RiPPLE

Mapping for Water Supply and Sanitation (WSS) in Ethiopia

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Research-inspired Policy and Practice Learning in Ethiopia and the Nile region

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Research-inspired Policy and Practice Learning in Ethiopia and the Nile region (RiPPLE) is a five-year research programme consortium funded by the UK's Department for International Development (DFID). It aims to advance evidence-based learning on water supply and sanitation (WSS) focusing specifically on issues of planning, financing, delivery and sustainability and the links between sector improvements and pro-poor economic growth.

RIPPLE Working Papers contain research questions, methods, preliminary analysis and discussion of research results (from case studies or desk research). They are intended to stimulate debate on policy implications of research findings as well as feed into Long-term Action Research.

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Acronyms

BoFED	Bureau of Finance and Economic Development
BoWERMD	Bureau of Water, Energy Resources and Mining Development
DAG	Donor Assistance Group
GIS	Geographical Information System
M&E	Monitoring and Evaluation
MDG	Millenium Development Goals
MoWR	Ministry of Water Resources
RiPPLE	Research-inspired Policy and Practice Learning in Ethiopia and the Nile Region
SNNPR	Southern Nations, Nationalities and Peoples Region
UAP	Universal Access Plan
WASH	Water supply, Sanitation and Hygiene

Executive Summary

In this working paper we highlight ways in which mapping approaches can help Ethiopia achieve the Universal Access Plan for water supply and strengthen links between water and sanitation service delivery and pro-poor growth. The paper is based on experiences of using mapping approaches as part of the RiPPLE (Research-inspired Policy and Practice Learning in Ethiopia and the Nile Region) project, a five year Research Programme Consortium that aims to meet the country's water supply and sanitation challenges by supporting evidence-based learning in the sector. Our main premise is that:

> *The regular collection, organisation and use of spatial data on water availability, access,demand and use at all levels makes for more effective, sustainable, transparent and accountable WASH. Mapping is a useful approach for organising and using this spatial information for planning, analysis, advocacy, implementation and monitoring of WASH services.*

The first part of the paper sets out a conceptual framework for mapping. Mapping is more than just providing colourful pictures to brighten reports and offices – it is about collecting and using spatial data and information to provide the best available evidence to support decisions at all stages in projects and programmes. Within Ethiopia, there is growing evidence that maps can be an important part of the process of turning raw data into useful information and practical knowledge.

There is great diversity in the types of maps and mapping approaches that can help to improve WASH. The main different uses for maps are: data analysis (particularly interdisciplinary analysis); advocacy; planning; implementation and monitoring. For a map to be effective, the use to which the map is to be put must be clear before making the map. Maps for different uses may require different data, combined in different ways, and displayed at different scales. Within this working paper we describe various examples from Ethiopia (mostly developed as part of RiPPLE) where maps have been used for each of these five purposes.

Despite the obvious benefits of using maps within the WASH sector in Ethiopia, maps are not widely used. Perhaps the main reason is uncertainty about how maps can be used to inform decisions, what type of map is fit for purpose, and the process of gathering information to develop maps. We trust that the framework developed in this paper helps to bring clarity about when maps can be of assistance, and how to develop fit for purpose approaches. As discussed, maps are only part of the process of turning data into knowledge or even wisdom. They form the useful step of turning data into more readily interpreted information. However, to truly increase knowledge, they must be used.

The second part of the paper highlights the practical challenges that exist when using mapping to support decision making in the WASH sector. In particular the challenges of data availability, data accessibility, poor data management and the capacity required to make maps and manage data. There is a great appetite for mapping in Ethiopia, but appropriate capacity must first be built before maps can be used routinely and widely by different WASH stakeholders. .

The paper concludes by summarising the steps needed to integrate mapping in a WASH programme:

1. Decide whether a map is the best tool for the job, and whether the purpose is planning, advocacy, implementation, analysis or monitoring.
2. Carry out a careful analysis of data requirements and whether the data are available, or need to be collected from the field.

3. Identify who will be involved in the production and use of the map; who will be developing the map (often this will mean building the GIS); who will be deep users of the map (able to manipulate or add data to the map or GIS); who will be shallow users (able to use and interpret the data); and who will be collecting and generating the data on which the map will be used.
4. Collect data wisely. Careful planning of data collection activities – e.g. water scheme surveys – will ensure the most useful data is collected.
5. Facilitate communication between users, developers and data collectors. All should be clear on the purpose of mapping and their role in the process.

