

Analysis of Private Water Providers in Urban and Peri-Urban Areas in Sana'a

Part A: A Field Survey of Service Providers

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Executive Summary

A. Introduction

The MDGs set a high target for water supply and sanitation in Yemen. In Sana'a, the Local Corporation covers only half of households and faces many constraints in expanding coverage affordably, as well as many operational constraints that reduce the extent and quality of service. Consequently, private water suppliers have become increasingly active to fill the gap. The 2008 PSIA survey found that little more than a quarter of Sana'a households rely on the public network as a sole source.

At the policy level, public private cooperation has long been a goal and the 2008 NWSSIP Update for the first time proposed a practical policy shift to 'systematically include the private sector in service provision'. A 2008/9 study, the Urban Water Poverty and Social Impact Assessment (PSIA), identified some successful localized partnership approaches (e.g. at Ibb) and discussed a partnership for water supply to poor areas that was to be tested in Sana'a. The study recognized that government and the private sector had a history of mistrust of each other, but found some evidence that the organized private sector might be willing to cooperate. The PSIA recommended some possible transaction models suited to partnerships between public and private sectors, and recommended that Local Corporations review these and include them in their business plans. The PSIA included a quick assessment of the Sana'a situation and highlighted several alternative ways to increase access.

The present study was undertaken in order to provide the data and findings needed to underwrite a more detailed analysis of how the private sector might be further involved in water supply and sanitation in the capital in line with the NWSSIP policies and the PSIA recommendations. The objectives were to document private sector activities and to suggest how private sector might be more effectively involved in water and sanitation service provision in Sana'a.

B. Findings

Market share and growth rate

The private water suppliers have a larger market share than the Local Corporation. The private water sector serves more customers in Sana'a than the Local Corporation, and provides a greater quantity of water. Extrapolating from the survey, it is estimated that the 189 wells recorded by NWRA as serving the Sana'a urban market are supplying 27 MCM a year, more than the 23 MCM supplied by the Sana'a Local Corporation (LC) in 2008. Of the total water pumped by the 189 wells, about 6% is supplied to agriculture, and the rest to urban consumption, largely through the tanker trade (78%) and networks (8%).

The estimated number of tankers serving the Sana'a urban market is 709 (NWRA 2007). The tankers sell water to about 50% of all Sana'a households each month. Tankers also supply many other water users within the city: workshops, industry, construction, government and private organizations.

The private supply business is growing rapidly in response to demand that the LC cannot meet. Over one third of wells have only started supplying the urban market in the last five years. Although some networks have closed down, others have been starting up, particularly in new fringe development areas in the south of the city. The tanker business is growing particularly rapidly – 50% of the sample started up in the last four years, and 15% in the last one year. The increased demand for pure drinking water has also led to rapid growth in the number of water purification shops/stations – one third of the shops surveyed (32%) opened during the last year.

The small scale of private water businesses enables them to remain nimble and to meet peaks in demand that the LC cannot satisfy. Tanker water deliveries are higher in summer than in winter, showing how the tanker trade is a flexible way of meeting peak demand during the hot months. Private network sales are also higher in summer than winter.

Service standards and sanitation

Service standards are generally good. Tankers are freely available at known points, and can easily be ordered by telephone. Tankers are available all day and into the night. About 25% of networks have 24 hour water supply. However, only one quarter of networks have installed a meter at households, and only one fifth of those meters were reported as working properly. No private network provides sanitation services to the population.

Scale, associations and regulatory frameworks

The water supply business remains largely small scale, dominated by small owner managed businesses and sole traders. The well water supply business is dominated by owner operators employing few staff. Networks are all quite small scale, operated by well owners and serving households around a single well. In the survey, only three of the networks surveyed served more than 400 households.

Three quarters of tankers are run by owner operators, working locally and serving 7-8 households each day, delivering an average of 24m³ daily. Most water purification shops are run by owner/managers with a few staff, although a number are branches of small chains. The scale of operations is generally small to medium (< 300 m³ a day), except for the industrial scale bottlers (Shemlan, Hadda).

Only about two thirds of the wells are considered legal. About two thirds of wells surveyed (69%) were stated as ‘licensed by NWRA’. In most cases, there was no license, but the well simply antedated the 2003 Water Law, and so was considered by the owner to be legal. About half (49%) of the well owners surveyed had had some dealings with NWRA (or other public agency) regarding operating or deepening the well or otherwise running the business. The remaining 31% of wells were recently dug unlicensed wells (outside the law).

Although many businesses are registered, and there are professional associations, the private water supply business remains generally unorganized and unrepresented, with no active trade representation. About half the networks surveyed are registered as businesses but only two were members of business associations. Very few tanker owners are members of a business association, although there is some cooperative organization, for example of queuing at the well. For water purification shop owners, the registered association has 60-70 members but is currently inactive.

Regulation is very limited and seems to add little or no value. Only 4% of wells were metered. About one third of wells were formally registered as businesses with the local council. Four fifths of water purification shops are registered, but in the survey, most purification shop owners did not know who was the responsible inspection authority. This is, in fact, the Ministry of Public Health (MoPH) which seems quite active in regulation, closing some shops down. This regulation is not, however, generally seen as helpful in raising standards. In addition, there seems to be some overlap of regulatory powers between the Ministry of Public Works, Ministry of Public Health, NWRA and the Local Councils.

Water resources and quality

Groundwater tables from which the private trade is supplied are dropping, and private water providers are aware of the problem. Well depths vary between 30 m in Bani al Harith (north) and 700 m in Sanhan and Bani Bahloul (south). One third (33%) of wells surveyed had been deepened during their operating life due to declining productivity, some by as much as 350 m and up to four times. Almost all (90%) of tanker drivers stated that they were aware that well depths are declining.

Self assessment by water providers shows satisfaction with water quality. About 96% of well owners believe that their water is of good quality. A NWRA survey in 2008 confirmed that water quality from private wells was in general good, with some exceptions largely in the northern part of the city near the wastewater treatment plant. Tanker water is not treated but again quality is considered good by the owner/drivers. However, a number of water purification shops have been closed down, ostensibly on quality and health hazard grounds.

Private water supply as a business

In general, private water supply is reported to be profitable, but high levels of competition keep margins down. Selling prices are well above the levels charged by the LC. For wells, net revenue/m³ appears to average Rls 40-50, making well ownership a profitable business. Production costs at the wellhead vary considerably by district, depending on well depth, with reported costs from as little as Rls 12/m³ (\$0.06) to Rls 80 (\$0.40). However, reported costs are not very reliable.

For networks, reported costs and revenues are also unreliable, but average water bills for the networks could be as high as Rls 150/m³, and net revenue (before depreciation) a significant proportion (up to two thirds) of that. Production costs average Rls 47/m³. Quite high investment expenditures on networks were reported, suggesting that this may indeed be a profitable growth sector.

Average profit for a tanker per day is about Rls 3,600 (\$18), equivalent to Rls 150 (\$0.75) per m³. Average selling price is about Rls 274/m³ (\$1.40/m³). Water cost at the source is much higher in southern Sana'a than in the north, and this is reflected in higher sales prices.

Margins in the water purification shops are quite small (Rls 1/litre) and selling prices are highly competitive (Rls 3/litre) compared to Rls 41/litre for Shemlan bottled water.

Development and social accountability

There was a considerable degree of interest in expanding businesses within a more formal, regulated framework and on a partnership basis. Although most wells are run as informal

small businesses, about half of the well owners surveyed showed interest in expanding their operations and moving to a more formal status, such as working in partnership with the local community, the Local Council or the Sana'a Local Corporation. More than half of network owners would also apparently consider a partnership with the community, local council or Local Corporation. Two thirds (65%) of tanker owner/operators said they would consider a system under which they are officially licensed and regulated.

Almost all water purification shop owners agreed that some combination of self-organization and regulation would be helpful, involving the businessmen themselves, the local community and council, and the Local Corporation.

All private water suppliers make free provision for the poor and for mosques. On average, 5-10% of water is supplied free to mosques, standpipes and the poor, and all water purification shops allow the poor to take water for free.

C. Recommendations

Private water supply in Sana'a is a thriving business that meets a critical need that cannot be met in the foreseeable future by the Local Corporation. Private water supply is growing fast as demand grows along with the population, and it is inevitable that private supply will continue to provide a large share of the capital's water needs in the coming years. Government policy recognizes this, and seeks to optimize supply by cooperating with the private sector. What should be the nature of that cooperation?

There are a number of problems attached to the current laissez faire approach:

1. There is no regulation of the quantity extracted, and this is contributing to the haphazard exhaustion of groundwater stocks. In the absence of regulation, private supply cannot be considered for Yemen's movement towards the MDG targets.
2. There is little or no licensing or regulation of quality, and hence there is a risk to the consumer. In addition, public and private sewage is contaminating water supplies.
3. Tanker supplies predominate and provide a needed flexibility to meet peaks of demand, but tankers are a very high cost form of supply, and it is particularly the poor who lack access to the network and hence pay the highest prices.
4. The small scale of private water enterprises mean that planning and coordination are difficult and there are no economies of scale.
5. There is no private investment in sanitation.

It is recommended that in the light of the findings of the present study, a dialogue be begun involving the office of the Mayor of Sana'a, the Local Councils, the Local Corporation, the Ministry of Water, the Ministry of Public Health, and private suppliers and consumers. The first steps should cover the following areas:

- How to encourage the organization of the private sector in water into responsible and representative professional associations mandated to dialogue with government.

- The scope for bringing private water providers within a light regulatory framework, preferably self-administered by representative professional associations, under the supervision of the MWE or the water regulator when established. Examples could include regulating private wells selling tanker water, and regulating the tanker fleet and providing certificates to hygienically suitable tankers.
- Possible partnership projects such as the one at Ibb (a local area concession for a piped network under regulation, see box in Chapter 5) or the proposed output based aid project at Wadi Dahr.
- Providing water to tankers from specific municipal wells
- Developing equitable and efficient instruments for orderly transfer of water out of farming into urban water supply (e.g. purchase of wells and the run off rights on the surrounding recharge area, licensing of agricultural wells for urban supply, hooking up agricultural wells to the LC's trunk main for metered water purchase etc.)
- Providing sewerage network feeding points for vacuum trucks (against fees), and stimulating private investment in decentralized cluster sewerage solutions
- Institutional development and capacity building for the private sector, including raising awareness of private water providers about water shortage, water quality, proper water management, hygiene and other issues.

Solutions could be reflected into the Sana'a City Master Plan, and into the LC's business plan. Financing could be provided under WSSP.

1. Introduction

1.1 The MDGs set a target that the Sana'a Local Corporation cannot meet

The MDGs set a high target for water supply and sanitation that mean that the private sector will have to be involved and its performance improved. The United Nations (UN) declared the Millennium Development Goals (MDG) in 2000 which were adopted by all UN Member States in the same year. These goals since then became a universal framework for development and a means for developing countries and their development partners to work together in pursuit of a shared future for all. MDG no. 7 states to “Reduce by half the proportion of people without sustainable access to safe drinking water”. For Yemen as a whole, this means increasing coverage of the urban population by a further 350,000 house connections 2008-2015. Even this will leave Yemen well short of the MDG targets, and the shortfall will have to be made up by improved standards in private non-network supply.

The Sana'a Local Corporation covers only half of households and faces many constraints in expanding coverage affordably. The rapid rate of urbanization in main cities as in the capital Sana'a has left coverage in water and sanitation services trailing. Nowadays, the SWSLC covers not more than 50% of the total population (about 2 million inhabitants) with safe water through 80 operating wells pumping 22 MCM/year in 2008, and the city is the third fastest growing city in the world (6% annually). The investment required to increase public network water and sanitation coverage to reach the MDGs (71% for water, 52% for sanitation) would cost almost \$2 billion.

There are also many operational constraints to the performance of the Sana'a Local Corporation. According to reporting on “Water Production and Distribution” in 2009 by SWSLC, constraints and problems on water distribution are faced by SWSLC in addition to productivity problems. The expired public network is currently under partial replacement causing unstable water provision during the transfer from the old to the new system. Some consumers use suction pumps to household connections preventing others from getting sufficient amounts of water. Due to daily power cut offs for several hours, water pumping is interrupted and the problem increases monthly. The unaccounted-for water is estimated to be 37% including technical and administrative reasons as leaking pipes and taps and water stealing.

1.2 The private sector has become increasingly active to fill the gap in Sana'a

Private water supply has become increasingly active to fill the gap left by the Local Corporation. Already in 1997, the SAWAS Project estimated that 230 private wells were in operation in 1997 pumping between 15 and 20 MCM per year for Sana'a water supply. A first comprehensive study on the existing private water market in Yemen was conducted by Chris Handley in 1997. The study found the private sector providing an essential service. Prices of piped water were similar to those of the public network, offering a direct alternative to it. Tanker supply offered a 24 hour supply at that time although prices of tanker water were very high. Water purification shops appeared increasingly due to declining water quality.

A 2007 study confirmed the active and expanding role of the private sector and found water quality from private wells generally good. In a survey on private wells (189 operating wells) selling water to tankers (NWRA 2007) it was stated that some districts in Sana'a were not covered by public water supply leading to an increase in the active involvement of tankers. It was found that the water quality in general was good with some exceptions of slightly higher pH values, higher EC values and microbiological contamination of some wells. Most of these exceptions were found in the northern part of the city where the wastewater treatment plant is located.

The 2008 PSIA survey found that little more than a quarter of Sana'a households rely on the public network as a sole source. The 2008 PSIA Customer Satisfaction Survey confirmed that only 27% of Sana'a consumers rely on network coverage as their only source, while 13% buy expensive water from tankers as the main source. The survey also found out that 83% of the unconnected would be happy to pay for a water supply connection, and 59% would be prepared to pay for a sewage connection.

1.3 The NWSSIP Update: a policy shift

The 2008 NWSSIP Update for the first time proposed a policy shift to 'systematically include the private sector in service provision'. A strategy was to be developed for public private partnership and for private sector participation (1.3), making the private sector eligible for subsidies (e.g. on the basis of output based aid). In addition, it was proposed that private supply be considered for planning and monitoring purposes as part of the national water supply within the MDG targets provided that the water met the four criteria of 'safe, affordable, available and regulated'. Tanker supply was included amongst the seven eligible supply systems, provided that it met the four criteria.

1.4 The UWSS PSIA proposals

The UWSS Poverty and Social Impact Assessment (PSIA) of the Yemen urban water sector was carried out by the World Bank, GTZ and the Ministry of Water and Environment in 2008/2009. One recommendation was to implement the policy shift towards greater private water sector involvement in urban water services under the NWSSIP Update.

The PSIA confirmed that network supply was the most pro-poor approach, but recognized the many constraints to expanding the network rapidly. The study found that the private sector was an important provider of water supply and sanitation services, but that although partnership had long been a policy goal, attempts at large scale partnership with the private sector had proved impossible. However, the study identified some successful localized partnership approaches (e.g. at Ibb) and discussed a partnership for water supply to poor areas that was to be tested in Sana'a. The study recognized that government and the private sector had a history of mistrust of each other, but found some evidence that the organized private sector might be willing to cooperate.

