

SOCIO-ECONOMIC FACTORS RELATING TO THE EVALUATION AND SELECTION OF SMALL WATER TREATMENT SYSTEMS FOR POTABLE WATER SUPPLY TO SMALL COMMUNITIES

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by

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1. INTRODUCTION

A large variety of local and international types and brands of small water treatment systems (technology) are available to the South African market. These small treatment systems supply up to 2.5 Mℓ/d and are utilised to purify water for household usage in rural- and peri-urban areas. The selection of an appropriate water system is crucial as part of ensuring a sustainable supply of potable water for household usage. Those responsible for selecting the technology often consider technical, financial, and managerial factors as criteria for selection. Socio-economic factors of recipients and beneficiaries are seldom considered when selecting a technology.

Socio-economic data provide valuable information for determining factors that might influence overall development. Table B.1 illustrates how socio-economic information resulting from this water related study could be used as an indication of performance towards the millennium development goals (MDGs).

Table 1: Millennium Development Goals and Water

Millennium Development Goals	Socio-Economic Factors
1. Eradicating extreme poverty and hunger	Although most people have some sort of income, these incomes are not fixed monthly salaries but result out of part-time work, pensions and other grants
2. Achieving universal primary education	School going age children are currently at school. Adults have at least a primary level education.
3. Promoting gender equality and empowering women	The role of women as household water managers makes them main role players in mediating between the water system and the household. Women are responsible for managing water in households. This they do by deciding how water is used and how much water to use for household activities. Women, in the sense that they monitor cost and prevent wastage of water, also control water usage. Where water collection takes place, they decide on the frequency and quantity of water to be collected.
4. Reducing child mortality	Improved water quality means less water related illnesses and deaths.
5. Improving maternal health	Knowledge regarding cleanliness and health has been instilled. Hand washing practices are not neglected.
6. Combating HIV/AIDS	Availability of safe water supply assists the reduction of HIV. Soap and water could be used as weapons against HIV transmission (Li et al., 2003; Price J, 2003).
7. Malaria and other diseases	Waste water is reused mainly for gardening purposes but refuse is seldom recycled and sometimes disposed of indiscriminately where no removal service exists. This could act as breeding grounds for diseases.
8. Ensuring environmental sustainability	To ensure sustainability of any intervention, it is crucial that the community be consulted and participates fully in decision-making, implementation, evaluation, and maintenance thereof. This needs to occur in order to avoid inappropriate services, conflict, and vandalism of water treatment equipment. Environmental problems experienced may vary from area to area and also depended on the location of the community in relation to observable environmental hazards

Adapted from the United Nations Millennium Goals:2002

It is critical to understand the social issues that communities are faced with and thus it is important to take into account socio-economic factors when selecting/deciding on a water treatment technology for the supply of potable household water to small communities.

Social and political realities, which are embedded into the fabric of societies, play important roles in the use of water and, therefore, in efficiency considerations. Challenges, including social and institutional obstacles, such as public acceptance or regulatory developments, must be met in order to make full use of water resources (Hermanowicz & Asano, 1999; Tate, undated). Studies in water reuse (Po *et al.*, 2004) reveal that there is an obvious lack of social research in understanding the basis of public perceptions and the psychological factors governing the decision making processes.

2 PURPOSE OF THE STUDY

The purpose of this study was to determine the socio-economic factors that need to be considered when selecting small water treatment systems for the supply of potable water for household usage.

3 METHODOLOGY

3.1 Study Design

A cross-sectional descriptive study design aimed at collecting both qualitative and quantitative data was used. Descriptive studies address a wide range of topics and cross-sectional studies captures the research scene at a given moment (Stone and Clements, 1998; True, 1989). Descriptive research also provides an accurate picture or account of the characteristics of a particular individual, event or group, in real-life situations. Qualitative research, on the other hand, seeks answers to questions that stress how social experience is created and given meaning (Burns & Grove, 2005; Denzin and Lincoln, 2000).

3.2 Pilot Study

A pilot study was conducted in the rural town of Saron in the Western Cape; 20 questionnaires were administered after which the questionnaire was edited and modified.

3.3 Study Sites

The study was conducted throughout the nine provinces of South Africa. Specific sites (water treatment plants) were selected based on the capacity criteria of $< 2.5 \text{ M}\ell/\text{d}$. The target population is defined as households from small rural or peri-urban communities whose potable household water is supplied by a small water treatment system, with a capacity of $\leq 2,5 \text{ M}\ell/\text{day}$. Sites that meet the criteria were provided by various water boards, municipalities and engineering consultants. A total of 43 sites were selected (see Fig 1).



Figure 1: Selected Study Sites

3.4 Sampling

Accidental, non-probability sampling was done, whereby one representative per household was interviewed. Twenty households per community (at the selected sites) formed the sample.

Data were collected at household rather than individual level via a structured questionnaire. Reliable respondents were regarded as one person, per household, over the age of 16 years, present at the time of the interview. For phase one data were collected during the period June/July 2003, for phase two data were collected during June/July 2004, and during June/July 2005 for phase three.

Table 2: Total Number of Questionnaires Administered per Province

Province	Eastern Cape	Free State	Gauteng	Kwa-Zulu-Natal	Limpopo	Mpumalanga	Northern Cape	North West	Western Cape
Questionnaires administered	86	120	21	62	141	112	120	75	100

Only one plant in Gauteng Province met the criteria. Community entry was denied in some communities in KwaZulu-Natal and violent behaviour was experienced in North-West Province.

