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Introduction

The Water and Environment Centre is currently engaged in a study within the scope of an ongoing preparation for a long-term Sana'a Basin Water Resources Management Project.

The Terms of Reference lists the following objectives for the study:

- *To develop a clear picture of the current water resources, agriculture, social, institutional, environmental and economic situation in the entire Sana'a Basin.*
- *To define the scope of a medium term program (15 years) aiming at improving water resources management and use, and to highlight the main challenges and constraints facing the program.*
- *To identify the data and information gaps and prepare a water resources monitoring strategy for the entire basin*
- *To identify, on the basis of this assessment and appropriate criteria, a set of three pilot sub-basins for the implementation of Phase I of the IDA program.*

With respect to the socio-economic aspects of the study, two main activities have been defined:

- *Using the homogeneous sub-basins a Rapid Rural Appraisal(RRA) will be carried out with the goal of developing a clearer picture on basin physiography, water resources, agriculture, social, environmental and economic characteristics.*
- *Conducting stakeholder and user meetings to explain the objectives of the project preparation studies and to seek input and encourage early cooperation/coordination with the local stakeholders. A total number of 10 meetings are envisaged. Per meeting around 30-50 persons (local stakeholders) are expected to attend.*

The aim of this report is to give a comprehensive account of the socio-economic aspects of water resources management in the basin, based on data/information collected within the course of the present study as well as relevant information available from previous studies. The report is prepared in three different parts. Part I gives an overview of the general information on the Basin that is expected to help orient the reader through the remaining parts of the report. This is followed by a

second part which presents the main findings from the structured meetings that took place during the RRA survey. The last part describes in a summary form the major issues raised in the group meetings, both at the village level and the district level. More detailed information on these issues can be found in the attached annexes. It is to be remembered in particular that the stakeholders meetings were held in Arabic. Hence while the main results of these meetings are summarized in part III, the readers who are able to read arabic may want to refer to the relevant annex for more details.

Part One: General Background

1. *The Socio-Economic System in the Basin*

1.1 Administrative and social structure

The Sana'a Basin is one of the heavily populated areas in Yemen as it incorporates the national capital as well as a number of rapidly growing districts around this major urban centre. It extends across the central part of the Sana'a Governorate and covers about 24% (3250 km²) of its total area of the Governorate (13700 km²). It includes parts or all of twelve administrative districts (figure 1.1A). The local population of three of these districts (*Kharif, Raydah, and 'Iyal Surayh*) live outside the Basin. Therefore these districts have been excluded from the socio-economic survey. Major population centers in the other nine districts (*Bani Hushaysh, Bani Al Harith, Khawlan, Bani Matar, Arhab, Hamdan, Nihm, Sanhan-Bani Bahlul, and Al Amana* (Sana'a urban area), are shown in figure 1.1B).

In addition to the administrative division, there exists a tribal divisions, which coincides with the administrative divisions. For example the district of Bani Al-Harith is a distinct 'tribal zone' that have the same geographical boundaries to that of the district which carries the same name. It thus can be concluded that the administrative system was established as to coincide with the earlier tribal divisions to ensure homogeneity and avoid intertribal conflicts. Although not apparent at present, Sana'a city was too subdivided into several parts, with each part belonging to the tribe closest to it.

The local population belongs to the biggest two tribes in Yemen: *Hashed* and *Bakeel*. According to the information obtained from the elderly citizens in the region, two of the nine districts are populated by *Hashed* (*Sanhan-Bani Bahloul* and *Hamdan*) while the remaining seven are all *Bakeel* (see figure 1.1B).

1.2 Urban-rural interaction

The socio-economic conditions across the Sana'a Basin has changed considerably in recent years. The rapid growth of the urban population in the national capital city (Sana'a) has resulted in this change. The expansion of the urban center into the rural areas as well as the modernization of life style and improvement of infrastructure have increased the interaction between the city and its surroundings. Hence, the socio-economic conditions prevailing in the city are significantly different from those affecting the lives of the rural population in remote areas.

In the vicinity of the city or at relatively distant but accessible areas, it is likely that some of the issues that are of relevance to both the urban and rural areas would prevail. This is mainly due to the interaction between the urban and rural areas (physical, socio-economic, and institutional). Because of the complexity and the dynamic nature of these interactions, many of the issues related to these processes cannot be singled out. Nevertheless, some of the most important water resources issues related to such interactions can be illustrated by the following examples:

- Physical processes may extend beyond the administrative (city) boundaries (*physical interaction*):

Example 1: Groundwater pollution (both industrial and domestic).

Example 2: Groundwater abstraction in rural areas for urban uses.

- The rural populations are often not aware that the city is indirectly supporting their economy in more than one way (*socio-economic interaction*):

Example 1: Irrigated agricultural products are sold in the city, hence the city people not only contribute directly to rural economy but also pay indirectly for the consumed water.

Example 2: Expansion of the city creates more jobs in construction, factories, etc. and a significant portion of the income of migrating villagers goes for investment into their regions.

- Without mutual understanding and cooperation between the urban and rural populations for law enforcement, many policies and institutional arrangements for development would become ineffective (*institutional arrangement*):

Example: agricultural credit banks will not get any loans (hence cannot exist) if their policy is not useful to farmers.

Figure 1.1A: Main local districts within the Basin.

Figure 1.1B: Major population centers (>500 persons) across the main district and tribal boundaries.

2. *Water and Land Use Features*

2.1 Water use zones

The rate at which the city of Sana'a is expanding into the neighboring rural areas and the direction of this expansion suggest the development of an urban-rural zone (UR) as a marginal zone between the urban (U) and rural (R) areas. Drawing boundaries between the three zones (figure 2.1) was based on two main hypotheses:

1. It is likely that the recently observed high growth rate in the urban zone is being gradually offset by a corresponding rise in the population of surrounding rural areas. Among the main factors contributing to this would be the expanding facilities in the city outskirts induced by the growing complexity of roads network and heavy traffics, increasing number of city dwellers, etc. due to Government centralization as well as innovation of job opportunities.
2. With the current expansion, the neighboring rural areas are gradually shifting to 'more-water – demanding' domestic life styles which, in turn, would necessitate higher per capita consumption.

The current population in each of these zones (at the district level) and the expected increase over the next 25 years has been estimated displayed (see also Volumes I and II for more details) and the results are displayed in table 2.1. The following observations can be made:

1. The present rural population in the Basin (347,465) represents only about 20% of the total population in the Basin, with the remaining 80% living within the current administrative boundary of the city.
2. 54% of this population live in the rural areas surrounding the city (UR zone), which comprise three districts: Sanhan (16.8%), Bani Al-Harith (17.8%), and Bani Hushaysh (19.7); the remaining 46% are scattered across zone R in the following proportions: Hamdan (15.7), Bani Matar (11.4%), Bani Bahloul (4.9%), Arhab (9.0%), and Khawlan (5.0).

It is to be remembered also that information from the last census indicates that only the first three districts are entirely within the Basin.

Table 2.1: Projection of the population in Sana'a Basin (by water-use zone and district), based on 1994 Census.

