ANNEX 3: LAFIA

Introduction

The study was carried out in Nasarawa State, Central Nigeria, in the following Local Government Areas: Keana, Lafia and Nasarawa Eggon (Figure A3.1).

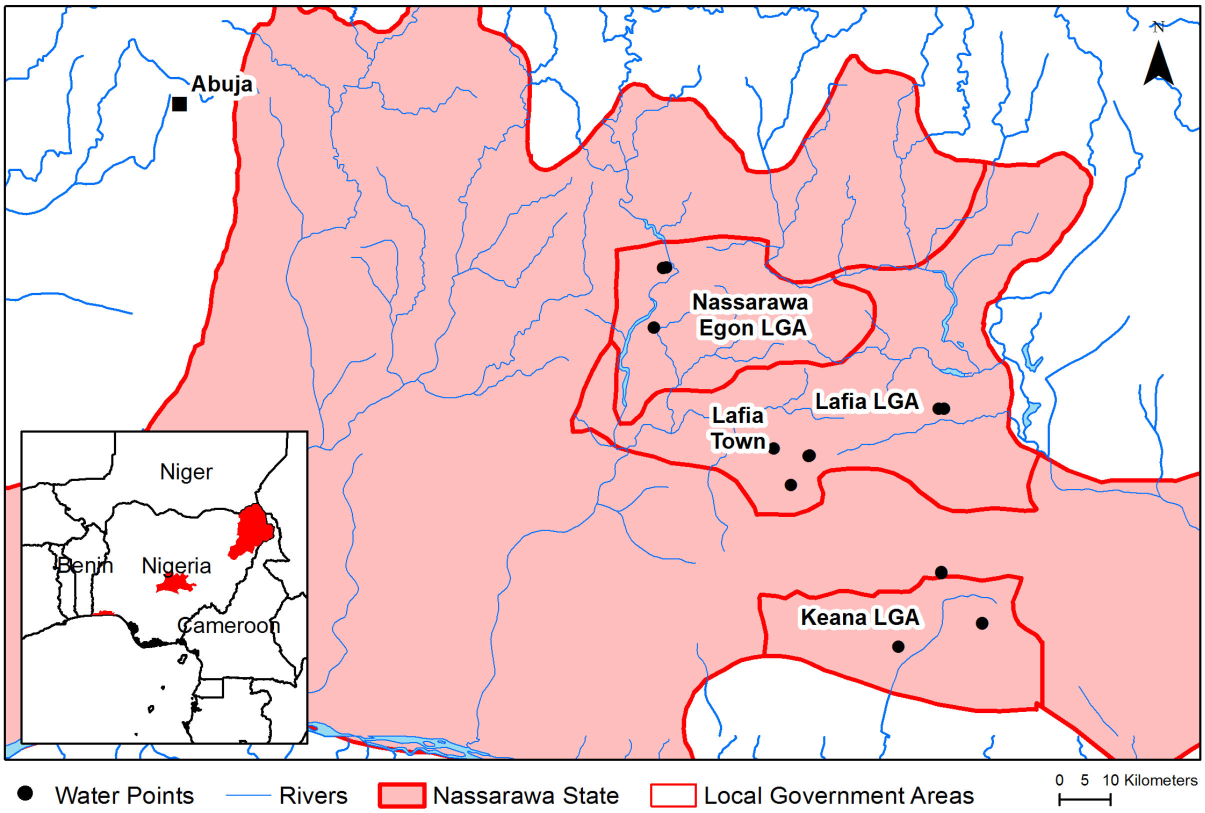


Figure A3.1 Location map of Lafia Study Area in central Nigeria; inset shows the 3 pilot study regions

Nasarawa State is predominantly rural with an economy centred on arable agriculture for the production of cash crops such as yams, sesame seeds, and soya beans, and to a lesser extent, small-scale mining. Key issues relevant to the use of groundwater in this region include: the nature of the geological conditions, which can make groundwater difficult to access; low population densities in rural areas; low income levels in rural areas. The area also suffers from inter-communal violence (particularly between nomadic Faludi herders and sedentary pastoralists). Tensions between these groups are increasing as climatic conditions force herders further south in search of better grazing, creating conflicts over land and water access. Intercommunal violence is a significant factor in the destruction of water points and is also encouraging the migration of remoter rural populations in larger villages, placing new demands on existing water points.