4 ETHICAL CONSIDERATIONS

Community entry was negotiated with all relevant community structures, individuals and local authorities. In the Limpopo Province community entry had to be arranged via the community chiefs (*'indunas'*). In addition, informed consent was obtained from all respondents prior to proceeding with the interview. Apart from the purpose and benefits of the study, respondents were informed that they had the right to refuse participation in the study and refrain from answering certain questions. Confidentiality and anonymity were guaranteed.

5 RESULTS AND FINDINGS

5.1 DEMOGRAPHY

5.1.1 Study Population

Table 3 is an illustration of the study population in terms of gender and age groups.

Table 3: Gender Breakdown per Province

Age group (yrs)	Actual number of females and males per province																		TOTAL
	E/Cape		F/State		Gauteng		KZN		Limpopo		Mpum.		N/Cape		N/West		W/Cape		
	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	
>6	25	26	39	40	5	1	36	33	57	40	38	57	55	58	35	27	15	20	607 (14%)
6 – 13	32	58	54	40	4	4	38	41	71	89	65	41	58	75	34	34	50	31	819 (19%)
14 – 18	42	23	36	29	2	1	31	27	63	46	52	43	35	26	24	31	27	21	559 (13%)
19 – 30	35	35	68	56	19	14	46	43	121	70	68	50	69	54	54	39	34	40	915 (21%)
31 – 45	47	22	52	36	3	3	32	34	68	54	51	37	63	34	32	23	43	35	669 (15%)
46 – 60	18	26	35	27	3	3	23	08	40	36	22	27	43	49	27	29	43	31	490 (11%)
> 60	21	18	21	29	1	1	06	21	38	24	11	20	28	29	20	09	32	25	354 (08%)
Missing	0		0		0		0		0		3		0		1		0		4 (0.1%)
SubTOTAL	220	208	305	257	37	27	212	207	458	359	307	275	351	325	226	192	244	203	
	51%	49%	54%	46%	58%	42%	51%	49%	56%	44%	53%	47%	52%	48%	54%	46	55%	45%	
TOTAL (%)	428 (10%)		562 (13%)		64 (01%)		419 (09%)		817 (19%)		582 (13%)		676 (15%)		418 (09%)		447 (10%)		4 417

The household size across the nine provinces varied between 1 and 10 persons per household, averaging 5 persons per house.

5.1.2 Education

In all four provinces children of school-going age are currently at school. Adults have at least a primary level education, in the Cape provinces, Free State and KZN. More adults with high-school education and matric are present in the Limpopo, Mpumalanga and North-West provinces. A higher number of unemployed adults have a matric level

education in the Limpopo and Mpumalanga provinces compared to all the other provinces.

5.1.3 Economic Activity

(i) Employment Status

Table 4 provides an illustration of the percentages of persons of employable age, employed in the different employment categories at the time of data collection.

Table 4: Employment Types per Province

Province	Full Time (%)	Part Time (%)	Casual (%)	Unemployed (%)	Missing (%)	Unsure (%)
E/Cape	21	4	1	74	0	
F/State	19	5	1	75	0	
Gauteng	20	2	20	46	2	
KZN	15	5	1	77	1	1
Limpopo	16	7	1	76	0	
Mpumalanga	12	4	1	82	1	
N/Cape	20	7	3	70	0	
N/West	17	1	4	77	1	
W/Cape	23	8	10	59	0	

The majority of adults in the Western Cape and Northern Cape are employed as seasonal workers on farms surrounding the communities and in the Eastern Cape most persons are self-employed.

The type of work in the Limpopo Province varies extensively, from people being employed in professional services, such as teachers, nurses and managers (approximately 3%), to the majority of those employed doing work of a hands-on nature, e.g. game rangers, fixing fencing in the nature reserve, or drivers and domestic workers. The majority of individuals indicated that they are self-employed, and that they obtain an income through the selling of food and/or clothes.

The largest variety of employment types is in KZN, Free State and Mpumalanga provinces. Here employment types range from those that are skilled and semi-skilled labourers, such as house-keepers, child minders, municipal labourers, gardeners and farm-hands, to those that are in professional employment, in the form of administrative clerks, teachers, policemen, etc. To a larger extent, those employed in the Free State province are persons working in agriculture, e.g. farm labourers and farmers.

(ii) Skills Available in Communities

In addition to their current employment, and amongst those unemployed, communities have the following skills available, as illustrated in Table 5.

Table 5: Skills Available per Province

Skill category	Number of persons with skill, per province								
	E/Cape	F/State	Gauteng	KZN	Limpopo	Mpum.	N/Cape	N/West	W/Cape
Agriculture & Nature Conservation	6	17	0	6	6	9	24	4	24
Culture & Arts	0	0	0	0	5	8	0	4	3
Business, Commerce & Management Studies	5	3	6	7	27	13	9	18	8
Communication & Language	0	1	0	0	0	0	0	5	0
Education, Training & Development	1	1	4	4	5	3	2	0	3
Manufacturing, Engineering & Technology	0	5	1	8	10	6	5	2	5
Human & Social Studies	1	3	0	0	0	0	1	1	1
Law, Military Science & Security	1	1	5	6	2	0	2	2	1
Health Sciences & Social Services	1	4	0	1	2	5	0	5	5
Mathematical, Physical, Computer & Life Sciences	1	0	0	0	0	0	1	0	1
Services	24	16	10	13	60	32	71	30	52
Physical Planning & Construction	13	3	1	2	13	8	8	3	15
Don not know	0	1	0	1	27	0	0	3	0
Not applicable (N/A)	0	0	1	21	2	5	0	5	0
Missing	0	1	0	1	20	10	0	3	0
None	0	48	0	0	7	25	0	1	0

(iii) Income and Expenditure

97% of households in the Western Cape and 83% in Limpopo have some means of income while this is the case for 80% in Gauteng and 81% Free State. The North-West Province has the highest number (27%) of households without an income. This income is mainly derived from formal and informal employment, contract work, or a social grant, (i.e. old-age pension, disability or child maintenance grant). Table 6 illustrates the household income status.