Zone	Urban	Urban - Rural			Rural						Total
District	Sana'a	Bany Al Hareth	Bany Hushaish	Sanhan	Hamdan	Bany Matar	Bany Bahlowl	Arhab	Khawlan	Nehm	
Percent	5.6 %	3.5 %	3.0 %	3.5 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %	2.0 %	
2000	1,323,536	60,454	64,927	57,182	53,396	38,706	16,308	30,476	16,559	9,456	1,671,001
2005	1,738,022	71,800	75,268	67,915	58,954	42,735	18,005	33,648	18,282	10,441	2,135,070
2010	2,282,312	85,276	87,256	80,662	65,090	47,183	19,879	37,150	20,185	11,527	2,736,519
2015	2,997,054	101,281	101,154	95,801	71,865	52,094	21,948	41,016	22,286	12,727	3,517,225
2020	3,935,629	120,290	117,265	113,781	79,344	57,515	24,233	45,285	24,606	14,052	4,532,000
2025	5,168,134	142,867	137,265	135,136	87,603	63,502	26,755	49,998	27,167	15,514	5,853,940

Figure 2.1: Water-Use Zones

2.2 Agricultural regions

The success of any community-based program, as an effective measure for water resources management in the Basin, would depend mainly on the extent of cooperation, coordination, and communication among all concerned parties. The complexity of the socio-economic system in the Sana'a Basin and the diversity of the various groups with different, and most likely conflicting interests in the limited available water resources, calls for a careful approach in dealing with socio-economic issues. Two other important factors have to be considered: (1) the residency of some of the most powerful tribes in the rural areas (see section 1.1) and (2) the proximity of these tribal zones to the nation's decision-making center (Sana'a city) which gives additional power and authority to tribal leaders.

As stated above, the relationship between the urban centre (Sana'a city) and the rural areas across the Basin is based on physical, socio-economical, and institutional interactions. The driving mechanism for these interactions is primarily the *availability of land as well as a dependable source of adequate water resources (in terms of quantity and quality) to irrigate this land*. Hence, irrigated agriculture is the main activity in the Basin. This activity seems to be growing at a very rapid rate.

On the basis of mesoclimatic conditions prevailing in the region (due to altitude, topography, and rainfall distribution), the Sana'a Basin has been divided by Mosgiprovodkhoz (1986) into six natural agricultural regions. Furthermore and based on recent land-use survey (ITC-WEC, 2001), 16 different regions have been identified that are proposed in this study to serve as water management zones (figure 2.2A). Comparison of results summarized from previous studies shows that there has been a substantial expansion in agriculture between 1985 and 2000 (see Volume III-3: Agro-ecology). This expansion has taken place mostly in the relatively flat areas mainly below 2400 m.a.s.l. (figure 2.2B) where both cultivable land and groundwater are available (see Volume I and II). In this study, therefore, two basic criteria were adopted:

- (i) Water – use zones, major district zones, and agricultural regions as defined above have to be covered in the survey.
- (ii) There will be more concentration on the lowlands and wadi areas such that approximately 70% of the villages visited should be, preferably and where feasible, within these heavily cultivated areas while the remaining 30% can be in the hilly and mountaneous plateau zones.

Figure 2.2A: Natural agricultural zones and proposed water management zones (after Mosgiporovodkhoz, 1986 and ITC-WEC, 2001)

Figure 2.2B: Aquifer distribution across the basin showing major abstraction areas in 1994 based on SAWA well inventory.

2.3 Current land - use issues

With the exception of the outskirts of Sana'a city, where land is undergoing a change from agriculture into urban uses (Urban-Rural zone), the majority of the surveyed areas lie in the rural zone where agriculture is still the main practice. It has been estimated that the total arable land within the Basin is about 1065 km² (Mosgiprovodkhoz, 1986). Distribution of the arable land and cultivated areas over the entire Basin is illustrated in figure 2.3 (A and B) where it can be seen that most of the recent agricultural development has taken place in the lowlands and downstream areas of major wadis, below about 2400 m.a.s.l.

As for the availability of water resources in the Sana'a basin, comparison of figure 2.3B with figure 2.2B above shows that most of the irrigation water is being withdrawn from the sandstone and/or alluvium areas with high permeability (see also Volume II for more details). Thus it is apparent that groundwater is the main water source that is expected to satisfy both the agricultural (in the rural zones) and the public water supply demand (mainly the urban zone at the present). Table 2.1 shows the distribution of land use on the basis of the irrigation water source in each of the 16 water management zones within the Basin.

Figure 2.3A: Arable land distribution in the Basin as delineated in 1984 by Mosgoprovodkhoz, 1986.

Figure 2.3B: Current land-use map showing expansion of groundwater-irrigated areas as represented mainly by cash crops. Shown also are areas where traditional rainfed agriculture is still practised.

Table 2.3: Distribution of irrigated areas across the Basin during 2000 (source: ITC-WEC 2001).

	<i>Subcatchment</i>	<i>Total area (ha)</i>	<i>Irrigated area (ha)</i>	<i>Qat</i>	<i>Grapes</i>	<i>Mixed cereals& others</i>	<i>Fruit trees</i>
1.	Alluvium-North	30546	5561	2300	2531	720	10
2.	Alluvium-South	17546	1081	556	240	230	55
3.	Bawsan Al Madani	24185	663	198	409	56	0
4.	Barwean Al Ghayl	40565	3181	1555	939	642	45
5.	Dula' Hamdan Bani Hawat	6221	774	495	86	157	36
6.	W. Al Furs Rijam	5121	1198	659	478	59	2
7.	W. Al Kharid	17913	659	83	568	8	0
8.	W. Qatab Al Ma'adi	11156	187	30	156	1	0
9.	W. As Sir	22703	3461	1566	1769	122	4
10.	W. Ghaber Al I'shash	7260	314	134	52	83	45
11.	W. Hard Al Ghayl Zahr	36638	2387	1191	338	732	126
12.	W. Hizyaz Ghayman	36127	893	323	276	251	43
13.	W. Lafaf Asir	20963	1107	441	563	102	1
14.	W. Sa'wan ar Rawnah	8966	870	453	250	154	13
15.	W. Shahik Al Ajbar Sha'b	21787	650	251	167	192	40
16.	W. Thumah Al Mahajir Shira	8110	391	64	311	16	0
Total		315807	23377	10299	9133	3525	420

3. *General Methodology and Sample Size*

Given the time and budget allocated to this study, it should be realized that a Rapid Rural Appraisal (RRA) survey of a rather limited scope such as the one carried out in the study could not produce results that would be adequate for a detailed characterization of the entire Basin. This was clearly indicated in our first comments on the TOR and later reflected in the proposal. With this limitation, a special attention has been paid to the methodology adopted so as to come up with the best outcome possible. The fieldwork survey of the RRA consisted of three main parts:

- (i) Individual-level structured meetings (interviews with farmers, both owners and non-owners)
- (ii) Village-level semi-structured meetings (group meetings in selected villages using the same questionnaires as in the structured interviews)
- (iii) District-level unstructured meetings (stakeholder meetings with representatives from the nine districts inhabited by the majority of the population).

The program originally proposed for the structured meetings consisted of the following:

<i>Target group:</i>	<i>farmers</i>
<i>Sample size:</i>	<i>60-100</i>
<i>Max. sub-basins to be visited:</i>	<i>10</i>
<i>No. of individual interviews per sub-basin:</i>	<i>6-10</i>
<i>Field teams:</i>	<i>3 of persons each</i>
<i>Duration of field visits:</i>	<i>ne week</i>
<i>Duration of whole program:</i>	<i>four weeks</i>

For the benefit of the study, however, the number of interviews with individual farmers was extended to 174 interviews (136 well owners, and 38 non-owners, or water buyers), which is significantly more than what has been originally proposed. The reason for the higher number of well owners is justified by the fact that we consider them to be the main *decision makers* regarding the use of groundwater. The sample was as much as possible randomly selected. In addition to the structured interviews, a total of 39 village-level semi-structured meetings were held (20 meetings with male groups + 19 meetings with female groups) where issues of a more general nature were raised and discussed. Furthermore, four meetings with key stakeholders (traditional leaders, agricultural association representatives, and governmental officials) were held at the Headquarters of the National Water Resources Authority (NWRA). With the exception of the governmental officials, other participants

were selected as to represent a socially and administratively homogeneous region or tribe, for each of the meetings.