The study was conducted in rural villages surrounding the administrative centre of Lafia, which is the capital of Nasarawa State with a population of c. 330,000. A total of eight towns and villages were visited across three Local Government Areas, with varying degrees of remoteness from main transport routes and urban centres. These communities ranged in size from 1000 to 20,000 inhabitants. Some were located very close to Lafia, while others were more remote and accessible only by unmade roads.

Three fieldwork activities were undertaken:

1. Household/community Surveys: to understand how different water sources are used and what users' perceptions of these sources are in terms of quality, reliability, and resilience
2. Water Point Surveys: water point descriptions, water quality sampling and vulnerability assessments
3. Stakeholder Discussions: with NGOs responsible for water supply in the region, to understand key issues and trends for groundwater development

Geology & Hydrogeology

The geology of Nasarawa State consists of Basement Complex and Sedimentary rocks. Nasarawa Eggon LGA is underlain by Basement Complex rocks composed of granites and gneiss. Groundwater occurrence in these terrains is in the (upper) weathered parts of the basement or in fractures. The depths vary depending upon location but tend to be in the 20-60m range.

Lafia and Keana LGAs are underlain by sedimentary rocks of the Middle Benue Trough. The lithology consists of shales, siltstones, sandstones, clays and coal seams. Groundwater occurs in these rocks although some are highly saline.

The State of Play

Sources of water used in communities visited (from Community Interviews)

Water in this study area is primarily used for domestic purposes – drinking, hygiene and sanitation. The main sources used across the three LGAs, as identified from the household/community interviews are summarised in Table A3.1.

Source Type	Nbr Communities (Dry Season)	Nbr Communities (Wet Season)
Borehole	7	7
Rainwater collection	7	7
River/stream	7	6
Unprotected hand dug well	6	6
Spring	4	4
Cart with small tank	2	2
Bottled/sachet water	2	1

Table A3.1 Number of communities accessing different source types during the wet and dry season in Nasarawa State

Water source preferences

In the rural communities around Lafia water source choices are relatively limited. Most villages rely on hand-dug wells, community boreholes (primarily hand-pump but with some motorised pumps). There is no piped public water supply provision. Boreholes tend to be drilled by government authorities or on behalf of international NGOs. In some villages, private individuals (typically village chiefs/elders or politicians) have contributed a borehole for community use. Many of the observed boreholes have issues with functionality, with non-functional water points attributed to: damaged or stolen solar pumps, cost or availability of fuel for motorised pumps, broken pumps not repaired due to cost, poor siting or construction of boreholes, and poor water quality. Sources are often used conjunctively, with rainwater and streams used for non-drinking purposes such as washing clothes.

In the larger villages and towns, such as Mada Station and Lafia, boreholes are generally the preferred water source. In more remote rural areas, boreholes also tended to be preferred, although this was not universal, and there was an acceptance of the role of unimproved surface water sources (including springs) for providing domestic water needs.

Trend to development of private domestic boreholes (from Community Interviews)

In the remoter rural villages no privately-operated boreholes were reported. In the larger, more accessible, settlement of Mada Station, households reported that there were some (2 or 3) boreholes owned by households, and in other economically-accessible villages some commercial boreholes were present, including a privately-owned borehole associated with a fish-farming enterprise which was available for community use. In the town of Lafia it was reported that many (1000s) households are now choosing to invest in private boreholes if they can afford to do so. For those with private boreholes it is common practice to sell water to neighbours. One interviewee expressed the view that many people living in Lafia are also now starting to invest in private boreholes in the rural villages where they have family homes.