The PSIA recommended the conduct of a national study complemented by local level technical assistance to identify and develop (for inclusion in the Business Plans) transaction models suited to partnerships between public and private sectors. Several models were

considered promising: (1) local area service or management contracts or concessions; (2) outsourcing of discrete functions; (3) bringing private wells, networks and tankers progressively within the regulatory framework in return for security of market access and possible support; (4) bulk delivery of water to the private sector; and (5) output based subsidies. A participatory process was recommended that included an information and communication program to inform both public and private stakeholders and address their concerns, to start changing perceptions and to dispel political resistance to partnerships between public and private sector. The PSIA included a quick assessment of the Sana’a situation and highlighted several alternative ways to increase access (see box).

1.5 The present study

The present study was originally aimed to test the potential for private service provision in order to contribute to the policy analysis as part of the PSIA. However, due to scheduling problems, the present study was delayed, and it has now been undertaken in order to provide the data and findings needed to underwrite a dialogue and decision making on how the private sector might be further involved in water supply and sanitation in the capital in line with the NWSSIP policies and the PSIA recommendations.

The objectives of this study were:

1. to identify key activities of private water providers (wells, networks, tankers and water purification shops) in Sana’a and peri urban areas.
2. to map the areas of operation of the previous mentioned providers.
3. to suggest possible policy shifts towards the involvement of the private water sector in water and sanitation services in Sana’a and surrounding areas.

<p>Alternative ways to increase access in Sana’a</p>
<p>The example of Sana’a shows that Yemen has to make some very hard choices. Current network coverage is only 40%, and meeting the MDG coverage target through expansion of the public network would cost almost \$2 billion.</p>
<p>In both water supply and sanitation, the private sector is currently filling the gap: in water supply through tankers, purification shops and local networks, and in sanitation through private cess pits and cess pit emptying. Costs are higher than public network services</p>
<p>The Sana’a LC could concentrate on teaming up with the private sector for the unconnected areas, and on consolidation of its current network systems rather than expansion, except for the sewage treatment plant, which is an environmental must. LC Sana’a is one of the few utilities which is already considering decentralized sanitation.</p>
<p>Non-conventional options for expanding services include: (i) regulating private wells selling tanker water (including pro-poor tariff structure), (ii) regulating the tanker fleet and providing certificates to hygienically suitable tankers, (iii) providing water to tankers from specific municipal wells, (iv) regulating construction of cesspits (technical assistance and specifications), (v) providing sewerage network feeding points for vacuum trucks (against fees), (vi) stimulating private investment in small water networks and eventually decentralized cluster sewerage solutions, (vii) provision of output-based aid approaches, and (viii) promotion of rooftop rainwater harvesting.</p>
<p><i>Source: Box 19 of the UWSS PSIA based on the NWSSIP Update and a key-informant interview with KfW Director, Sana’a, May 2008</i></p>

2. Methodology

2.1 Literature Review

Literature on private and public water providers was collected and reviewed from different sources as listed in the bibliography.

2.2 Survey Area

Based on empirical work and gathered information, the boundary of the survey area was defined as Sana'a city and peri-urban areas. The survey area (Map 1) covers about 665 km² and is divided into 10 districts as listed in Table 2.1 (Census 2004). The objective for taking administrative divisions into consideration was to select a random representative sample size.

Table 2.1: Name of districts in Sana'a (urban areas) and peri urban areas

No.	District
<i>Urban Areas</i>	
1	Old Sana'a
2	Shaoub
3	Azal
4	Al-Safiah
5	Al-Sabein
6	Al-Wahdah
7	Al-Tahrir
8	Maein
9	Al-Thawrah
10	Bani Al-Harith
<i>Peri Urban Areas</i>	
11	Part of Hamdan
12	Part of Sanhan and Bani Bahloul

2.3 Sample Size

A sample size according to the estimated population per water provider category was defined as indicated in Table 2.2. A representative sample size according to random distribution over districts was chosen whenever possible.

Table 2.2: The sample size per private water provider

Private Water Provider	Estimated population	No. of respondents
a. Wells	189 operating (NWRA 2007)	72
b. Networks	> 63 (Handley 1997)	20
c. Tankers	709 (NWRA 2007)	72
d. Water purification shops/plants	84 (MPWH 2009)	25

Total	>1048	189
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2.4 Questionnaires

The first draft of questionnaires (English) was prepared for a face to face interview with the owner of the enterprise whenever possible or an available employee, after translation into Arabic. However, after testing the questionnaires in the field, fine tuning was still needed to ensure proper entry of data into the statistical software program and to prevent data loss. The questionnaires were then adapted to get reliable answers (see final version at Annex 1)

2.5 Field Work

The field team (Annex 2) included one female (for interviews with respondents of water purification shops) and four male enumerators (wells, networks and tankers) who conducted the survey during an average of 15 working days beginning from early morning till 9pm in some cases. The general aptness towards the interviews was quite satisfactory, although the questionnaires were quite long.

2.6 Statistics

Data gathered from the field were entered into well developed statistical software tables using the SPSS 13 program. Outputs were tabulated and accordingly analyzed for interpretation.

2.7 Mapping

Several maps (Map 1-5, Annex 3) were prepared to visualize the project area and sample size and location, representing all four private water providers. Many location coordinates were available from former studies, some others were determined by a GPS.

2.8 Data Analysis and Interpretation

Output tables from statistics were carefully analyzed, interpreted and transformed into tables and figures for each private water provider.

2.9 Reporting

A progress report was submitted to the World Bank in December 2009 describing the main activities conducted during the previous period. The final draft report was written and overseen by a water expert and consultant for the World Bank. The report includes an introduction, methodology, results and discussion parts in addition to a short summary, annexes, bibliography, conclusions and recommendations (list of lessons and policy issues and opportunities).

3. Results and Discussion

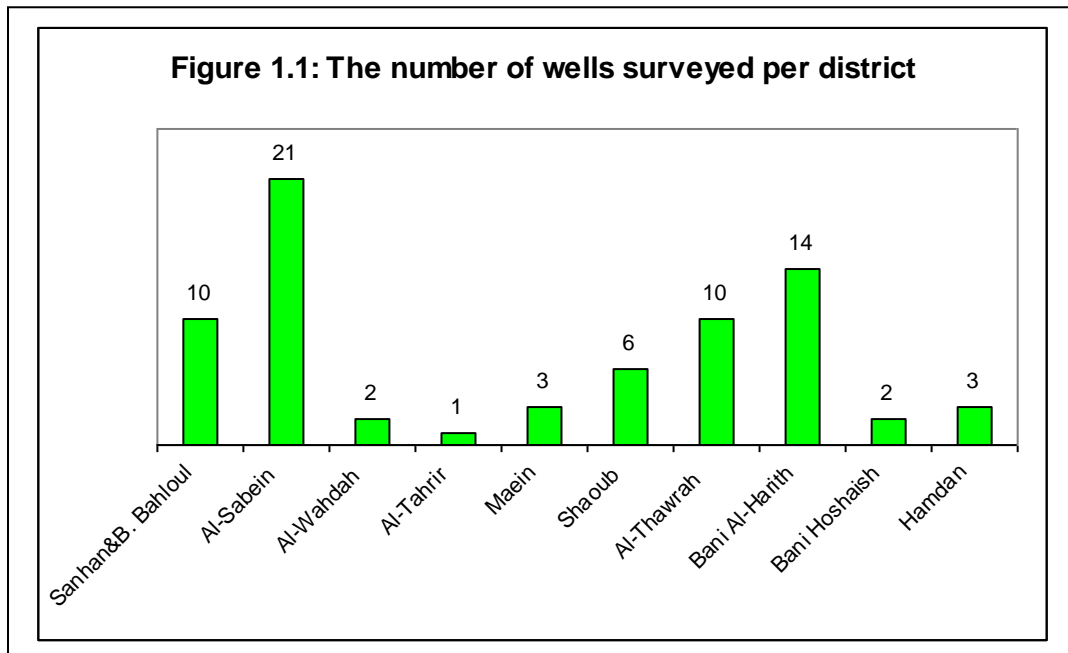
3.1 Wells

KEY MESSAGES

- Extrapolating from the survey, it is estimated that the 189 wells recorded by NWRA as serving the Sana'a urban market are supplying 27 MCM a year, more than the 23 MCM supplied by the Local Corporation in 2008. (3.1.2)
- Of the total water pumped, about 6% is supplied to agriculture, and the rest to urban consumption, largely through the tanker trade (78%) and networks (8%). (3.1.2)
- Over one third of wells have only started supplying the urban market in the last five years (3.1.1)
- On average, 5-10% of water is supplied free to mosques, standpipes and the poor. (3.1.2)
- Production costs vary considerably by district, depending on well depth, with reported costs from as little as Rls 12/m³ (\$0.06) to Rls 80 (\$0.40). However, reported costs are not very reliable. (3.1.3)
- About two thirds of wells surveyed (69%) were stated as 'licensed by NWRA'. In most cases, there was no license, but the well simply antedated the 2003 Water Law, and so was considered by the owner to be legal.
- The remaining 31% of wells were recently dug unlicensed wells (outside the law) (3.1.3)
- Only 4% of wells were metered. (3.1.3)
- Well depths vary between 30 m in Bani al Harith (north) and 700 m in Sanhan and Bani Bahloul (south) (3.1.3)
- About one third of wells surveyed were formally registered as businesses with the local council. (3.1.1)
- 33% of wells were deepened during their operating life due to declining productivity, some by as much as 350 m and up to four times.
- About 96% of respondents believe that their water is of good quality. (3.1.3)
- Nearly 49% of respondents have had some dealings with NWRA (or other public agency) regarding operating or deepening the well or otherwise running the business. (3.1.3)
- All wells made some provision for free supply to the poor. (3.1.4)
- Although lack of accounting systems make the data rather unreliable, net revenue/m³ appears to average Rls 40-50, making this a profitable business. (3.1.5)
- Although most wells are run as informal small businesses, about half of the well owners surveyed showed interest in developing their business and moving to a more formal status, such as working in partnership with the local community, the Local Council or the Sana'a Local Corporation. (3.1.6)

3.1.1 General

The number of surveyed wells is 72; their locations are given in Map 1. These wells are distributed over several districts as seen in Figure 1.1.



Many wells have been supplying the urban market for years, but over one third (37%) of the wells surveyed had only started to supply the urban market in the last five years. The years in business range between 1 and 50 years (Table 3.1) with about 37% of surveyed wells being since five years in business covering all districts except Al-Tahrir and Al-Wahdah districts (wells are between 30 and 40 years old, respectively). None of the wells at Sanhan are older than 18 years. In the last 50 years an average of one well was dug per year in Al-Sabein district except between 10 and 15 years. The two wells in Bani Hoshaiish are not older than 5 years and the 3 wells in Maein are not older than 10 years.

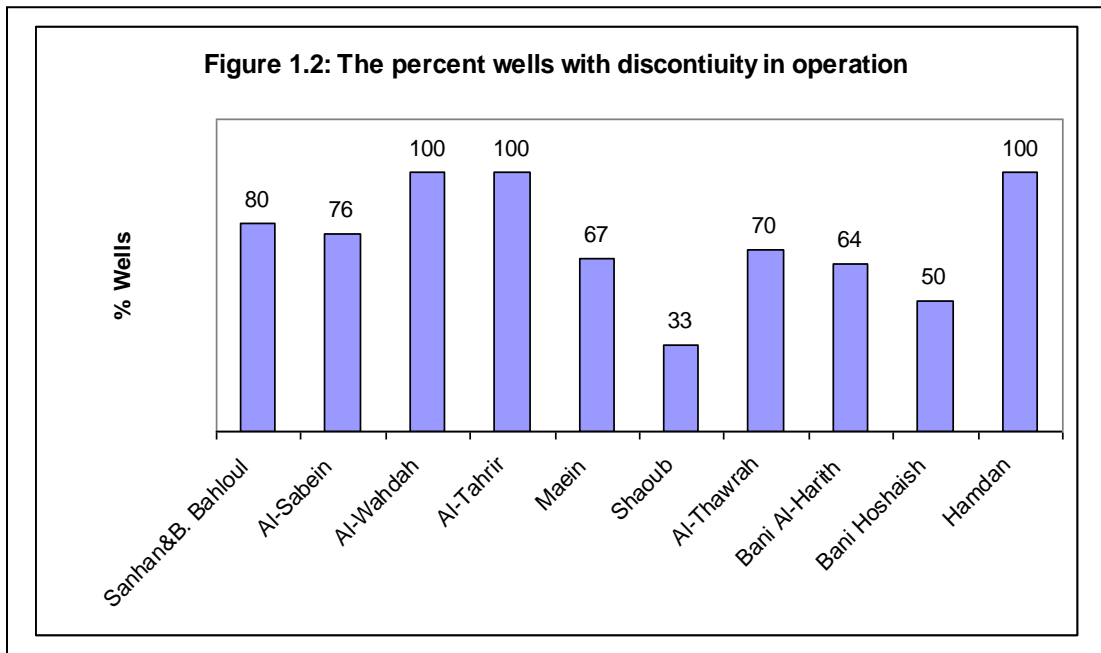
Table 3.1: The years in business of wells

Years	% Wells	Years	% Wells
1	3	15	6
2	7	18	4
3	6	19	1
4	10	20	6
5	11	22	1
7	3	25	6
8	7	28	3
9	1	29	1
10	6	30	6
11	1	32	1
12	3	40	2
13	1	50	1
14	3		

in

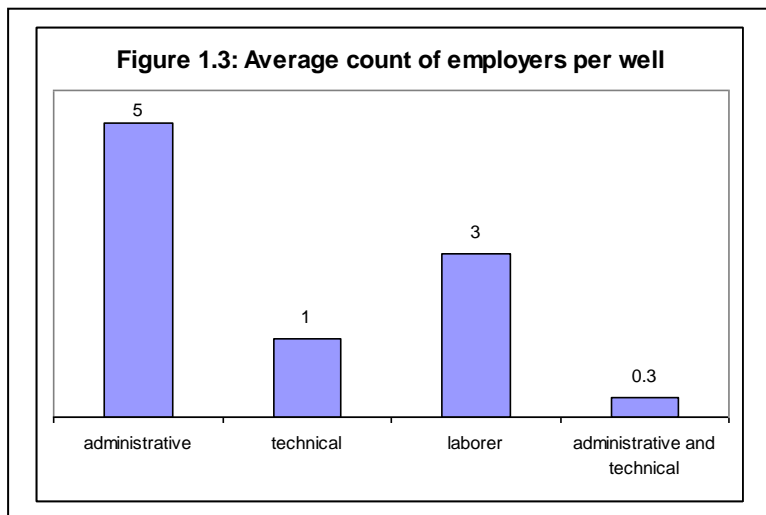
Almost all wells surveyed have to suspend operations periodically, largely due to technical problems. Discontinuity of operation occurred to most of these wells as shown in Figure 1.2, with 100% wells in Al-Wahdah, Al-Tahrir and Hamdan districts during their years in business. The least discontinuity of operation was observed for wells Shaoub. About 57% of wells refer discontinuity to technical reasons, 8% to deepening and 5% to financial and administrative reasons. The study indicated that most deepening took place in the southern areas of Sana'a (50 % in Sanhan and Bani Bahloul and 12.5% in Al-Sabein district). Another 12.5% of deepening was observed in Al-Wahdah district. Discontinuity referred to dryness is mainly

recorded in Bani Al-Harith and Hamdan district.



The number of employees at wells is in general, slightly higher in summer than in winter seasons due to higher water consumption.