The RRA structured survey covered 40 villages in nine districts: *Bani Hushaysh, Sanhan, Bani Bahloul, Khawlan, Bani Matar, Hamdan, Bani Al-Harith, Arhab, and Nihm*. Each of these districts was studied separately using two (parallel) structured interview methods. First, interviews were conducted with about 174 farmers, namely 136 well owners and 38 non-well owners farmers, they were randomly selected according to the size of the population of the nine districts, its altitude / topographic location and its reliance on different sources of irrigation water.

Second, village-level informal (semi-structured) meetings and discussions were held with male groups in 20 villages selected randomly. In addition, separate meetings (also semi-structured) were held with female groups from 19 villages selected in a similar manner. These were conducted by 3 assistants female interviewers of the team work for the purpose of exploring more specific 'gender-related' subjects, particularly water supply and environmental issues.

Finally, stakeholders meetings were held with representatives that included some of the identified informant farmers from the structured meetings as well as traditional leaders and village local council members. The main aim was to discuss the preliminary results and findings from the field surveys, the Project's objectives, justifications for undertaking improvements in water-use and demand management issues, ..etc., as well as to assess their willingness to participate and be committed in implementing the project activities. All collected data were entered and processed by computers and analyzed in accordance with the objectives specified. Detailed statistics relevant to all issues raised with the informant individuals/groups are given in the attached annexes.

Part Two: The RRA (Individual-Level) Survey

1. The RRA Methodology

1.1 Design of questionnaires

After a careful review of the study objectives, project goals, stages, and the expected outputs/results as well as discussions with the WB experts/missions, an appropriate survey guidelines/questionnaires were designed. Two types of questionnaires were developed for the purpose of structured interviews:

Questionnaire A: Well owners

Questionnaire B: Non-owners, i.e. water buyers

The questionnaires contained a number of questions and phrases that reflected fundamental issues and indicators which identify and assess the current conditions and the targeted groups regarding groundwater use, supply, irrigation methods, crop production practices, farm developments, and groundwater depletion in the main sub-basin/districts of the Sana'a Basin. The socio-economic data were collected, recorded, and authenticated with the goal of developing a clear picture on Basin physiography, water resources use and management, agriculture, social, environmental, and economic factors / characteristics.

The survey process was based essentially on personal interviews that were conducted by the work team who participated in the survey process. In this regard, the consultant benefited from similar questionnaires that were used in previous similar surveys, including those used by Al-Hamdi, 2000) for the project area. The survey questionnaires were formulated in such a manner that is appropriate with the socio-economic peculiarities to acquire the necessary data from this survey. In general, the survey questionnaires included a number of major divisions / aspects, whereby the indicators / variables thereof were measured by a number of questions. These questionnaires were prepared in Arabic (see Appendix 1) on the basis of the questions list prepared in advance. Individual meetings were held on farms with well owners as well as non-owners (water buyers).

1.2 Identification of main issues

For achieving the overall purpose of the study, it is essential to identify the main issues relevant to each of the objectives. These issues can be grouped into four different categories as shown in table 4.1:

Table 4.1: Details of main issues

<i>Main Issue</i>	<i>Details</i>
1. Water Resources	General shortage of water. Salinity increase. Pollution (industrial and domestic).
2. Water Use	Increase of demand over supply. Prioritization of uses. Public utility reform. Efficiency and reduction of losses. Sanitation.
3. socio-economic	Communal structure. Intra-community organization. Intra-zonal communication. Income level and sources.
4. Management and Policy Making	Enhancing recharge through appropriate structures. Water ownership and water rights. Monitoring the available resources. Monitoring and regulating abstraction. Levying tariffs for different uses. Applying tariffs for effluent discharges. Community participation. Exploring for new water sources. Intra-zonal water transfers.

Based on these main issues, a question list has been prepared. The complete list of questions is given in Appendix A.

1.3 Sampling process and sample size

A total of 40 villages have been covered by structured meetings using either type A Questionnaire and/or type B. The number of interviews corresponding to each of the two types of questionnaires is given in table 4.2. Figure 4.1(A and B) shows the locations of the relevant villages where the meetings were held.

Figure 4.1 A: Location of villages where (structured) individual meetings were held.

Figure 4.1 B: Location of villages where (semi-structured) group meetings were held.

Table 4.2 Summary of field visits and corresponding questionnaires for the structured meetings.

<i>Districts</i>	<i>Well owners (Questionnaire A)</i>		<i>Non-owners (Questionnaire B)</i>	
	<i>No. of villages</i>	<i>No. of interviewees</i>	<i>No. of villages</i>	<i>No. of interviewees</i>
Bani Hushaysh	8	39	3	5
Sanhan	5	20	3	4
Bani Bahloul	2	9	2	2
Khawlan	2	9	2	3
Bani Matar	2	7	2	4
Hamdan	5	18	4	6
Bani Al-Harith	4	12	1	4
Arhab	3	13	3	7
Nihm	3	9	2	3
Total	34	136	21	38

As indicated above, the program has been expanded significantly. The following considerations were taken into account:

- Farm size: Given the expected correlation between farm size and water use for irrigation, it is suggested that a larger percentage of the sample (around 70%) be devoted to large farmers. Large farmers are to be identified by the size of cultivated land (> 3ha).
- Access to a water source: It is believed that reliability of the access to the irrigation water source should be reflected in the sample. Therefore, it is suggested that the sample should consist mostly (around 80%) of well owners (main decision-makers on water use). This means that the remaining 20% of the sample will be farmers relying exclusively on purchased water for irrigation.
- Cropping pattern: The sample should reflect as much as possible the cropping pattern of the sub-basin on hand. Nevertheless greater emphasis should be put on farmers growing cash crops with the highest potential for future expansion (Qat mainly).

The survey sample consisted of 174 farmers (136 well owners and 38 non-owners) selected on the basis of a number of considerations as described above. To ensure a reasonable representation of the local populations by the selected sample and sample size, the survey team utilized a simple random sampling and categorization approaches/methods in sample selection.

2. *Data Collection and Analysis*

2.1 Interviewing and data collection processes

Within the time schedule and work program allowed for the survey, the socio-economic team visited the project area to conduct the task of data collection, filling questionnaire forms and conducting personal interviews and group meetings. The work team included 13 persons distributed into three groups. Each group consisted of a supervisor and 2-3 enumerators. The task was carried out under direct supervision of the the senior socio-economic consultant. In all interviews, intimate atmosphere was developed, whereby assurances were emphasized to all farmers.

At the beginning, the team members explained the objectives of the survey process and the significance thereof to the farmers and the project area. Furthermore, the Consultant supervised the process of revising and editing of the completed questionnaires, wherein adequate corrections and completion of missing information conversion of units and recording of observations and remarks were done. The process lasted for approximately 12 days/two shifts a day covering the nine districts. Most sample respondents cooperated closely with the team. They were plain, clear, and interactive in their responses with respect to all questions placed. A record of all names of the selected villages in each district has been maintained, which may be used as a 'reference' for any further survey during the life of the project or upon termination thereof. This record is deemed an integral part of this report for authentication.