Details of sources tested

The following 16 sources were tested across the study area:

- 4 boreholes with hand pumps
- 4 boreholes with motorised pumps
- 6 hand dug wells
- 1 spring
- 1 undeveloped borehole

Of these 16 sources, four were private (two hand dug wells and two motorized boreholes) and the remainder were available for public use. Information on installation, age and funding was not available for the two private hand dug wells. Of the remaining 14 sources, all were less than 30 years old, with two installed in the last year (motorized boreholes, one of which is private), five installed in the last 10 years (one private motorized borehole), and seven of which are more than 10 years old (none private). Of those 12 non-private sources, four were installed and funded by the community or an individual acting on behalf of the community, six were installed and funded by government, and two were installed and funded by NGOs or donors.

Permissions were not required for any of the sources to be developed and none of them are routinely monitored.

A summary of the data collected at each water point is provided in Table A3.2.

Source Type	Source Depth Measured /Known	Water Level Measured	Vulnerability Assessed	EC Measured	Nitrate Measured	Iron Measured	E. Coli Measured
HPB (4)	4	4	4	4	0	0	4
MB (4)	4	4	4	4	0	0	4
HDW (6)	6	6	4	6	0	0	3
SPR (1)	n/a	n/a	1	1	0	0	1
UBH (1)	0	1	0	1	0	0	1

Table A3.2 Summary of data collected for water sources in Lafia Pilot Study Area (HPB: hand pump borehole; MB: motorised borehole; HDW: hand dug well; SPR: spring; UBH: undeveloped borehole)

As shown in Table A3.2, depth and/or water level data was known or measured for the majority of the water points surveyed. The depth of the sources ranged from 8-11m for the hand dug wells and 25-60m for the boreholes (Figure A3.3).

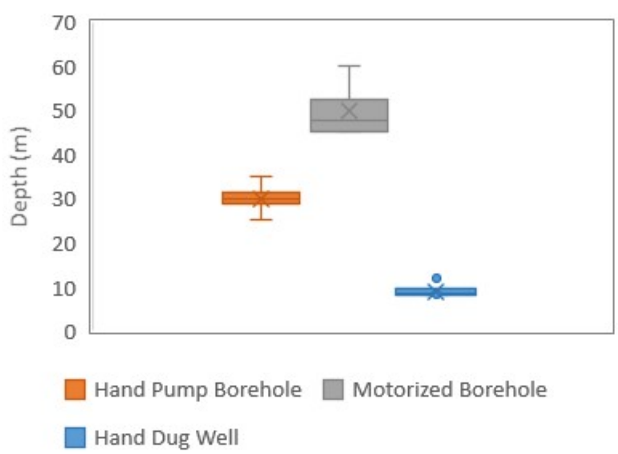


Figure A3.3 Known or measured source and water level depth

Vulnerability assessments were carried out at 13 water points, providing a vulnerability score between zero (low vulnerability) and seven (high vulnerability). The factors considered in this score are summarised in Table A3.3. The results (Figure A3.4) show that the majority of sources in Lafia were classed as low to medium vulnerability, with two highly vulnerable sources: one hand dug well and one motorised borehole.

Factor contributing to vulnerability	Vulnerability Score
Presence of a pollution source within 10m of the water point: No / Yes (at a lower elevation) / Yes (at a higher elevation)	0 / 1 / 2
Poor drainage around the water point causing ponding within 2m: No / Yes	0 / 1
Concrete apron of radius > 1m: Yes / Yes but damaged / No	0 / 1 / 2
Cover over the water point: Yes / No	0 / 1
Fencing around the source: Yes / No	0 / 1
TOTAL SCORE (sum of all scores above)	0 to 7