1 Introduction

Ethiopia faces a major water and sanitation challenge. For many years, Ethiopia has remained at the bottom of the international league tables for access to safe water and sanitation services (UNICEF/WHO 2008). In response, the country has launched the Universal Access Plan (UAP) – an ambitious plan to ensure access to safe water and sanitation by all by 2012, which the government reviewed and reaffirmed in 2008. The capital investment in the sector has roughly doubled over the past four years (Ministry of Water Resources, 2008:4). The Ministry of Water Resources (MoWR) is working towards this goal in collaboration with the Ministry of Health and the Ministry of Education (through a Memorandum of Understanding), and with donors through the Donor Assistance Group (DAG).

What role do maps and mapping have in supporting the UAP? At their best, maps can challenge preconceptions and combine different sources and types of information to give an accurate picture of the reality on the ground. Mapping is more than just providing colourful pictures to brighten reports and offices – it is about collecting and using spatial data and information to provide the best available evidence to support decisions at all stages in projects and programmes. They are a major part of the process of developing and sharing knowledge from existing data and information. For the UAP, mapping approaches could help target major investments in water and sanitation services more effectively, for example by combining maps of available water resources with data on existing coverage, or the vulnerability of communities. Mapping can also play a key role in monitoring and evaluating the impact of investment in UAP.

The objective of this working paper is to highlight ways in which mapping approaches can help Ethiopia achieve the Universal Access Plan for water supply and increase links between water and sanitation service delivery and pro-poor growth[1]. The paper is based on experiences of using mapping approaches as part of the RiPPLE (Research-inspired Policy and Practice Learning in Ethiopia and the Nile Region) project, a five year Research Programme Consortium that aims to meet the country's water supply and sanitation challenges by supporting evidence-based learning in the sector (see Box 1.1 for more information on mapping-related activities carried out under RiPPLE).

The first part of the paper sets out a conceptual framework and illustrates the potential uses of mapping approaches in the Ethiopian water supply and sanitation sector. The second part highlights some of the conceptual and practical challenges faced when using mapping to support decision making in the sector and suggests entry points for using mapping to further the UAP in Ethiopia.

[1] The link between improved water and sanitation services and pro-poor growth relates to, for example, encouraging multiple uses of water including small-scale irrigation and other productive uses to improve livelihoods.

Box 1.1: RiPPLE mapping activities in Ethiopia

Mapping cuts across the major research themes of RiPPLE: improving access to water supply and sanitation services, and linking water supply, sanitation and hygiene services to pro-poor growth. The mapping component of RiPPLE also functions as a capacity building activity for researchers, practitioners and policy entrepreneurs to improve the design, implementation and monitoring of water supply and sanitation services.

The guiding principle for RiPPLE's mapping work in Ethiopia is to encourage the use of spatial information to improve decision making in the sector. Mapping is not confined to the use of Geographical Information Systems (GIS)-based technology, such as ArcGIS, but also includes simple techniques such as hand-drawn maps. RiPPLE embarked on a number of activities at different administrative levels to demonstrate the usefulness of 'spatial thinking' – another way of describing the process of mapping – and to better understand the opportunities and obstacles for developing and using spatial information in the Ethiopian water sector.

At federal level, RiPPLE focused on a particular problem that can be well illustrated through the use of spatial information, namely fluoride concentrations in drinking water. RiPPLE engaged with partners from the Ethiopian Fluoride Steering Committee to investigate fluoride problems in drinking water across Ethiopia, and in particular the relationship between geology and fluoride concentrations in drinking water. The group produced advocacy material to support and revive the existing debate around the issue: in particular, a poster highlighting fluoride distribution across Ethiopia and related health problems.

Regional sector ministries carry much of the responsibility for planning and implementing water supply services in Ethiopia. Many of RiPPLE's mapping activities were therefore concentrated at regional level. In order to get a better understanding of the opportunities and challenges of developing and using spatial data in the sector, RiPPLE worked with government officials and NGOs in the Benishangul-Gumuz region. Through a number of workshops and applied training activities, RiPPLE pieced together the kind of spatial information that is collected, stored, interpreted and used at different administrative levels in the WASH sector from the region downwards (region, zone, woreda and community), and the challenges affecting these activities – for example, lack of capacity, hardware, incentives, and structures. The team worked most closely with a small group of people from the Bureau of Water, Energy Resources and Mining Development (BoWERMD), the Bureau of Finance and Economic Development (BoFED) and WaterAid. Within this network, the team demonstrated and trialled various mapping approaches, with an emphasis on practical tools for collecting and using spatial information, and developed a number of new maps, including a groundwater availability map for Benishangul Gumuz.

