

**Perceptions of trends in the  
development of private boreholes for  
household water consumption:  
Findings from a survey of water  
professionals in Africa**

**RIGSS Working Paper**

**Cardiff University  
in association with  
Skat Foundation**

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The RIGSS research has been a collaboration between Cardiff University, UK; the University of Ibadan, Nigeria; the University of Maiduguri, Nigeria; Skat Foundation, Switzerland; and the British Geological Survey, UK.

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## Executive Summary

In recent decades there has been strong progress made towards the global goal of securing access to safe drinking water for all. Across much of Africa, these achievements have often been secured through increasing exploitation of available groundwater reserves, particularly through the development of water wells, or boreholes. Many countries are also experiencing a widening proliferation of boreholes commissioned privately by households, particularly in urban areas. This reflects the falling costs of accessing groundwater reserves, rising incomes and the greater availability of relevant drilling capacity and other expertise, as well as deficiencies in public water supplies.

The implications of the rise in private boreholes have not yet been fully considered. To address this question a survey of professionals working in the field of water supply was undertaken, drawn from the membership of the international Rural Water Supply Network<sup>1</sup>.

The research sought to explore 5 key themes:

- The perceived importance of different forms of household water supply
- The observed significance of groundwater resources for household water consumption
- The perceived trend in the development of boreholes commissioned directly by households
- The perceived risks and opportunities this offers
- The procedures in place for managing and monitoring groundwater resource use.

A total of 92 responses were received from 25 countries across Africa. The findings of the survey are informative, **indicating the important role that privately-commissioned boreholes are now seen to play in domestic water supply across much of Africa.** This is particularly so in non-rural areas, where it is seen to be almost as significant a source as public piped water supplies. **The survey emphasises the strong preference of households for having access to their own borehole and demonstrates the rising trend anticipated in the number of households accessing water through their own boreholes.**

The survey also reinforces the significant role by groundwater reserves in

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<sup>1</sup> The Rural Water Supply Network (RWSN) is a free to join global network of more than 10,000 professionals and practitioners working to raise standards of knowledge and evidence, technical and professional competence, practice and policy in rural water supply. The network is governed by the African Development Bank, IRC, Skat Foundation, Swiss Agency for Development and Cooperation, UNICEF, WaterAid and World Bank Group.

domestic water supplies, which is linked to the important role played by boreholes in water provision. Whilst this is solely based on the judgement of respondents it echoes evidence emerging from other studies. **Significantly, whilst the demand for groundwater is anticipated to rise, the amount of groundwater available is expected to fall.** This is partly due to the increased rates of abstraction predicted, and to expected falls in the level of recharge, coupled with changes to the timing of seasonal demands.

**Respondents to the survey express concern regarding the risk of contamination to domestic water supplies.** Whilst groundwater supplies are regarded as slightly more at risk than public water supplies, both are regarded as vulnerable. The main concern relates to the risk of pathogenic contamination from human waste, although other risks are also identified. **Concerns for the future quality of groundwater supplies are particularly acute,** with more than 80% of respondents expressing their professional concern. In contrast, less than 10% stated that they are not concerned.

A key finding of the survey **is the limited governance arrangements for privately-commissioned boreholes and groundwater supplies.** Most respondents report that government authorities do not have a good knowledge of the number of private boreholes sunk in their area. The majority also report that there is no procedure in place for monitoring the amount of groundwater abstracted from these boreholes. Similarly, two-fifths of respondents reported that there was no procedure in place to monitor the quality of water sourced from privately-commissioned boreholes and almost a third reported suggesting this was the responsibility of the borehole owner. Less than a third of respondents reported that government authorities were responsible for monitoring the quality and the quantity of water abstracted from such boreholes in their areas.

According to the survey respondents, **the skills and expertise to drill domestic boreholes are generally available, although this is often not regulated by the state.** Respondents also suggested that although households would often choose to use contractors that were not certified by government authorities, contractors could normally be trusted to do a good job. However, the quality of the work undertaken by contractors for households is rarely subject to any quality checks by government authorities.

From the survey returns it is apparent that in many parts of Africa, **boreholes that are privately-commissioned by households are believed to be becoming an important means of augmenting publicly provided water supplies.** Around half of the survey's respondents reported that they felt that privately-commissioned boreholes, operated by individual households or

community groups, could form a part of their city, town or municipality's water supply system in the future.

This is an area of emerging importance that deserves more detailed consideration. It raises important wider questions regarding the sustainable management of groundwater resources including questions of governance and oversight; equality of access; the quality of water sources, and the resilience of communities dependent on such resources. Further work to explore the implications of these trends is strongly merited, including a stronger understanding of the preferences and behaviours of households themselves as key actors in the process<sup>2</sup>.

### **Acknowledgements**

This work has benefited from the financial support of the UK's Natural Environment Research Council. We would also like to acknowledge the support of the Rural Water Supply Network, whose membership generously responded to the request to participate in this survey.

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<sup>2</sup> An initial study on household preferences and behaviours was undertaken as part of the RIGSS project, focusing on the city of Lagos, Nigeria. Results of this work can be found here ([http://www.cardiff.ac.uk/\\_data/assets/pdf\\_file/0003/1090650/Perspectives\\_of\\_households\\_in\\_Lagos.pdf](http://www.cardiff.ac.uk/_data/assets/pdf_file/0003/1090650/Perspectives_of_households_in_Lagos.pdf)).

## 1. Introduction

In recent decades there has been strong progress made towards the global goal of securing access to safe drinking water for all. Across much of Africa, these achievements have often been secured through increasing exploitation of available groundwater reserves. This has, in part, been enabled through a significant increase in water wells, or boreholes, financed by governmental development programmes and NGOs as well as investments by water users and local businesses. As the cost of accessing groundwater reserves fall; incomes rise, and drilling capacity and expertise becomes more widely, available many countries have witnessed a rising trend towards the private commissioning of boreholes<sup>3</sup> and wells, particularly by individual households in urban areas.

This trend towards a more individualised system of domestic water supply, based on groundwater resources, may make an important contribution to realising SDG 6.1, that is to achieve universal and equitable access to safe and affordable drinking water for all by 2030. However, the implications of this rising trend, and its future potential, remains an area that has not been fully considered to date. In order to address this gap, a survey was undertaken of specialists working in the field of water supply from across Africa to assess the professional understanding of the trends and patterns prevalent in the geographical areas with which they were familiar.

The research sought to explore 5 key themes

- The perceived importance of different forms of household water supply
- The observed significance of groundwater resources for household water consumption
- The perceived trend in the development of boreholes commissioned directly by households
- The perceived risks and opportunities this offers
- The procedures in place for managing and monitoring groundwater resource use

Although the survey is, by its nature, based on the perceptions of respondents, it offers a valuable insight into current patterns of development and likely future trajectories in the field of domestic water supply, based on the practical working knowledge of practitioners on the ground. Building on their knowledge, this Briefing Paper provides a summary of the main findings of this assessment. It forms part of a wider study looking at how privately-commissioned boreholes may impact on the ability of communities to respond to environmental hazards,

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<sup>3</sup> The word borehole is used interchangeably with the term well, or water well.

financed by the Natural Environment Research Council of the United Kingdom. The project was led by Cardiff University, with the involvement of the Skat Foundation, University of Ibadan, University of Maiduguri and British Geological Survey.

