

GROUNDWATER

Groundwater, boreholes and ethical issues

Sharing of groundwater produced by boreholes may be a generous and praiseworthy idea, but is it really feasible in practice? Handré Brand explores.



It is logical to expect that during the drought situation in the Western Cape the demand for boreholes would increase significantly. Sometimes it may also happen that homeowners with boreholes fail to install proper borehole notices on their gates. The provision of visible borehole notices is, in fact, prescribed by municipal regulations.

Why would some borehole owners not be willing to cooperate and comply? Psychological ownership is the conviction that a person acknowledges that a particular target for ownership is indeed his. In such a case, the borehole is the target of ownership. It is also known that the construct of psychological ownership varies on a continuous scale from higher to lower values. It may well be that a borehole owner with relatively lower psychological ownership identifies less intensely with his possessions because it is not strongly associated to his self-identity. As a result, the installation of notices is simply not an important issue for such a borehole owner.

Owners with strong psychological ownership of property, on the other hand, may show a different reaction pattern, for example, it is my property and my borehole. "If I violate a regulation, it is my concern, it is my privilege to choose whether to display a notice or not".

It is possible that such a reaction may indicate an attitude of self-righteousness or self-entitlement, in other words, an inherent and excessive self-determination to make an own decision. It comes down to self-assertion of the right to violate local borehole regulations. Of course, there should always be a caution against generalisation. Various variations on this theme of psychological ownership are possible, but the issue is directly linked to ethical awareness and ethical responsibilities of borehole owners.

During a recent conversation with a friendly drilling technician about the depth at which a good supply of groundwater might

be found, it was indicated that in this specific municipal area water is usually found in granite rock between 70 m and 100 m. Such a borehole may cost around R100 000 depending on the depth, including the pumps and additional equipment.

The technician further states that about six hundred drilling machines in South Africa are actively drilling for water every day. If one argues that 400 successful holes are drilled every two to four days by these operators, then it is a large number of new boreholes that are added annually to the existing total. However, the technician does not know exactly how many boreholes have already been sunk in South Africa.

There are specific regulations regarding drilling of boreholes, and the regulations differ for boreholes on farms and municipal areas. The piles of soil that lay in a neat pattern on the pavement are soil samples taken every few meters of minute rock splinters blown out during the drilling process.



The brown piles are gravel (unconsolidated and weathered rock); the blue is granite (solid rock or bank) and then the mud piles (the structure or shift) that indicate the depth at which water has been found. A borehole sank into certain types of underground rock structures can be problematic due to the dewatering of rock openings and caves.

The unknown nature of the underground water flow and the vibration of the drilling process may cause cracks and cracks in the walls and structures of buildings or houses. The actual effect of the extraction of water will only be seen long after the borehole is drilled. In such a case, the borehole can be filled with cement in order to cut the supply of water from the borehole, and the further implications are the owner's responsibility.

In theory it is possible to consider the possibility that each resident of a particular town could each drill a borehole on their own premises. What will be the consequences if bursts in rock formations arise underground and create conditions for earthquakes and sink holes and craters? What the effect on the available underground water resource will be remains an open question.

Knüppe (2011) identified four key challenges to adaptive and sustainable groundwater management in South Africa. These

are: the undervaluation of groundwater importance and significance; the need for expertise and information at all scales; the centralisation of power; and the disregard of ecosystems and the associated goods and services.

A first step to improving the respect for groundwater may be if neighbours share groundwater extracted by boreholes, because whose water is actually flowing into a borehole? Groundwater is a national asset. Sharing water will promote the ethical principle of humanity and compassion in our society.

The free market principle, of course, determines that those who are financially capable can buy themselves out of water constraints, while the rest must reduce their water consumption. It is also well-known and commendable that neighbours already share borehole water in several towns and villages. Some divide the total costs between them, but there are also examples where borehole owners have offered to share water with their neighbours despite the cost.

These are truly innovative and valued ideas, but will groundwater self-righteousness and the willingness to share groundwater over the long term become truly compatible and sustainable bedfellows in everyday life?

A pilot study

The hypothesis explored in this pilot study was that a group of ratepayers or property owners in a specific municipal area will differ in terms of their perceptions of and attitudes towards the management and sharing of groundwater extracted by means of private boreholes.