2.2 Sample distribution

In accordance with the selected criteria (see section 1.3 above) and for the purpose of evaluating how representative is the survey sample, it was analysed statistically in terms of its distribution across districts and topographic zones. The results are displayed in tables 5.1 and 5.2 where it can be seen that:

- The selected respondents are proportionally distributed in nine districts as follows:

Bani Hushaysh: 25.3%; Sanhan: 13.8%; Hamdan: 13.8%; Arhab: 11.5%;
Bani Al-Harith: 9.2%; Khawlan: 6.9%; Nihm: 6.9%; Bani Bahloul: 6.3%;
and Bani Matar 6.3%.

- With respect to the distribution across the topographic zones, the results are as follows:
 - 33.3% of the sample is from mountains / foothill areas,
 - 50.0 % in major wadi areas, and
 - 16.7 % from plain areas (lowlands + peneplains).

From the above, it can be seen that about half the individuals interviewed are from the urban-rural water-use zones (Bani Hushaysh, Sanhan, and Bani Al-Harith). This means that the districts that are likely to be affected by future city expansion are better covered than others. The topographically-low areas (major wadis and central plain areas) that may undergo similar changes are also represented by two thirds of the samples as displayed in table 5.2. Figure 1.1B above shows that a relatively heavy concentration of sampling points in the Bani Hushaysh and Sanhan districts. This can be justified by the fact that these two areas represent major abstraction and recharge zones, respectively (see Volume D).

Table No. (5.1) Distribution of the respondents according to districts.

<i>Districts</i>	<i>Well owners</i>	<i>Non-owners</i>	<i>Sample size</i>	<i>Percentage of the total</i>
Bani Hushaysh	39	5	44	25.3
Sanhan	20	4	24	13.8
Bani Bahloul	9	2	11	6.3
Khawlan	9	3	12	6.9
Bani Matar	7	4	11	6.3
Hamdan	18	6	24	13.8
Bani Al-Harith	12	4	16	9.2
Arhab	13	7	20	11.5
Nihm	9	3	12	6.9
Total	136	38	174	100.0
%	78.2	21.8		100.0

Table No. (5.2): Distribution of the respondents according to topographic zones.

<i>Sana'a districts/ sub-basins</i>	<i>Mountains & Foothills</i>		<i>Major wadi areas</i>		<i>Plain areas</i>	
	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>	<i>No.</i>	<i>%</i>
Bani Husheish	11	25.0	24	54.5	9	20.5
Sanhan	10	41.6	11	45.8	3	12.4
Bani Bahloul	8	72.7	2	18.2	1	9.1
Kholan	10	83.4	1	8.3	1	8.3
Bani Matar	4	36.4	3	27.2	4	36.4
Hamdan	5	20.8	3	12.5	16	66.7
Bani Al hareth	1	6.2	2	12.5	13	81.3
Arhab	1	5.0	7	35.0	12	60.0
Nehem	4	33.3	6	50.0	2	16.7
Total	54	31.0	59	33.9	61	35.1

2.3 Presentation of main results

Results of statistical analyses of all issues raised in the questionnaires are given in Appendix 3. They are tabulated on issue-basis with both the number of respondents and corresponding percentages. The main findings on major issues are briefly described below.

2.4 Summary of results

Well Depth: The survey results revealed that the average depth of the respondents' wells was 182.8 m and ranged from 24 m to more than 250 m. However, significant depth variations were found within each of the nine districts. The table below shows the significant variation across the districts as well.

Well depth distribution (averages in meter)

<i>Bani Hushaysh</i>	<i>Sanhan</i>	<i>Bani Bahloul</i>	<i>Khawlan</i>	<i>Bani Matar</i>	<i>Hamdan</i>	<i>Bani Al-Harth</i>	<i>Arhab</i>	<i>Nihm</i>	<i>All Districts</i>
258	181	125	24	160	169	142	259	55	183

Groundwater Drawdown m/yr: The survey results revealed that the yearly average of the water drawdown in the villages/districts of Sana'a Basin included in the survey was 2.3 m, and ranged between 0.36 to 4.47 m as shown below.

Groundwater Drawdown m/yr

<i>Bani Hushaysh</i>	<i>Sanhan</i>	<i>Bani Bahloul</i>	<i>Khawlan</i>	<i>Bani Matar</i>	<i>Hamdan</i>	<i>Bani Al-Harth</i>	<i>Arhab</i>	<i>Nihm</i>	<i>All Districts</i>
3	4.09	0.6	0.36	0.65	0.9	1.75	4.47	0.39	2.3

Daily Operation Hours of Wells: The average number of daily hours reported was 10.4 hours per day/well and ranged between 2.9 to 17.9 hours across the districts.

<i>Bani Hushaysh</i>	<i>Sanhan</i>	<i>Bani Bahloul</i>	<i>Khawlan</i>	<i>Bani Matar</i>	<i>Hamdan</i>	<i>Bani Al-Harth</i>	<i>Arhab</i>	<i>Nihm</i>	<i>All Districts</i>
12.2	9.8	4.6	2.9	11.4	15.2	17.9	13.2	8.6	10.4

Changes the Groundwater Quality: The majority of the respondents (78%) indicated that there is no change in groundwater quality while the remaining (18%) indicated that they have observed some changes in the quality of the groundwater in their wells.

	<i>Bani Hushaysh</i>	<i>Sanhan</i>	<i>Bani Bahloul</i>	<i>Khawlan</i>	<i>Bani Matar</i>	<i>Hamdan</i>	<i>Bani Al-Harth</i>	<i>Arhab</i>	<i>Nihm</i>	<i>All Districts</i>
Change %	64	90	100	100	100	88	78	85	56	78
No Change %	36	10	0	0	0	12	25	15	44	12

Irrigation Water Application: The survey results show that the water application for Qat ranges from 0.1 to 2.9 m / y with an average of around 0.77m in six of districts growing Qat.

Districts-wise, the survey results also show that the average water application for Qat in each district are around 0.8m and 0.9m per year in Arhab and Nihm respectively, both averages are above the overall average mentioned above. Regarding the grape irrigation, the survey results also show that the water application for grapes ranges from 0.1 to 3.6 m/ year and averages around 0.8 m/y for grape growers in six of the surveyed districts, mainly Bani Hushiesh, Bani Bahloul, Khawlan, Hamdan, Bani AL-Harth, and Arhab.

The survey results also show that the averages and ranges of the water application average for cereals is 0.49m/y and it ranges from 0.02 to 2.2 m/y in six districts.

The Prevailing Irrigation Practices / Methods: Water Conveyance Methods .

The distribution of respondents regarding the irrigation water convey methods to the farm land show that the sample respondents indicated that they convey irrigation water through open unlined 12.3%, earth canals 49.2%, iron pipes 21.4%, plastic pipes and hose pipes 17.1%, respectively.

It is quite evident that the galvanized / iron pipes are the most common water conveyance method used in the mountaneous district regions.

	<i>Bani Hushaysh</i>	<i>Sanhan</i>	<i>Bani Bahloul</i>	<i>Khawlan</i>	<i>Bani Matar</i>	<i>Hamdan</i>	<i>Bani Al-Harth</i>	<i>Arhab</i>	<i>Nihm</i>	<i>All Districts</i>
Earth Canals	4	6	7	27	55	28	8	4	22	14.15
Galvanized	63	52	36	64	45	36	46	52	22	46.70
Plastic Pipes	23	18	21	9	0	20	38	22	33	21.70
Hose Pipes	11	24	36	0	0	16	8	22	22	17.45

(all values in %)

Knowledge of other irrigation methods/means that can save water and related issues: In general, 78% of the respondents reported knowing other irrigation methods that can save water, while 22% of the respondents stated that they do not know other methods.