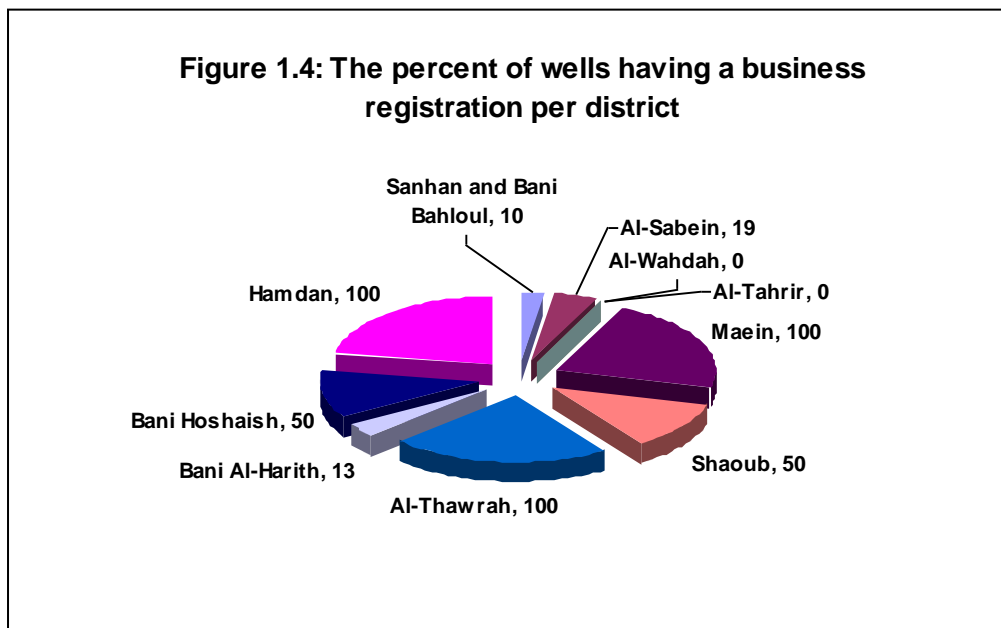
Most work is executed by administrative employees who are mainly responsible for financial management (collection of revenue), followed by labourers who are mainly responsible for filling up tankers (Figure 1.3).



Only one technician (in most cases comes on call) is needed per well and only few wells have administrative employees who are in addition responsible for technical problems.

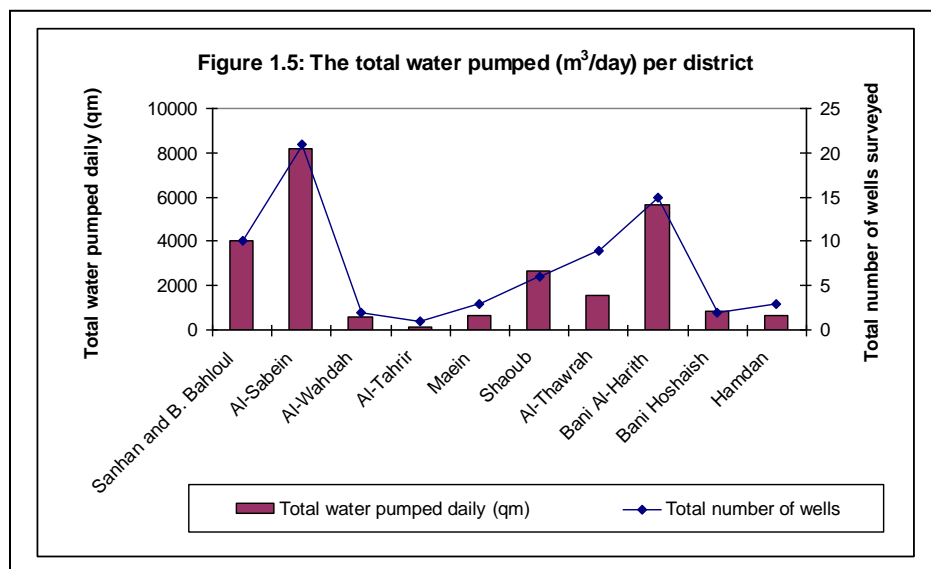
About one third of wells (36%) have business registrations at the local council, with 100% in Hamdan, Al-Thawrah and Maein districts. About 58% of wells don't have a business registration (no dealing with local council), whereas 6% of respondents are not informed about any registration (Figure 1.4).

Figure 1.4: The percent of wells having a business registration per district



3.1.2 Service provided

Extrapolating from the survey, it is estimated that the 189 wells recorded by NWRA as serving the urban market are supplying 27 MCM a year, more than the 23 MCM supplied by the Local Corporation in 2008. The daily water pumped ranges between 25 m³ in Al-Sabein district and 1270m³ in Sanhan and Bani Bahloul with an average of 554 m³ daily over all



districts. As the number of wells are representative samples of districts, most water is pumped in Al-Sabein, Bani Al-Harith and Sanhan districts (8183 m³, 5675 m³ and 4053 m³ daily, respectively) All 72 wells pump about 29,000 m³ of water per day (about 10.6 MCM/year). A

total estimation of water production at 189 private wells (NWRA 2007) operating in Sana'a and sub urban areas would then be around 27 MCM/year, significantly more than that produced by LC during 2008 (22.5 MCM/year).

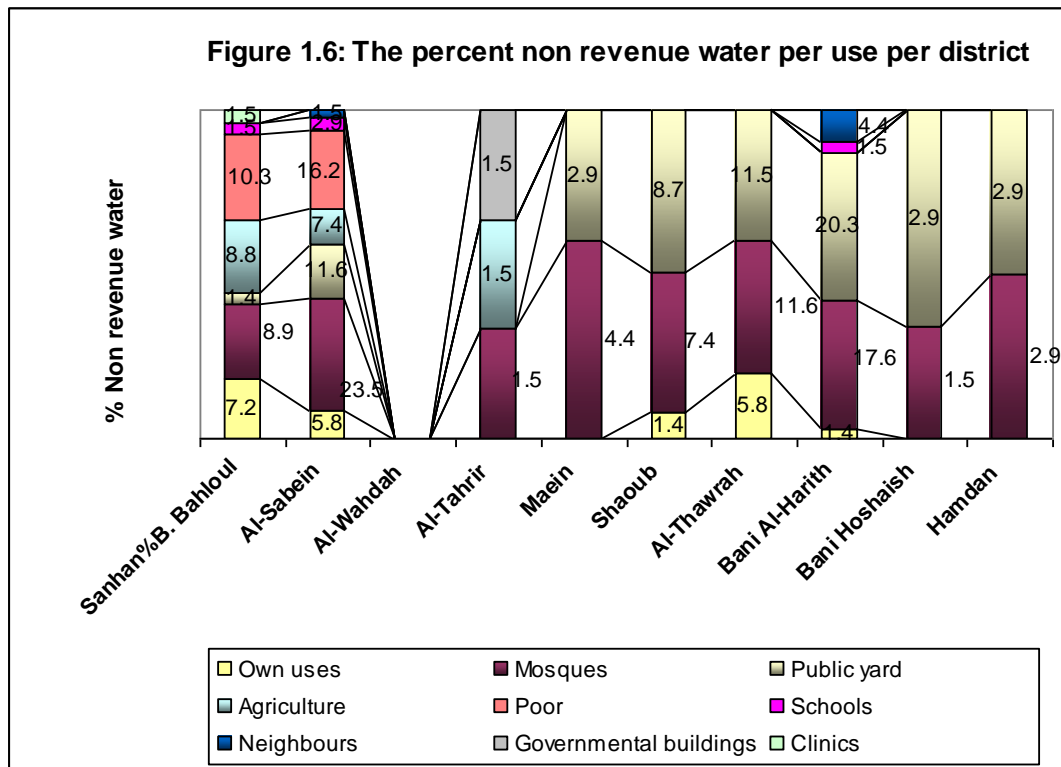
Of the total water pumped, about 6% is supplied to agriculture, and the rest to urban consumption, largely through the tanker trade (78%) and networks (8%). The total break down of uses or sales (Table 3.2) reflects clearly that tankers are on the top of uses/sales in all districts with an average of 2272 m³/daily. Networks follow tankers in water supply to the

customer with an average of about 234 m³/daily, particularly in the southern areas as Sanhan, Al-Sabein and Al-Wahdah districts. No private networks are found in Hamdan, Bani Hoshaiish and Al-Wahdah districts. Wells provide agricultural areas in almost all districts (mainly in Bani Al-Hareth) except in Al-Wahdah district. About 85% of farms provided with water use less than 50m³/day. Other water uses/sales include schools, neighbours and army camps. The total break down of uses is not consistent with the total water pumped per day. Since most wells do not have registrations for business expenses and revenues the given data are estimated averages. The average of both values (total water pumped daily = **25,000 m³** and total break down of uses = **28,952 m³**) is **27,000 m³** a rough overview of the giving a rough overview of the total water produced per day.

Table 3.2: The total break down of uses/sales (m³/day) over districts

Total break down of uses/sales (m ³ /day)	Sanhan and B. Bahloul	Al-Sabein	Al-Wahdah	Al-Tahrir	Maein	Shaoub	Al-Thawrah	Bani Al-Harith	Bani Hoshaiish	Hamdan	Total count	Percent
Own use	64	103	10	10	9	20	22	19	0	0	257	1%
Agriculture	205	202	0	40	35	160	28	658	250	143	1721	6%
Mosques	95	434	0	5	65	30	98	102	10	10	849	3%
Networks	290	1823	175	0	5	10	8	30	0	0	2341	8%
Tankers	3290	9010	400	0	510	2300	1365	4650	600	590	22715	78%
Other uses	114	602	95	95	4	10	29	105	10	5	1069	4%
Total	4058	12174	680	150	628	2530	1550	5564	870	748	28952	100%

On average, 5-10% of water is supplied free to mosques, standpipes and the poor. About 43% of wells do not get revenue for 5% of the total water sold mainly in Bani Al-Harith and Al-Sabein districts (Figure 1.6). Another 14 and 13% of respondents do not get revenue for 10 and 15% of their total sold water, respectively. The two wells at Al-Wahdah districts get revenue on all their water produced. Most non revenue water goes for mosques followed by public yards, followed by poor.



3.1.3 Water sources

Production costs vary considerably by district, depending on well depth, with reported costs from as little as Rls 12/m³ (\$0.06) to Rls 80 (\$0.40). However, reported costs are not very reliable. According to results (Table 3.3), water production costs vary widely in the study area between 11 to 17,000 YR/m³ (both in Al-Sabein district). The highest mean production cost was observed in the southern districts of Sana'a (Al-Sabein with 6,091 YR/m³ and Sanhan with 2,702 YR/m³) and the lowest in Bani Hoshhaish (25 YR/m³) and Al-Tahrir (609,126 YR/m³). The deep sandstone aquifer in the southern districts is the main reasons for high production costs.

Table 3.3: The production costs of water over districts

Production cost (YR/m ³)	Al-Wahdah	Al-Tahrir	Maein	Shaoub	Al-Thawrah	Bani Al-Harith	Bani Hoshhaish	Hamdan
Min	24	26	70	25	12	20	25	33
Max	80	26	70	30	70	35	25	70
Mean	52	26	70	58	35	67	25	56
Total	104	26	140	173	313	401	25	168

About two thirds of wells surveyed (69%) were stated as 'licensed by NWRA'. In most cases, there was no license, but the well simply antedated the 2003 Water Law, and so was considered by the owner to be legal. According to the water law no. 33, 2002 paragraph 33, wells are allowed to be dug or deepened after issuing a permission or license by NWRA. Since most wells were dug before this law, they were considered licensed. The 31% unlicensed wells in this study are illegally, recently drilled wells.

85% of wells have diesel water pumps, 14% electric pumps and 1% operates in both systems. Only 4% of all wells are metered.

Water is almost pumped from the well into a storage tank (Photo 1.1) fixed near to the well. The capacities of such tanks vary between 6 and 2000 m³, with highest capacities found in Al-Sabein district. The time to fill up these tanks ranges according to their capacities between 30 and 1,440 minutes with an average of 340 minutes.

Photo 1.1: A storage tank located near by the well

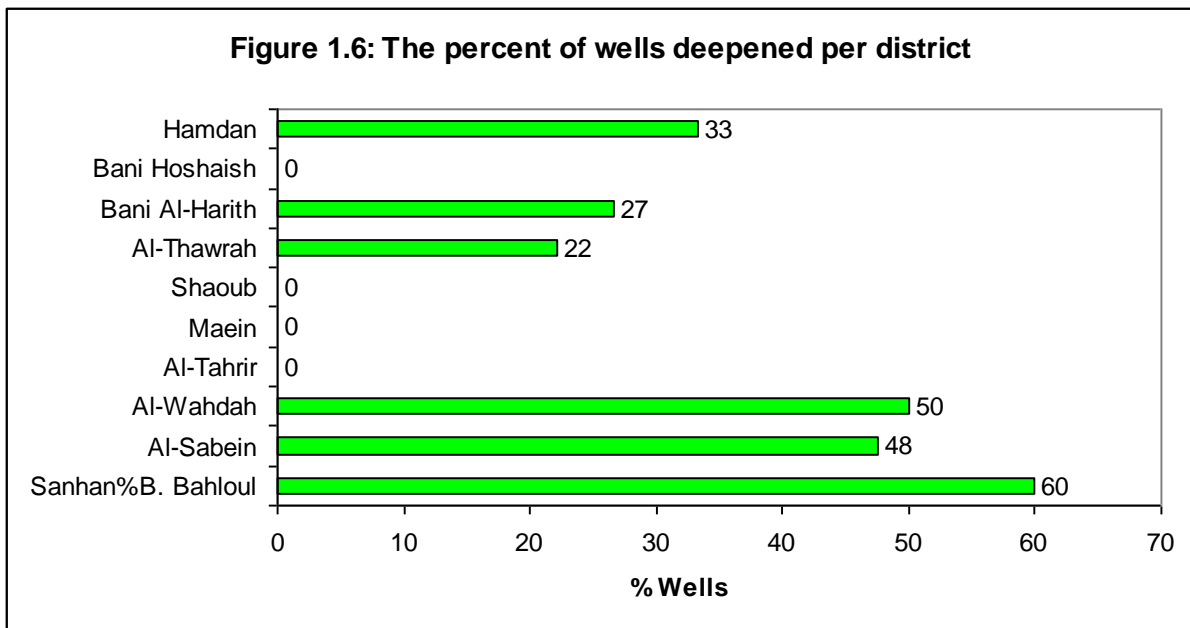


Well depths vary between 30m in Bani Al-Harith (North) and 700m in Sanhan and Bani Bahloul (South). More than 50% of wells in Sanhan and Al-Sabein districts have well depths higher than 400m where water is found in the deeper Tawila sandstone aquifer. Even in the northern Bani Al-Harith and in Al-Thawrah districts, the depth of one well respectively was recorded to be 500m (Table 3.4).

Table 3.4: The well depths per districts

Well depths (m)	Number of wells									
	Sanhan and Bani Bahloul	Al-Sabein	Al-Wahdah	Al-Tahrir	Maein	Shaoub	Al-Thawrah	Bani Al-Harith	Bani Hoshaiish	Hamdan
30								1		
50								1		
60							1			
90			1							
100		1					1			
120			1	1						
150		1						1		
180								1		
200							1			
250	2					3	2	1	2	
270						1				
300	1	1				1		5		1
320		1				1	1			
339					1					
350		2					1	2		1
360	1									1
370							1			
380								1		
400		3			2			1		
420		3								
450	2	2								
500	2	7					1	1		
550	1									
700	1									

33% of wells were deepened during their operation life due to declining productivity, some by as much as 350 m and up to four times. The percent of wells deepened per district is shown in Figure 1.6 with the highest percent in Sanhan and the lowest in Al-Thawrah district). In Shaoub, Maein, Bani Hoshaiish and Al-Tahrir no deepening of well was undergone. Deepening was carried out by 20m in Al-Thawrah and Al-Wahdah districts till 350m in Sanhan and Al-Sabein districts with deepening frequencies varying from 1 to 4 times. Insertion of new pipes is the common practice in case wells get less productive.