Table 6: Household Income per Province

Province	Income - Yes (%)	Income - No (%)	Missing
Eastern Cape	84	16	
Free State	81	19	
Gauteng	80	20	
KZN	62	14	24
Limpopo	84	16	
Mpumalanga	79	21	
Northern Cape	91	9	
North-West	72	27	1
Western Cape	97	3	

5.2 TECHNOLOGY

5.2.1 Water Supply and Technology Awareness

Respondents knew where their water came from. In the Cape provinces, 52% of respondents were aware of treatment plants ('water machines') in the area, having been informed via a community meeting, staff, or by word of mouth from other community members. Others only found out after construction commenced and they could see pipes being laid in the area.

In the Limpopo Province 57% of respondents (collectively) were aware of a water treatment plant within their community. People related this awareness to the mere presence of the plant in the area, having been informed by the headman, seeing 'outside people' coming to place the plant in the area, or by the fact that some of the community members were involved in installing the plant.

Respondents in the North-West and KwaZulu-Natal provinces generally knew the sources of the water, relating them to rivers and underground sources. In KZN only 46% of respondents were aware of a water treatment plant within their area, while this was the case for 43% of respondents in the North-West Province.

In the rest of the provinces, i.e. Free State, Mpumalanga and Gauteng, they related the source of water as being the tap (communal and otherwise). Awareness of a water treatment plant in these provinces was as follows: Free State 39%, Mpumalanga 42% and Gauteng 45%.

5.2.2 Involvement With Technology Implementation

In areas where respondents indicated an awareness of a water treatment plant in their area, they indicated that the local authority or government was responsible for implementing the water project. Most people did not know who participated in its implementation.

(a) Limpopo Province: 32% of respondents did not know who participated in the installation of the plant, while a further 9% said that the government was involved. 4.3% said that it was installed by the community and contractors.

(b) Free State Province: Respondents became aware by the municipality informing them and, to a larger extent (19%), as a result of seeing the physical structure in their area. Others indicated that they were informed via a councillor of the plant's construction. A

large proportion (65%) indicated that no one informed them about anything.

(c) Gauteng Province: 45% of the respondents were aware of the plant because they could see it. The rest (55%) knew nothing thereof.

(d) KwaZulu-Natal: The 28% of respondents who are aware of the plant said they were either informed via a community meeting or via their municipality. Others merely saw the plant being constructed and therefore knew about it.

(e) Mpumalanga: People who were aware of a treatment plant (42%) were informed via neighbours and friends, and also saw the plant being constructed.

(f) North-West Province: The respondents who were aware of the plant said they were informed by the Botshelo Water Board (3%), Sedibeng Water Board (3%), and others knew it was there because they could see it (20%). The rest heard about it from others in and around their communities, and saw it being constructed.

5.2.3 Employment Opportunities Resulting From Plant/Technology Presence

Table 7: Indication of Employment Opportunities per Province

Province	YES (%)	NO (%)	N/A (%)	Unsure (%)	Missing (%)
Eastern Cape	40	19	36	0	5
Free State	20	53	23	1	3
Gauteng	10	30	45	15	0
KZN	28	20	34	5	13
Limpopo	32	29	32	6	1
Mpumalanga	29	9	56	2	4
Northern Cape	55	27	17	0	1
North-West	17	28	52	0	3
Western Cape	34	26	36	3	1

44% of respondents in the Cape provinces reported that the plant provided job opportunities while it was under construction. In the Limpopo Province this varied from community to community, from as few as 10% of respondents relating community employment opportunities during plant installation in Shatale, to as many as 60% relating this in Tours. Only 10% and 17% respondents from Gauteng and North-West Province respectively indicated that the plant created employment opportunities.

5.2.4 Respondents' Understanding of Plant Operations

Most people, 76% in the Cape provinces and 82% in Limpopo Province, did not understand how the plant works. 24-30% of respondents in the remaining provinces (Free State, Gauteng, KZN, Mpumalanga and North-West) did not understand how the plant works.

On average, across the nine provinces, 75% of respondents did not understand how the technology works.

5.2.5 Willingness to Learn How Plant Operates

Only 51% in the Cape provinces want to learn about the plant, while this holds true for 64% in Limpopo Province, 71% for KZN and North-West Province, 66% for Free State, 65% for Gauteng, and 60% for Mpumalanga.

For all communities, a willingness to learning varied from finding out how the water gets

purified to how the water gets pumped into their homes. In addition, communities also wanted to improve their general knowledge on all aspects relating to water purification.

5.2.6 Community Suggestions on Plant/Project Implementation

Community members suggested that water projects could be implemented as follows:

- a) People must be informed about the proposed plans. They expressed this by requesting that the following be done prior to project implementation: “Call a community meeting and talk about the machine and find out how people feel about it” and “Community committee holds meetings with the community and everyone talks together and comes to a decision.”
- b) Raise water awareness and provide education on how the plant works. Communities are keen on finding out how to conserve water and also learning more about the technology implemented to improve their water quality and quantity. They also want to “see that the plant works” before actually accepting the technology.
- c) Use local community skills. Community members want to be part of the project after they have accepted it. The reason is that they have skills that can be used in project and/or plant implementation. This will also create job opportunities albeit for the duration of the project only.
- d) Planners should do the following: “Attention must be given to work that community members can do” and “Have a meeting and discuss how people can participate and they will because they are unhappy with the current water system.”
- e) Meetings about the project should be arranged with all concerned and everyone should have a say regarding the proposed project. This should be done by taking into account the community needs: “...have a community meeting whereby we talk about the topic and discuss it with the community...” and “have a meeting with us and tell us about it...it will help if we understand the project...”.
- f) Teach community members how to fix the plant when it breaks. This will limit costs and time, as the community will not have to wait for someone from outside to come into the community and do the necessary repairs.
- g) Community members want to be part and parcel of any project taking place in their community. Many skills are available and community members feel that these are under-utilised, especially since unemployment exists.