The paper does not consider all forms of water supply. It purposely discounts surface water sources (such as rivers and springs), which may form a part of the water supplies of particular households. It also takes no account of the time required to collect water that is not supplied into household premises, nor of the quality of the water supply. This reflects the purpose of the survey. This means that the data should not be directly compared with more recent publications by WHO/UNICEF which now frame their definitions of access to water using location, time and quality dimensions (WHO/UNICEF, 2017<sup>4</sup>).

The remainder of this paper is divided into eight short sections, focusing on:

- A summary of the approach adopted
- The prevalence of household boreholes as a source of domestic water
- The wider significance of groundwater for domestic water supplies
- The perceived risk of contamination of domestic water supplies
- The degree of governance of privately-commissioned water supplies
- Perceptions of the drilling industry working with households
- The potential for household boreholes to augment public water supplies
- Conclusions

## **2. Approach**

An online survey instrument was developed, structured around closed-ended questions. The survey was administered by Skat Foundation and an invitation to participate was sent to all of members of the Rural Water Supply Network (RWSN), an international grouping of individuals with a professional interest in the supply of water. The survey was administered in French and in English to achieve a wider coverage.

In total, 9,965 network members located in 151 countries were invited to participate. The survey was open for two weeks during May 2017 and received 115 responses. The response rate is regarded as typical for a niche survey of this type with a short timeframe. The total number of responses slightly exceeds the number anticipated in the original study-design (100).

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<sup>4</sup> WHO/UNICEF (2017) Safely managed drinking water - thematic report on drinking water, Available at <https://data.unicef.org/wp-content/uploads/2017/03/safely-managed-drinking-water-JMP-2017-1.pdf>

Of the 115 responses, four-fifths were received from the African continent. This possibly reflects both the membership network of the RWSN and the languages in which the survey was administered. As a consequence of the weight of responses (and the low numbers split across other geographies) it was decided to analyse the responses for Africa only. This provided a total of 92 responses from 25 countries. Country responses were broadly distributed across Africa with a focus on Sub-Saharan Africa (Figure 1). A full breakdown of responses is included as Annex 1.

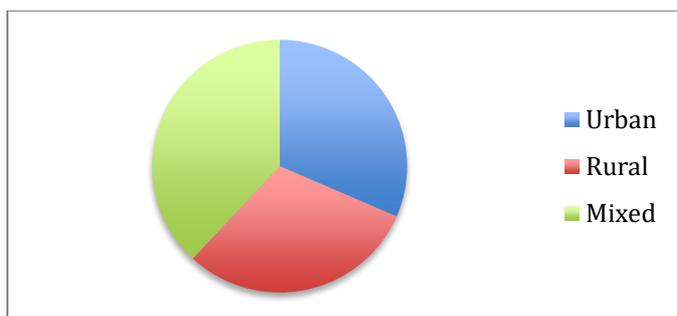
**Figure 1: Distribution of respondents (in green).**



Map created in mapchart.net

Respondents were asked to identify whether their response related to an urban area, a rural area or to an area with a mix of urban and rural characteristics (Figure 2). Respondents were not provided with a definition of urban or rural to allow for different local contexts. Responses demonstrate a relatively even split between those referring to urban areas (32%), rural areas (30%) and mixed urban-rural geographies (38%).

**Figure 2: Urban Rural Mix**



The largest proportion of respondents to the survey identified their employment as an NGO, closely followed by the private sector (Table 1). Government, international bodies and academia were also well represented amongst respondents.

**Table 1 Employing organisation**

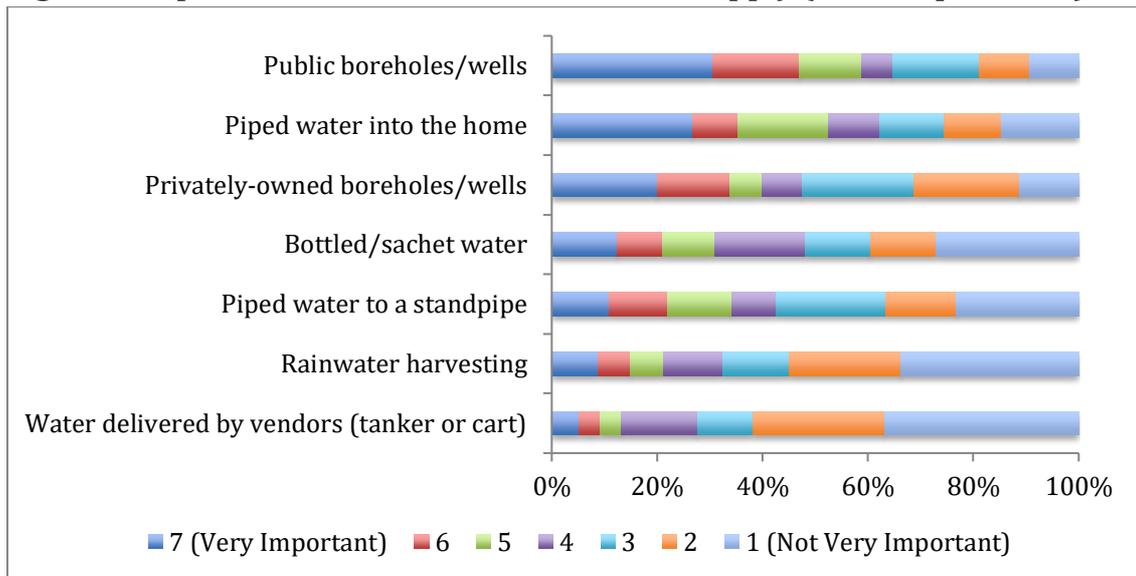
<i>Organisation</i>	<i>Respondents (%)</i>
Non-governmental organisation	29.7
Private sector	25.3
Government	15.4
International body	14.3
Academia	12.1
Other	3.3

N=91

### **3. Common forms of domestic water supply**

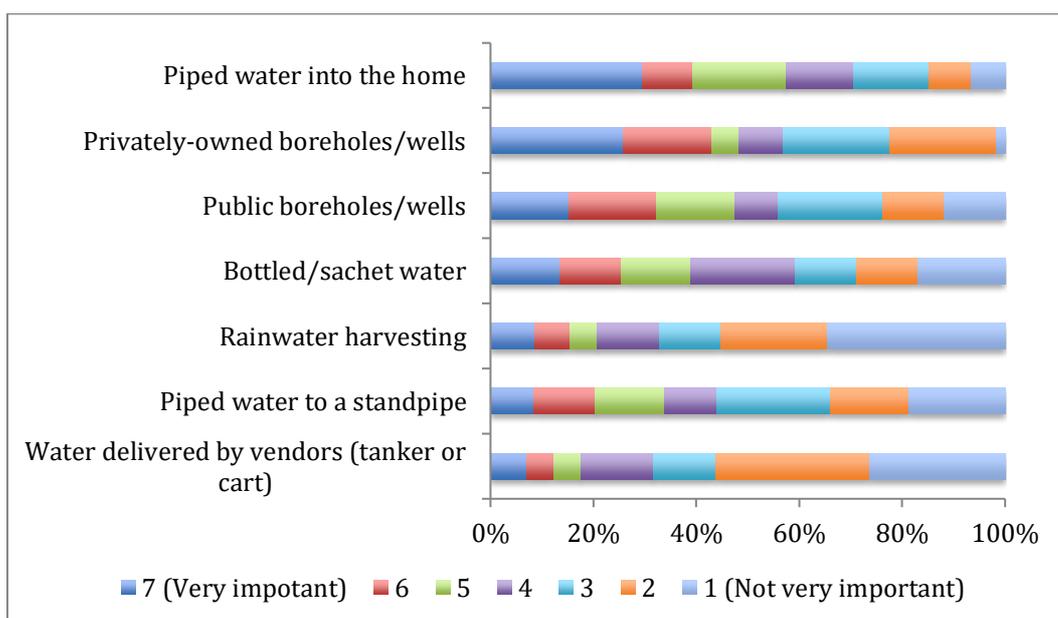
Respondents reported on the significance of different forms of water supply in their area (Figure 3). The most important sources of water for domestic use identified by respondents are public boreholes/wells (important for around 60%) and water piped directly into the home (52%). The third most significant source of household water supply is privately-owned boreholes and wells. It is notable that the proportion of respondents identifying privately-owned boreholes as very, or highly, important is very similar to that for piped water into the home. The relative importance of bottled/sachet water is also noteworthy.