About 96% respondents believe that their water is of good quality, 1% of fair quality (Maein) and 3% respondents do not know about well water quality. Although 14% respondents stated that water quality is declining, no one was treating the water.

Nearly 49% respondents have had some dealings with NWRA (or other public agency) regarding operating or deepening the well or otherwise running the business, particularly wells located at the center of Sana'a city and Bani Hoshaiish. This percent is relatively low comparing with the number of licensed wells (69%) and can be referred to several reasons. One reason is that many wells were deepened without referring to NWRA. The other reason is that some wells drilled before 2003, although becoming by default licensed after 2003, did not have any dealings with NWRA, since there was no need for deepening the wells yet.

3.1.4 Water sources for the poor

All wells made some provision for free supply to the poor. The study indicated that 95.8% out of the surveyed interviewees assure the presence of poor in their neighborhood. About 92% respondent stated that poor get water from a stand pipe at the well, 6% respondents stated that they get water from the mosque, 4% from tankers and 3% from networks.

3.1.5 Business aspects

Although lack of accounting systems make the data rather unreliable, net revenue/m³ appears to average Rls 40-50, making this a profitable business. The business revenues and expenditures are listed in Table 3.5. The least total water billed monthly was observed in Al-Thawrah district (2,100 YR), while the highest amount was observed in Al-Sabein district (35,000YR). The total water billed monthly in all districts was about 49 Million YR. The minimum and maximum monthly net revenues of -60,000 YR and 3,32 Million YR were both recorded in Sanhan The least investment expenditures of 60,000 YR over the last year were found at a well in Al-Thawrah district, whereas two wells at Al-Sabein district have had expenditures of 15,000,000 YR each well. The monthly net revenue is not in consistence with the difference between monthly revenues and monthly expenses due to the absence of such registrations. All data recorded were estimated by the respondents at the time of interview. However, the monthly net revenue is not that bad.

Table 3.5: Business revenues and expenses

	min	max	average	Average RIs/m3
Monthly business expenses (YR)	3500	1,000,000	255,242	29
Monthly water billed (m ³)	2,100	35,000	8,823	
Monthly revenue (YR)	0	3,800,000	584,197	66
Monthly net revenue (YR)	-60000	3,320,000	446,500	51
Investment expenditures over last year (YR)	0	150,00,000	1,199,347	

Reflecting levels of unaccounted for water (see above) data indicated that Al-Sabein district show the highest estimate of non-revenue water with 28.6% followed by Bani Al-Harith of 21.4%.

46% of respondents are facing problems during the operation of wells; 24% of them complain about the unavailability or high diesel costs, 17% complain about high costs of spare parts, and 13% of declining in water quantity. Among other problems are, stealing meters and water, electricity cut offs, maintenance and partner conflicts.

3.1.6 Development aspects

Although most wells are run as informal small businesses, about half of the well owners surveyed showed interest in developing their business and moving to a more formal status, such as working in partnership with the local community, the Local Council or the Sana'a Local Corporation. The business of 22% wells is organized in terms of revenue collection according to consumers, mainly tankers,...etc. (Table 3.6). About 25% of respondents stated that their organization activities at wells are useful and effective and of 18% honest.

Table 3.6: Development aspects of wells

	Yes	No	Don't know
Business is currently organized in any way.	22	78	0
Organization is useful and effective.	25	47	28
Organization is honest.	18	53	29
Respondent is interested in developing in a better way	28	64	8
Respondent considers a partnership with the local community	51	44	5
Respondent considers investing in a private distribution network on terms agreed with local community	49	47	4

28% of respondents are interested in developing in a better way through:

- Increasing production 30%
- Establishing house connections 25%
- Extending and developing networks 20%
- Purchasing a new pump 5%
- Changing the pump 5%
- Establishing an accountant system 5%
- Deepening the well 5% (Al-Thawrah and Al-Sabein districts)
- Establishing a treatment plant 5%

Al-Wahdah and Al-Tahrir districts are not interested in developing their business furthermore.

51% of respondents would consider a partnership with the local community- e.g. selling water to the local community through pipes, whereas 49% of respondents would consider investing

in a private distribution network on terms agreed with the local community (excluding Al-Tahrir, Bani Al-Harith, Bani Hoshhaish and Hamdan districts) through:

- Taking turns in managing the business
- Administrative organization using sealed bills
- Billing according to flat rates
- Organizing accountings
- Scheduling water distribution
- Sharing in maintenance expenditures
- Managing tankers rotation
- Solving technical issues

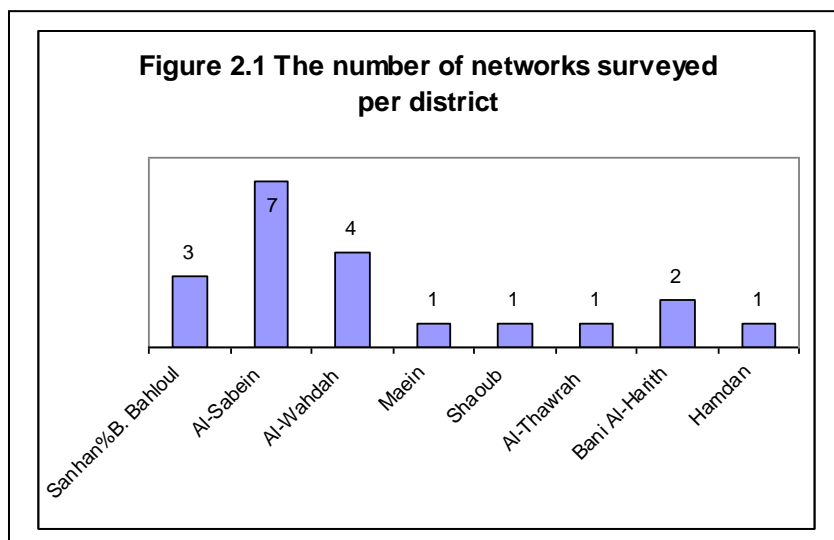
3.2 Networks

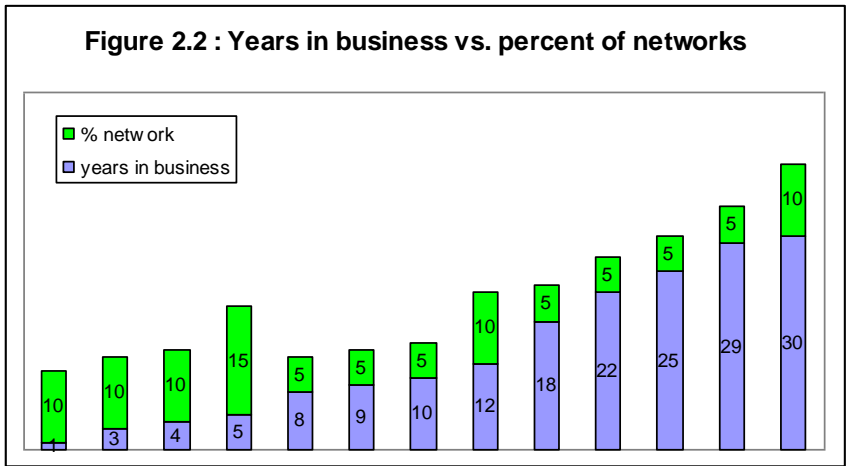
KEY MESSAGES

- Networks have been closing down, but others have been starting up, particularly in new fringe development areas in the south of the city. (3.2.1)
- Three of the networks surveyed serve more than 400 households, of which one has metered house connections.
- Networks supplied, on average, 5-20 m³/month to individual households, except in areas of large rich villas where supply was up to 50m³ or more per household. (3.2.5)
- About 25% of networks have 24 hour water supply (3.2.5)
- Only one quarter of networks have installed a meter at households, and only one fifth of those meters were reported as working properly. (3.2.5)
- No private network provides sanitation services to the population. (3.2.6)
- Reported costs and revenues are unreliable, but average water bills could be as high as Rls 150/m³, and net revenue (before depreciation) a significant proportion of that. Production costs average Rls 47/m³ (3.2.7)
- Quite high investment expenditures were reported, suggesting that networks may indeed be a profitable growth sector. (3.2.7)
- About half the networks surveyed are registered as businesses but only two were members of business associations
- All networks make provision for the poor
- The government provides neither regulation nor support.
- Networks are typically owned and operated by well owners.
- About 45% networks have organized business practices (3.2.8)
- More than 50% of network owners would consider a partnership with the community, local council or Local Corporation (3.2.8).

3.2.1 General

The number of private networks counted in 1997 (Handley) was estimated to be over 63. During the current field survey, many of these networks were found to no longer exist, and only 20 networks were studied with locations shown on Map 3. Their distribution over districts is reflected in Figure 2.1. The years in business of these networks range between 30 years and less than one year.





Surprisingly, as networks have been closing, about 45% of the networks under study have been developed during the last five years (Figure 2.2).

Box 1: A success story

Al-Fakih well (360m deep) is located in Beit Bous (Sanhan district) and has been deepened twice. The well is connected to a private network system (same owner). The total number of households served is 400; 350 households through single connections and the rest through shared connections. In addition it serves one mosque and one school. All house connections are metered and accordingly paid for. The average monthly household consumption is 12m³. The network owner complains about stealing of meters and water and about the damage of the network during road constructions or maintenance. Nonetheless, the business is profitable - the monthly net revenue of the network is about 300,000 YR – and the consumers are satisfied.

About 80% of surveyed networks faced discontinuity in operation which is mainly referred to technical problems (Table 3.7).

Table 3.7: Reasons for discontinuity in operation of networks

	% Repondents
Financial	25
Technical	56.3
Others	18.7

The number of employees per network varies between 1 and 7 employees. 40% networks have only one administrative or technical employee or one labourer.

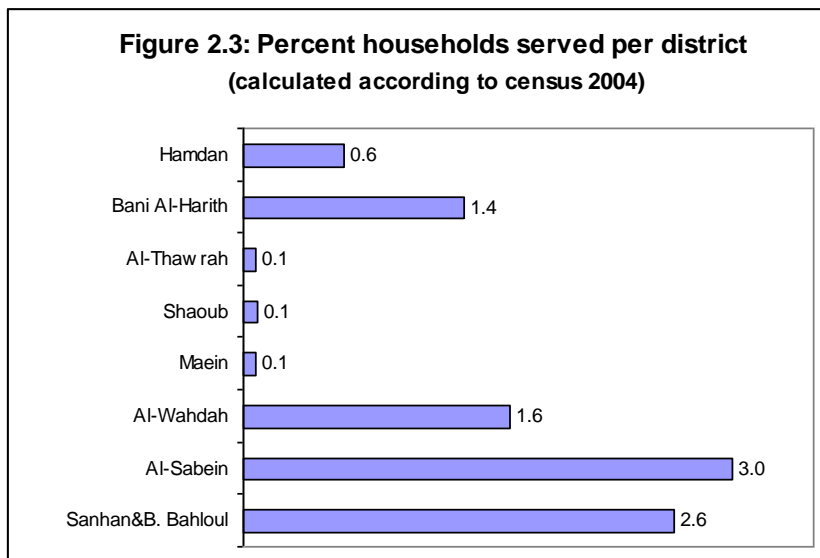
Less than 50% of networks have a business registration at the local council, while only 10% have a membership in a business association (Table 3.8).

Table 3.8: Business registration and membership in business association

	Yes	No	Total
Business registration	45	55	100
Membership in a business association	10	90	100

3.2.2 Population served

The total number of households served by the 20 networks is 2,478. Networks at Al-Sabein and Sanhan districts serve 3 and 2.6% of households in these districts, respectively. Much less coverage is observed in Al-Thawrah, Shaoub and Maein districts (0.1% households).

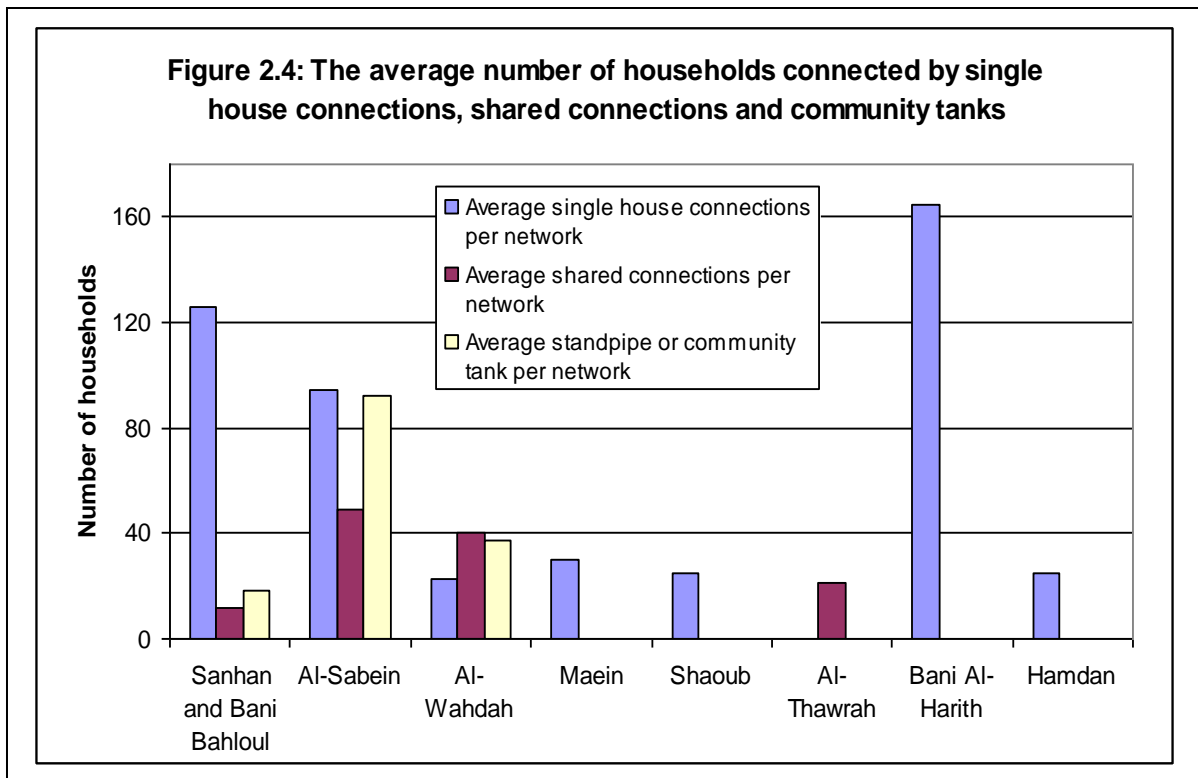


	Number of households								Total count
	Sanhan and Bani Bahloul	Al-Sabein	Al-Wahdah	Maein	Shaoub	Al-Thawrah	Bani Al-Harith	Hamdan	
House connections	377	662	91	30	25	0	330	25	1540
Shared connections	36	344	160	0	0	21	0	0	561
Standpipe or community tank	55	645	150	0	0	0	0	0	850
Total households per district (2004)	16890	44730	15933	40381	30293	25200	24345	4041	201813
Total served networks	3	7	4	1	1	1	2	1	20