Survey Data show that 84% of those who know indicated sprinkler and drip irrigation methods. Furthermore, 98% of the respondents in all districts indicated that they did not use or adopt any of those methods.

Part Three: Village-Level Survey

1. *Basic Infrastructure and Services*

Schools: The survey results revealed that there are 25 schools (10 basic and 14 basic + secondary) s with a total of 181 class rooms, 274 teachers and 8750 male and female students in the respondents' villages–districts. Furthermore, the ratios of male/female students attendance were 76% to 24% in the villages included in the survey. It was observed during the field interviews / visits that most of the basic schools exist mostly far away from students' villages and were poorly maintained. Combined schools (basic / secondary) were used for two shifts.

Drinking Water Sources: 42% of the respondents reported that the drinking sources in their villages are from public project, 21% of the respondents reported that the drinking source in their villages are from private project. 21% of the respondents reported that the drinking source in their villages are from tankers, other, and 16% of the respondents reported that the drinking source in their villages are from other sources.

Sanitation: 68% of the respondents had septic tanks, whereas 26% of the respondents had soak/away.

Electricity: The survey results revealed that 79% of the respondents connected to Public network, while the rest (21%) of the respondents connected to Private Generators.

Hospitals/Health Centers and Distances Villages: The survey results revealed that there are 6 hospitals and/or clinics existing in the respondents' villages and are distributed in five districts mainly in Bany Bahlol, Khawlan, Bany Matar, Hamdan and Bany Al-Harith.

With respect to the distance of the hospitals/clinics from the respondents' villages and the number of staff, the results show that the range of distance is between 5 to 10 minutes with an average of 8 minutes from the villages. Furthermore, there was 57 staff in these hospitals, the staff ranges from 6 to 40 persons and an average of 19 persons.

Most common diseases its spread and the pests & insects in the respondents' villages: The survey results revealed that 15%, 10.5% and 5.3% of the respondents in all villages of the districts included in survey indicated that the most affected diseases were malaria and diarrhea respectively.

Regarding the pests and insects which infest the villages mostly, the respondents in all villages / districts included in the survey indicated that mosquitoes (47.4%) insects (21.1%) and pests (15.8%) were the main pests and insects infested the villages mostly.

The Role of Family Members in Bringing Drinking Water: 47% of the total respondents indicated that both boys and girls bring water while 21% said only the boys were responsible for bringing drinking water to the family houses.

Means of Bringing Drinking Water to the Houses: 26.3% of the respondents indicated that they rely on donkeys and tankers while 31% use other means to bring water from its source in the villages or nearby farms to the houses. An additional 5.3% to 10.5% indicated that they rely on tankers; donkeys and tankers; pipes, donkeys, tankers and other means.

Time Needed to Bring Drinking Water to the Houses: 63% and 26.3% of the respondents indicated that the time needed to bring water was less than one hour and one - two hours, respectively.

Number of Times for Bringing Drinking Water to the Houses: The majority (79%) of the respondents indicated that they brought the water to the house everyday, whereas 16% and 5.3% of the respondents indicated that they brought water to the houses every day, 2 to 3 days and 2 to 4 days or as needed.

Quantity of Water Brought to the Houses: The survey results revealed that 84.2%, 5.3% and 10.5% of the respondents in the villages of the districts, indicated that the quantity of water brought to the houses were 100 liters and above, less than 50 liters, 50 to 100 liters per day, respectively.

It is quite evident that the majority of the rural women/respondents interviewed in the villages of the study area consumed 100 liters and more, on daily basis.

Average Quantities of Different Water Uses and Related Issues: 20.8 liters of water was the average quantity of water used for drinking, 67.2 liters of water used for cooking, 65.2 liters of water is used for cleaning and washing, and 140.7 liters of water is used for bathing, as reported by the respondents in the seven districts.

About 41% of the respondents indicated that there is an additional use of water, of which 21% of the respondents indicated for animals, whereas, 69% of the respondents indicated that there is no any use of water. The survey results also revealed that 74% of the respondents indicated that the source of water uses is the same, i.e.: from the same source, whereas, the rest of the respondents indicated that the source of water uses is not from the same source.

Water Containers Types, Volumes and Cleaning Times of the Preservation Containers (Days/Weeks): The overall estimated volume of galvanized containers/tanks used to reserve drinking by the respondents in the seven districts of the study is 34750m³ with an average of 1829m³.

Furthermore, the estimated volume of the plastic water containers used by the respondents is 486m³ and an average of 30m³ as reported by the respondents.

Regarding the cleaning times of the water reservation containers/days or weeks, the figures presented in table 21 show that 26%, 21%, 16% and 11% of the rural women respondents in the village/districts of the study area indicated that they cleaned the water preservation containers every 7-10 days, daily, once every two weeks to three weeks and daily and every two days respectively.

Furthermore, four groups of respondents (5% for each group) indicated that they cleaned the water preservation containers every two days, daily and weekly, weekly and once every two weeks, and daily; every two days and another days respectively.

Respondents' Notices of any Remains or material inside the water reserve containers: The survey results revealed that 74% of the respondents had noticed some gangues, impurity and materials in water containers, whereas 10.5% of the respondents had not noticed any thing.

Villages, Needs for Drinking water and Sanitation schemes/projects and Respondents' Readiness to Contribute: 74% and 89.5% of the rural women respondents in the villages-districts of the survey / project area, indicated that their villages need drinking water and sanitation schemes.

The majority (89.5%) of the respondents expressed their readiness to contribute in the above-mentioned schemes/project, of which 79% and 10% of the respondents indicated that their contribution would be financial and efforts or both.

Sources of drinking Water: The survey results indicate that:

- 55.1% of the respondents reported that they are obtaining drinking water from the groundwater well connected to their houses,
- 14% of the respondents reported that they are obtaining drinking water from the same pump unit/groundwater well not connected to the houses,
- 13.1% of the respondents reported that they are obtaining drinking water from the public network connected to the house, and
- 12.1% of the respondents reported that they are obtaining drinking water from the public scheme not connected to the houses respectively.

The rest of respondents reported that they are obtaining water from a combination of the above-mentioned sources.

It is apparent that pump unit/ground water represent the main drinking water sources to most of the interviewed farmers/households in the study area. It is quite obvious that the connection from public water supply in the sample districts is very low, where such basic service or supply did not exist in

about five of the districts, thus it indicates the level of development of the inhabitants in one hand, and may resulted in losing their trust in any related activities or projects on the other hand.

2. *Gender Issues (Problems facing female family members)*

2.1 Status of the interviewed rural women in the districts of Sana'a Basin

2.1.1 Problems encountered

General Problems: The survey results revealed that the main problems encountered by the respondents in the survey are:

- 1) Shortage of water and lack of water scheme/ project;
- 2) lack of enough clinic/health centers;
- 3) lack of sanitation facilities;
- 4) inadequate infrastructure services (electricity, public telephones and paved roads); and
- 5) lack of enough schools, especially female schools, while the existing ones are mostly far away and with inadequate number of teachers.

The majority of respondents pointed out that they have encountered one and more of these problems; 66.7% of the respondents in Bani Hushaysh (about 10.5% of the total respondents) indicated that they are facing problems: 2, 3, 4, and 5 whereas 33.3%, of indicated that the problem they face generally is: unavailability of sanitation facilities only. Similarly, 40% of the Bani Al-Harith respondents (26.3% of the total respondents) stated that the problems they encounter are # 1, 2 and 3 while 20% of the respondents encountered problems 2, 3, 4, and 5 and another 20.0% complain only from lack of infrastructure services.