A semi-structured questionnaire was constructed as a research instrument. The primary questionnaire items (N=19) were categorical and of a forced choice design, but the respondents could also motivate their answers if they preferred to do so. The instrument could either be used as a face-to-face framework for the verbatim recording of the respondents' answers and motivations or as an online questionnaire sent via email.

It was decided to use a convenient or available non-probability sampling method for the purposes of this study. A convenient sample consists of subjects who are easy to reach, and is obviously not the best way of sampling, but for the purposes of this study (a private project with a zero budget) it was regarded as the best option to approach the matter.

Two nearby and accessible neighbourhoods in a town located in the Winelands District of the Western Cape were identified for sampling purposes. In total there were 280 plots owned by individual ratepayers in these two neighborhoods used for the purposes of this study. One single plot number from the municipal valuation roll and was randomly selected and was regarded as a logical and objective point of departure for this exploratory study.

The owner of this randomly selected property was contacted by the researcher to discuss the nature, aim and procedure of the prospective survey. This respondent was asked whether he was willing to take part in an individual interview and would be willing to refer the researcher to a next possible respondent (or

respondents) in the same neighborhood. The procedure was repeated for all 20 respondents taking part in this study.

Some participants preferred to summarise and finalise their motivational responses and to return their questionnaires via email. Eight possible participants declined the invitation to take part in the study. Following this procedure the 20 individual semi-structured interviews were conducted over a period of three months. The obtained response frequencies and percentages are summarised in Table 1.

Results

According to Table 1 the property owners which were included in the sample were mostly male (90% male and 10% female). In terms of chronological age the sample mostly represented the 60 plus age group (80%).

Twenty five percent of the respondents owned a private borehole and 10% was previously an owner of a private borehole. The yield of the boreholes varied from 3 000 to 20 000 litres per hour. All the owners of boreholes were highly satisfied with the performance of their boreholes.

Seventy percent of the respondents were intensely concerned about the long-term impacts of the extraction of groundwater by means of boreholes on the water table, while 20% were not concerned about the impact and 10% were uncertain about the effects. Most respondents (75%) were of the opinion that it is a good idea to share groundwater between neighbours. However, on the question whether there should be a municipal by-law forbidding the sharing of groundwater the response pattern changed to Yes (45%); No (45%) and Uncertain (10%).

Most respondents (75%) said that the receiver of shared groundwater should contribute to the installation and running cost of a borehole owner. Fifty five percent thought that a formal contract between borehole owner and the sharer of the groundwater should be negotiated, 15% said "No" and 25% "Preferable".

There was general agreement among the respondents that the willingness and ability to share is a positive and universal humanistic characteristic.

Eighty percent of the participants stated that boreholes should be officially registered and 15% of respondents were of the opinion that registration is not at all a good idea, while 5% were uncertain on this issue. Sixty five percent of respondents were of the opinion that a borehole owner should install a visible borehole notice or sign on his premises, while 25% did not agree with the statement and 10% were uncertain on this matter.

Most respondents (70%) preferred desalination of seawater to the extraction of groundwater by means of boreholes, while 10% preferred boreholes and 20% were uncertain about the pros and cons of the two options.

As expected there was consensus that the humanistic value of sharing between people in general is an important human characteristic (100 % of respondents agreed on this statement). Most (75%) also agreed that those who identify strongly with their belongings would be less inclined to share a commodity such as groundwater. The relative importance of the common good principle showed a wide range of responses and was rated as very important by 45% of the respondents, important 20%, less important 30% and uncertain 5%.

Discussion

A convenient sampling procedure was used in this study, and surprisingly gave a relative accurate indication of the characteristics of the neighbourhood demography that was identified for research purposes. Most property owners were from the older, white, and higher-middle class sector of the population. The obtained results of this study should therefore be interpreted within the context of this observation.

Five respondents were current owners of private boreholes representing 2.6% of the total number of registered boreholes (N=195) according to the Manager of Water Affairs, local municipality) for this specific town. Boreholes were generally perceived as valuable assets by their owners. Borehole yield covered a wide spectrum. Respondents pointed out that boreholes contributed to the added value of their properties and also were a reliable source and provider of groundwater as an important commodity during the dry summer months.

Most respondents agreed that receivers of groundwater should contribute to the capital cost and running cost of borehole owners. Some said that the owner should contribute proportionally more than the receivers, and others were of the opinion that receivers could not only contribute in monetary terms, but also contribute in other non-material ways for example good neighbourliness, childcare, sharing expert advice and even gardening services.