**Figure 3 Importance of various forms of water supply (% of respondents)**



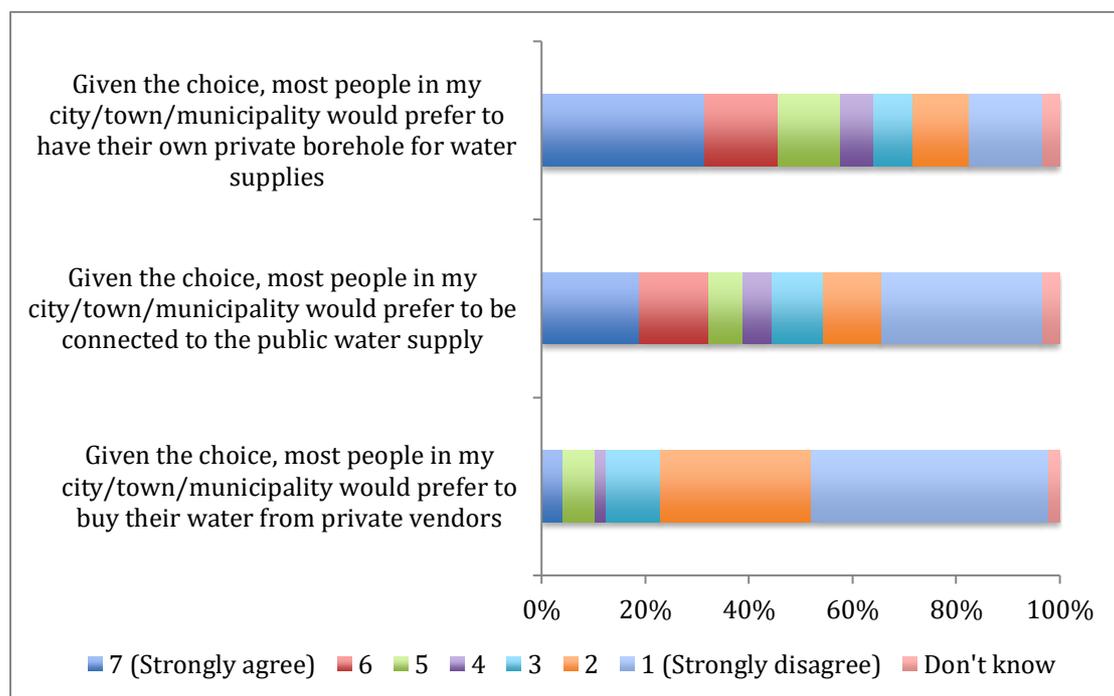
If we look at results from respondents from urban or mixed rural-urban areas (i.e. non-rural), the importance of public boreholes falls relative to the importance of both water piped into the home and privately-owned boreholes (Figure 4). The proportion of respondents identifying privately-owned boreholes as very, or highly, important highlights the particular significance of this water source in these areas. It is also notable that the proportion of respondents identifying bottled/sachet water as important rises, with 40% of respondents saying it was important (up from 30%).

**Figure 4 Importance of various forms of water supply in urban and mixed urban-rural areas (% of respondents)**



Amongst respondents, there is a strong belief that, given the choice, households would prefer to have access to their own borehole (Figure 5). This has stronger support than the view that people would prefer to be connected to the public water supply. Very few respondents felt that households in their area have a preference for purchasing water from private vendors. The reasons underlying these preferences were not explored in this study. Further information from a survey of households in Lagos can be found in an accompanying publication: “Findings from a Survey of Private Households in Lagos, Nigeria” (available here [http://www.cardiff.ac.uk/\\_data/assets/pdf\\_file/0003/1090650/Perspectives\\_of\\_households\\_in\\_Lagos.pdf](http://www.cardiff.ac.uk/_data/assets/pdf_file/0003/1090650/Perspectives_of_households_in_Lagos.pdf)).

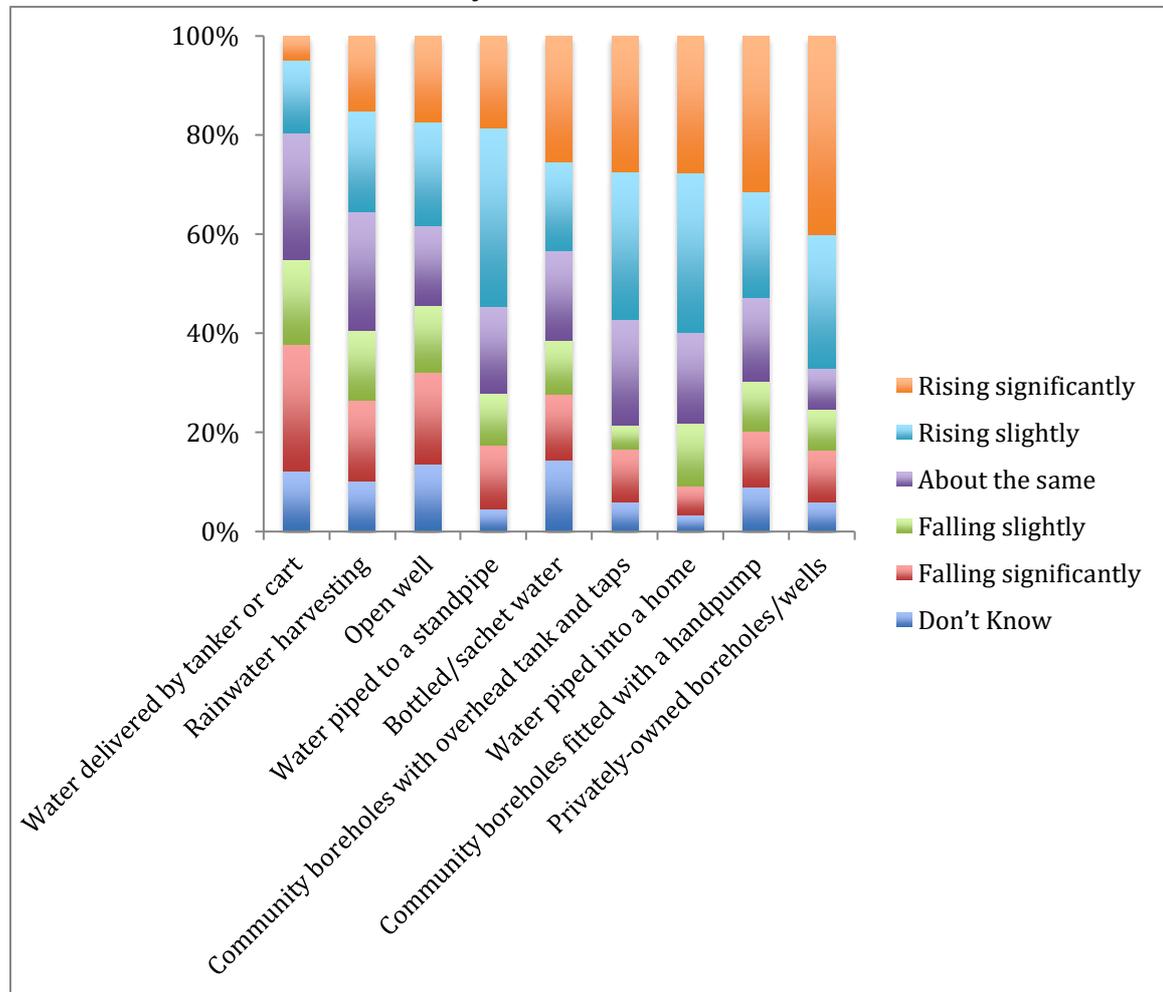
**Figure 5 Perceived preference for different forms of water supply**