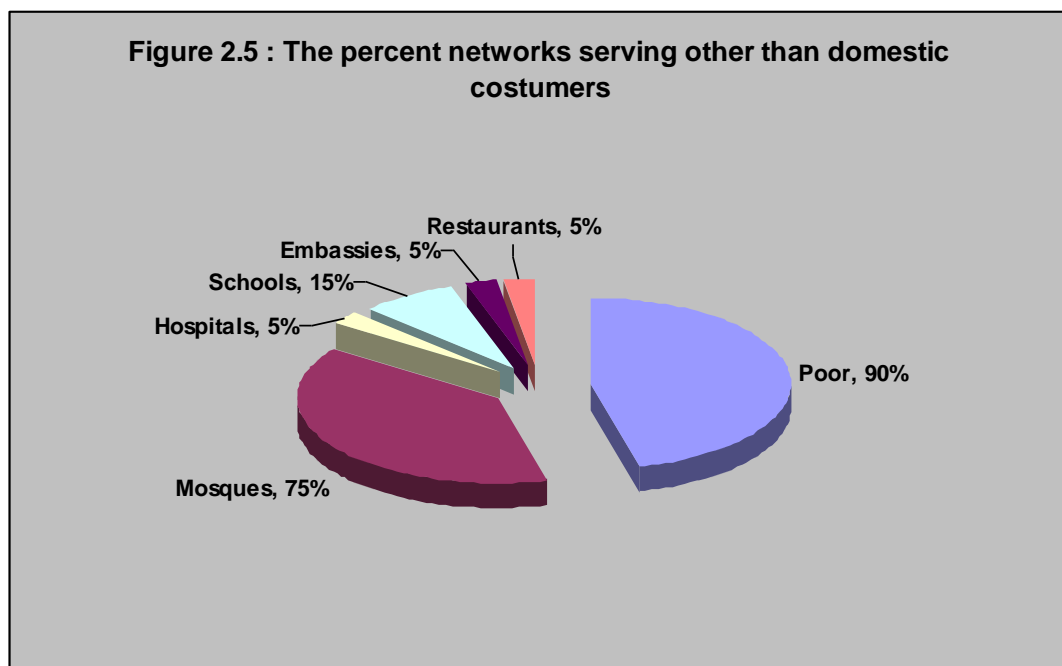
The number of households served per district is given in Table 3.9. Most networks are connected through single house connections (1,540 households), followed by standpipes or community tank service (850 households) and 561 households have shared connections (apartment blocks).

Table 3.9: The number of households served per district according to type of service

The highest number of households per network as single house connections was recorded in Bani Al-Harith (165 household/network) while the highest number of households per network in terms of shared connections (apartment blocks) was recorded in Al-Sabein district (49.1 household per network) as indicated in Figure 2.4.



In addition to serving households, private networks serve other customers (Figure 2.5). About 90% of networks serve poor, 75% serve mosques and 15% serve schools. Other customers are embassies, restaurants and hospitals each with only 5% of network coverage.



3.2.3 Water source

The cost of water at the source varies between 13 YR/m³ in Sanhan and 100 YR/m³ in Al-Sabein district, with an average of about 47 YR/m³.

70% of networks get their water directly from the well, 25% from the main storage tank and 5% from a Sabeel (public drinking fountain or tap). 80% of wells (source) are licensed while no well is connected to the network by a meter. The lowest well depth (90m) was recorded in Al-Wahdah district with the highest depth of 700m in Sanhan. More than 50% of wells in Al-Sabein have depths of 500m. The times of deepening range between one and 4 times per well with main occurrences in Al-Sabein and Sanhan districts. 6 out of 8 deepening events took place in the past two years, while the remaining two wells were deepened 3 and 10 years ago in Sanhan district. These wells were deepened by minimum 20m (Al-Wahdah district) and maximum 300m in Sanhan.

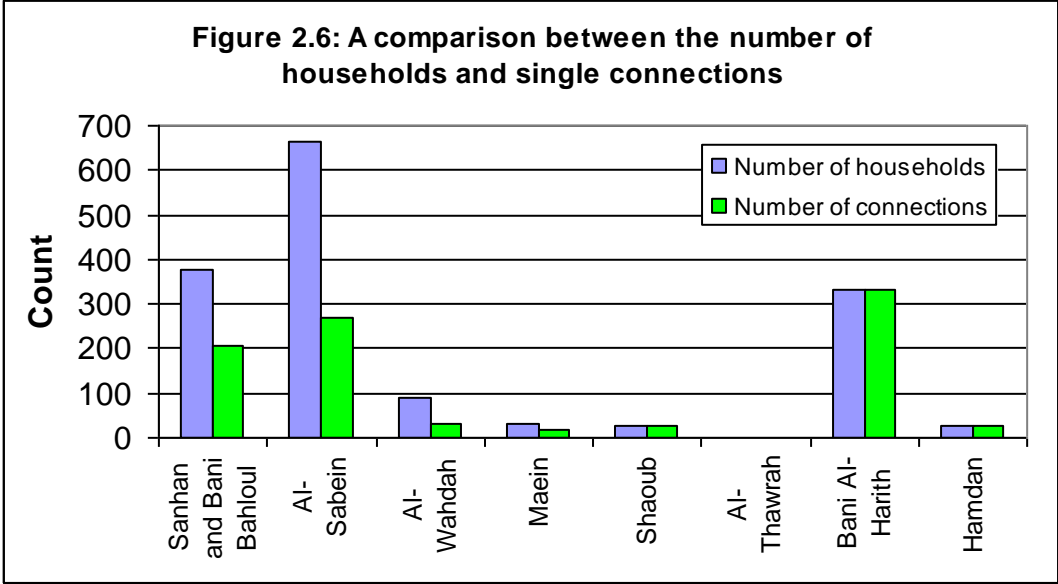
The attitude of respondents towards the water quality is 95% good and only 5% fair. Water is in general not treated.

3.2.4 Water sources for the poor

About 90% of network respondents have poor in their neighbourhood; all of these poor get water from a public tap. In Hamdan poor get water also from mosques and in Al-Wahdah they get water by connecting a temporary hose to the Sabeel tap.

3.2.5 Consumer service

Networks supplied, on average, 5-20 m³/month to individual households, except in areas of large rich villas where supply was up to 50m³ or more per household. The number of connections does not fit in all cases to the number of connected households as seen in Figure 2.6. It can be concluded that more than one household is served by a single connection as in Sanhan, Al-Sabein, Al-Wahdah and Maein districts (stated earlier in Handly’s report 1997).



The highest average number of households per one apartment block is observed in Al-Sabein district, followed by Al-Wahdah district (Table 3.10).

Table 3.10: The number of households connected by shared connections per district

	Sanhan and Bani Bahloul	Al-Sabein	Al-Wahdah	Al-Thawrah
Number of households	36	344	160	21
Number of shared connections (apartment blocks)	2	6	3	1
Average households per one shared connection	18	57	53	21

The highest average monthly consumption of water for single house and shared connections was observed in Al-Sabein district (54m^3 and 372m^3 , respectively) followed by Al-Wahdah district with 47m^3 and 212m^3 , respectively (Table 3.11). These values are relatively high compared to the lowest average of single house connection consumption of 5m^3 found in Maein district and to the lowest shared connection consumption of 50m^3 in Al-Thawrah district. Al-Sabein district is known for its large villas with prominent and rich occupants, which might reflect the high water consumption. The monthly water consumption using standpipes or community tanks was 73m^3 , 117m^3 and 160m^3 in Sanhan, Al-Sabein and Al-Wahdah, respectively.

Table 3.11: The average monthly consumption per single and shared connection and per standpipes or tanks per district

About 25% of networks have 24 hour water supply, mainly in Sanhan and Al-Sabein districts. Only, 25% of networks have installed a meter at households (Table 3.12) and only one fifth of those meters were reported as working properly. Installed meters would definitely regulate the consumption per household leading to an exact calculation of water charges and decreasing the possibility of non revenue water.

Table 3.12: The number, total count and total percent of networks having 24 hour water supply and meters at households

	Sanhan and Bani Bahloul	Al-Sabein	Al-Wahdah	Maein	Al-Thawrah	Total count	Total %
24 Hour water supply	2	2	0	0	1	5	25
Water metered at households	1	2	1	1	0	5	25

3.2.6 Sanitation

No single network provides sanitation services to the population. Wastewater is disposed either to the public sanitation network or to cess pits. Provision of sanitation services would probably further increase the income of network owners and may give safe solutions in discarding their waste water regularly instead of sucking out full cess pits or digging new ones.

Average monthly consumption (m^3)	Sanhan and Bani Bahloul	Al-Sabein	Al-Wahdah	Maein	Shaoub	Al-Thawrah	Bani Al-Harith	Hamdan
Single house connection	9	54	47	5	12	0	7	20
Apartment block	110	372	212	0	0	50	0	0
Standpipes or tanks	73	117	160	0	0	0	0	0

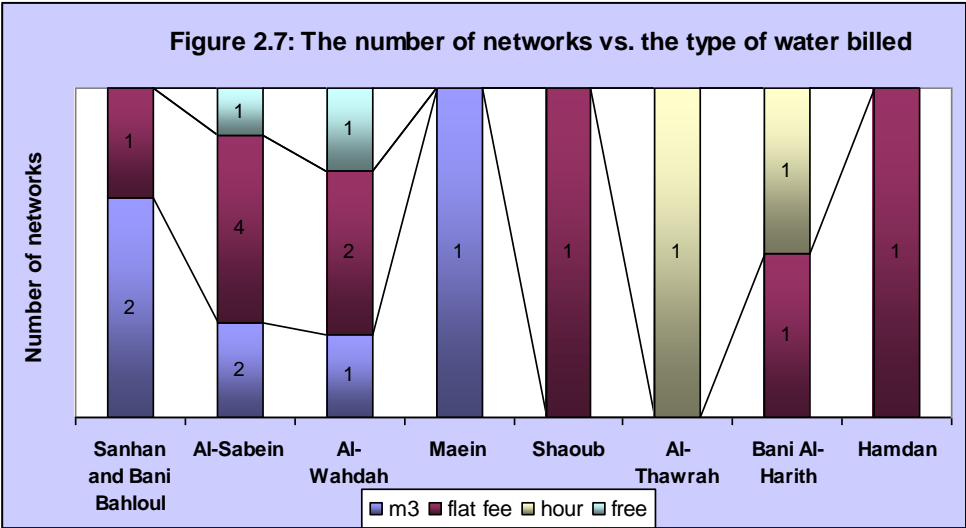
3.2.7 Business aspects

Reported costs and revenues are unreliable, but average water bills could be as high as Rls 150/m³, and net revenue (before depreciation) a significant proportion of that. Quite high investment expenditures were reported, suggesting that networks may indeed be a profitable growth sector. The revenues and expenditures of private networks are listed in table 3.13. The lowest average monthly water billed of 30m³ was recorded in Sanhan while the highest water billed of 3,000 m³ was in Sanhan and Bani Al-Harith. Two networks in Al-Sabein and Al-Wahdah districts have had no monthly revenues, while the highest revenue of 600,000 YR/month was observed in Al-Sabein and Sanhan districts. The average monthly business expenses vary from 390 YR in Sanhan to 400,000 YR in Al-Sabein district. One network at Al-Wahdah district has monthly net revenue of -40,000, while the highest net revenue of 300,000 YR was recorded in Sanhan. Non revenue water counts for free water for the poor. The average monthly net revenue of 130,000 YR is quite reasonable, however very high investment expenditures are drastic and may lead to the ruin of the enterprise. About 75% of networks have had investment expenditures over the last year with the highest investment in Al-Wahdah district.

Table 3.13: Revenues and expenditures of private networks

	Min	Max	Average
Average monthly water billed (m ³)	30	3,000	877
Average total monthly revenues (YR)	0	600,000	139,143
Average monthly business expenses (YR)	390	400,000	86,216
Average monthly net revenue (YR)	-40,000	300,000	130,000
Average investment expenditures over last year (YR)	0	19,000,000	9,500,000
Estimate of non revenue water (%)	1	35	11

About 30% of networks bill their water according to cubic meters consumed, 50% of networks according to a flat rate, 10% per hour and the remaining 10% are for free (Figure 2.7).



Half of metered networks have a step tariff system (higher per m³ rate for higher metered total consumption), about 33% have a tariff system per size of the household and 17% of networks do not have a tariff system.

The principal problems faced by networks can be summarized in the following points:

- Unwillingness to pay bills
- Annoyance by the municipality
- Network demolishing by road constructions
- Unprofitable house connections
- Diesel crisis
- High investment expenditures
- Maintenance

The government provides neither regulation nor support. Networks are typically owned and operated by well owners.

3.2.8 Development aspects

About 45% networks have organized business practices, including billing (35%), organized work based on participation (5%), water saving (5%) and regulating pumping hours (10%). About 50% of respondents are interested in further development of their business in terms of expanding the network, using an accounting system, introducing meters and increasing productivity.

About 60% of respondents would consider a partnership with the community e.g. selling water to the local community through pipes. 60% of respondents would consider investing further in a private distribution network on terms agreed with the community.

The key points respondents would want to see in a partnership agreement with the local community are:

- Assurance of water source (40%)
- Water supply all day long (30%)
- A better role of community in monitoring price, quantity and quality (30%)
- Community investment in networks (10%)
- Facilitating operations (10%)

3.3 Tankers

KEY MESSAGES

- The tanker business is growing rapidly – 50% of the sample started up in the last four years, and 15% in the last one year.
- Three quarters of tankers are run by owner operators, working locally and serving 7-8 households each day, delivering an average of 24m³ daily.
- Water deliveries are higher in summer than in winter, showing how the tanker trade is a flexible way of meeting peak demand during the hot months.
- The estimated number of tankers is 709 (NWRA 2007), and tankers are serving about 50% of all Sana'a households each month (3.3.2)
- Tankers also supply many other water users within the city: workshops, industry, construction, government and private organizations. (3.3.2)
- Tanker water is not treated (3.3.2) but quality is considered good by the drivers (3.3.3)
- Very few tanker owners are members of a business association, although there is some cooperative organization, for example of queuing at the well.
- Average profit per day is about Rls 3,600 (\$18), equivalent to Rls 150 (\$0.75) per m³. Average selling price is about Rls 274/m³ (\$1.40/m³).
- Water cost at the source is much higher in South Sana'a than in the North, and this is reflected in higher sales prices.
- 90% of respondents stated that well depths are declining.
- 65% of respondents would consider a system under which they are officially licensed and regulated (3.3.6)

3.3.1 General

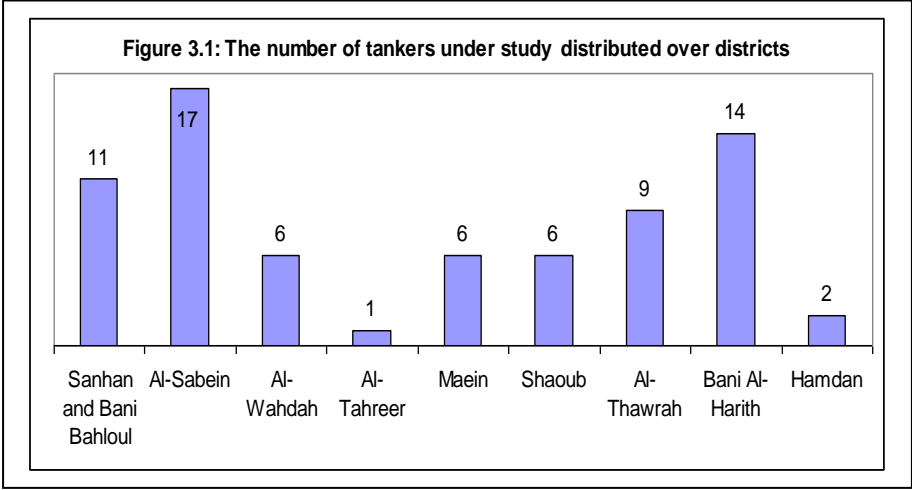
Former studies revealed an estimated number of 709 tankers (NWRA 2007) in Sana'a city. The number of tankers surveyed in this study was 72. Since Water tankers (Photo 3.1) are

Photo 3.1: Enumerator interviewing a tanker driver near well



unregistered mobile water providers delivering water to different districts, it is not possible to determine the exact number of tankers moving within a definite area. All data referred to districts are therefore not reflecting a real sample size.