Mapping approaches were also used in a sustainability case study carried out by RiPPLE in the Southern Nations, Nationalities and Peoples Region (SNNPR) to highlight the distribution of water supply services across a district.

List of RiPPLE outputs with a mapping theme (most of these are available at http://www.rippleethiopia.org/):

Poster/Map: Groundwater availability in Benishangul-Gumuz region, Ethiopia

Poster/Map: Fluoride Problems In Ethiopian Drinking Water

Toolkit: Mapping: spatial thinking. Using mapping to support WASH in RiPPLE activities.

Infosheet: Mapping: Spatial Thinking.

Sustainability Case Study: The Sustainability of Water Supply Schemes: a case study in Alaba Special Woreda.

Report: RiPPLE Mapping Visit to Benishangul-Gumuz.

Report: RiPPLE Mapping: Second report, Benishangul-Gumuz Region

2 Mapping: a framework for its use in WASH

2.1 What is mapping?

In this chapter we discuss what is meant by mapping, and attempt to bring clarity to the different ways it can be used to support the delivery of water supply, sanitation and hygiene services (WASH). Our main premise is that:

> *The regular collection, organisation and use of spatial data on water availability, access, demand and use at all levels makes for more effective, sustainable, transparent and accountable WASH. Mapping is a useful approach for organising and using this spatial information for planning, analysis, advocacy, implementation and monitoring of WASH services.*

Maps allow us to gain perspective. They reduce the complexity of the world so that we can see patterns that cannot normally be observed on the ground. Any data that can be spatially referenced (i.e. located on the earth's surface) can be shown on a map. Therefore, different types of data can be shown together: not just the physical environment, but also social and economic data. By combining different kinds of data, patterns and relationships are revealed that would otherwise be hard to see. This unique perspective can then be used for many things, including detailed data analysis, planning, advocacy, monitoring and implementation.

2.2 Mapping and improved decision making

An evidence-based approach to WASH interventions means collecting data, identifying the issues, and identifying and using the tools that can help address those issues. So, for example, someone planning a new water scheme development in a region may need to know early in the process where existing developed water schemes are, how sustainable they are, how many people are already served, where the settlements are that are currently unserved, whether there are suitable roads to these settlements, and where the potential water resources are – either groundwater or surface water, and their seasonal variability.

Maps are a key part of the process of turning raw data and experience into usable information, which in turn can build knowledge and even wisdom (Ackoff, 1989). With *data* we refer to facts such as administrative boundaries, geology, or borehole locations. *Information*, as understood here, is the result of processing these data so we can use them to answer particular questions. By *knowledge* we mean gaining an understanding of a particular issue and being able to apply this understanding for planning, analysis, advocacy, implementation and monitoring around WASH service delivery (Figure 2.1).

The political process that accompanies the transformation of raw data into knowledge greatly determines whether and which type of evidence will actually be used to inform decisions. The mindset and experience of those who collect information and develop maps have a bearing on what data is included and what particular information the map will communicate. Who participates in the mapping process and is able to convey their experience and interests onto the map is therefore important. In this process, the use of technology can limit participation to particular actors, such as GIS experts. Power and accountability structures between different actors, for example between the users of water services, sector experts, the private sector and politicians, also play an important role in the process of turning data into knowledge and in the actual use of maps.

Since maps are powerful tools for communication, they can also be potentially dangerous. There is a tendency to perceive maps as showing the 'true' picture. However, maps are always a subjective representation of the environment, conveying a particular version of reality. Maps can also misrepresent reality and provide support for policy interventions that are not helpful. It is therefore always useful to question the selection and combination of raw data that convey a strong message via a map (see examples later).