Looking to the future, respondents anticipate increases in the proportion of households accessing water across a range of technologies (Figure 6). The strongest growth is foreseen in the proportion of households accessing their water supplies directly from privately-owned boreholes. Other areas of strong growth are seen to be in the proportion of households accessing water from sources which pipe directly into their home and from community boreholes with overhead tanks. Whilst a rise in the proportion of the population accessing water from standpipes and from community boreholes fitted with handpumps is foreseen, this is less substantial. When considering urban, rural and mixed (urban-rural) areas separately, 76% of urban respondents foresaw an increase in the proportion of households using private boreholes over the next 10 years, compared to 60% of respondents commenting on mixed urban-rural areas.

Interestingly, 68% of respondents commenting on rural areas also foresaw an increase in the use of private-boreholes by households in their areas, suggesting that the trend is not solely restricted to urban areas.

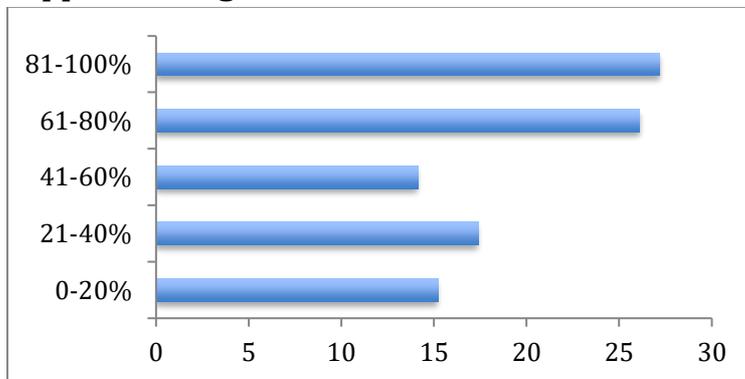
**Figure 6 Expected trends in the proportion of households using different water sources over the next 10 years**



#### 4. Significance of groundwater for domestic water supplies

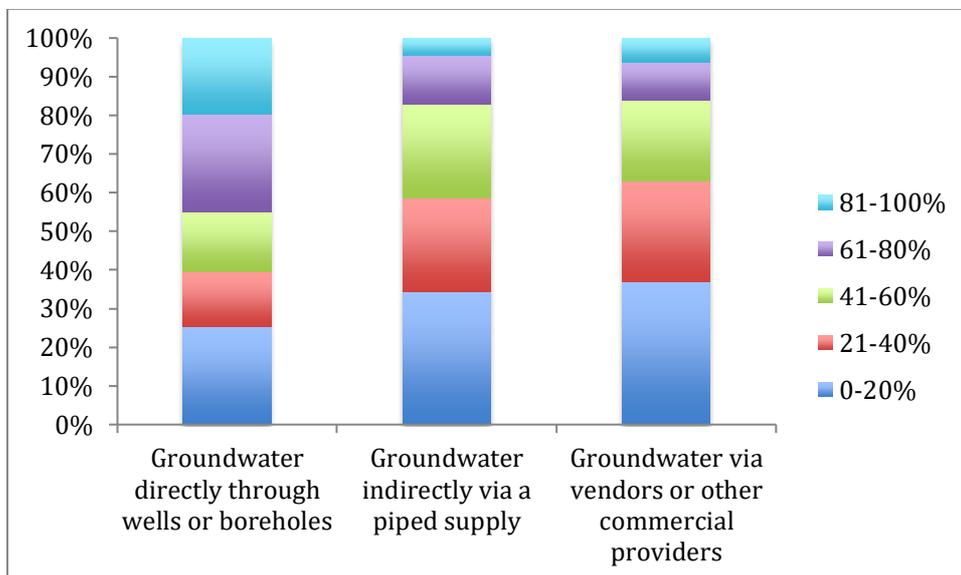
Groundwater is a significant source of domestic water supplies across the survey territory. More than half of respondents report that 60% or more of inhabitants in their area, either directly or indirectly, access their water from a groundwater resource (Figure 7). Around a third suggest that less than 40% of inhabitants' water supplies comes from groundwater.

**Figure 7 Perceived proportion of population accessing domestic water supplies from groundwater sources**



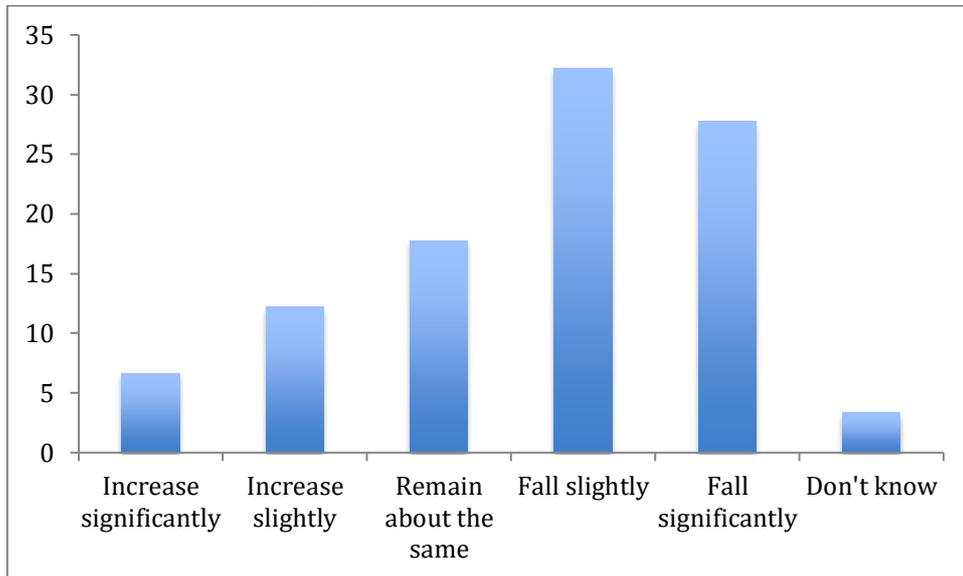
Respondents suggest that most of the population access groundwater directly through wells or boreholes (Figure 8). Similar proportions of the population gain access to groundwater indirectly through either a piped supply or via commercial providers or other vendors.