5.3 SATISFACTION

5.3.1 Satisfaction with Water

69% of respondents in the Cape provinces indicated that they are satisfied with the treated water. In Limpopo Province, satisfaction with the water quality differed between the towns, mostly relating to whether the plant was up-and-running and to the frequency of interruptions in the supply. Satisfaction with the water relates to the fact that the plant cleaned the water, making it easily palatable and aesthetically acceptable.

Least satisfied with water were respondents from Gauteng, with only 40% of respondents being satisfied with the water they were receiving, and Mpumalanga, with only 44% of respondents being satisfied with it. Table 8 illustrates respondents' satisfaction with the water supplied across the provinces.

Satisfaction with the water quality differed between regions and water treatment systems. In general, where a plant was up and running, community members experienced the benefits in terms of taste, smell and appearance of the water and usability for household chores. Highest levels of dissatisfaction were expressed in Gauteng (60%), Mpumalanga (54%) and North-West Province (49%).

Table 8: Respondents' Satisfaction with Water Supplied

Satisfied with water supplied?					
Province	Yes (%)	No (%)	N/A (%)	Unsure (%)	Missing (%)
Eastern Cape	62	29	4		5
Free State	53	45		2	
Gauteng	40	60			
KwaZulu-Natal	53	45		2	
Limpopo	59	40			1
Mpumalanga	44	54			2
Northern Cape	66	22			12
North-West Province	51	49			
Western Cape	18	15	5		

(a) Community members were satisfied with the following (with reasons):

(i) Constant Supply

Respondents indicated that interruptions to the supply of water only occurred when plant maintenance takes place.

(ii) Purified and Clean Supply of Water

Water is cleaner than before, as observed by no objectionable taste, colour or odour in the water.

(iii) Improved Accessibility

Instead of having to walk long distances to collect small volumes of water, it is now constantly available and households can use as much as required for daily household activities. Water does not have to be stored. Users find this to be an improvement in convenience.

(iv) Few Problems Experienced with the Plant

Respondents indicated that they are experiencing less incidences of interrupted water supply, unpleasant water in term of taste, odour, colour, and unwanted residues in water. They also feel that the water is safer and healthier as they experience less incidences of disease.

(b) Community members were dissatisfied with the following (with reasons):

(i) Interruption in the supply

Communities are not informed, in advance, of interruptions due to maintenance. They may then end up having no water for hours, sometimes days. They are also not informed of breakages in the plant, which then results in interruptions of water supplies to homes.

(ii) Unclean water

In certain areas respondents feel the amount of chlorine added to the water is exceeded. This they attribute the unpleasant or 'jik' (chlorine) taste. They also find the colour brought about by the chlorine to be unpleasant and then regard this water as being unclean and not suitable for drinking or use in other household activities. After interruptions and when the plant is up and running again, water has unpleasant residues present that are also unacceptable.

(iii) Accessibility

During interruptions in the supply of water respondents have to walk, sometimes to unprotected sources, to collect water. This water then has to be stored until the water supply to their homes is resumed again. This can take up to several days and is inconvenient.

In communities where the local authority (LA) had suspended water supply, as a result of non-payment, affected households have no other option but to collect water from raw sources where available. They are aware that this water is unpurified but say they have no other way out. Where the plant is not working, respondents indicated that the water is polluted.

(iv) Unsuitability for Daily Household Activities

Respondents complained of poor physical quality of water, which makes it unsuitable for use in laundry.

5.3.2 Satisfaction with Local Government Services

Respondents in the Northern, Eastern and Western Cape provinces expressed satisfaction with the local authority and local government waste and refuse removal system. Their unhappiness, in their opinion, stems from the fact that the LA is: "not transparent" and "does not consult with community members about the implementation of projects". In addition, it was felt that the LAs "don't deliver", "don't render service", "make empty promises", "are not fair with work allocation on projects", and "are not visible".

For communities in Limpopo Province the respondents who were satisfied with the local government services ascribed it to the following:

- LAs provided assistance with child maintenance grants.
- Electricity and water are present.

Satisfaction with local government services varied between the North-West, Mpumalanga and Gauteng provinces. However, there is an indication that most people are dissatisfied with local governments services. Higher levels of satisfaction were present within the Free State province. In general, communities feel that local government is not concerned about their well-being, and that only empty promises are made to them.

They expressed dissatisfaction with the local government services as a result of the following:

- No job creation takes place within the community.
- In instances where employment opportunities are available, these are given to friends and/or family of those already in employ of the local government.
- Water and electricity supplies are frequently interrupted without notice.
- Not enough attention is paid to essential services such as the provision of roads and a proper infrastructure.

5.3.3 Plant Reliability

In terms of reliability, few respondents in the Cape provinces expressed dissatisfaction

with the plant and the water that is supplied by it. A few respondents (19%) indicated that the plant in their area is highly unreliable, while 37% found it to be highly reliable. The rest (35%) found it to be moderately reliable or moderately unreliable (9%). For Limpopo Province, dissatisfaction in terms of plant reliability stems from the fact that plant breakdowns and interruptions occur frequently as a result of breakages, power-supply interruptions or maintenance to the plant.

Table 9 illustrates the respondents' opinions of the reliability of the plant.

