 1) supervising the cleaning/weeding of canals.
- 2) supervising the construction of the *uqmas*, Sawaed, and Sawaqat (ditches) according to acknowledged customs.
- 3) handling the "Tadameed" process: i.e. determining the amount due by each farmer for the works carried out by the irrigation department.
- 4) hiring laborers during the flood season and paying them out of the 1 Dinar/feddan. This in coordination with the head of the sub-internal irrigation department.

Annex (C) outlines the organogram and mechanism of operation of the irrigation system in Abyan.

### 3) Wadi Tuban

The present irrigation system in Tuban is an extension of the traditional system. That is, the locations of intakes and priorities are the same as they used to be in the traditional system. The priority system (locally known as "Rada'ah") is similar to the other wadis; i.e.; priority of the upstream lands.

Delta Tuban bifurcates into two wadis: Wadi Alkabeer and Wadi Alzagheer (literally the large and the small wadis).

- Wadi Alkabeer (the large wadi) is on the western side and it comprises the channels of Al Makhraj, Saodeyen, Falej Abyan, Al-Mujahed, and Alwaht.
- Wadi Alzagheer: is on the eastern side and it comprises the channels of Al-Hassan, Beizeg, Thalab, Hadarem, Yacob, Salem and Berot, Al habeel, Haydaraj and Mahjef, Bugee, ... etc.

Notably, since the modern irrigation system doesn't cover the entire delta, the wadi has two irrigation systems: the traditional and the modern ones.

The traditional system comprises channels whose headworks are built of reinforced concrete (except the channels of Makhraj & Sadden in the large wadi), in which the irrigation is field to field. Some of the fields in this system are in the lower region of the wadi.

The other system is designed as a modern system with primary, branch and secondary canals which deliver the water to the fields. This system doesn't entail field to field irrigation. The system serves the upper regions of the two wadis as well as Ras Beizeg.

The water is diverted from the wadi through *uqmas* and diversion weirs to the main (primary canals) which command areas ranging from 2,000 feddan (as is the case in Beizeg) to 3,000 feddans (in the upper wadi region). Each primary canal branches into upto 10 *Shrouj* (branch canals) in defined quantities according to customs. Each *Shrouj* irrigates 80-200 feddan and it branches into secondary canals which flow directly to the fields.

Diversion of water from the main to the branch canals requires the installation of *uqmas*. These are usually built using wooden logs with empty wheat sacks to receive the mud so as to build enough weight to stabilize it. These *uqmas* divert the water to the branch canals. Smaller earthen *uqmas* are also built on the branch canals to divert water to the fields. The internal fields are irrigated field -to-field.

#### 3.1) Water Distribution Responsibility

The distribution of water between the large and small wadi using the diversion works is the responsibility of Sheikh al-Wadeyeen (Sheikh of the two wadis). This person applies customs to distribute water and he operates under supervision by the agriculture extentionist. His task is to determine the water share of each main canal after consulting with the Sheikhs of these canals, and deciding the number of days allocated for each canal and the required works to divert the flood waters into these canals. This person still functions till today and has become an employee of the irrigation office in the governorate (Abulula, 1978; p. 246).

As mentioned, each main canal has a Sheikh (Sheikh al-Ubr) whose tasks are:

- 1) water diversion during the floods.
- 2) deciding the quantity of water to be diverted to his canal, so as not exceed the capacity and erode it.

- 3) supervising the irrigation process so that each farmer would take his share according to customs, and monitoring violations.
- 4) determining the maintenance costs for the canal and wadi during the season and collecting it.

### 3.2) Maintenance

There are two different maintenance systems in W. Tuban: the modern system which is entirely the responsibility of the irrigation department, and a traditional system in which there are no branch or secondary canals. Nevertheless, although there are two different systems, the irrigation department does maintain all main channels and *uqmas* which irrigate "large" areas, especially the modern network. However, the level of maintenance is generally inadequate.

In the traditional maintenance system the beneficiary pays the maintenance cost (50% by the land owner and 50% by the share cropper). The channel master (locally called Sheikh AlUbr) determines the cost per unit area and collects the shares. Each farmer is obliged to clean/weed the sides and bottom of the channel. These works are repeated annually.