Box 2.1: The main data in the WASH sector that can be used in mapping

Maps are not only useful for showing information about the physical world, but are also powerful ways of illustrating political and socio-economic data, and in integrating data from these different sectors. Some of the important parameters in the WASH sector that can be investigated using maps are:

Socio-economic data

- Locations and characteristics of settlements.
- Demographic information (population – people and households) on villages and kebeles.
- Locations and characteristics of the built environment (e.g. roads).
- Locations and characteristics of water-using activities (e.g. gold mining, market gardening, and beer brewing; how much water they use at different times of year).
- Regional and woreda budget information (e.g. total, capital and recurrent budget, and underspend).

WASH data

- Water scheme locations – both improved and unimproved sources.
- Physical characteristics of water schemes (e.g. source type, depth, pump type, seasonal yield variations, and water chemistry).
- Socio-economic characteristics of schemes (e.g. number of users, water use tariff, WATSAN committee).
- Locations of village latrines and of schools and health centres with latrines, and latrine characteristics.

Physical environment

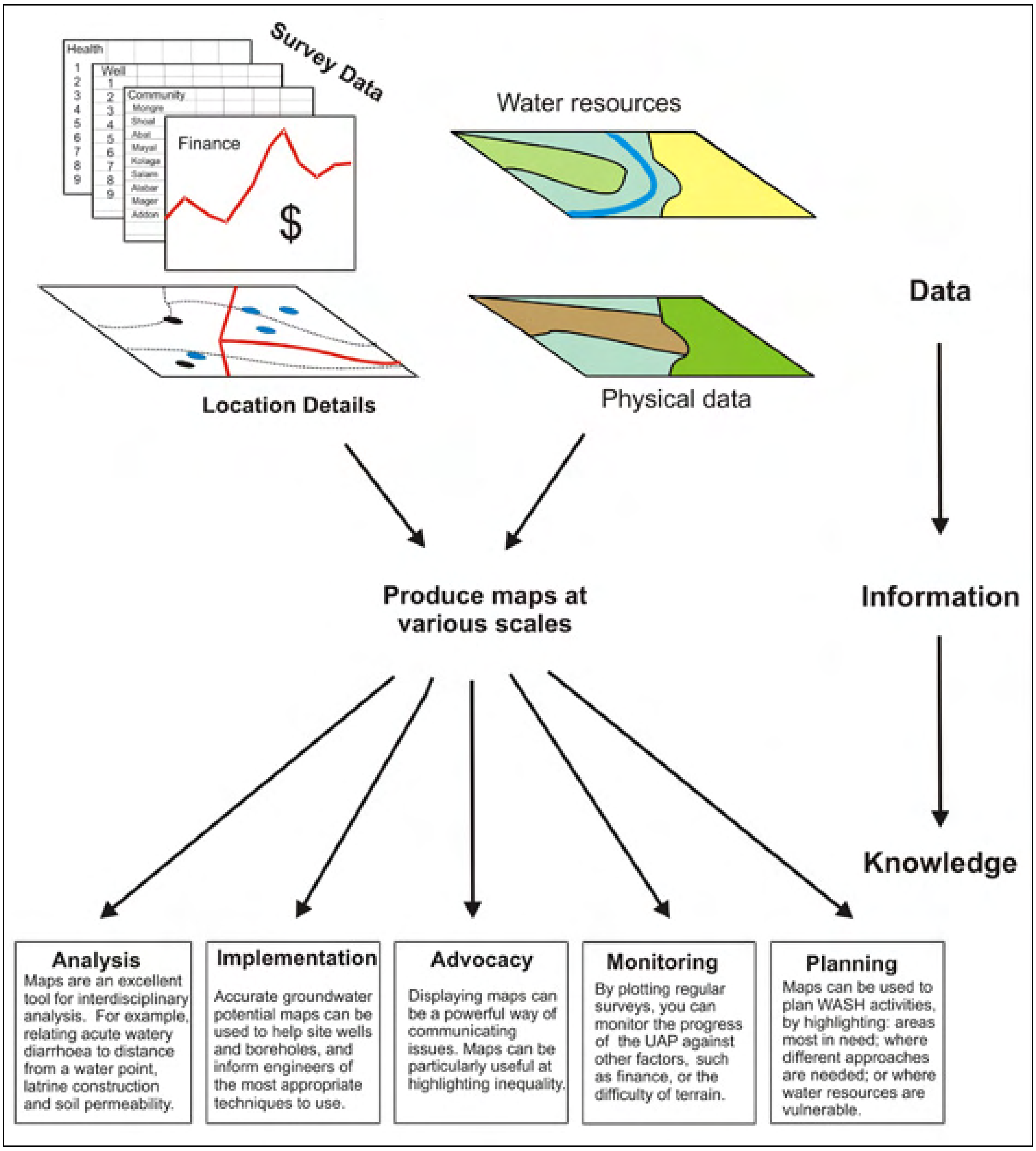
- Topography and land use.
- Location and characteristics (e.g. seasonality) of rivers.
- Volumes and variations in rainfall and other climatic information.
- Geology and hydrogeology, including the groundwater potential of different rocks.