**Figure 8 Proportion of population accessing groundwater via different means**



Whilst respondents suggested that the proportion of the population accessing water from boreholes (private or communal) would probably increase (see Figure 6 above), most (60%) also felt that the amount of groundwater available was likely to decline, with more than a quarter expecting it to fall significantly (Figure 9). Less than a fifth expect the amount of groundwater available to increase.

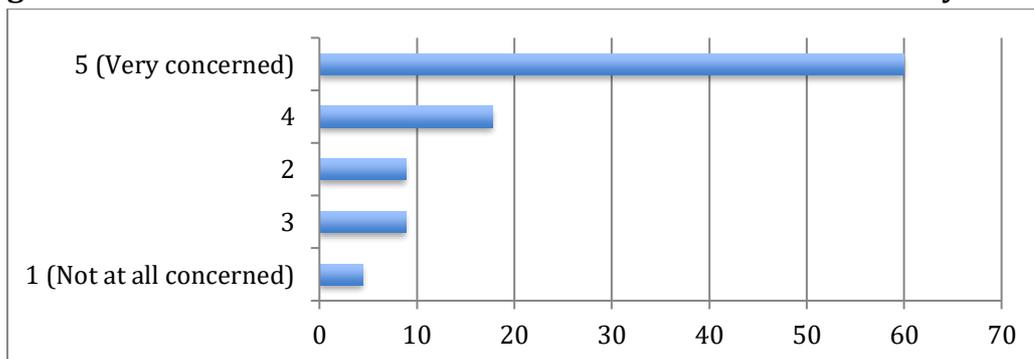
**Figure 9 Expectations of the amount of groundwater available for use in the next 10 years (% respondents)**



n= 90

Reflecting these trends, the majority of water professionals reported a very strong concern about the potential change to the amount of groundwater available in their areas over the next 10 years (Figure 10).

**Figure 10 Degree of concern about potential changes to the amount of groundwater available for domestic water use over the next 10 years?**

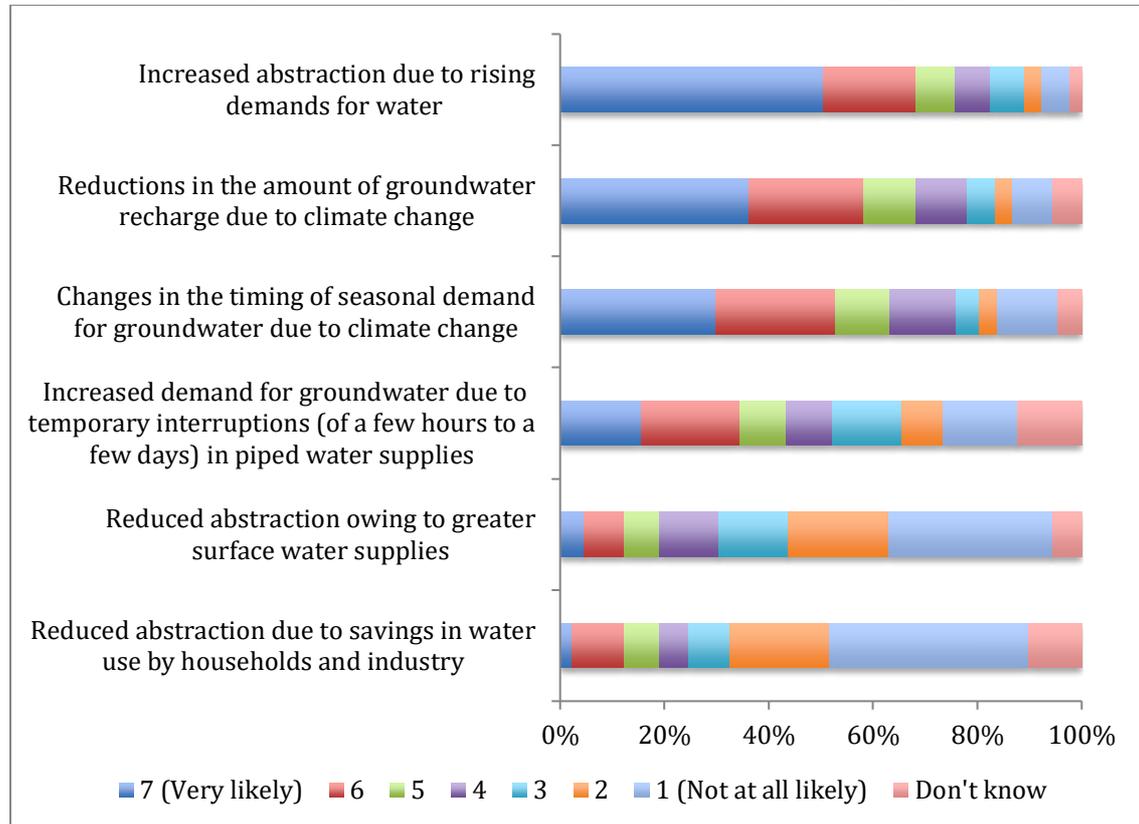


N=90

There may be many reasons underlying these concerns that are related to particular local conditions and contexts. However, some anticipated trends are more widely expected than others (Figure 11). Broadly, respondents foresee increased levels of abstraction, coupled with reductions in the amount of groundwater available. They also believe a risk that climatic changes will alter the timings of seasonal demand for groundwater. Very few respondents foresee reductions in the level of abstraction emanating from savings in water use (by

domestic or industrial consumers) or because of an increasing availability of surface water supplies. Respondents were less sure of how potential interruptions to piped water supplies might impact on groundwater demands. This elicited a greater proportion of 'Don't Know' responses and a balance of those in agreement and disagreement.

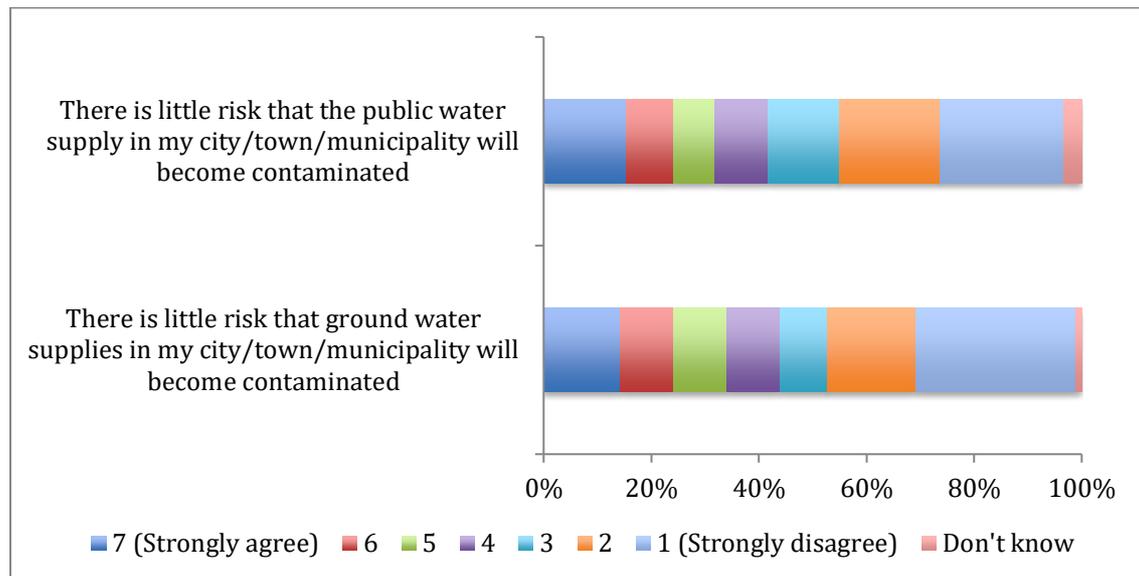
**Figure 11 Anticipated trends in demand for and supplies of groundwater**



## 5. Perceived risk of contamination of domestic water supplies

The majority of respondents perceive a risk of contamination to both ground water supplies and the public water supply (which may in itself be drawn from groundwater resources). Just a third of respondents feel that there is little risk of contamination to groundwater supplies or the public water supply. Overall, respondents are slightly more likely to identify risks of contamination to groundwater supplies than the public water supply.