Most respondents were of opinion that a formal and written contract between receivers and owners should be negotiated bilaterally. Preventing unforeseen legal issues during the changing of ownership between properties was given as a reason in favour of a binding contract. A different opinion was that an understanding between neighbours concerning the sharing of groundwater should be based on goodwill and not on a formal contract. There was also uncertainty whether a formal contact between role players would be based on private law or public law principles.

Participants were less in agreement about whether visible borehole notices for properties are important or not. Some owners said they do not want to "stand out", or to be "placed on a pedestal". They thought that honouring the integrity of borehole owners is more important than the controlling and identification of owners by means of signs and notices.

There was consensus that the registration of boreholes should be compulsory. Some of the motivations were:

- "There has to be a correlation between groundwater extraction (usage) and rainfall which should be monitored"
- "Yes, and the extraction thereof should be determined"

- beforehand, through a meter"
- "Registration implies more effective monitoring and management of ground water"

Compared to the extraction of groundwater more respondents indicated that desalination of sea water would be a better option of water management in future, mainly because the negative effects on nature are limited to a greater extent by desalination.

Although most of the participants (70%) agreed that the extraction of groundwater will impact negatively on the water table, 20% of the group was not concerned about the possible negative impacts and 10% was uncertain about the possible effects. This question created a varied response pattern among the participants.

Some of the respondents motivated their responses as follows:

- "No, the water table differs from area to area. Boreholes cannot therefore have a constant effect on the water table. Drought has a bigger effect on the water table when compared to boreholes"
- "Uncertain, we simply do not know enough about the effects of boreholes and the extraction of groundwater on the water table"
- "Yes, consequences of increased extraction of groundwater results in vanishing soil moisture and hence fertility. Aquifers tend to follow fault lines and generally take the shortest route between two points. Over time, there will be vacuums within fault lines, leading to land collapse and the possibility of damaged property"

There was general agreement among the respondents that the willingness and ability to share is a positive and universal humanistic characteristic. Consensus consisted about the issue of whether strong identification with belongings will result in less willingness to share groundwater. Strongly developed psychological ownership is thus seen as a contravening factor regarding the development of share-ability as a human trait. A more diverse response pattern (less agreement) was noted concerning whether the common good principle should be regarded as an important or less important issue.

When an ethical dilemma or epistemic conflict in terms of voluntary groundwater sharing was introduced (i.e. whether or not to abide by a bylaw forbidding groundwater sharing between neighbours) an equal split in the response pattern was observed (45% =Yes; 45% =No; 10% =Uncertain). Some of the respondents, who were willing to share groundwater despite a regulation not to share, overrode the ethical dilemma by questioning the validity and reasonableness of such a municipal regulation.

They were of the opinion that the selling of water to the public is an important source of income for municipalities, and that a regulation forbidding the voluntary sharing of groundwater should be seen in this context. Other respondents reacted in a more law-abiding manner and were not willing at all to act in any contradictory way to legal matters. This interpretation is in accord with the work of Jagers, Berlin and Jentoft (2012), who found that compliance/non-compliance was based on respondents' own benefit; whether they feel morally compelled to do one way or another; whether compliance is believed to

create a negative impression among peers and also whether they accept the justification given for introducing the rules.

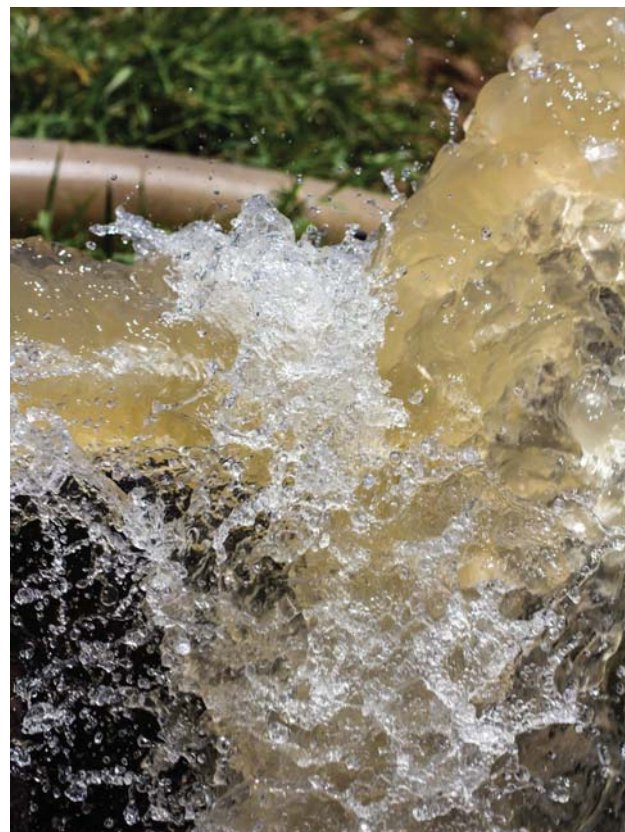
The interaction between Kohlberg's stages of moral reasoning (see Froming, 1978) and compliance behaviour, particularly Stage 3 (moral judgements are significantly influenced by the attitudes and opinions of others), Stage 4 (strict adherence to laws and rules of society) and Stage 5 (moral judgements are guided by internal standards and principles) may be relevant to explain the differences in the observed response patterns.