Table 9: Respondents' Opinions of Plant Reliability

PROVINCE	LEVEL OF RELIABILITY								Total
	Highly reliable	Mod. reliable	Mod. unreliable	Highly un-reliable	N/A	Do not know	Un-sure	Miss.	
Western Cape	40	32	11	4	6	0	0	7	100
Eastern Cape	29	25	12	7	3	0	0	10	86
Northern Cape	45	51	5	4	0	0	0	15	120
KwaZulu-Natal	9	23	10	12	3	0	0	4	61
Free State	42	34	15	0	1	0	0	0	92
Gauteng	7	10	3	0	0	0	0	0	20
Limpopo Province	22	54	35	21	1	1	0	6	140
North-West Province	26	23	22	2	0	0	1	1	75
Mpumalanga	20	30	21	25	1	0	0	14	111
Total	240	282	134	75	15	1	1	57	805

Mod: moderately
N/A: not applicable
Miss: missing

5.4 CURRENT WATER COLLECTION PRACTICES AND USAGE

5.4.1 Perception of Main Water Source

Few respondents could positively identify what their main water source was. Throughout all provinces, high proportions (up to 74%) were of the understanding that the water came from the tap. To a lesser degree, 17-26% indicated that their main water source was either an underground or surface-water source.

Water collection (fetching) differs between the provinces, with proportionately more households collecting water in the Eastern Cape compared to the Western Cape. All communities interviewed in the Limpopo Province indicated that they fetch water, for which they have to walk to the raw water source, or that the tap is not inside the home, e.g. communal standpipe. In Mpumalanga the proportion of households fetching water is

86%. The lowest percentage of water collection is in Gauteng Province, where 20% of households have to fetch water. Table 10 illustrates this:

Table 10: Respondents' Indication of Water Collection

Is water collected/fetched?									
	E/Cape (%)	N/Cape (%)	W/Cape (%)	Lim-popo (%)	KZN (%)	N/West (%)	Mpum (%)	F/State (%)	Gau-teng (%)
Yes	75	50	34	86	82	89	78	59	100
No	24	38	61	13	18	9	22	41	
Missing	1	12	5	1		2			

The average number of households collecting water throughout all provinces in the communities interviewed was 70%.

Households having to collect water indicated that they collect water as needed. Water is generally used for all household activities.

(a) Communities do not like fetching water. Reasons for this are as follows:

(i) Eastern Cape

- Long (walking and carrying) distances: Respondents related that the distances from their homes to the water source are quite far and this is inconvenient as they spend much time having to fetch water for daily household activities.
- Security risks: Linked to the long distances from homes and community is the safety risk associated with having to fetch water.
- Collection containers: Another factor linked to the long distances is the size of the collection container. Community members will collect as much water as the container allows. They also collect as much as possible to eliminate having to do return trips for more water as a result of the long distances. The risk associated with carrying as much water as the container can hold is that it (the container) may break; it is heavy and uncomfortable to carry.
- Poor water quality: Communities regard the water source to be "polluted", "not clean", containing "animal faeces" and carrying "cholera germs". They do not like using this type of water but have no other choice when interruptions or shortages occur.

(ii) Northern Cape

- Disagreements over water: Sometimes the community from which the water is to be obtained is not friendly, and they argue over the water.
- Long (walking and carrying) distances: In some communities, because of the distance to the source, water needs to be fetched with a car or some other means of transport. This often results in households having to pay for the transportation.
- Collection containers: Communities have to carry the heavy containers over long distances. Some who collect water are elderly or ill, and this poses a great inconvenience.
- Safety risks: Having to fetch water is sometimes dangerous.

(iii) Western Cape

- In this province the distances to the water do not pose a problem. Most respondents find the task of having to collect water as tedious and unpleasant, saying there is

“nothing nice” about fetching water.

- Security risks: Having to fetch water poses a safety and security risk, especially at night.
- Collection containers: These are heavy and uncomfortable to carry when filled with water. One person remarked that they make the house look untidy when stored. These are open containers and insects may fall in and contaminate the water.

(iv) Limpopo

- Collection containers: Containers are bulky and uneasy to cart.
- Long (walking and carrying) distances: Distances, in the case of communal taps, are far.
- Long queues at the tap: Apart from having to walk the long distance, another time-consuming factor is the wait in the queues at the water collection point.
- It is tiring to fetch water, especially for the old and sickly.

(v) KZN

- Long distances: Distances from homes to tap are quite far and collection takes lots of energy and time.
- Unsafe: Because of the long distances, water often has to be fetched from taps which are in quiet and deserted spots and this creates a security risk, especially to vulnerable groups such as women and children.

(vi) Free State

- Heavy containers: In this instance the amount of water fetched should ensure an entire day's supply, which often necessitates many or large containers to be carried.
- Cold night-time temperatures: In this case respondents indicated that when it is a cold night they would rather be without water should they run short, as opposed to leaving the house to fetch water outside.

(vii) Gauteng

- Long distances to water source
- Containers are heavy and uncomfortable to move.
- There is nothing they like about fetching water.

(viii) Mpumalanga:

- Long distances to water source
- Heavy containers are uncomfortable to carry.
- There are safety risks as a direct result of the long distances to be covered.
- It is tiring, especially for older persons.
- When it rains it is not easy to fetch water.

(ix) North West

- Long distances
- Heavy containers
- Safety risks.

(b) Reasons given for liking the act of water collecting include the following:

(i) Eastern Cape

- No long distances: In this instance most households have a tap on their property so distance is minimised. It is thus near enough for them to collect large or small quantities as needed, as related by some of them — it (the water) is “nearby and very easy to get”.
- Water quality: As the water is piped to a tap on a property, or to nearby homes, the water is purified and they feel that it is clean and safe to use.
- Social interaction: Some community members enjoy collecting water as they find this to be an opportunity to have “fun at the river and chat to friends”.