Maps range from simple (e.g. points showing the locations of wells or springs) to complex (e.g. combining information on population, water scheme location and the number of users of each scheme to produce a map that shows the coverage by safe water schemes in an area).

2.3 Mapping: a framework

There is great diversity in the types of maps and mapping approaches that can help to improve WASH. Figure 2.1 illustrates the main uses for maps: analysis, planning, implementation, advocacy and monitoring. For a map to be effective, the use to which the map is to be put must be clear before making the map. Maps for different uses may require different data, combined in different ways, and displayed at different scales. There is no point in making a map if it is not going to achieve the purpose for which it is intended. The following sections illustrate different applications for mapping approaches. International examples are given, and also Ethiopian examples based on work carried out under RiPPLE.

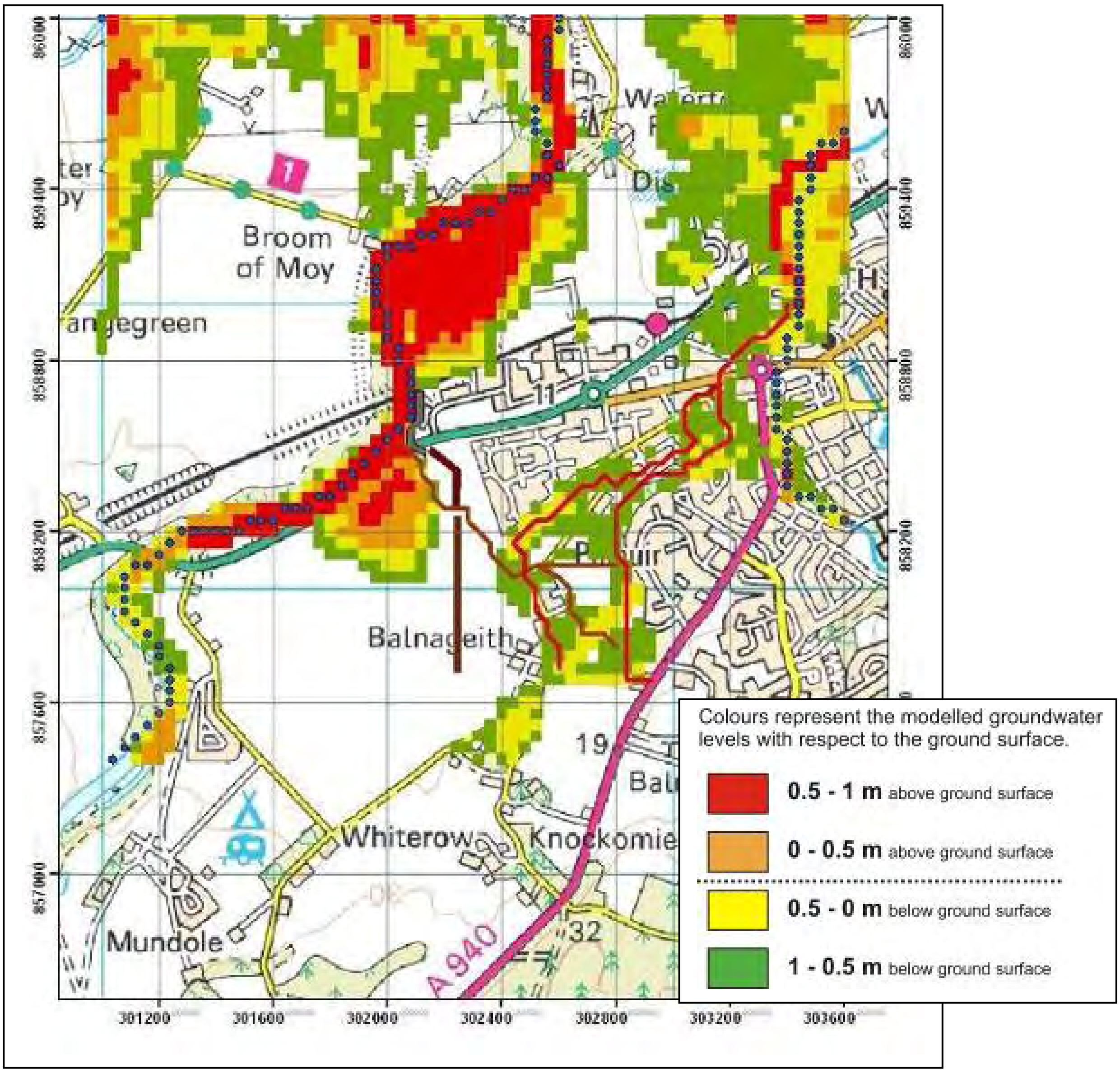
Figure 2.1: Applications of mapping in WASH