Table A3.3 Factors considered in the water point vulnerability assessment score

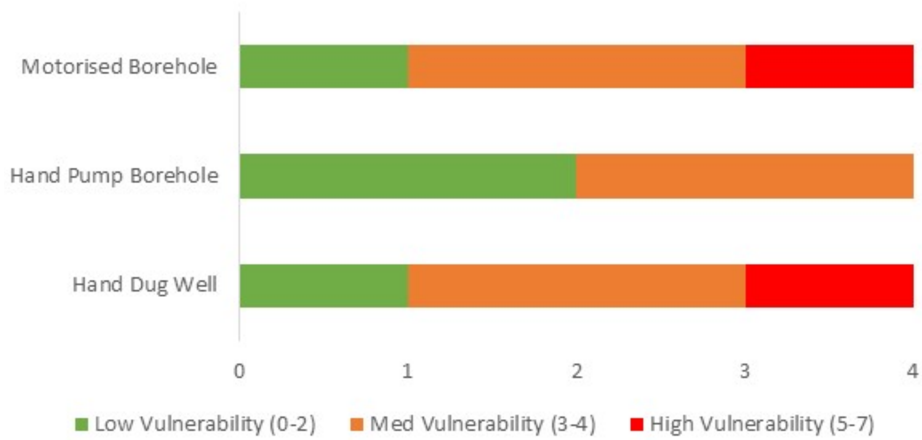


Figure A3.4 Number of sources classed as low, medium and high vulnerability

Water Quality of Sources Tested

Two key water quality parameters were collected to determine the quality of groundwater from different source types across the Lafia Pilot Study Area: E. Coli concentration and specific electrical conductance (SEC). SEC gives a measure of the dissolved material in groundwater and can be elevated by natural or anthropogenic processes. SEC is often used in combination with other water quality indicators, such as nitrate and microbiological parameters, to indicate anthropogenic contamination. E. Coli is a coliform bacteria indicative of faecal contamination in groundwater, which is a known contributor to the diarrhoeal disease burden (Pruss-Ustun et al, 2014). The main source of faecal contamination in urban groundwater is municipal and domestic waste (e.g. pit latrines, septic tanks, sewer leakage, sewage effluent and sewage sludge), particularly where there is high population density and inadequate sanitation and sewage treatment facilities. The ability of these microorganisms to survive in the environment is determined by the characteristics of the organism and the properties of the soil, unsaturated zone, and aquifer (Pedley et al, 2006). Concentrations in groundwater are dependent on the pathway from source to receptor, and may be attenuated in deeper and/or lower permeability aquifers.

Figure A3.5 shows that SEC was slightly elevated in the deeper boreholes relative to the shallow hand-dug wells, suggesting a natural rather than anthropogenic source. Conversely, E. Coli was higher in the shallow hand-dug wells (Figure A3.5) with all wells classed as high risk (MPN of 10-100/100ml) or very high risk (MPN >100/100ml) according to the World Health Organisation Drinking Water Guidelines (Figure A3.6), which set the safe limit for E. Coli in drinking water at 0 MPN/100ml (MPN: Most Probable Number).