If the channel requires, at the head works, repairs which cannot be paid for by the benefactors, then the channel master pays a small fee to get a team consisting of an agriculture extensionist, two persons (one selected by the farmers and one selected by the land owners) to visit the site and assess the damage. If the committee decides that the farmers need assistance to repair the damage, then they indicate so in their report which they sign together with the channel master. Repairs are then paid from the fund whose revenues come from irrigation fees and fines. The cost of repair is then recovered from the farmers, proportional to the areas served by the channel. This procedure remained in effect until the early 70's. Then, the agriculture cooperatives, together with the extensionists were delegated the responsibility of inspecting the damages and deciding what needs to be done through the agriculture equipment rental stations. The costs were then deducted from the farmers after harvest.

In the mid 90's, the governor of Lahej issued a decree (No. 14/91) regulating the irrigation process in the governorate. Based on that decree, the irrigation department in the governorate began to collect irrigation fees (100 YR/Feddan irrigated from flood, and 500 YR/Feddan irrigated from baseflow).

Indeed, fees were collected for 1996 and were split 75% to the irrigation department to cover the maintenance costs and to pay staff incentives, and 25% to the public treasury. However, the collection process ceased because of conflict with the Ministry of Finance which demanded that all the revenues be deposited in public treasury. The staff at the irrigation department believe that this opinion of the Ministry of Finance contradicts customary practices.

For this reason, and because the irrigation department can no longer carryout all the maintenance works, the benefactors had to carryout these works for them selves (as they indicated during the interviews). The maintenance works are carried out in two stages. Stage 1 involves manual works like channel clearance and it commences after the season. The second stage involves works which require mechanical equipment. It commence in February to prepare for the incoming floods of May.

In some areas the maintenance works of the channels and preparations for flood inflows are carried out manually or using animal power (cows). In other areas the equipment are rented either from the irrigation department (for fuel and driver's wages) or from the private sector (a D6 bulldozer costs 1,500 YR/hr, and a D5 costs 1,200 YR/hr).

Interviews with the farmers indicated that some kind of cooperation exists between them. They join resources to work together in their lands. In other cases they may split the rental cost of the equipment. Interviewed farmers indicated that machines have taken over most of the works and that each farmers pays proportional to his area.

### 3.3) Level of Equity

After independence from the British role large areas of agricultural, about twice the original area, were reclaimed.

There are the lands which were surveyed and leveled by the Yemeni-Soviet projects and which were distributed to the benefactors in accordance with the agriculture reform law, in addition to lands confiscated after independence.

An Agriculture Law and an Agriculture Court were established in 1950. In 1970, the law was modified and the court canceled and new bylaws were issued. The main modification in the law was the simplification of its provisions to enable the so called "people's committees" and irrigation department to implement it. Hence, the penalties for violators of the law remained as they were without change, and the revenues from irrigation fees were not considered a "public" revenue that should go to public treasury.

After reunification in 1990, many of the landowners demanded that their nationalized lands be returned. The government couldn't solve this problem, especially that of the benefactors who will become land-less as well as the benefactors of the State's reclaimed lands. Several problems appeared in the wadi, which resulted in deterioration of adherence to the irrigation system, particularly that there is no irrigation law. These issues become evident from the interviews with the farmers who indicated that the current irrigation system is not equitable and should be changed, for the following reasons:

- 1) The farmers do not receive water when it is their turn. The majority of the farmers indicated that they used to get their water shares in the past, but not now. They pointed out that farmers in the upstream region irrigate their lands twice or even more in each season while lands in the middle and lower regions are suffering from drought. For instance, there are lands in Falij, Mujahed, Feyoush, etc. which haven't received water for many years.
- 2) Many farmers, do not observe the rule not to repeat irrigation during the season.
- 3) Violations by the influential people who break the uqmas and divert water to irrigate their lands by force.
- 4) Limited financial resources allocated by the government for maintenance.
- 5) That the problem of the compensating the benefactors (to return the nationalized land to the owners) has not been solved (in general).

#### 4) Farmers Attitude Towards Contributing to the O&M Cost

The guide for interviews contained questions which aimed to assess farmers' willingness to contribute/ share to the cost of O&M. The main findings are:

- a) On the type of works which the beneficiaries could do: with respect to the main structures, some 70% of the interviewed farmers said that they cannot maintain these structures because these structures are far away from their villages. About 28% of the farmers believe that these works should be kept with government authorities so as to avoid conflicts which would arise among the farmers themselves. The majority of the farmers indicated that they are currently responsible for the O&M of the irrigation canals and the diversion works which divert water to the fields directly.