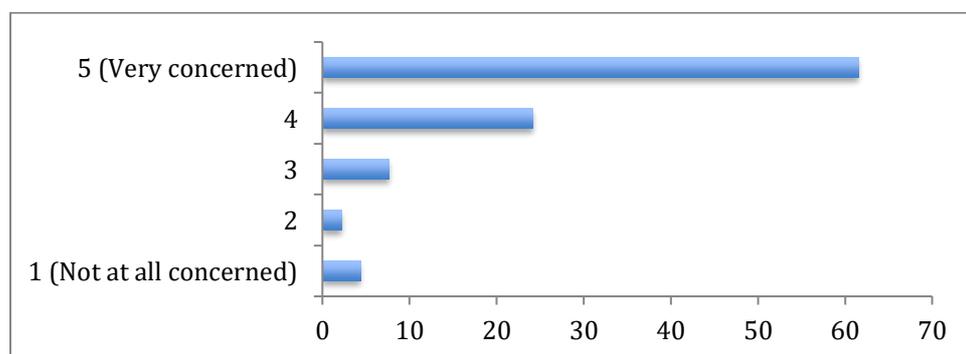
**Figure 12 Perceived risk of contamination of water supplies**



n=91

The concerns expressed in terms of the risk of contamination to groundwater are also reflected in the proportion of respondents reporting a strong professional concern regarding potential changes to the quality of groundwater available for domestic water use in their areas over the next 10 years (Figure 13). Some 86% of respondents highlighted that they are concerned or very concerned regarding potential changes to the quality of groundwater available for domestic water over the coming 10 years.

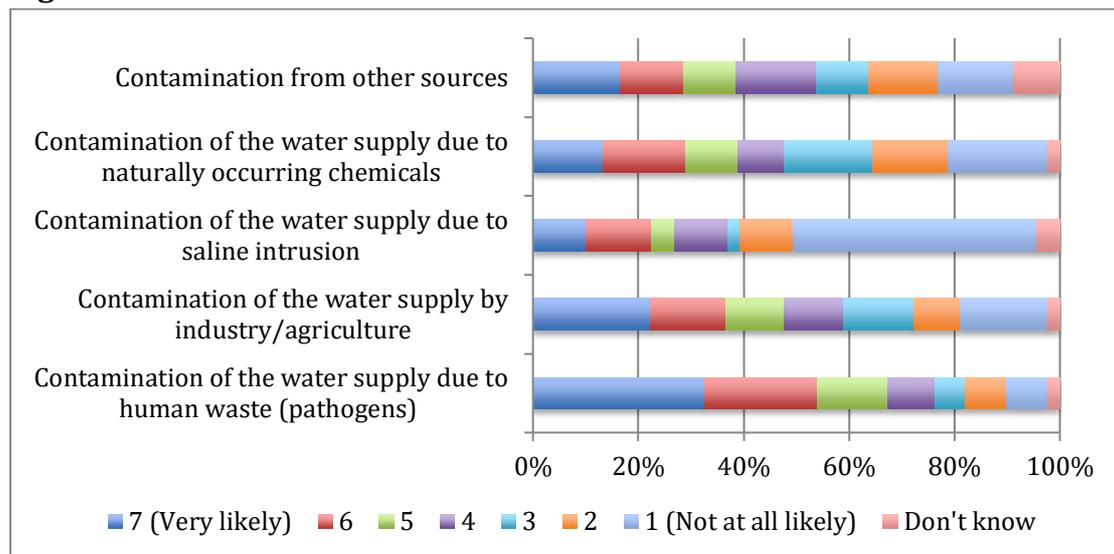
**Figure 13 Degree of concern regarding potential changes to the quality of groundwater available for domestic water over the next 10 years**



n=91

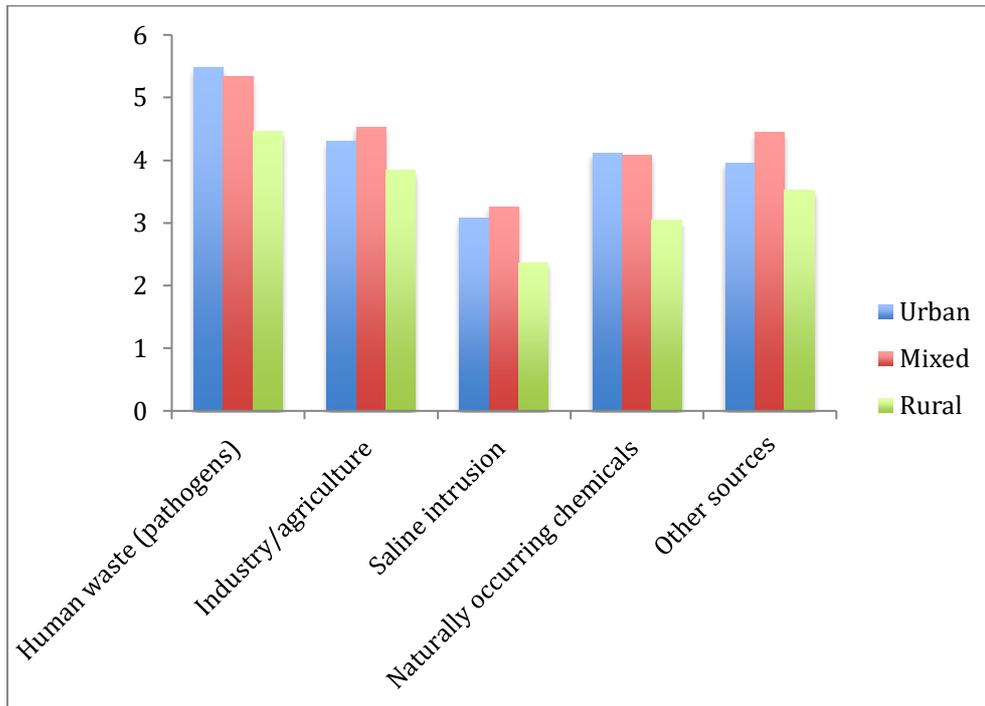
Potential sources of contamination were explored with respondents, focusing on principal typical sources rather than an exhaustive listing. From the responses received (Figure 14) it is apparent that the strongest risk factor is perceived from human waste (pathogenic) followed by other anthropogenic sources, particularly industry and agriculture. The risk of contamination from naturally occurring chemicals (geogenic) is widely recognised but is seen likely to occur in fewer cases. Contamination from saline intrusion is regarded as least likely, possibly reflecting its geographical determinants.