Map 4 (Annex 1) shows the locations of tankers included in the interviews at registered and unregistered private wells. However, tankers developed a water delivery system by having the service point at locations other than the wells for easier access to the customer. No interviews in this study were conducted at such locations. The distribution of studied tankers over districts is presented in Figure 3.1.



According to Table 3.14 tanker deliveries have been growing rapidly. The high percent (15.3%) of tankers in business since last year gives a clear evidence for the great water demand in Sana'a City and sub-urban areas and that the LC is unable to serve a great proportion of Sana's population. About 50% of tankers studied started their business in the last 4 years.

Table 3.14: Years in business of tankers per respondent number

Years	1	2	3	4	5	6	7	8	9	10	11	12	15	16	18	19	20	30
% Tankers	15.3	11.1	11.1	12.5	6.9	5.6	9.7	4.2	2.8	6.9	2.8	2.8	1.4	1.4	1.4	1.4	1.4	1.4

Each well deals on average with about 26 tankers. The great majority of 73.6% respondents interviewed own the vehicle, 20.8% act only as a driver and 5.6% are both the owner and driver in one person. Only 26.1% of all responding drivers have an assisting driver.

80% of responding tanker drivers get their wages based on their daily income. The rest 20% get a regular monthly salary with an average of about 20,400 YR.

Only 5.6% respondents are members in a business association.

3.3.2 Nature of Business

The highest percent of respondents (40.3%) work 12 hours/day, 19.4% respondents work for 15 hours/day, the rest works between 4 and 14 hours daily. The highest total estimated working hours were found in Al-Sabein district. The number of daily tanker deliveries per driver varies from 2 to 11. The highest percent of respondents (20.8%) operate about 6 tankers per day as shown in Figure 3.2. Most tankers cover an estimated area of about 2 km² around the private well (see Table 3.15) and may extend to a maximum of 20 km². The latter was noticed for tankers located in Al-Thawra and Bani Al-Harith districts.

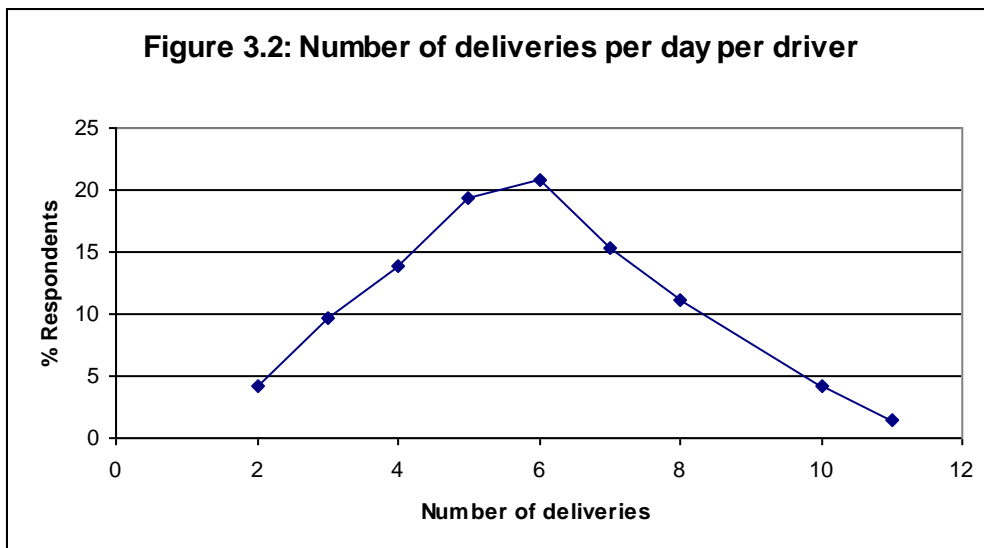


Table 3.15: Area of operation in km² over the percent of respondents

Area of operation (km ²)	1	2	3	4	5	6	8	10	11	20	Total
% Respondents	11.1	23.5	16.7	12.5	15.3	2.8	1.4	11.1	1.4	4.2	100.0

67.6% respondents get their water from more than one well, particularly in districts as Al-Sabein and Bani Al-Harith districts (16.9% and 12.7%, respectively). The remaining percent get water from only one well.

69% drivers have to wait at the source (well) in a queue to fill up their tankers (Photo 3.2). Waiting time varies from about 5 to 240 minutes. Most respondents (24.3%) wait for about 72 minutes. An overseer paid by tanker drivers usually regulates the turn of each tanker. Options to decrease waiting times could probably managed by scheduling systems or by having more than one outlet for the storage tank of the well.

Photo 3.2: Water tankers waiting in queue at the well



About 90% of respondents pay to well owners for the water in cash. The rest percent of respondents pay on a monthly basis.

Table 3.16 shows that water is delivered to 5 households daily by 31% whereas the average number of

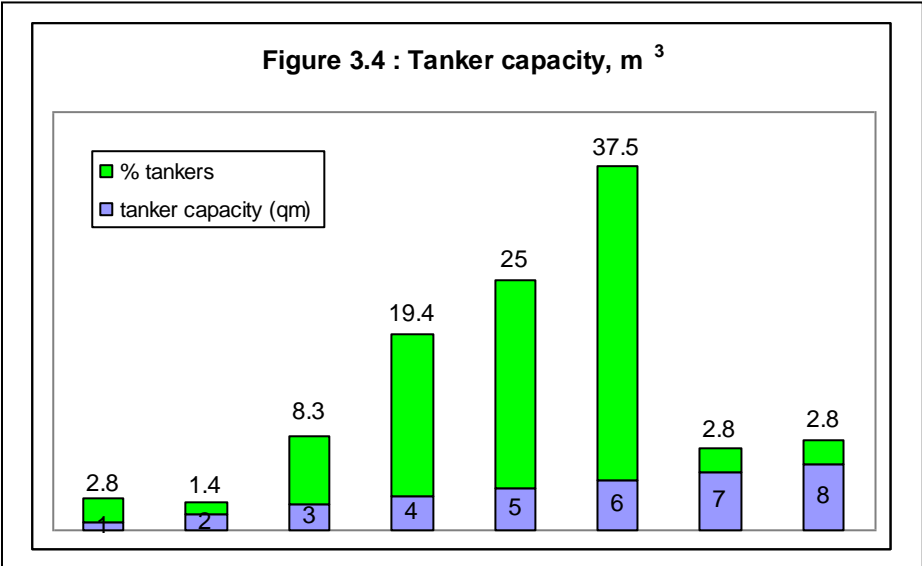
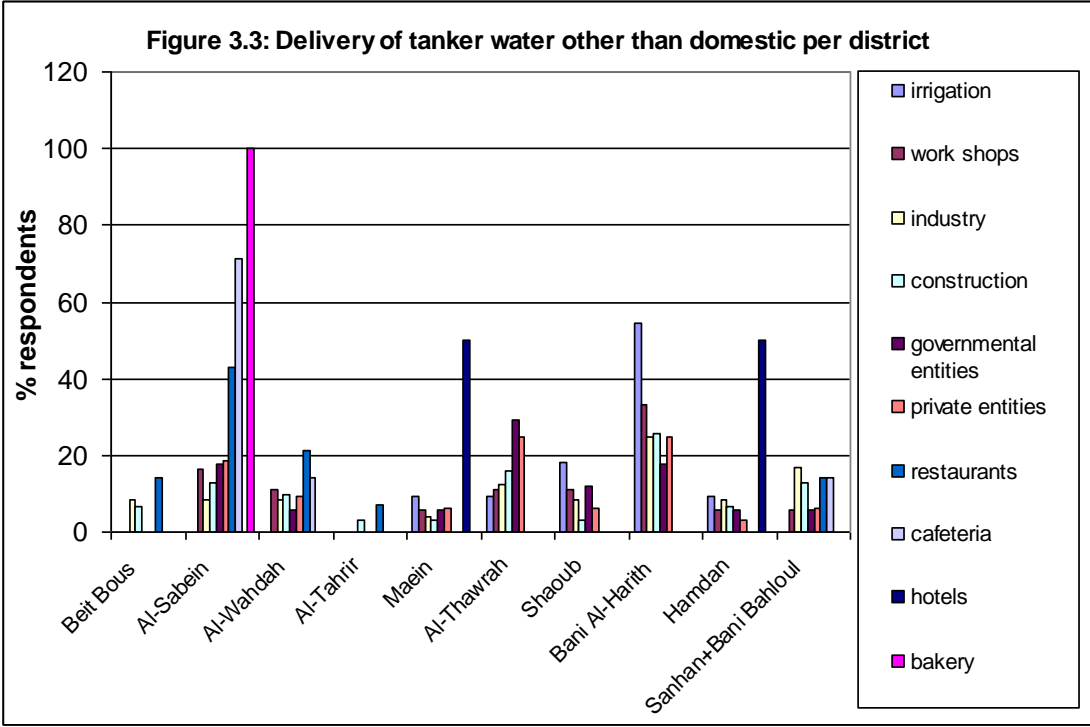
households served daily is 7.5 as indicated in Table 3.3. The highest delivery rate was observed in Al-Sabein district. The total number of households served daily by these tankers are about 429 household which equals 0.17% of total households according to census 2004 (total households in the study area = 254,866). That equals a monthly service of 12,870

households (5% of total households). If the estimated number of tankers is 709 (NWRA 2007), the monthly coverage by tankers would be about 50% of total households. This is quite a tremendous service and fitting well into the economic policy of private water supply plans.

Table 3.16: Number of families served daily

No. of households served daily	2.0	3.0	4.0	5.0	6.0	7.0	8.0	10.0	10.0	13.0	15.0	Total
% Tankers	1.4	9.9	15.5	31.0	12.6	11.3	4.2	1.4	9.9	1.4	1.4	100.0

68.1% respondents deliver water for other than domestic uses, with the highest percent (13.9%) in each Bani Al-Harith and Al-Sabein districts. The customers are farms, workshops, industries, and constructions, private and governmental institutions as shown in Figure 3.3. Bani Al-Harith is the most district supplied by tanker water for farms, workshops, industries and construction with percents of 54.5%, 33.3%, 25% and 25.8%, of each customer category, respectively. Governmental institutions are mostly served in Al-Thawra district (29.4%) and private entities (25% each) are mostly served in Bani Al-Harith and Al-Thawra districts. Tankers located at Al-Tahrir district deliver water only for construction purposes.



The tanker capacity ranges from 1 to 8 m³ as seen in Figure 3.4. Most tankers (37.5%) have a capacity of 6 m³, while the average tanker capacity is about 4.5 m³.

Tanker water is generally not treated.

Water delivery by tankers changes according to demand, as 68 out of 72 respondents stated that water demand in summer is higher than in other seasons.

Tankers may supply customers on a regular basis, usually informally. A total of 87.5% respondents deliver water on a contract basis to customers, with the highest percent in Al-Sabein district (23.6%, Figure 3.5).

Tankers get a request for water supply either by a phone call (69%), by the direct request at the service point (34%) or by a regular supply of the customer (19%). A call office for tanker deliveries would probably regulate water supply more efficiently and might save time and money.

3.3.3 Water Source

The average estimated cost of water at wells (Table 3.16) varies between 74 YR/m³ in Bani Al-Harith (North) and 164 YR/m³ in Al-Sabein district (South) with well depths between 30 and 700 m. High water costs at the southern parts of the city are in consistency with the deep Tawilah sandstone causing high drilling costs.

Table 3.17: Cost of water at source

District	Cost at well (YR/m ³)		
	min	max	average
Sanhan&B. Bahloul	100	150	125
Al-Sabein	50	400	164
Al-Wahdah	70	120	95
Al-Tahreer	100	100	100
Maein	100	350	160
Shaoub	60	70	65
Al-Thawrah	50	125	82
Bani Al-Harith	50	100	74
Hamdan	100	200	150

Most respondents (89.5%) are aware about the increasing in well depth, since access to water controls their daily income and ensures the sustainability of their business. Whether the well is registered or metered is not that important, as most respondents (58.3% and 37.5%, respectively) do not seem to be interested to know this information (Table 3.18).

Table 3.18: Some information about the wells as the water source for tankers

		Yes	No	Don't know
% Respondents	well registered	36.1	5.6	58.3
	well metered	1.4	61.1	37.5
	well depth increases	89.5	6	4.5

Water is usually pumped from the well into a big storage tank located on a stand nearby or high above the well. Tankers are generally completely filled up from these storage tanks (Photo 3.3).



76.4% of respondents believe that the water quality at the source (well) is good while the remaining 23.6% respondents think that it is fair. However, it is well known that water quality of wells in Sana'a is in many cases contaminated with faecal or total coliforms.

90% respondents stated that the well depth is declining. Only 4 respondents stated that the wells are not declining (2 in Shaoub, 1 in Bani Al-Harith and 1 in Al-Sabein districts) while the remaining respondents are not informed about this problem. These results are in consistency with former reports.

3.3.4 Water sources for the poor

About 96% of respondents have poor living in the neighbourhood. Poor get their water mainly from mosques, filling up a jerry can with tanker water, get tanker water for a lower price, get water from a stand pipe connected to the well or getting quarter or remaining quantity of tanker water for free.

3.3.5 Business aspects

Water delivered per day ranges between 3 and 57 m³ with an average of 23.6 m³ (Table 3.19). Most respondents (16.9%) deliver 24 m³ daily. It is worthy to mention that the highest delivery (31m³/day) is in Shaoub district which has the third highest number of households and is believed to be covered by the public network. After domestic uses, water is delivered in that district for irrigation purposes, workshops and governmental institutions.

Table 3.19: The total water delivered daily

District	Water delivered/day (m ³)			households
	min	max	Average	
Sanhan and Bani Bahloul	6	32	20	16890
Al-Sabein	7	40	20	44730
Al-Wahdah	12	40	21	15933
Al-Tahreer	30	30	30	10893
Maein	10	45	22	40381
Shaoub	21	42	31	30293
Al-Thawrah	14	57	25	25200
Bani Al-Harith	3	40	27	24345
Hamdan	8	32	20	4041

Average profit per day is about Rls 3,600 (\$18), equivalent to Rls 150 (\$0.75) per m³. Average selling price is about Rls 274/m³ (\$1.40/m³).