Water Supply Problems: Female members of families in the visited villages, including young girls, face the following problems related to water supplies either directly or indirectly:

- *Inadequate level of water supplies:* Increasing difficulties in finding enough water in wells; frequent pumps breakdown/failure; close down of wells due to large drawdowns; and giving up farming due to water shortage and short of irrigation water.
- *Inadequate water quality and sanitation facilities:* Some well are opened/uncovered and subject to contamination; women are often stressed due to water transportation/ fetching, purchasing of water at high priced/water due to rising costs of diese; some wells discharge hot water that is difficult to transport; and changes in the taste and color of water are often in others.

- *Decreasing crop income:* Yield is becoming less over the years because of increasing cost of drilling; owned wells becoming insufficient for irrigation and the shared / cooperative wells are getting salty.

Respondents' Views on the Solutions of the Problems Related to Water: The Suggested Solutions reported by the respondents were grouped and summarized as follows:-

- Build a water reservoir and / or a dam, a public water project, connecting water to the houses (52.6%)
- Drilling wells and ensuring at the same time how to save / economize on water.

Part Four: District-Level Survey

1. The Stakeholders Meetings

1.1 Main issues for stakeholders meetings

A realistic evaluation of the situation and identification of specific problems that may be particular to any basin requires a direct involvement of all concerned stakeholders / users. Information collected through meetings with such parties is usually the ‘safeguard’ for the success of any action plan for water resources management. Important issues relevant to the situation in the Sana’a Basin were identified as described above. Specific issues to be discussed during the stakeholders meetings and a provisional questions list for this purpose are given in table 5.3

Table 5.3: A provision list from which main issues to be addressed can be selected

Main Issue	Questions to be addressed
Identification of the water problem perception by the government agency responsible for the management of the Basin (NWRA)	<p>What are the objectives / plan of NWRA for the Basin? What are its views on water resources management?</p> <p>How does NWRA perceive itself (including institutional problems)?</p> <p>What does NWRA consider as possible measures for water resources management (i.e. possible solutions)?</p> <p>What are the means that NWRA has, or hopes to have, to implement these measures?</p>
Description of the existing situation in water resources management	<p>What is the existing socio-economical system?</p> <p>What is the existing natural resources system?</p> <p>What is the existing administrative and institutional system?</p> <p>How does NWRA perceive the current situation in the Basin?</p> <p>What are the problems that NWRA considers relevant?</p> <p>What are the possible solutions for these problems, from NWRA's point of view?</p>
Identification of stakeholders / users in relation to water resources management	<p>Which stakeholders / users are involved and how are they organized?</p> <p>What are the objectives of stakeholders?</p> <p>How do they perceive the current situation?</p> <p>What possible solutions do they consider?</p> <p>What are the points of view of stakeholders towards NWRA and its future activities?</p> <p>What are the bases for these points of view?</p> <p>What measures are feasible for stakeholders?</p> <p>What measures are acceptable to stakeholders?</p> <p>What measures are they willing to negotiate?</p> <p>What are the means of the stakeholders to contribute to the implementation of possible solutions?</p> <p>What are the means of the stakeholders to frustrate the implementation of possible solutions?</p>
Relations between stakeholders / users	<p>How do stakeholders perceive each other?</p> <p>What are the similarities and the differences between the individual problem perceptions?</p> <p>What kind of communication structures is there?</p> <p>What kind of mechanisms is there for coordination?</p> <p>Are there stakeholders who cooperate and, if yes, in what way?</p> <p>What kind of interaction between stakeholders and NWRA is there at this moment, if any?</p> <p>To what extent can the structures between stakeholders be incorporated in NWRA's policy structures and to what extent are these structures contradictory with NWRA's objectives?</p> <p>Which sub-groups can be identified within each stakeholder group?</p>
Possible improvements of the relations between stakeholders:	<p>Between which stakeholders would additional interaction be useful?</p> <p>What kind of alternatives is there for this additional interaction?</p> <p>What are the criteria to assess these different alternatives?</p> <p>Which alternatives seem promising, and how?</p>
Possibilities to implement the promising alternatives	<p>How do stakeholders feel about the promising alternatives?</p> <p>What are their means to support or frustrate successful implementation of these alternatives?</p> <p>What are the means of NWRA to implement the alternatives?</p> <p>Which first steps could NWRA take to implement the alternatives?</p>

2. ***Main Outcome of the Meetings:***

2.1 **Main issues**

Main issues that appeared to be of most concern to all stakeholder groups are summarized as follows:

1. ***Groundwater depletion scarcity:*** This was raised by all groups as the most serious problem affecting all districts. Several evidences were cited including:
 - In *Wadi Rijam – Sa’awan* shallow hand-dug wells (~ 15m deep)were most common in the past. Farmers began to deepen these wells to ~ 30m in 1972 using local metal tools known as “*Suppayr*” until modern drilling techniques were introduced in the late 70s. from early 1980 onwards, a significant drop in water level was observed such that the average well depth ranged between 200-250 meters. Now most boreholes are \geq 400m deep and the “water reservoir” is still getting deeper and deeper.
 - In *Hamdan*, there are large number of wells which are being over-pumped in a manner that according to one farmer is likely to be disastrous unless quick and effective measures are taken.
 - *Arhab* district is practically a mountaneous zone devoid of groundwater resources except for 4 or 5 areas, as a result of which many locals migrate to Sana’a city because of lack of fresh water for drinking.
 - In *Bani Al-Harith* many farmers started rehabilitating catchment areas for agriculture purposes by using surface flow/flood water that used to either recharge the shallow aquifer or benefit down-stream users. As a result, more and more users are drilling boreholes that tap the deeper aquifer system.
 - In *Sanhan-Bani Bahloul* there is a drastic change in groundwater use where practically very few shallow dug wells (known locally as *Yousufi* wells) existed in the near past whereas deep boreholes are now spreading across the district in a frightening manner. In the Bani Bahloul part of this district, the inhabitants of *Bait Uqb* village had to abandon their wells as the depth of finding groundwater has reached 500-800 meters.
2. ***Inadequate infrastructure:*** A good number of water harvesting structures (small dams, reservoirs, pondsetc) have been constructed through puplic/private cooperative efforts and funds. However, many of them have totally collapsed. Those that still exist are in a poor shape due mainly to lack of financial resources and/or proper maintenance. Specific examples given by the participants include:

- In *Sanahan-Bani Bahloul*, construction of the Hamal Dam, constructed by the locals as a good means of aquifer recharge, is now abandoned.
- In *Hamdan* a reservoir dam was built in *Tawthan* area long time ago for collecting rainwater but the locals are not benefiting from it apparently because “the water infiltrates deep through the rocks”.
- In *Bani Al-Harith* there is an ideal location for a dam in *Al-Ushsha* east of *Bayt-Doudah* in *Al-Baahili* that the locals would like to be considered as a potential site within this study.
- In *Sanhan-Bani Bahloul* there are a number of suitable sites for dams such as *Al-Qushaybah* area, which is known to have good catchment characteristics.
- In *Nihm* there is substantial quantities of surface water that flows out towards *Wadi Al-Jawf* and and that could be utilized by the locals for irrigation if proper dams and/or other water-retaining structures.
- In *Arhab* there are a number of reservoirs for water harvesting in different areas, some in good shape while others need rehabilitation.
- In *Nihm* there are two dams (*Shayban* and *Hatha*) that could not be completed due to lack of resources.
- Two other sites that are considered important for the population in both *Arhab* and *Nihm* are:
 - *Musayreka* plain in the foothills of *Jabal Sama'* , and
 - *Al-Kharid* spring area which could also be used for supplying the urban population in Sana'a with fresh water.
 -