(ii) Northern Cape

- Distance: Most communities in this province have taps on their properties or close to the houses and the distance is thus not a problem. This also proved very convenient as no safety risk was present and it did not really take “much effort” to collect water, especially where the tap is on-site.
- Social interaction: Some respondents regard collecting water as something positive as it gives them a chance to interact with friends who also collect water.

(iii) Western Cape

- No long distances: Distance to a source that is not too far from the home makes collecting water as convenient as when a tap is on the property.
- Social interaction: The interaction that takes place between community members is seen in a positive light: “(I) enjoy walking with my brothers”, “(I) like getting out and seeing my friends’ and “(I) like to get out and look at the plants”.

iv) Limpopo

- No long distances: In instances where the tap is on the property, but not inside the house, the distances are ‘not too far’;
- Constant supply: It is available when they need it.

(v) KZN

- Assurance of purified water: Water from the raw source, e.g. a river, contains disease-causing organisms, and the treated tap water is safer.

vi) Free State

- Accessibility: The taps from which water is collected are either on the property of the respondent or not too far from their houses.

(vii) Mpumalanga

- Ensured of clean water, which is also palatable.

(viii) North West

- Opportunity to socialise with friends

- Distances are not too far: This holds true for respondents who either have a tap on their property in the outside yard, or where the communal tap is considered close to the house of the respondent.
- A need is satisfied, i.e. that of obtaining clean, safe water.

5.4.2 Amount of Water Used per Day

The amounts of water used per day are determined by need and type of household activities set out for that day, e.g. on laundry days more water is collected. People also indicated that they try not to waste water, as it is a valuable and expensive resource. The fact that they have to pay for the water also determines how much of it they used.

5.4.3 Water Shortages

In total, 72% of respondents indicated that they had already been short of water. In the Cape provinces a total 67% of all communities have experienced water shortages whereas this was the case for 84% of respondents in the Limpopo Province.

(a) In the Western, Northern and Eastern Cape provinces this shortage ranged from a few hours to a few days to months. This they experienced to be as a result of the following:

- Regular maintenance to the plant
- Breakages and subsequent repairs to the plant
- Water supply suspended as a result of non-payment
- Unable to fetch water as a result of illness
- Seasonal variation in water supply, e.g. in the Western Cape sources dry up during summer and in the Eastern Cape during winter.

During times of interruptions in the Cape Provinces water is obtained in the following ways:

- From the raw source
- From friends or family in another town, or in the same area where the water supply had not been suspended
- Stored water, as they had been informed of the intended pipe or plant maintenance
- Municipality (LA) delivers water via truck (lorry)
- Wait until water is turned back on again or simply stay without water.

(b) In the Limpopo Province these water shortages are experienced as often as 2-3 times per week. During this time water is obtained from a variety of sources, including the following:

- Collect at the raw source, i.e. river, stream, dam, borehole
- Buy water from shop owner in the community or from neighbours
- Fetch water from the municipal building
- Stock-up on water, as supply is always unreliable.

(c) In KZN shortages are also experienced on average once per month, during which time water is obtained from boreholes or raw river sources, or people simply wait for the water to be available again. This is usually as a result of maintenance to purification systems and pipes.

(d) Free State respondents (83%) indicated that most of their interruptions in supply happen as a result of non-payment. They then source water from neighbours and friends, or obtain it from a raw source, where available.

(e) In Mpumalanga, 82% of respondents had experienced water shortages during the past week. This was also as a result of non-payment, and the household supply was then

subsequently suspended, or as a result of system maintenance. Water was then obtained from friends, neighbours, or a raw source that is present in abundance.

(f) Gauteng respondents mostly experience interruptions in supply when maintenance to the system takes place. They are usually informed ahead of time and then make provision for this by storing water in containers inside their homes.

(g) North-West Province respondents (61%) have also experienced shortages, but have indicated that this was as long ago as three months before the interview. During this time they were also informed of the supply interruptions and could then make alternative arrangements.

5.5 WILLINGNESS TO PAY FOR WATER

59% of households in the Cape provinces, and only 20% of households in Limpopo Province, pay for water. This they do because they get a monthly account from the LA, and are therefore obligated to pay for the services. People who do not pay for water (40% in the Cape provinces) either simply cannot afford it, had not received an account for it, or water meters had not been installed yet.

Respondents suggested that non-payment of water be solved in the following ways:

- Service providers must discuss, either at household or community level, how water arrears can be sorted out.
- A payment plan should be made available for those who cannot pay the monthly water bill, e.g. the pensioners and unemployed.
- Suspend the service of those who do not pay for the water.

In Limpopo Province, those who do not pay for water (80%) do not do this because of the following:

- It comes from a communal tap which does not belong to them
- Water is free
- A community decision not to pay for the water
- Do not have water meters
- Do not get accounts from the local authority.

For KZN, Mpumalanga and the North-West Province, 30% of respondents indicated that they pay for water. Reasons given are that they regard water as a need; they receive an account from the local authority, and are afraid that their supply will be suspended should they refuse to pay.

Gauteng had the least amount of respondents indicating that they pay for water, namely only 5%. One reason for this is that they do not have taps on their property. Most respondents (95%) were reluctant to provide reasons.

69% of Free State respondents do pay for water. This they do because of the following: the water supply may be suspended if they fail to pay, they receive an account for water usage from the local authority, and water is a need without which they cannot live.

On average, across all nine provinces, 43% of respondents indicated that they pay for water.