As for the maintenance, all the interviewed farmers indicated that they lack the required skills for this work. However, a large percentage of them (42%) expressed willingness to clean the branch canals (which feed their fields) and 56% were willing to weed by themselves. It should be noted that these works (cleaning and weeding) are presently being carried out by the farmers, anyway.

- Willingness to contribute to the wages of the O&M laborer: 70% of the interviewed farmers expressed willingness to contribute to these wages, as per their respective "financial capabilities" in proportion to their irrigated areas and provided that they get their share of water. Some 30% were not willing to make such contribution.
- Willingness to contribute to the O&M cost: 76% were willing to contribute, provided that they get the water and according to their financial capabilities. But 24% were not willing.
- Willingness to share responsibility for management of the spate irrigation works: almost all of the interviewed benefactors refused this idea and insisted that the operation and supervision of their systems should remain with the government. The farmers also emphasized the important role of the enforcement authorities in reinforcing the irrigation department. This refusal stems from farmers concern that the influence of the large landowners might increase and that they may take more of the water. This remark is the bottom line in the living experience of the benefactors nowadays.

The above response clearly indicates that the benefactors are willing to contribute and cooperate provided that equity in water allocation is restored and the law (customs) are implemented and violators are punished, and the local authorities stop their frequent orders to the irrigation departments to divert water to illegible lands more and above their shares.

About 95% of the interviewed indicated that there is no equity in water allocation. In Wadi Zabid and Rima all of the interviewed farmers indicated that they used to get water before the modern irrigation systems and that these systems have deprived them of water. As for benefactors in Tuban and Abyan (20 interviews) they indicated that the old system was more equitable and should be restored.

## 5) Conclusions and Recommendations

### 5.1) Conclusions

It may be concluded that it is not feasible on the short term to transfer the O&M functions to the farmers whether through WUA's or cooperatives. for the following reasons:

- 1) Deterioration/ collapse of the irrigation networks in the studied wadis and the need to repair, rehabilitate and complete the uncompleted parts in Lahej and Abyan .

In Abyan, for instance, 'the inefficiency of the network (which was severely damaged/ washed away in the 1981/1982 floods) is evidenced by:

- a) The defects in Haija weir (too much sedimentation) which was partly repaired in 1987 (through the Yemeni-Soviet projects) and the need to use earth *uqmas* to divert the water from the main channel to the weir and thence to the main intake.
- b) The gate of the Daeo weir is not functioning and is currently replaced by an earth *uqmas*, which is frequently washed away.
- c) The need to repair the gabion works near Makhzan weir which divert water to the main intake.
- d) The Dehl Ahmed canal (Garaeb weir) which has been washed away and which needs a earth *uqmas*.
- e) Earth *uqmas* are also used in Abr Hussein and Abr Aydarooos (west wadi Hassan). These *uqmas* are frequently washed away and they need to be replaced by permanent structures.

In Wadi Tuban (Lahej), the irrigation system requires about 300 million YR for completion of the network.

- 2) The large volume of maintenance works being carried out by the TDA for wadis Zabid and Rima, as well as the works carried out in Tuban and Abyan. These works require large financial resources and equipment. For instance, maintenance works in W. Abyan require more than 40,000 working hours per year. Because of lack of adequate finances and equipment, the irrigation department carries out only 15,000 hours.
- 3) The inadequacy of the financial resources allocated for O&M. And the decline of these resources compared to the eighties (before the wash away of many weirs). For instance, the allocations for Delta Abyan were about 200,000 Dinars (600,000 US\$) while the allocations for these works in 1998 are 2.7 million YR (20,000 US\$). Meanwhile, the benefactors are no longer paying the 1 Dinar per feddan, the role which some government agencies used to play in promoting some crops (like cotton) is no longer there.
- 4) The weak role of the government and its reliance on the large landowners who are an essential part of the power build up in rural communities. This reflects in their control of the gates and confiscation of most of the water. As well as the failure of the enforcement authorities to adequately respond to such violations.
- 5) The interviews indicated a strong opposition by the small landowners and share croppers to the handing over of the spate systems to any community-based entity. The interviewed farmers believe that the government (irrigation department) should maintain the role of supervising the O&M of these structures as well as the allocation of water according to

customs. The government should also enhance the powers of local authorities to enforce water rights and penalize violators.