The business revenues and expenses are reflected in Table 3.20. The highest total daily revenue of 15,000 YR and the highest total daily business expenses of 8,000 YR are observed in Al-Wahdah district with an average water delivery per day of 21 m³ (i.e. high price). Water in that district is supplied for domestic uses in addition to restaurants. The highest daily net revenue of 16,000 YR is observed in Al-Sabein district and the lowest in Bani Al-Harith giving an average monthly net revenue of 108,540 YR. The highest investment expenditures over the last year were noticed in Al-Thawrah district which are not that high compared with networks.

Table 3.20: Business aspects

	min	max	average	YR/M3 (based on 24 m3 a day)
Daily revenue (YR)	300	15,000	6,567	274
Daily business expenses (YR)	200	8,000	3,494	146
Daily net revenue (YR)	0	10,000	3,618	150
Investment expenditures over last year (YR)	0	2,000,000	258,379	

Tanker owners and drivers face many problems. About 44% of respondents complain about too long waiting times to fill up the tanker, about 30% complain about heavy traffic and 20.8% complain about the steady maintenance of their vehicle. Some other problems faced by tankers are the annoyance by the municipality and traffic police, less work in winter, the control over water by well owners and less number of costumers.

The attitude of respondents (the percent in brackets) towards the actions by government, that local authority or the local council would most help to provide a good and profitable service can be summarized in the following points:

- Decreasing heavy traffic, particularly at road crossings (100%)
- Road pavement (40%)
- Lowering inspection of tankers by municipality, police... etc. (40%)

3.3.6 Development aspects

The business of 55% tankers is organized somehow through:

- electing an overseer (58%),
- writing the service phone number on tanker body (58%),
- a rota system (50% respondents), and
- keeping a record of debits (27.6%).

About 98% of respondents believe that this type of regulation is useful and effective. 50% believe that it is honest, 47.2% think that it is not honest and the remaining do not know whether it is honest or not.

About 50% of respondents are interested in developing their business through:

- buying a new tanker (36%)
- fixing water prices (33%)
- punishing tankers not following regulations
- establishing an association to solve their problems and to protect tanker owners (16.7%)
- expanding the tanker fleet (11%) and
- owning a tanker (11%)

Sixty five percent of respondents would consider a system under which they are officially licensed and regulated in kind of defining sell points (53%), fixing water prices at well and selling prices to customers (22%), road maintenance (21.3%), and in not increasing public network connections (14%). Many other suggestions were made as regulating the coverage area of water supply between the private and public sector, regulating work between well owners and tankers and raising awareness of traffic police to regulate traffic more efficiently instead of complicating tankers traffic.

3.4 Water Purification Shops

KEY MESSAGES

- The increased demand for purified water has led to rapid growth in the number of water purification shops/stations – one third of the shops surveyed (32%) opened during the last year.
- Most shops are run by owner/managers, although a few are branches of small chains
- 20% of shops are not registered.
- Most respondents do not know who is the responsible inspection authority, which is, in fact, the Ministry of Public Health (MoPH)
- MoPH seems quite active in regulation, closing some shops down, but this regulation is not generally seen as helpful by the shop owners.
- 68% of water purification shops get their raw water delivered by tankers.
- Sales are higher in summer than winter, demonstrating the flexible nature of the business in meeting the excess demand the Local Corporation cannot supply.
- The scale of operations is generally small to medium (< 300 m³ a day), except for the industrial scale bottlers (Shemlan, Hadda)
- Margins are quite small (Rls 1/litre) and selling prices are highly competitive (Rls 3/litre) compared to Rls 41/litre for Shemlan bottled water.
- All shops provide water to the poor free of charge
- The registered association has 60-70 members but is currently inactive.
- Almost all interviewees agreed that some combination of self-organization and regulation would be helpful, involving the businessmen themselves, the local community and council, and the Local Corporation.

3.4.1 General

A list of water purification shops obtained by the Ministry of Public Works and Highways (MPWH) included 84 registered water purification shops/stations in December 2009. Table 3.21 gives an indication about the number of water purification shops counted in different years.

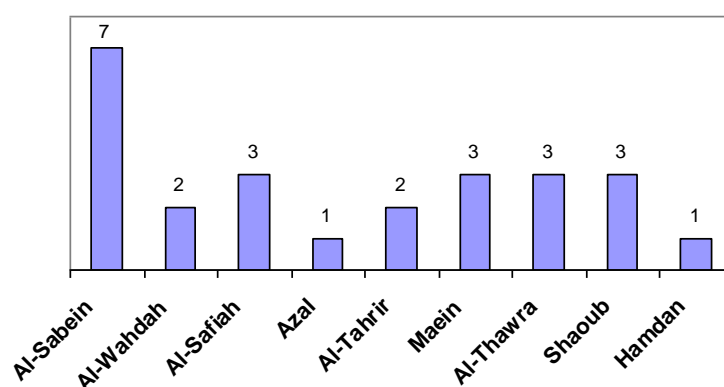
Table 3.21: The number of water purification shops counted in different years

Year	No. of water purification shops	Source
August 1997	50	A.S. Babaqi and M. Al Aroosi, 1997
May 2007	76-80 (excluding branches)	Mona Naji, 2007
December 2009	84	MPWH, 2009

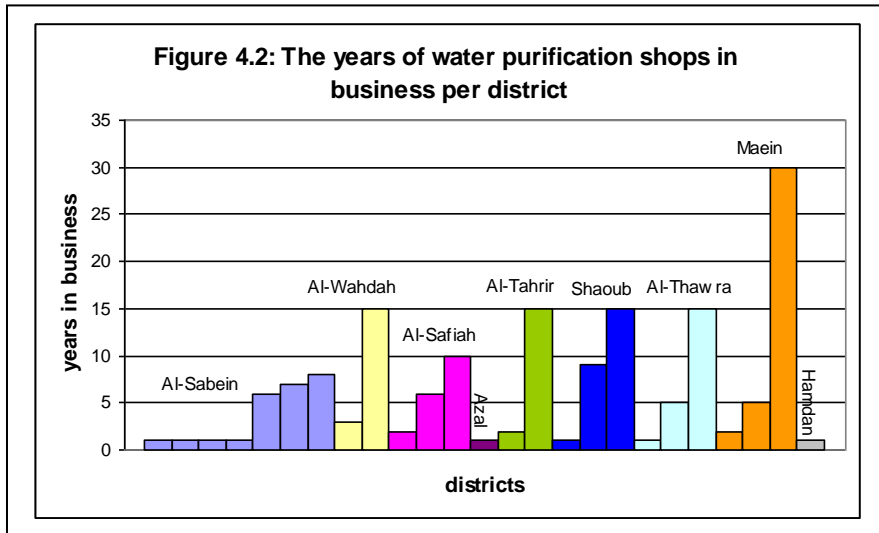
The increasing number of these stations since 1997 gives an indication about the increasing demand of purified water in Sana'a City.

The 25 water purification shops targeted are distributed over several districts in Sana'a city as seen on Map 5 (Annex 1) and Figure 4.1. The Shamlan water bottling factory (whole sale

Figure 4.1: The number of water purification shops under study per district



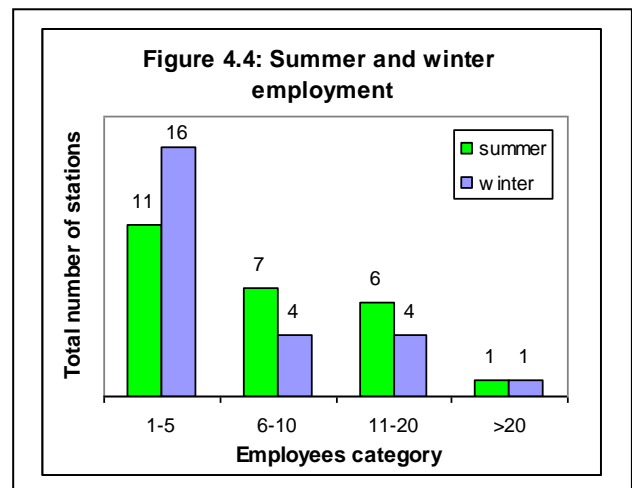
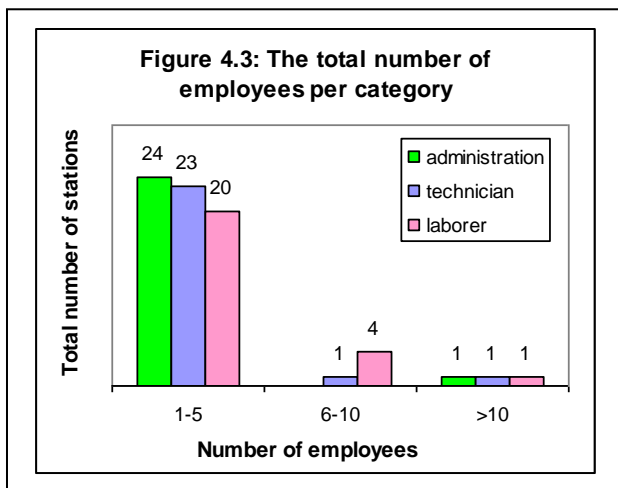
provider located in Maein district) was added to the study as one of two water bottling enterprises located in Sana'a. All other 24 respondents fill the water in jerry cans of different sizes. Most water purification enterprises are located at the center of the city. Ten of the interviewees were the managers of the enterprise, 9 the owner and manager in one person and 6 held other positions.



The years in service of enterprises range between 1 and 30 years as shown in Figure 4.2. Eight stations (32% of enterprises) are since one year in business indicating a rapidly expanding market.

In general most stations have one administrative and one technical employee, except Shamlan water

bottling factory which has 48 administrative and 50 technical employees and 252 labourers. The total number of employees in all stations per category is shown in Figure 4.3. Figure 4.4 shows the distribution of employees during summer and winter seasons. In general, more people are employed in summer than in winter (see categories 6-10, 11-20 and >20). In winter more shops (16) prefer to have only 1-5 employees. This indicates that more employees are needed during summer times to cover water demand.



Six (20.8%) out of 25 water purification shops were not registered officially at the MPWH. Though all respondents gave different answers as the responsible entity to issue a permit for opening a water purification shop, 6 respondents did not even know who the responsible agency is (see Box 4.1). Only one of the managers mentioned exact name of the Department of Environmental Health and the Ministry of Public Health and Population (MPHP). Others mentioned some departments at the MPHP or the Ministry of Industry and Trade (MIT). The varying responses indicate an unclear and overlapping responsibility of several authorities. It is worthy to mention that during the project execution it was noticed that several new shops

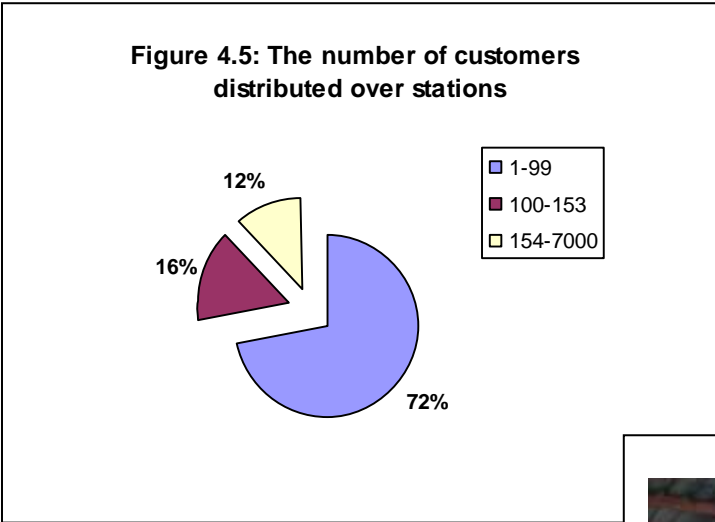
opened, some of them as branches of main stations. Some other shops were closed by the MPWH for illegally operating the enterprise or for unhygienic conditions.

Box 2
The Ministry of Public Works and Highways (MPWH) is the ministry responsible to issue operation permissions for these water purification shops through the department of Environmental Health. A signed agreement with the Ministry of Public Health and Population (MPHP) represented by the National Center of Public Health Laboratories (NCPHL) gives the latter the right for quality control of purified water through random inspections.

82.6% of respondents are not members in a cooperative or association. The remaining respondents are members of a water purification shops association with a very cooperative leading head. This association includes nearly 60-70 members, but is currently inactive.

3.4.2 Nature of business

The number of primary (first hand) customers served daily ranges from one to 7000 (including whole sale and retail clients) as categorized in Figure 4.5. The total daily number of customers is 16,031. Estimating a total of 84 water purification shops, the total daily served customers would be about 54,000. This indicates a high pressure on water purification shops in general.



The area of operation varies strongly and could not be stated accurately by the respondents.



23 water purification shops (92%) are operated by only one purification unit (see Photo 4.1), one station has two units and one has five (Shamlan water bottling factory).

Water is purified using several types of filters as shown in Figure 4.6. Most stations (28%) use about 4 filters for water purification as listed in Table 3.22.

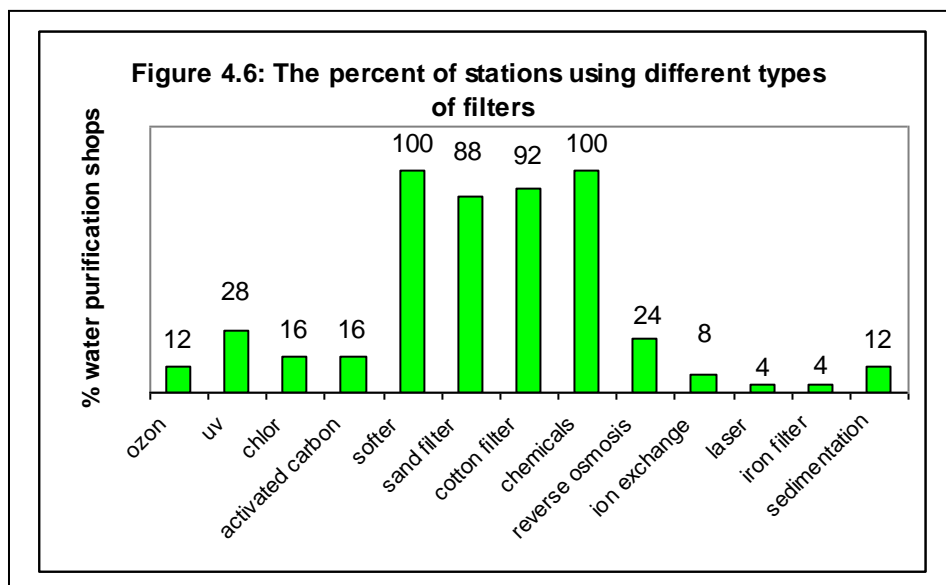


Table 3.22: Number of filters used by respondents

no. of filters	1	3	4	5	6	7	8	20	31	total
% respondents	4	20	28	12	4	8	16	4	4	100

The total volume of water treated daily ranges from 1.5 – 300m³ at the 24 water purification shops whereas 1500m³/day is treated at Shamlan water bottling factory. About 56% of stations produce less than 10 m³/day.

All respondents believe that the treated water is of GOOD quality. Although the monitoring of water quality is the responsibility of the Environmental Health Department at MPWH as mentioned earlier in Box 4.1, 92% of respondents gave different answers when asked about this issue. Either the exact expression for the responsible authority is not known or there might be an overlap of responsibilities of the different departments of MPHP, MPWH, MIT, and the MWE.