2.3.1 Planning

Maps are an invaluable tool for planning. For example, maps can be used to zone land to help inform planning decisions for new developments. Groundwater vulnerability maps are used to target potentially contaminating activities to less vulnerable areas (e.g. Gogu and Dassargues 2000), while flood risk maps are used by local authorities to help make decisions on the location of new housing developments (Figure 2.2). More recently, small area mapping approaches have been used to identify areas at sub district level and below where health is poor, or poverty is particularly severe, to help better target interventions (Bedi et al. 2007).

Figure 2.2: Flood risk map for Forres in northern Scotland.

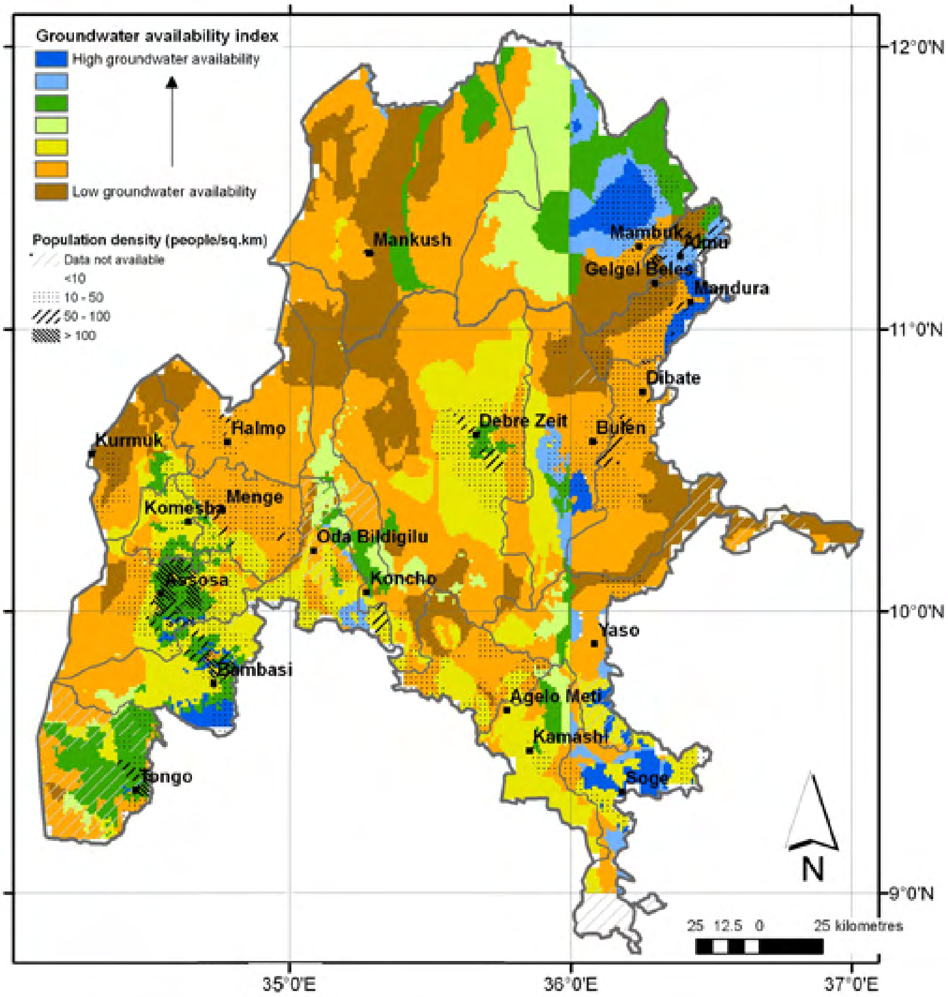


Coloured areas show where the groundwater table is shallow and new houses will not be given planning permission (from MacDonald et al. 2008)