5.6 SOCIAL AND ECONOMIC MOBILITY

In all provinces community members use public transport, mostly taxis. They also hire vehicles, hike, or walk to get from one place to another. Only 1,5% of all respondents

said that they travelled between 0–15 km for work, while 40% of respondents said they travelled further than 15 km for work. 57% of all respondents indicated that they had been away from their homes for three days or longer due to the following:

- Work
- Holiday
- Tending to ill family members
- Church conventions and outings
- Attend funerals
- Studies
- Medical reasons, e.g. visit hospitals or doctors outside their town.

Most respondents (67%) have no objection to being away from the home for longer than three days.

5.7 VOLUNTEERISM

69% (Free State), 68% (North West), 66% (Cape provinces), 60% (Limpopo), 55% (Gauteng), 54% (Mpumalanga) and only 44% (KZN) of respondents are willing to voluntarily promote the implementation of a water plant or project within their area. Those not willing to do this voluntarily cite the following reasons:

- Presence of an existing chronic illness
- Old age
- Need to have an income as they have families to support
- Not willing to work for free.

56% of respondents, from all nine provinces, indicated that ‘others’ would volunteer to assist with the promotion or implementation of a water plant or machine.

5.8 COMMUNITY COHESIVENESS

58% of respondents in the Cape provinces and 67% in Limpopo Province belong to a club or organisation. The least number of respondents in KZN (26%) belong to a club or organisation. These clubs and organisations varied from community to community between church groups, sports clubs or organisations, and political groups. Very few community members (88%) had had fall-outs with neighbours during the past two years.

Problems on household level are sorted out by talking about it in the home. On a few occasions outside help in the form of family, or church leaders, or in the case of the Eastern Cape, KZN, Mpumalanga and Limpopo provinces, the headman or chief (‘induna’) is called in to sort out the problem that has arisen. When the community as a whole has a problem, they sort it out by having a meeting, talking about it, and coming to some sort of agreement. Sometimes, however, no agreement is reached. In rural Eastern Cape, KZN, Mpumalanga and Limpopo Province, the headman is the one who decides on how the problem should be resolved.

5.9 HYGIENE AND SANITATION

5.9.1 Refuse Disposal

In areas where the LA provides this service, waste is collected and disposed by them. Other communities dispose of their waste in the following ways: burying the waste, incinerating it, creating/transporting it to a landfill site in the area themselves, and uncontrolled dumping of the waste.

Refuse products are seldom re-used or recycled simply because no facility for this

practice is available within the community. A large number of respondents (76% throughout all provinces) also indicated that they do not recycle, or re-use waste products as they do not know anything about it, how to do it, or there is no service or facility available for this activity.

In instances where re-use and recycling occurs, it includes re-using water for gardening purposes and re-using plastic bags for storage of household refuse. Empty soda bottles are returned to the shops for money.

5.9.2 Waste Water Disposal

Where drainage is available in the area, wastewater is disposed of in this way. Wastewater is generally re-used for gardening purposes and disposed of in the following ways: via drainage, used for gardening purposes, disposed of in road, disposed of in yard area, and in Limpopo Province disposal is via septic tanks.

5.9.3 Sewage disposal

Sewage is disposed of as follows: VIP latrines, drainage via water-borne toilets, septic tanks, bucket toilets that are collected by LA or private company when full, the bush, and neighbour's toilet.

5.9.4 Environmental Problems Experienced

In the Cape provinces these varied from area to area and depended on the location of the town in relation to other activities in and around the town.

In the rest of the provinces the environmental problems experienced varied from area to area and also depended on the location of the community in relation to observable environmental hazards. Problems related by respondents included the following:

dust, especially in areas where no tarred roads are present, vermin, including cockroaches, rats, mice, snakes, mosquitoes (related to location) and amount of rainfall and stagnant water in the area, smoke, especially in areas where refuse incineration occurs within the communities, and bad odours, especially where communities make use of the bush as a toilet facility.

5.9.5 Health and Hygiene

Respondents or members of their households had experienced stomach ailments at least once during the two weeks preceding data collection. Incidences thereof varied on average from once to about three times during this period.

Hand-washing practices are not neglected. Respondents say they wash their hands regularly especially after having used the toilet or for those with babies and infants after a nappy change, working outside – in the yard area or garden – and especially before handling food – preparing or eating it. They wash hands regularly because of the following:

- It prevents sickness from occurring: “...if you handle food with dirty hands you can get sicknesses...”
- It prevents worm infestations: “ ...not to get things like tape worms on your hands...”
- For hygienic purposes: “...to be clean and prevent diseases...”

Knowledge regarding cleanliness has been instilled at school or via parents and grandparents.

6 DISCUSSION

6.1 EDUCATIONAL STATUS

Adults of employable age have at least a primary school level of education. All children of primary school age are at school. In most instances age corresponds with the grade (standard). This, combined with a willingness to learn, indicates that communities can be trained, and access and communication to parents can take place via the primary schools.

a) Literacy Levels and Trainability

Illiteracy is more prevalent amongst older adults, i.e. senior citizens, as in this group little to no schooling is reported. For this reason, where training takes place, the levels of training, as well as the type of training materials and training aids should be appropriate to the literacy levels of the group being trained. The focus of the training could also be varied between the different groups.

Given the current low education status of the community in general, as well as an eagerness to learn and develop skills, communities can be trained, educated and made aware of aspects relating to basic aspects regarding health, the environment, water purification, etc.

b) Education Status of Women

Women's education levels generally vary from primary school to high school. In limited instances tertiary levels of education are present. Training, education and awareness of the women, as family and household managers and subsequently managers of household water supply, is highly recommended.

c) Training needs

In all communities a need to be educated on water issues is reported. This includes improving general knowledge on all aspects of water purification to learning how the water is piped from the raw source into the home.