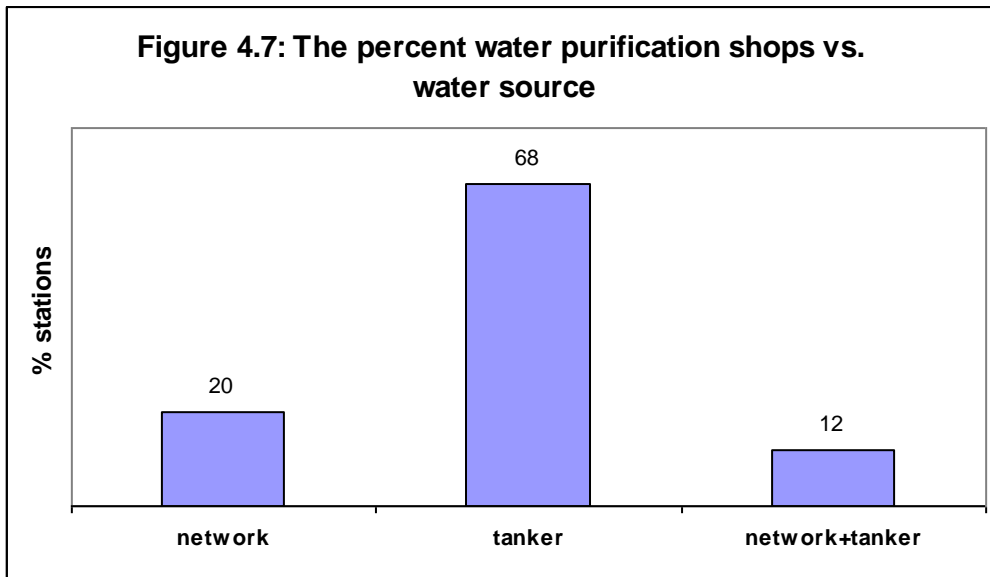
3.4.3 Water source

68% of the water purification shops under study get water from only one well as listed in Table 4.3, whereas the rest of respondents get their water from more than one well as a water source.

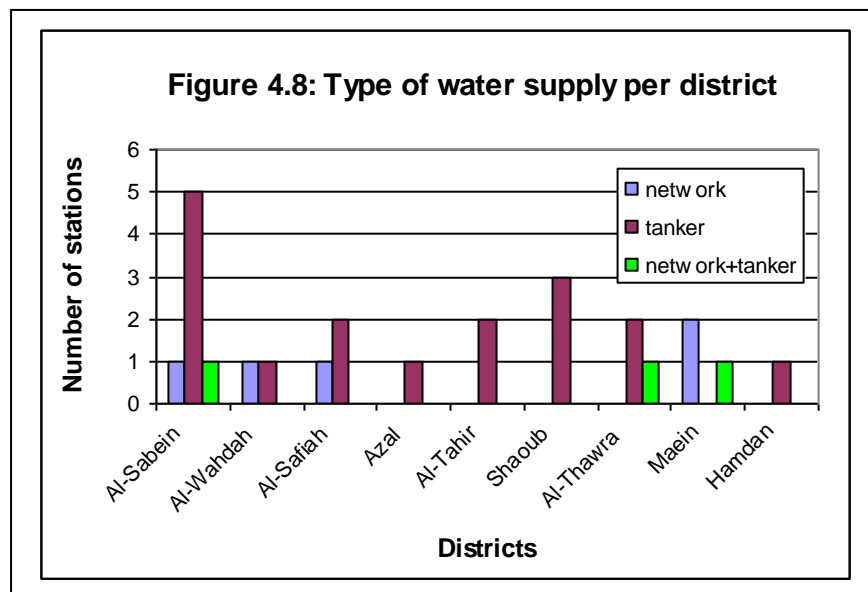
Table 3.23: Number of wells providing stations

no. of wells as source	% respondents
1	68
2	24
3	4
5	4

Figure 4.7 shows that 68% water purification shops get their raw water supply transported by tankers, 20% from a water network, and 12% from both water tankers and networks. This is further evidence about the flourishing market of tanker water (see tanker supply).



Water Tankers are in general the most widely used type of water suppliers for stations over most districts as shown in Figure 4.8. In Azal, Al-Tahrir, Shaoub and Hamdan tankers are the only water suppliers according to the responses of interviewees. Less than 50% of stations get their water supply from networks. The main water resource for these networks and tankers is in all cases a private well. Out of these wells, 70.8% are not metered, 16.7% are metered and the rest 12.5% is unknown. 64% of these wells are believed to be licensed, 4% (one station) is not licensed and 32% respondents do not know if the wells are licensed.



of not are

3.4.4 Water sources for the poor

All shops provide water free to the poor. Almost all respondents stated that poor people are living in the neighbourhood except at Al-Tahrir district. All poor are provided with treated water in jerry cans for free. It is unknown how they get access to sanitation services.

3.4.5 Business aspects

Margins are quite small (Rls 1/litre) and selling prices are highly competitive (Rls 3/litre) compared to Rls 41/litre for Shemlan bottled water. Table 3.24 reflects the average business incomes and expenses of the water purification shops under study. The range varies widely from station to station. Shamlan factory as a whole sale provider cannot be included in the list

of the other stations due to the large difference in data collected. In only one station the daily revenue does not cover the daily expenses. This station was in business since one year.

Table 3.24: Business aspects of water purification shops in Sana'a City and peri urban areas

	Stations excluding Shamlan Factory			Shamlan Factory
	min	max	average	average
Water produced (m ³ /day)	1.5	300	35	1,500
Water sold (m ³ /day)	1.5	290	23	600
Price of water (YR/L)	1	13	3	41
Cost of sold water (YR/L)	0.5	10	2	40
Net revenue (YR/day)	0	90,000	11,688	500,000
Business expenses (YR/day)	1,500	200,000	20,300	15,500,000
Total revenue (YR/day)	2,500	290,000	31,975	16,000,000
Investment expenditures over last year (YR)	0	8,000,000	400,000	1,000,000,000

The principal problems faced by water purification shops are summarized in Figure 4.9. Most problems are faced in Al-Sabein district as it includes the highest sample size, while some stations at Al-Sabein and Shaoub districts do not face problems while operating their stations (see table 3.25).

Figure 4.9: Principal problems in operating business

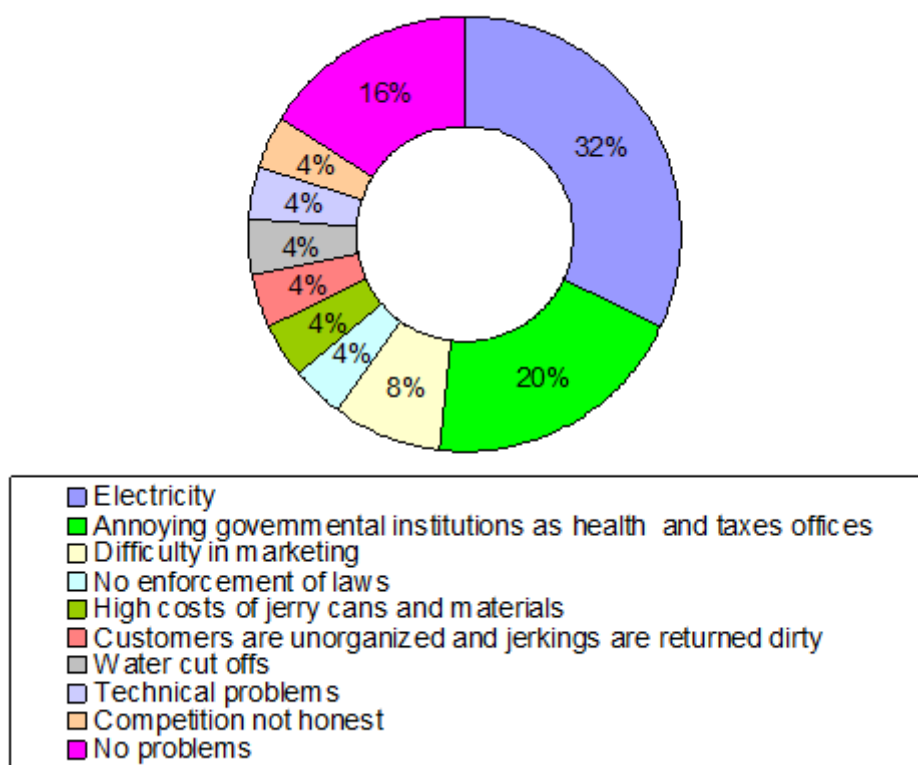


Table 3.25: The percent of water purification shops per district facing problems during operation

	Shaoub	Al-Safia	Al-Sabein	Al-Wahdah	Al-Tahreer	Maein	Al-Thawrah	Hamdan	Azal
Problems	8	12	16	8	8	12	12	4	4
No Problems	4	0	12	0	0	0	0	0	0

Only two stations stated that the government or local community is providing assistance for better service as testing the water quality by the health office or supporting the station at the municipality.

3.4.6 Development aspects

The business of 80% of respondents is organized in some kind as listed in Table 3.26. in descending order. Regulating and organizing the work and responsibilities among employees take the highest rank followed by the development of stations through the installation of new technological equipments. Water distributors are waiting for their turn to be provided with jerry cans (Photo 4.2) by one of the responsible employees.

Table 3.26: Type of organized business per district

	% respondents								
	Shaoub	Al-Safia	Al-Sabein	Al-Wahdah	Al-Tahreer	Maein	Al-Thawrah	Hamdan	Total
Introduction of new technology for production and development		5	5		5	10			25
Using jerry cans with different capacities			5						5
regulating water distribution and increasing distribution				5	5				10
Increasing hygienic conditions of station and equipments				5		5	5		15
Organization of work and interest	5	10	10					5	30
Expanding and developing the station	10						5		15
Total	15	15	20	10	10	15	10	5	100



All respondents agreed that on the whole business organization is effective and useful.

84% respondents are interested in developing their business in a better way by expanding the station, installing new automatic production lines for water treatment, obtaining new jerry cans and increasing marketing.

92% interviewees agreed that some combination of self-organization and regulation would be helpful,

including the businessmen themselves, the local community and council, and the Local Corporation. This organization was expressed in terms of unifying water prices, better water and electricity services, monitoring of water quality, monitoring of hygienic conditions at the station and cleanliness of jerry cans. Other ideas were that the association should be activated, taxes be lowered, marketing better organized

3.4.7 Observations

The general hygienic conditions were unsatisfactory in some water purification shops, whereas some others appeared tight and clean. Water is often covering the whole floor of the station. Labourers are often illiterate and not aware about hygiene. Successful stations were observed to be under the direct supervision of the owner day by night. Some interviewees were very kind and cooperative during the questioning process, while others were not.

4. Conclusions

From the results obtained by the current study following conclusions can be made:

1. The private water sector (wells, tankers, networks, water purification shops) is covering a great part of the population in Sana'a and peri urban areas and is increasingly growing.
2. The private water business is weakly regulated.
3. The private water sector does not provide sanitation services
4. Major problems are electricity cut offs, declining in water quality and quantity and well deepening
5. The private water sector is willing to further develop its business and to cooperate with the government and civil society.
6. Monitoring roles of governmental institutions are often unclear and overlapping
7. No real representative associations exist for the private water providers (associations for well and water purification station owners are inactive)
8. The lack in awareness about water quality and quantity, hygiene, water management and the importance of accounting systems

5. Recommendations

Private water supply in Sana'a is a thriving business that meets a critical need that cannot be met in the foreseeable future by the Local Corporation. Private water supply is growing fast as demand grows along with the population, and it is inevitable that private supply will continue to provide a large share of the capital's water needs in the coming years. Government policy recognizes this, and seeks to optimize supply by cooperating with the private sector. What should be the nature of that cooperation?

There are a number of problems attached to the current laissez faire approach:

6. There is no regulation of the quantity extracted, and this is contributing to the haphazard exhaustion of groundwater stocks. In the absence of regulation, private supply cannot be considered for Yemen's movement towards the MDG targets.
7. There is little or no licensing or regulation of quality, and hence there is a risk to the consumer. In addition, public and private sewage is contaminating water supplies.
8. Tanker supplies predominate and provide a needed flexibility to meet peaks of demand, but tankers are a very high cost form of supply, and it is particularly the poor who lack access to the network and hence pay the highest prices.
9. The small scale of private water enterprises means that planning and coordination are difficult and there are no economies of scale.
10. There is no private investment in sanitation.

It is recommended that in the light of the findings of the present study, a dialogue be begun involving the office of the Mayor of Sana'a, the Local Councils, the Local Corporation, the Ministry of Water, the Ministry of Public Health, and private suppliers and consumers. The first steps should cover the following areas:

- How to encourage the organization of the private sector in water into responsible and representative professional associations mandated to dialogue with government.
- The scope for bringing private water providers within a light regulatory framework, preferably self-administered by representative professional associations, under the control of the MWE or the water regulator when established. Examples could include regulating private wells selling tanker water, and regulating the tanker fleet and providing certificates to hygienically suitable tankers.
- Possible partnership projects such as the one at Ibb (a local area concession for a piped network under regulation, see box below) or the proposed output based aid project at Wadi Dahr.
- Providing water to tankers from specific municipal wells
- Developing equitable and efficient instruments for orderly transfer of water out of farming into urban water supply (e.g. purchase of wells and the run off rights on the surrounding recharge area, licensing of agricultural wells for urban supply, hooking up agricultural wells to the LC's trunk main for metered water purchase)
- Providing sewerage network feeding points for vacuum trucks (against fees), and stimulating private investment in decentralized cluster sewerage solutions
- Institutional development and capacity building for the private sector, including raising awareness of private water providers about water shortage, water quality, proper water management, hygiene and other issues.

Solutions could be aired in the form of information and communication program for stakeholders (see Chapter 1 above) and, when agreed, reflected into the Sana'a City Master Plan, and into the LC's business plan. Financing could be provided under WSSP.

Partnership with the local private sector in Ibb

In Ibb, the PSIA mission visited a private network owned by the al Najjar family working under a contract arrangement with the LC and the municipality

The well and network are in a high density newly constructed area outside the reach of the current LC network. The owner used to sell water to the qat trade. However, the well ran dry and the municipality and the LC refused him permission to drill a new well unless he stopped selling to the out-of-town qat farmers and instead converted to network water supply. He agreed to do this. He received a licence and signed a three party contract with the municipality and the LC, under which the LC: (1) allows him a specific service area; (2) supervises water quality; and (3) agrees the tariffs.

The well owner invested in a distribution network to 180 households. Each household has a meter and paid Rls 10-40,000 (\$50-200) connection charge according to the size of the building. The tariffs have been set by the LC after a study of costs at: Rls 120/m³ up to 10 m³ a month, and Rls 130.m³ above 10 m³ a month (60-65 US cents). Customers complained to the LC, but the LC replied "It is up to you. We cannot serve you. The price is fair." In fact, although the price is six times the LC's lifeline rate, it is the same as the LC's cost of supply, so is quite competitive. In the end, all households in the service area accepted and paid the connection fee. The well owner supplies the very large adjacent mosque for free and poor people can access water at the mosque.

The LC, the well owner, the local council and the local residents all said they were quite satisfied with the arrangement. Residents especially like the seven day a week, 20 hour a day service.

Source: PSIA Box 23, based on Focus Group Discussions and Key Informant Interviews, Ibb, May 2008

Other steps

A private network inventory in Sana'a and sub urban areas is recommended to be carried out to get an overview of the total operating networks and the reasons for closing many others.

The responsibility of governmental authorities regarding inspections as monitoring water quality and quantity, issuing licenses ... etc, should be defined and should not overlap in order to build up trust between public and private partners.

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