3. *Dis-honesty of the Government:*

All parties without exception expressed a great anxiety and mistrust in the Government, with regards to seriousness in alleviating the water-related problems that exist in their districts. It appeared that most of those present did not deal with NWRA or even hear about it. Rather, the negative feeling expressed was mainly engraved in them over many years of contacts with NWRA and the MAI, particularly the irrigation bodies attached to the latter mainly the Directorate of Irrigation and the ACU. Specific issues/incidents that were raised in relation to this institutional aspect include:

- Representatives from *Bani Al-Harith* expressed their anger mainly through the performance of NWSA, which they regard as a complete lack of concern for the local population in this district. They summarized their grief in the following points, all related to environmental aspects:

- Continuous discharge of sewerage into their cultivated lands and nearby wadi channel for 15 years.
 - Construction of treatment plant recently without any consideration for building a separate plant for the solid waste.
 - In-efficient operation of the new plant in a continuous manner as a result of which huge quantities of accumulated waste gets suddenly released to inundate the cultivated crop and human health degradation.
 - Lack of proper canal system to discharge the wastewater such that the local can make use of it while at the same time not being subjected to its harmful effects.
 - Total absence of any activities to fight disease-carrying insects that appeared as a result of the wastewater discharge.
 - Lack of Government response to the local populations' need for municipal water despite the fact that several boreholes have been drilled for this purpose, which only require the installation of distribution system.
- Representatives from the other districts expressed mainly their frustrations with Government officials (urban inhabitants) who “always promise but never do anything for the rural areas”. The following expressions were often thrown from different persons:
 - Farmers simply do not feel that anything positive will come out of the current meetings as nothing have materialized from similar meetings in the past.
 - Government officials, particularly those involved in projects implementations, “should first respect their words and we are ready to fully cooperate with them.”
 - We should not think only about how to get new water supply sources for the city but also about the rural population such that an action such as building dams could benefit both population groups
 - There are certain powerful social groups/individuals with strong links to the Government (e.g. the Irrigation Cooperative, Sheikhs, ...etc.) who monopolize the water-related issues, hence the implementation of any activity within the context of this project should be through direct contact with the main beneficiaries.

2.2 Perceived solutions

There was a strong consensus that *dams construction/rehabilitation; adoption of modern irrigation systems* and *implementation of an intensive public awareness program* in the rural area is the main solutions (in this order). Specific details relevant to these proposed actions included:

- Construction of surface reservoirs and other water-retaining structures is the ideal solution for alleviating some of the pressure from the aquifer system.
- Recharge dams have proven effectiveness in several areas (*e.g. Mukhtan in Bani Hushaysh*) and the experience learned should be taken into consideration.
- Let us start first with the rehabilitation of the numerous different structures scattered in the various districts, using local material (known as Al-Qudad) that has proven effectiveness and endurance. We can then evaluate the feasibility of resuming construction of incompleting works while at the same time planning for new ones.
- Planning for any new dams/structures should be in accordance with actual needs in each region rather than satisfying or pleasing certain tribe or social groups.
- Selection of sites should be based on careful and scientific analysis and approach.
- All farmers are willing to adopt using modern irrigation methods but first let the Government convince us that it actually works as an effective water-saving mechanism without affecting crop yield.

2.3 Specific issues:

A number of issues raised during the meeting were either *zone-specific* problems or expressed interesting opinions that reflected on the farmers perceptions stemming from their own point of views on the future of the region. Among the first category were the following:

- *Environmental and Water Quality Monitoring in Bani Al-Harith:*

It is clear from the information given above that pollution issues related to the current practice of wastewater disposal is spreading in *Bani Al-Harith* participants from this district put forward some interesting suggestions for handling the situation:

- Continuous monitoring on the wastewater treatment plant operations to ensure that water discharged from the plant is clean and suitable for irrigation use.
- Discharge of hydrocarbon-based pollutants into wadi channel, particularly oil and other lubricants discharged from gas station and car-wash workshops, should be closely monitored and controlled by forcing these

places to put all such materials in special tanks/barrels to be collected later on regular basis and stored in properly-sealed reservoirs.

- Any such monitoring programs are likely to be in-effective if local inhabitants from the district are not involved directly.
- *Heavy Reliance on Rain-fed on agriculture Sanhan- Bani Bahloul:* About 60% of the farmers in these two districts, officially combined into one district still live on rain-fed cultivation along major wadis. Among the most common problems affecting crop yields (and hence water-use efficiency) are soil/land erosion and infection diseases due to heavy attack by plant insects. Effective rehabilitation measures are therefore urgently needed.
- *Concentration of Dams Construction in Nihm and Bani Hushaysh - Khawlan:* A good number of dams have been constructed in *Nihm* as well as *Bani Hushaysh – Khawlan* districts, mostly through cooperative efforts with public and/or private money. In *Nihm*, the main aim behind constructing these dams was surface water retention while those in *Bani-Hushaysh-Khawlan* were both for retention as well as recharge purposes. Of particular importance with respect to the situation in the latter region is the heavy role that the Agricultural Cooperative Union (ACU) has played through the Cooperative Society for Irrigation and Hydraulic Structures. This society has been involved in the construction of 3 recharge dams (two in *Mukhtan*, one existing and another under construction plus a proposed one (in *As Sarf* area) and 3 reservoirs (one each in *Wadi Sa'awan*, *As sir*, and *Ash Sharya* area)
- *The Need of Galvanized Pipes in Hamdan:* Most areas in this district are mountainous such that many farmlands are cultivated on almost barren rocks with very limited soil cover. Experience has shown that the construction of modern irrigation systems using polyethylene pipes is not suitable for this terrain. Hence, any future development in the area should consider galvanized (metal) pipes.
- *High Rock Permeability in Bani Al-Harith:* During a heavy flood it has been observed that flood water directed in an open dug well has quickly disappeared from the well. The same water (as judged from its quality) was later found in a borehole 500m away that the locals were pumping from.
- *Horizontal Expansion of the City into Agricultural Land:* Farmers from this district complain that their agricultural land is shrinking due to the expansion of urban area as well as asphalt roads (highways) connecting the city to secondary towns in the Arhab and Nihm regions.

Interesting ideas that were brought up during the meetings and are related to future expansion in pump-irrigated areas include:

- Responsibility for regulating and monitoring any future expansion as well as controlling it must be vested in a specific body/institution that, preferably, should also be in charge of the expansion of urban areas into agricultural lands.
- The implementation of any development works or management plans is bound to fail without involving the immediate beneficiaries in an effective manner, particularly with respect to operation and maintenance.
- Controlling the expansion means “sacrificing and compromising with the future of our sons and grand children so what are we (farmers) getting from the Government in terms of compensations”.