A new groundwater availability map for Benishangul-Gumuz region in Ethiopia was developed within the RiPPLE programme (Figure 2.2). In Benishangul-Gumuz, as in much of Ethiopia, groundwater is the most important source for rural and urban water supply for much of the year, but its availability varies significantly across the region. In a few localised areas groundwater is easy to find and to develop for water supplies, but in most of the region, groundwater is hard to find and to develop sustainably to maintain year-round sustainable supplies. RiPPLE combined information on the geology, hydrogeology, rainfall and population of the region, derived from existing datasets such as published hydrogeological maps and government demographic information, and used them to produce a map that shows how groundwater availability varies across the region (Figure 2.3). This map can be used for a number of purposes:

- To inform planners at a regional level about where high population density (and therefore high water demand) coincides with low groundwater availability. These are areas where developing and maintaining sustainable water supplies is likely to be more difficult, needing more resources and possibly non-traditional solutions, such as reducing the criteria for the number of households served per well, or developing sand dams.
- To inform planners concerned with food security about areas of high groundwater availability where there might be scope for developing groundwater for community-scale irrigation schemes. Conversely, to identify areas of low or unreliable groundwater availability for targeting monitoring and early warning efforts.
- As an advocacy tool by woreda administrators or NGOs. For example, by highlighting the low groundwater availability in Kurmuk woreda (far west of Benishangul-Gumuz, Figure 2.3), regional planners could be encouraged to prioritise increased investment in water scheme provision here, particularly in drought years, and discouraged from promoting activities that are heavily dependent on groundwater, such as any new refugee camp.

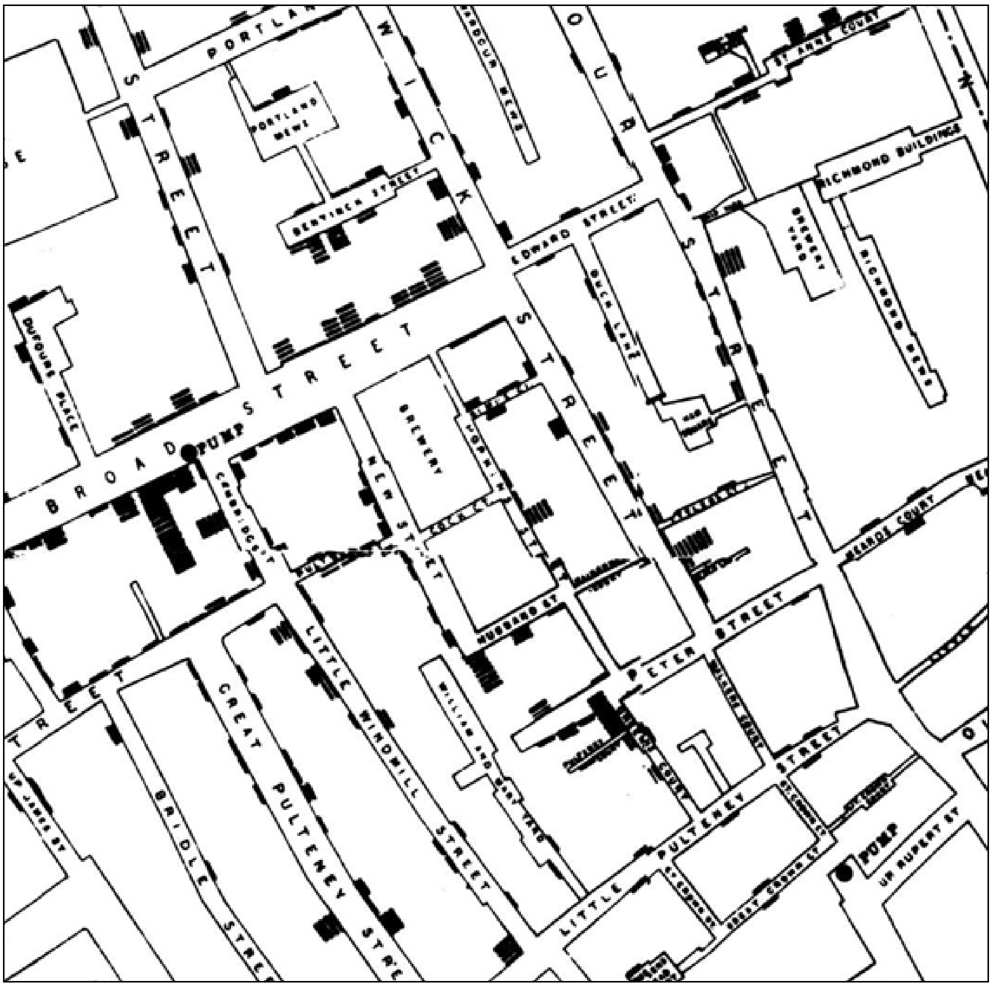
Figure 2.3: Groundwater availability and population density in Benishangul-Gumuz region, Ethiopia.