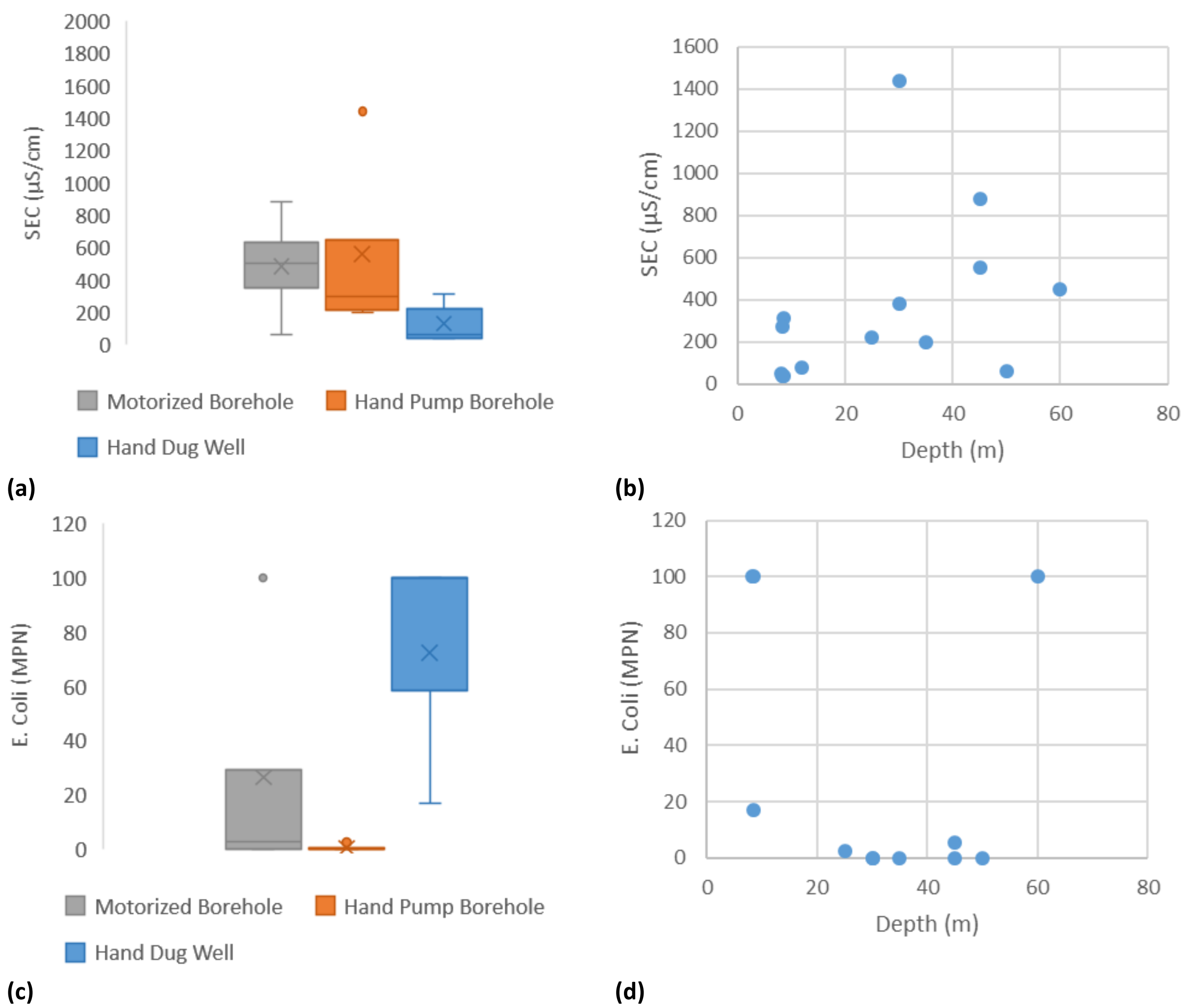


Figure A3.5 SEC (a and b) and E. Coli (c and d) results for sources across the Lafia Pilot Study area.

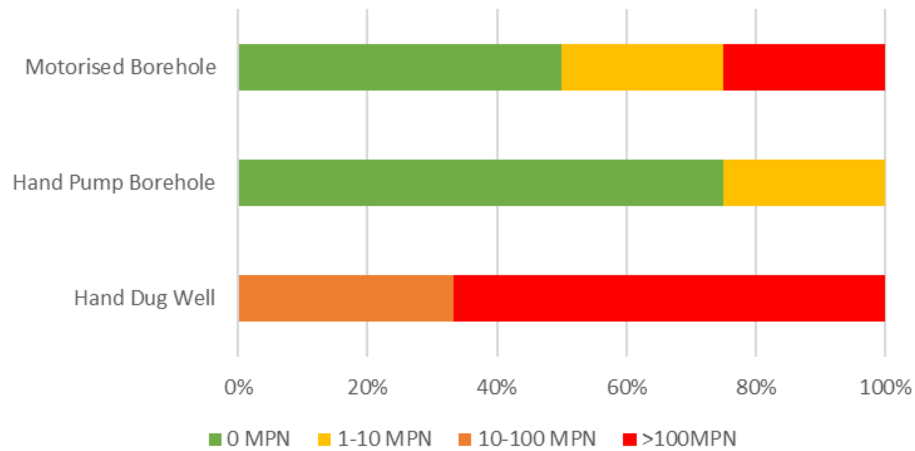
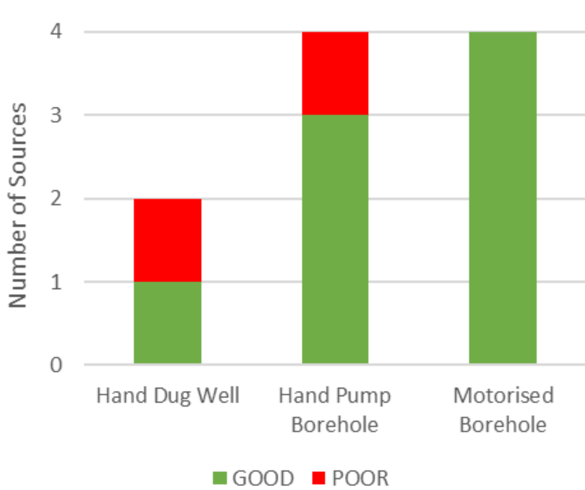