6.2 WILLINGNESS TO PAY

a) Operation and Maintenance Costs

Levels of income should be taken into account when a technology is selected, as affordability is important. In general, communities are willing to pay for water as it is a basic necessity, however the current costs of water should not escalate excessively.

b) Sophistication of Technology

Some technologies do have varying degrees of sophistication. In spite of this, communities express a need to know the basic operation of the plant and are willing to learn about these. If community members are aware of basic aspects regarding the plant this will limit costly tampering with the plant during interruptions. If some/one person is trained on maintaining the plant, it should further reduce tampering with it.

c) Skills Required from Operators

Communities are prepared to be trained in all aspects regarding the supply of potable and palatable water to their homes. One must be aware that the skills required for operating the plant could be found within the community, based on the level of education and diverse experiences. In most cases it is not necessary to appoint an operator from outside the community.

d) Frequency of Water Supplied

Frequent interruptions in the water supply system cause frustrations to households, even more so if the community is not informed about these in advance. A reliable supply, with limited interruptions, is also welcomed.

e) Quality of Water

Communities are willing to pay for water if the quality thereof is acceptable. Any technology selected should thus adequately treat and purify water to a level that the community finds acceptable in terms of appearance, odour and palatability.

f) Level of Income

The level of people's income as well as those with water payment arrears should be considered, with special regard to pensioners, the unemployed and low-income groups. When selecting a technology the current income levels as well as payment history of respective communities should be taken into account.

g) Local Authority's function/duty

In most communities where water payment occurs this is so because of receipt of an account/water bill from the local authority. Communities will not pay for water if there is no evidence of water meters. Visible billing, in the form of water accounts, water meters, and readers of water meters encourages payment.

6.3 IMPACT OF HUMAN ACTIVITY ON WATER QUALITY

When selecting a specific technology, it is important to first determine the activities that take place in and around the entire water supply chain. Activities may impact on both the water treatment plant and water supply chain in the sense that they may damage the plant, or cause unexpected pollution. These activities may include, amongst others: domestic, mining, agricultural, and industrial activities, from which emanate a variety of run-offs. The selected technology should be capable of safely and efficiently removing all hazards in such run-off, making it aesthetically acceptable to the communities who are its users.

6.4 COMMUNITY PARTICIPATION

Community members are often regarded as change agents and they therefore play a vital role in empowerment and development. Community participation on the other hand is a process in which members have the right to be actively part of any development that affects their lives and livelihood.

Favourable consideration has been given to the notion of local participation and increasingly more local authorities are actively engaging themselves in these processes. However, the following socio-economic aspects need to be considered when dealing with the aspect of community participation:

a) Process to be followed

Involving the community in certain activities does not signify participation. The processes of engagement, empowerment, participation and phasing out need to be strictly adhered to.

Community structures vary throughout and different levels of authorities exist. In some communities one may find two-tier levels of authority while in others there are up to four.

b) Inclusiveness

Communities are eager to learn about, and be included in, any venture that takes place within their area. The community needs to be included in the programme by means of collaborative partnerships between individuals, groups, organisations and the local authority.

c) Transparency

Transparency breeds trust. Communities demand that structures, processes and the local authority maintain a high degree of openness, truth and honesty, and vice versa.

d) Public Responsiveness

It must be accepted that communities do respond to what is said and done. A high degree of flexibility and open-mindedness facilitates greater responsiveness. Communities should be given the opportunity to debate and select between different options.

e) Tradition

The belief system and traditions of communities need to be respected. Common ground needs to be found between tradition and new initiatives that bring about change. This identified common ground will form the basis of the change process.

f) Community Perceptions and Expectation

The community's expectations on water quality and how it impacts on quality of life often differ from those shared by officials. Communities tend to concentrate on tangible aspects such as colour and taste of water rather than microbial counts. Issues such as the impact of water treatment facilities on the economic status and job creation are high on their agendas.

g) Service Delivery

Service delivery is a critical element in the participation process. Non-delivery leads to dissatisfaction, suspicion and distrust.

6.5 WATER DEMAND AND MANAGEMENT

There is a clear distinction between water supply management and household water management. On the community level, supply is often managed on organisational and/or committee level, whereas household water is managed mainly by the women.

a) Expectancy of Sustainability

Community growth and activities increase the demand for water. However, quantity/provision should not be seen as meeting this demand. Water quality and the selection of the appropriate water system are crucial in ensuring usage and sustainability.

b) Present and Future Source

Present and future sources should not only take community growth into consideration but also the aspects of supply and reliability. A consistent water supply and plant reliability is often associated with satisfaction.

c) Projected Plan and Alternative

The projected plant should satisfy current and future needs. Communities also need to be made aware of and educated on activities and practices that unnecessarily increase the demand for water. The daily output should be consistent with and reflect the capacity of the plant. If current plants do not satisfy community needs and expectations then suitable alternatives must be found.

7 CONCLUSIONS

The following conclusions are drawn from the study:

1. A reliable intervention, operating with minimal interruptions, is fundamental to the acceptability thereof.
2. Communities need to be part of the intervention initiative from the start in order to buy into the idea.
3. The role of women as household water managers makes them the main role players in mediating between the water systems and the households.
4. Levels of authority differ from community to community and also between provinces, and it is important that these 'levels of authority' be respected in order to gain entry into such communities.
5. Services delivery is crucial to whether communities are satisfied or dissatisfied with local government.
6. Communities are willing to pay for services but evidence of the delivery thereof must be tangible.
7. Communities are willing to learn about the basics of plant (technology) operations.
8. The communication gap between local government, technicians and communities needs to be bridged.

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