Summary

In this study, responses obtained by means of a semi-structured questionnaire for a relatively small convenient sample of property owners concerning sharing of groundwater were qualitatively analysed. The results indicated that sharing of groundwater between neighbours was generally perceived as a good idea and that sharing is an important human characteristic. Strong identification with one's own belongings contributes to the inhibition of the willingness to share.

Limited support for the common good principle were expressed by the participants. Whether or not to share when a regulation forbids the sharing of groundwater can be rationalized by cognitively overriding the dilemma by means of questioning the validity of such regulations in the context of municipal monetary policies. In general support was obtained for the research hypothesis that the sharing of groundwater is associated with specific and complex ethical issues as discussed in this study.

- A summary of the additional comments made by respondents on the different questionnaire items as well as the references are available from the author.



Questions	Variables				
1.	Gender	Male 18(90%)	Female 2(10%)		
2.	Age group	<40	41-50	51-60 2 (10%)	60+ 16 (80%)
3.	Are you a borehole owner (currently)?	Yes 5 (25%)	No 15 (75%)		
4.	Were you a borehole owner previously (in a different setting)?	Yes 2 (10%)	No 18 (90%)	NA	
5.	Residence: City, Town or Farm	City	Town 20(100%)	Farm	
6.	Capacity of your current borehole (litre per hour)	3000lpu 4500lpu 20000lpu 3(15%)	Litre per hour	NA 15 (75%)	No idea 2 (10%)
7.	Are you satisfied with your current borehole?	Yes 5 (100%)	No	Uncertain	
8.	Are you worried about the long-term effects of the extraction of groundwater on the water table?	Yes 14 (70%)	No 4 (20%)	Uncertain 2 (10%)	
9a	Is the sharing of borehole water (groundwater) between neighbours a good idea?	Yes 15 (75%)	No 2 (10%)	Uncertain 3 (15%)	
9b	Would you be willing to share groundwater even if a municipal by-law prohibits sharing?	Yes 9 (45%)	No 9 (45%)	Uncertain 2 (10%)	Unreasonable Question
10.	Should neighbours as sharers of groundwater contribute to the installation and the running cost of a borehole?	Yes 15 (75%)	No 3 (15%)	Uncertain 2 (10%)	
11.	Is it advisable to draw up a formal contract between neighbours sharing groundwater?	Yes 11 (55%)	No 3 (15%)	Uncertain 1 (5%)	Preferable 5 (25%)
12.	Should all boreholes be registered?	Yes 16 (80%)	No 3 (15%)	Uncertain 1 (5%)	
13.	Which is the best alternative: boreholes or desalination of sea water?	Boreholes 2 (10%)	Desalination 14 (70%)	Uncertain 4 (20%)	
14.	Is the ability to share, an important human characteristic?	Yes 20 (100%)	No	Uncertain	
15.	A person who identifies strongly with his/her belongings, would be less inclined to share groundwater.	Yes 15 (75%)	No 3 (15%)	Uncertain 1 (5%)	Not in a position to answer 1 (5%)
16.	Is it important for borehole owners to attach visible borehole signs to their properties?	Yes 13 (65%)	No 5 (25%)	Uncertain 2 (10%)	
17.	Do you regard the "common good principle" as an important concept in general?	Very important 9 (45%)	Important 4 (20%)	Not important 6 (30%)	Neutral or uncertain 1 (5%)