Figure A3.6 Source risk as indicated by E. Coli MPN method and World Health Organisation classification from their Guidelines for Drinking Water Quality

A vulnerability assessment was undertaken for four of the water points classed as high or very high risk. All of these water points had a pollution source (pit latrine, soak away, or refuse ditch) within 10m, only one had a concrete apron with radius >1m, and all had either no cover or a damaged cover.

Perceptions of Sources Tested

The household surveys provide information on peoples' perceptions of different source types in terms of the quality of water they provide. At 10 of the groundwater sources tested, users were asked whether they perceived the quality of water as good or poor. The results show that 50% of hand dug wells, 75% of hand pump boreholes, and all motorised boreholes were perceived as good quality (Figure A3.7a).



(a) **(b)**

Figure A3.7 (a) Number of sources perceived as good and poor quality by users; (b) perceptions of safe (MPN: 0/100ml) and unsafe (MPN: >0/100ml) sources according to the E. Coli results

However, Figure A1.7 indicates that people's perceptions of water quality from a source do not necessarily reflect the safety of the water for drinking. Of the sources perceived as good quality, 50% are classed as unsafe for drinking, according to the measured levels of E. Coli (Figure A3.7b). This includes one hand dug well, one hand pump borehole, and two motorised boreholes.

Information on the functionality of sources was collected for 13 water points in Lafia, of which eight are reported to provide water all year round. All of the motorised boreholes, which are drilled to depths of >40m, provide water all year, while only the deepest hand pump borehole (35m depth) and 50% of the hand dug wells (depths of 8-12m) provide sufficient water throughout the year. No breakdowns were reported for the hand dug wells or motorised boreholes within the last year, while all of the hand pump boreholes have broken down once in the last year. Repair times for these sources vary from less than one to 12 months. It should be noted that information on permanently abandoned boreholes was not collected. In many villages, abandoned boreholes were prevalent and outnumbered the number of operational boreholes.

General issues with water availability and drought were reported at six of the sources across five communities.

Developing boreholes (Underlying Drivers of Disaster Risk)

Reasons for sinking boreholes

The primary reason for boreholes being drilled in this area, either privately or for public use, is a lack of alternative sources. In rural areas there is generally no public water provision so private or community boreholes reduce the need to travel to collect water. In rural areas boreholes tend to be provided by the government, NGOs or private benefactors (potentially a politician, occasionally an elder/chief). Boreholes are often associated with clinics, but access for community use can vary.

Boreholes help to provide water security, and in some cases have financial benefits as water can be sold to other members of the community.

In Lafia town, there is an increasing tendency for households to commission their own boreholes. This is described as a response to failures in public water provision. The urban context was not the focus of this pilot.

Perceptions of public supply

There is no public water supply in the rural communities.

Risk perceptions/problems identified of borehole development

Several of the communities interviewed in this area reported that the wet season is often reduced from nine months to six or seven months due to the late onset and/or early cessation of rains.

Some of the shallower sources surveyed in this area have issues with reliability and do not supply water all year round. One NGO expressed the opinion that people do not generally think beyond the present and are primarily concerned with current water availability rather than worrying about the future.

There was some appreciation from an NGO involved in borehole development that having multiple boreholes drilled close to one another could lead to problems with water supply, but that this is more of an issue in urban areas.

Poor drainage leading to stagnant water around boreholes was an issue of concern from one interviewee.

Amongst rural communities there is some knowledge of the principles of good siting practices (separation from soakaways for example), however, the reasons underlying this are often not known.