2.4 Discussion and conclusions

A number of both general and zone-specific issues have been raised during the meetings. From the brief information given above (see section 2.1 to 2.3), it can be seen that many of these issues are very relevant to the management of the available water resources in the Basin towards sustainability. From what we observed during the meetings, however, there are a number of factors that may have either biased the general views of the attendees or inhibited them from expressing the real truth. Some of the more obvious ones were the following:

- ☆ The presence of representatives from the Agricultural Cooperates Union (ACU): As the meetings were organized through the ACU, the top management of the Union were represented in the first three meetings (Bani Hushaysh / Khawlan, Sanhan / Bani Bahloul, and Bani Al-Harith / Hamdan) by the following members:

<i>Group Meeting</i>	<i>ACU</i>	<i>Psition</i>
B. Hushaysh	Mohamed Basheer	Chairman of the Irrig. & Hydr. Struct. Cooperative (IHSC) of the ACU
Sanhan / B. Bahloul	Abdul Hadi Al-Najjar	Vice Chairman of IHSC
B. Al-Harith / Hamdan	Abdul Hadi Al-Najjar	Vice Chairman of IHSC

It was clear that these participants had their own agenda by steering the meetings towards the interests of the ACU and repeatedly emphasizing the important role played in the region by the by the IHSC. They continued to cite various examples of the claimed IHSC contribution without much reaction from the audience to confirm or contradict what they said. We took this passive reaction as a negative response from the present farmers who naturally would not like

to have any confrontation with such powerful individuals. This was confirmed by what has been expressed by other participants who apparently had enough prestige and / or authority than the average simple farmer (see below)

- ☆ The presence of representatives from the Local Councils (LC): Among this category were Major General Mohamed Al- Khumasi of Sanhan / B. Bahloul and Abdul Wahab Suray' of Hamdan as well as representatives of the LC's in Nihm and B. Matar. This group appeared to be politically motivated. Having been recently elected in general, they were very enthusiastic and showed interest in contributing to finding solution to the existing problems.

Despite the inhibiting factor of the “ powerful people” present in the meeting, a keen interest and honest concern of the existing issues were expressed mainly by the following two groups of participants.

- ☆ The representatives of local agricultural cooperatives: Representatives of a number of cooperatives from almost all districts were Present this group appeared more concerned about the interest of local farmers in their areas. They also were more outspoken than the individual farmers in responding to the “claims” of the IHSC members. One representative stated that “ the IHSC has started blackmailing the simple farmers and denying them of their services, particularly when it comes to supplying them with government funded irrigation equipment at reduced prices”.
- ☆ Highly educated individuals: A number of university graduates from different districts attended the meetings. Some of them were from disciplines related to the project activities and, hence, constitute an asset to the local communities. This was evident from their positive contribution in these meetings. For example, a graduate in Agriculture Sciences from Bani Al Harith reported on a number issues in his district. Similarly, a geologist from Nihm described the potential of groundwater in the sandstones which cover a good part of this district. It was also interesting to see that these young graduates were surrounded with good respect from most of those who were present. This suggests that these young men can play a very significant role in enhancing the achievement of the project's objective.

On the basis of the above observations, the following conclusions can be drawn:

1. **Groundwater depletion issue:** There has been a general consensus among all stakeholder that this is a common issue that is considered to be the most serious problem. This is a fact which

is a common knowledge now. It is however also an issue subject to a considerable misunderstanding as a result of which serious conflicts may arise among stakeholder groups (among local beneficiaries as well as between them and the Government). From what has been said and discussed, and despite the fact that the PPT study team / management has made it clear that the project objectives at this stage are targeted at specific selected zones, it is our belief that everyone has walked out of the meetings with certain expectations for their region. It is therefore essential to follow up these meetings with a public awareness campaign through which, among other issues, the project objectives/activities can receive a special attention. For this purpose it is essential that project management be prepared with the essential data (hydrogeological, agro-ecological, socio-economical ...etc.) required for convincing the local populations on the management approach and action plans taken.

2. **Other water resources issues**: A significant number of other water resources issues have been raised by the different stakeholder groups. It was interesting to observe that these issues were predominantly related to the supply aspect as most participants kept stressing the need for the construction and/or rehabilitation of small dams, reservoirs, ponds, ..etc. While such needs may very well be valid, the strong emphasis expressed may stem from the participants perception that these activities will be favorable for implementation. Partly this perception may have materialized from the stakeholders, knowledge of the project objectives as stated during the meeting but more importantly it is likely to be due to their awareness of the often-heard social stress and the positive response from the Government on the construction of small dams in the Basin. What has been expressed therefore may reflect a smart move from them to take advantage of the situation rather than representing actual needs. Hence it is necessary to further investigate this issue and clarify whether the structures claimed by each group actually exist in order to assess the real need.

3. **Water and land use issues**: The discussions revealed some important findings related to the distinct feature and/or peculiar characteristics of certain zones including:
 - Environmental issues in Bani A Harith related to wastewater and sledge disposal.
 - Heavy reliance on rain fed agriculture in Sanhan.
 - Large concentration of surface water retention dams in Nihm, built mainly through local cooperative efforts.
 - Significant activity of the IHSC in recharge dams construction at Bani Hushaysh.
 - Agricultural land shrinkage in Bani Al Harith due to urbanization.
 - Demand for galvanized pipes for irrigation water conveyance systems in Hamdan, as opposed to plastic pipes.

This is by no means a comprehensive list and more features, which may be characteristic of particular zones, possibly exist as suggested by the significant differences in geology, hydrology, agro-ecology, and physiography (see volume 1: Main Report). However it is reasonable to assume that the socio-economic survey undertaken within the limitations of the present study has not detected all such features. The follow-up studies planned within the scope of the project should aim at getting more details on this issue.

4. **Community involvement**: Practically all the participants indicated their willingness to cooperate with the Government in achieving the project goals and participate in implementation. This is however easily said than done. The key to any affective participation is *ownership* which in the present situation is based on trust in the Government as well as initiative efforts by the local populations. Judging from the response of the different stakeholder groups, it can be concluded that generally those from the city neighborhood districts expressed less trust than those coming from the more remote districts. Within the first group, Bani Al Harith and Bani Hushaysh districts were very antagonistic while the Sanhan-Bani Bahloul stakeholders showed a rather positive attitude towards the Government. This is understandable considering the position of the latter group and the fact that they were headed by an admiral retired from the military.

With respect to stakeholders from the two most remote districts (Arhab and Nihm), their trust in the Government appeared quite similar (generally positive) but there seemed to be a significant difference in their initiative efforts. The Arhab group gave the impression of being very passive. They hardly mentioned any significant achievement through cooperative work, complained a lot about the poverty of their region and stressed on the high number of people leaving it as a result of limited resources. Cooperative efforts among the Nihm people, however, can be judged from the numerous small dams built in the region although many need rehabilitation. They have also explicitly expressed their willingness to share the Al Khared surface water spring with the city of Sana'a if proper arrangements are made to exploit this water which gets wasted in the desert.

5. **Community leadership**: Leadership is an important factor in community willingness to participate in project implementation. Two groups appear to have potential for influencing community's decision to this regard : an elder group of social figures (Sheikhs, big land owners, businessmen, senior Government officials including military officers .. etc.) and a younger group with a certain prestige acquired mainly through higher education (geologists, irrigation engineers/agronomists, local councils representatives, ...etc.). Based on the discussions which took place, it is expected that these two groups can have considerable

negative or positive effects on the community's decisions, respectively. This is an important issue that deserves further exploration and project assessment.

6. ***The role of the ACU/IHSC:*** The significant role of the Agricultural Cooperative Union and its affiliates, particularly the IHSC, has been quite evident through the meetings. It has also been evident that decisions made by such organizations can be very biased depending on its management tribal affiliation and/or personal interests, such that certain communities may favor a lot while others could be deprived from their services. It is therefore important to assess the role of local cooperatives, particularly in relation to the issue of fairness of the services to the different communities.