- 6) The benefactors generally refuse to make financial contributions under the prevailing situation of lack of equity in water allocation. They expressed willingness to contribute provided that water reaches their lands.
- 7) The lack of legislation for water and irrigation, and hence the lack of adequate punishments to violators of water rights.
- 8) Because of water scarcity, the livelihood of many of land tenants and share croppers in the middle and lower regions of wadis Zabid, Rima and parts of Abyan have changed drastically. Many of them have sought employment in the cities, others have switched to groundwater while still others have become more dependent on the remittances sent to them by relatives working abroad or elsewhere in the country.

## 5.2) Recommendations

- 1- Measures must be taken to undertake repairs and maintenance works for the existing network to make up for the washed away and destroyed components of the systems.
2. An irrigation law must be issued so as to control the process of water exploitation, prevent violations of rights and enforce the penalties/ fines which were in effect in the past in Lahej and Abyan.
3. There is a need to establish an agriculture court and a specialized attorney for agriculture. Interviews indicated that the current general court system cannot undertake its duties in this regard (hence the many violations) and that a specialized law is needed.
4. Return to the old system so that each channel would be on its own, with its land owners is recommended. And adoption of the *Tadameed* system to make the benefactors bear the cost of maintenance of the *uqmas* which are built in the middle of the wadi to divert the water to the canals. This requires knowledge of the total cost of *uqmas* which are rebuilt 2-3 times every year.
5. A water tariff must be enforced in wadis Zabid and Rima to be born by all upstream lands, because of their huge water consumption to grow banana. This requires knowledge of the cost of water per m<sup>3</sup>, seasonal variations in cost (if any), water requirement for each crop, and an analysis to decide whether to base the water cost on the crop or area irrigated.
6. The need to issue a law that regulates the relationship between the land owners and tenants or share croppers.
7. a clear policy should be established to define the value of spate projects in enhancing the country's food security policy. Specifically, what crops do we want to grow? which crops should be allowed to expand? and which ones should be limited?
8. Farmers should be encouraged to organize themselves in agriculture cooperatives. The advantages and disadvantages in the past experiences should be considered. The role of the local development councils should be enhanced and they should be left alone to work without government intervention.
9. Revenues collected as irrigation fees should not be treated as State revenues (which must go to public treasury). Instead they should be left to the agriculture cooperatives or the irrigation department as was the case in the past in Lahej and Abyan.

10. Canceling the 2% "maintenance fee" which is collected with the Zakat (in wadis Zabid and Rima) because this tax has not generated the required revenues (according to w. Zabid project management the maximum collected was 250,000 YR) and also since these revenues never reach the project management anyway (they go to public treasury).
11. The ministry of waqf should be alerted so as to make its contracts of land lease directly to the farmers and to abort the current situation (e.g. in Zabid) in which the land is leased to leading community figures who then lease it to the farmers.
12. The agriculture equipment rental stations in Lahej and Abyan should be re-established and supported with necessary equipment in order to make available equipment at rental rates affordable to the farmers.
13. The supporting role of various government entities (like Abyan authority) which used to provide support to the farmers and purchase the crops (like cotton) should be revived. In this regard it is worth noting that in one year the Delta Abyan Authority provided some 3,000 metres of wood logs to help build/operate the gates and diversion.
14. The wooden gates in Wadi Tuban should be replaced with steel gates to better control the water diversion/ allocation.
15. a detailed study of water rights in the Tihama wadis is needed. Among the issues which are still to be answered is how to allocate water (priorities) among the canals/ individuals of the same group. It is this issue which causes the daily conflicts over water, especially in Wadi Zabid.
16. The principle of priority rights for the upstream land should be reviewed; especially with respect to the baseflow, which is now completely consumed by the upper lands. The principle of continuing the irrigation from the point where irrigation ceased in the last flood (as is the case Abyan and Tuban) should be enforced in Zabid and Rima.



## TERMS OF REFERENCE

### *Preparation of Background Papers for PIM Seminar*

#### **Participatory Irrigation Management in Surface Systems: Selected Studies**

The Aden Agenda has emphasized the promotion of water users associations (WUAs) and their enhanced role in the management of irrigation systems. Indeed, WUAs are already functioning in many parts of the country and are actively managing water distribution and system maintenance functions, in particular in the surface systems. There is also evidence of their contribution to the capital cost of system improvements. Available literature and other papers to be discussed at the PIM seminar would highlight some of the roles and functions of the WUAs. It is, however, necessary to commission specific papers or reports on three selected themes as below.