Choice of contractors

An NGO involved in borehole development outlined their commissioning process whereby quotes are obtained from multiple contractors, the track record of contractors is examined, and geophysical surveys are often carried out to site boreholes. Rural communities reported that they had little or no influence on the choice of contractor.

In urban areas, a similar commissioning process is not generally employed by individuals choosing to install private boreholes.

Treatment practices

Borehole water tends not to be treated. There is some treatment (sieving/alum) of stream waters.

Differential (dis)incentives for action

What influences choice of water source

In rural communities, the choice of water sources tended to be limited to boreholes/wells and surface water (streams)/springs.

The geology and cost are two primary factors influencing the choice of water source in this region. Where the water table is shallow, hand-dug wells are preferred because they are relatively low-cost. However, much of the area is basement rock, limiting the options for hand-dug wells. Where deeper boreholes are required to access groundwater, the higher cost inhibits many households or communities, leading to a reliance on government/NGO programmes or other donor-based approaches (such as by politicians).

Choices between water sources tends to vary on the basis of availability, reliability, the regularity of supply and proximity. Cost can also be a factor influencing choices between sources. Many households report using unimproved sources for reasons of convenience or availability (particularly where boreholes are non-functional owing to pump failure or to vandalism/theft).

Patterns of water use

The community and stakeholder interviews highlighted conflicting views on the effect access to a borehole has on patterns of water use. One interviewee was of the opinion that access to a borehole means people use more water because it is more readily available in the community. However, another reported that people in rural areas only pump what they need due to a lack of electricity and the cost of diesel. Overall, the sense is that the availability of borehole water increases the use of water, particularly for drinking and cooking, although traditional sources may still be used for other activities (such as washing).

Effects on adaptability

Several positive impacts were attributed the development of boreholes. A significant amount of time is saved by not having to travel long distances to access water. This has a particular impact on children, who are able to attend school for longer. There are also health benefits, with a reduction in water borne diseases such as typhoid. It is striking that in all communities, there is a strongly expressed demand for more boreholes in order to increase the amount of water available and improve convenience.

Attitudes to water resource

Rural communities were firmly of the opinion that the supply of groundwater was inexhaustible. Descriptions ranged from a sea to a river of water underground. Although, communities recognised that climatic conditions were changing (with later onset and earlier cessation of rains), it was not felt that this would impact on groundwater availability. In only one community – which was more prosperous and urban than the others involved owing to the presence of a rail junction – were surface-groundwater interfaces explicitly recognised and concerns expressed at falling water tables.

Role of governance

In the rural communities involved in this study, governance of water supplies tends to be the responsibility of the community itself, organised through village elders or a community management community. Youths may be involved in protecting the water source from vandalism by external actors. The focus of governance actions are managerial – concentrating on the mechanics and costs of the operation of the water supply on a daily basis. Women often play a major role in daily management practices. There is no ongoing governance of water sources by government actors, or by NGOs.

Governance of the water resources, in terms of monitoring or management of the quantity or quality of abstracted water is absent. No permissions are required or abstraction licences demanded for boreholes (partly because there is no legal basis for this as the Federal Water Law remains to be enacted).

Role of communication

The principal source of knowledge and understanding is through Intra-community exchange. There is limited use of newspapers, TV or radio – and where available women often have restricted access

Communication channels tend to be health-orientated, with antenatal visitors/health workers sources of information and the presence of clinics/health centres helping to provide access to information. In consequence there tends to be strong awareness of the risks of water-borne diseases, but limited awareness of other considerations in the development of boreholes.

Conclusions

- Water supply choices are generally limited in rural areas, where the majority source their water from hand dug wells or community boreholes
- Boreholes are the preferred source of water, however poor functionality (particularly of hand pump boreholes) is a significant problem
- SEC tends to be elevated in deeper boreholes, suggesting a geogenic source, while E. Coli tends to be elevated in shallow hand dug wells
- In addition to issues with functionality and water quality, reliability (availability of water over time) is a problem, particularly for hand dug wells
- Trends towards private borehole development are reported in the larger towns in this area, with anecdotal evidence that this may extend to rural areas
- The key perceived benefits of borehole development are convenience (time saved collecting water, particularly for children) and health benefits

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