**Figure 14 Perceived likelihood of different contamination sources**



Analysing the responses on the basis of the urban/rural location it is evident that risks of contamination tend to be regarded as lowest in rural areas, regardless of type (Figure 15). The calculation is based on a weighted average using the same scale as Figure 14 (above), where 1 signifies very low risk and 7 signifies a very high risk. The risk of contamination from human waste is perceived to be highest in urban areas, but for other forms of contamination the risks are viewed as generally regarded as greatest in areas with a mixed urban/rural composition. The exception is naturally occurring chemicals where the risk is perceived as similar in both urban and mixed geographies.

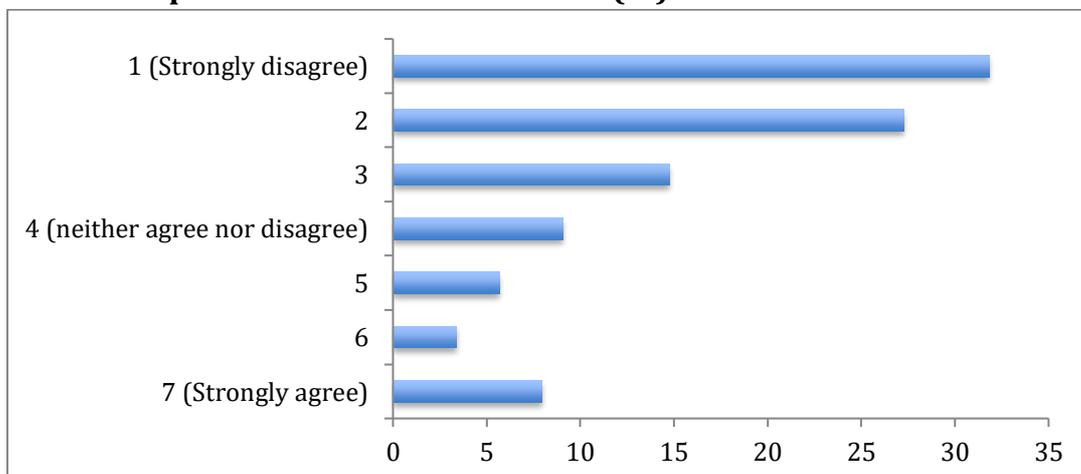
**Figure 15 Relative risk of contamination in urban, rural and mixed geographies**



## 6. Governance of privately commissioned household water supplies

It is, perhaps, symptomatic of what might be described as an ‘anarchic’ development process, that most respondents did not believe that the relevant government authorities have a good knowledge of the number of private boreholes in their area (Figure 16). Less than one-fifth (17%) agreed with the proposition, whilst almost a third strongly disagreed with it.

**Figure 16 The government authorities have a good knowledge of the number of private boreholes in this area (%)**

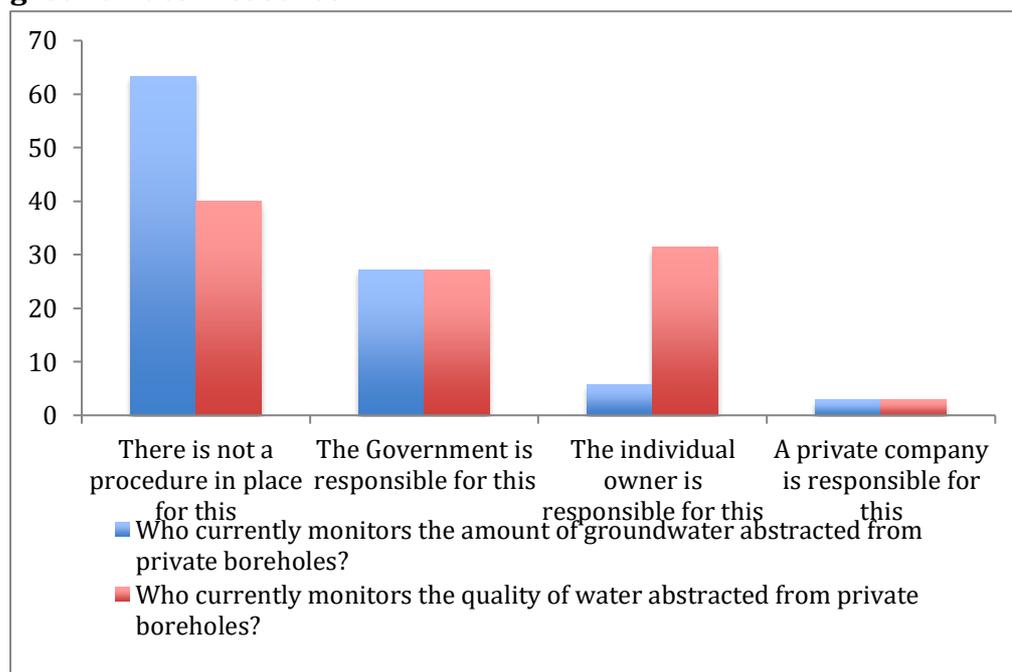


n=88

In what is perhaps a further reflection of the unregulated market for private boreholes, most respondents reported there was no procedure in place for monitoring either the quantity of water being abstracted from private boreholes, or its quality (Figure 17). This was particularly an issue for the amount of water being abstracted where more than two-fifths of respondents (63%) reported that there was no procedure in place for monitoring the amount of groundwater being abstracted by householders through their own boreholes. Just over a quarter of respondents reported that the government was responsible for this. Few felt that it was the responsibility of the individual owner.

In contrast, almost a third of respondents suggested that it is currently the responsibility of the individual owner to monitor the quality of the water being abstracted, slightly more than felt that this is the responsibility of the government. Again, the most numerous response reported was that there was no monitoring procedure in place in their area, suggesting that, by default, it falls to the individual owner, if at all.

**Figure 17 Responsibility for monitoring the quality and quantity of the groundwater resource**



## 7. Drilling practices and oversight

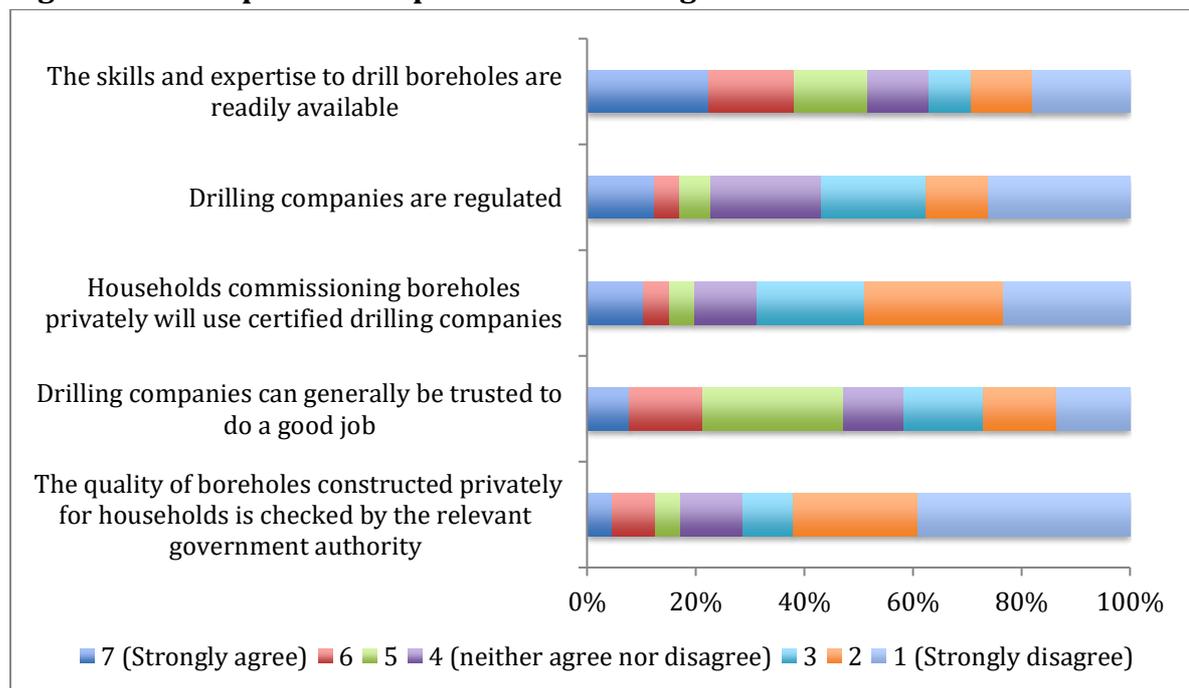
The survey also sought broad views on the nature of the drilling industry in the area which respondents were familiar with (Figure 18). The views expressed are only indicative and it should be noted that a proportion of respondents (9%) identified themselves as professional drillers. More than half of respondents