#### **1. PAPER I: The O&M Function of the Water User Organizations:**

It was observed during field visits by Bank missions that the irrigation department was responsible for water delivery up to the offtake of the branch canal, or sometimes, of the secondary canal. The farmers have assumed water distribution responsibilities beyond that point. The first paper on O&M functions of user organizations referred to above will identify and clarify.

- a) How the responsibility for water distribution among the farmers is carried out in terms of reliability of service and equity. That is, is the distribution largely field-to-field?
- b) Do farmers get water during their assigned turn?
- c) How reliable is this system?
- d) Do tail-enders get water at reliable times?
- e) How have farmers learnt to cope with the lack of reliability and inequity, if any?
- f) Who actually does the distribution --- is a "ditch-rider" hired for this purpose?
- g) How periodic maintenance works in terms of weeding and cleaning is done?
- h) Is this done manually?
- i) Do farmers themselves join together to do the maintenance work?
- j) Who organizes the maintenance work?
- k) Is this done through contract?
- l) Staffing and accounting --- How many staff are hired by the farmers for O&M below the branch/secondary?
- m) How much are they paid?
- n) Who pays them?
- o) How is money collected and accounted for?

The paper could be based on case studies in Tihama, in the south, and in the Highlands that clearly record the current O&M functions and their implementation by the farmer organizations as they exist.

**Annex (B): Interview Guide**

village ..... Weir Name ..... Governorate .....  
 District .....

- Q.1 Area presently irrigated from this canal: .....
- Q.2 Area used to be irrigated from this canal: .....
- Q.3 Who distributes/ allocates the water: .....
- Q.4 principle followed in water allocation: .....  
 Al-A'ala Fa Al-A'ala (priority upper lands)  all get water at the same time  
 Other: .....
- Q.5 Is this system different from the past  yes  No  
 Yes: in what respect .....
- Q.6 What is your sequence in the line of water priority rights: .....
- Q.7 What is required of you to get water  
 pay money  working days  nothing  other: .....
- Q.8 What crops do you cultivate? .....  
 Which crop requires more irrigation water? .....
- Q.9 Which crops do you sell to the market?.....
- Q.10 Is there a limit on the quantity of water you use  
 No  Yes What? .....
- Q.11 are you a  landowner  Sharecropper  tenant
- Q.12 Can you sell your water share  Yes  No
- Q.13 Do all farmers get their water shares  
 Yes  No Why? .....
- Q.14 How do you irrigate your canal: .....
- Q.15 what do you think is the solution: .....
- Q.16 Do you use canal water in your farming: .....  
 Yes  No  
 What other sources do you use: .....  
 What percentage do these represent: .....
- Q.17 Where does the operation of the irrigation structure begin ?  
 Channel (1)  Channel (2)  Channel (3)
- Q.18 Who undertakes the operation works: .....
- Q.19 What operation works can you do yourself? .....
- Q.20 do the operation works need training ?  Yes  No  
 What kind of training? .....
- Q.21 do the operation works require full time staff

Yes  No

Q.22 How many people do you think are needed to do the operation activities? .....

Q.23 How will they be paid? .....

Q.24 Are you willing to pay their wages ?  Yes  No

Q.25 Did the "Authority" train the benefactor on operation ?  
 Yes  No

Q.26 When do you do maintenance works" .....

Is that sufficient/adequate ?

Q.27 Who does the maintenance nowadays?

Q.28 Where do the maintenance works begin?

Q.29 What are the maintenance works which you can do on your own?

Q.30 What are the equipment needed for maintenance?  
Are these available  Yes  No

Q.31 Are you ready to contribute to the cost of O&M  Yes  No

Q.32 Are you going to cooperate to do the maintenance works?  
 Yes  No

Q.33 Have you done that (cooperated) before?  Yes  No

Q.34 What are the sites (in the system) which need more labor force  
 channel intakes  branch canals  downstream

**Annex (c)**    The irrigation system in Abyan  
Duties the Chief of the Irrigation Department, procedures to mobilize the work force  
Duties of the division head

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