(51%) felt that the skills and expertise to drill boreholes were readily available to households, although this was not universal, with almost 30% of respondents feeling quite strongly that this was not the case. However, most respondents felt that, on the whole, drilling companies were not regulated and, even where they were that households would not tend to use companies that were certified, highlighting a strongly informal dimension to the industry.

Despite this, most respondents felt that drilling companies can generally be trusted to do a good job, although this was a relatively weak assertion (just a fifth felt this strongly or quite strongly). In fact, two-fifths of respondents disagreed with the suggestion that the drilling companies could be trusted to do a good job, suggesting a high degree of distrust in the quality of boreholes being commissioned by private households.

In a further reflection of the low level of governance in this field, more than three-quarters of respondents suggested that the quality of privately-constructed boreholes was not being checked by relevant government authorities. In such situations the risk of poorly-constructed or poorly-sited boreholes, and associated issues of potential contamination, is compounded.

**Figure 18 Perceptions of expertise and oversight**

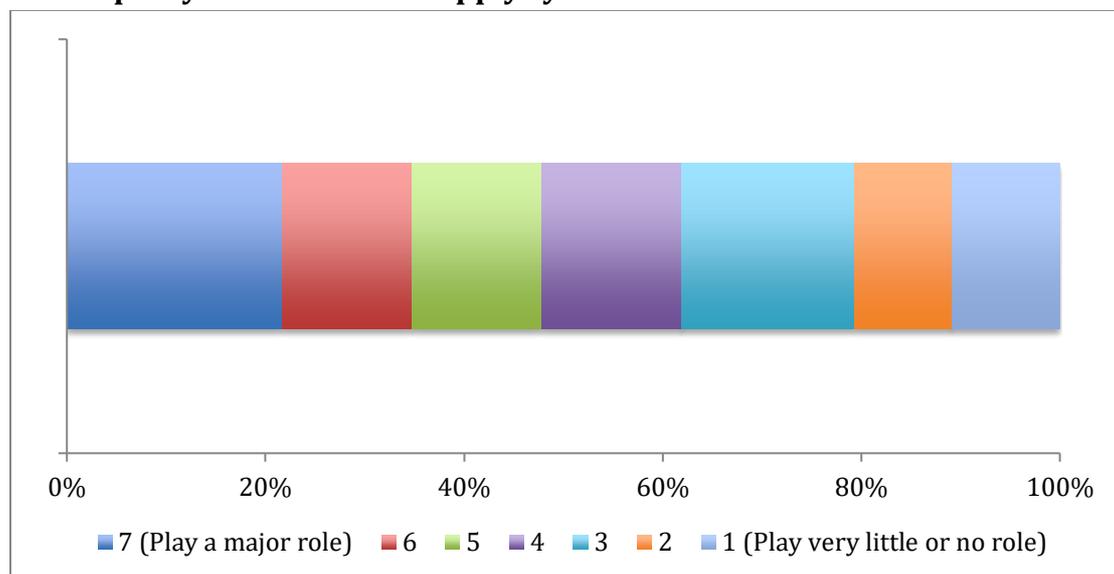


## 8. Augmenting public water supplies

Given the prevalence of privately-commissioned boreholes for domestic use, one potential consideration is the extent to which this could form part of a municipal

water supply strategy. Around half of respondents felt that privately-commissioned boreholes operated by individual households or community groups could form a part of their city, town or municipality's water supply system in the future (Figure 19). It is noticeable, that those who believed that this was an option were stronger in their views than those who only saw a more limited role. More tellingly, our respondents suggest that only in around a fifth of places are privately-commissioned boreholes not likely to play a role in municipal water supplies, either formally or informally.

**Figure 19 Potential for privately-commissioned boreholes operated by individual households or community groups to form part of a given municipality's future water supply system**



## 9. Conclusions

This survey has formed one of the first attempts to understand the perceptions of development of privately-commissioned boreholes for domestic water consumption at the household level. It highlights the rising significance of the trend across many parts of Africa and the increasingly important role that this is now playing as part of the domestic water supply system. Whilst the survey took no view on whether this trend is desirable or not, respondents to the survey have clearly identified some emerging concerns. These include the risk of contamination and the perils of increasing abstraction.

Given these concerns, the limited governance of household boreholes identified in the survey is particularly problematic. The sector is epitomised by individual action and individual responsibility. Survey respondents identified a strong preponderance of private governance practices, which may not result in a strong collective management of the common resource. In areas where the density of

demand is high, such as in urban areas, this may prove an important issue for the sustainable management of the water resource.

From the evidence available it is apparent that this is an area of emerging importance that deserves more detailed consideration. It raises important wider questions regarding the management of water resources including questions of sustainability, governance and access. These include questions of governance and oversight; equality of access to the collective resource; the long-term quality of water sources, and the resilience of communities dependent on such resources. Given the rising significance of the private exploitation of groundwater resources, further work to explore the implications of these trends is strongly merited.

## Annex 1 Characteristics of survey respondents

### Responses by country

	<b>Country</b>	<b>Number of respondents</b>
1	Benin	2
2	Burkina Faso	4
3	Cameroon	8
4	Comores	1
5	Côte d'Ivoire	6
6	DR Congo	8
7	Ethiopia	2
8	Ghana	3
9	Kenya	8
10	Liberia	2
11	Madagascar	3
12	Malawi	3
13	Mali	4
14	Niger	3
15	Nigeria	5
16	Rwanda	2
17	Senegal	2
18	South Africa	4
19	Sudan	2
20	Tanzania	4
21	Chad	3
22	Tunisia	3
23	Uganda	4
24	Zambia	5
25	Zimbabwe	1
	<b>TOTAL</b>	<b>92</b>

### Sectoral distribution

<b>Sector</b>	<b>Number</b>	<b>%</b>
Non-governmental organisation	27	29.7
Private sector	23	25.3
Government	14	15.4
International body	13	14.3
Academia	11	12.1
other	3	3.3
<b>TOTAL</b>	<b>91</b>	<b>100.0</b>