2.3.2 Analysis

One of the main strengths of using mapping approaches is the possibility for superimposing and integrating different layers of information on a map, revealing relationships between two or more parameters that are not otherwise obvious. One of the earliest examples of this occurred in 1854, when John Snow used a mapping approach to demonstrate that a cholera outbreak was linked to a contaminated well, and therefore was a water-borne disease (Figure 2.4).

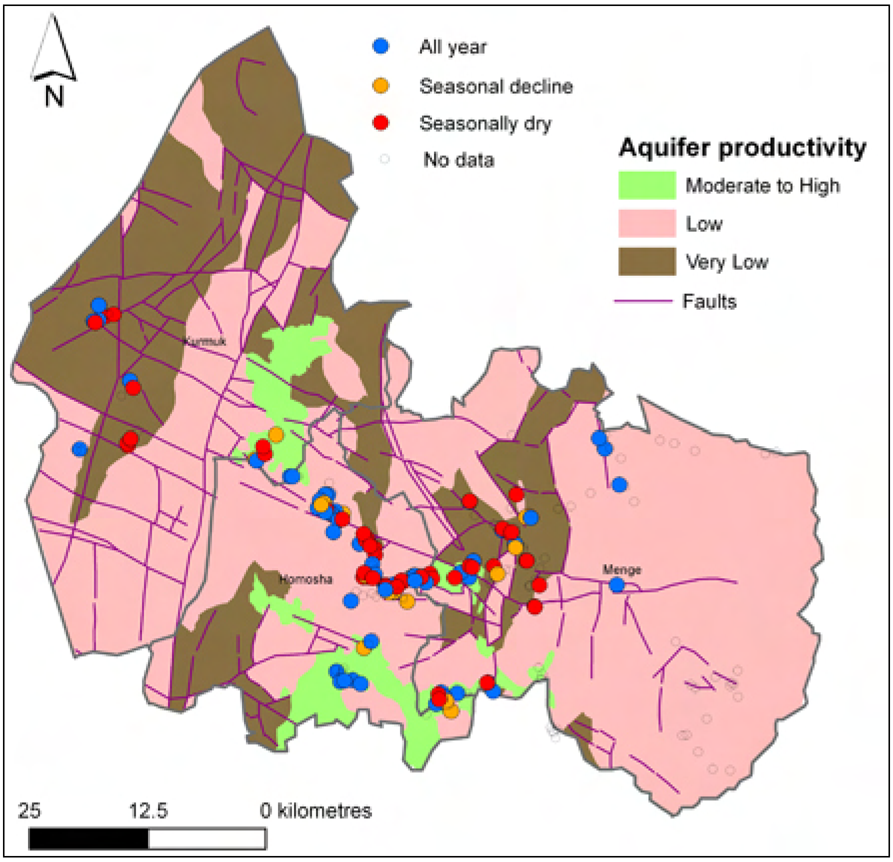
Figure 2.4: A section of John Snow's 1854 'Cholera Map' of the Soho area of London



Note: Based on a detailed street map and showing the location of hand pumps and instances of deaths from cholera (each black line stacked away from the street is one death). Most deaths cluster around a single well (marked 'pump') on Broad Street. When the pump in this well was removed following John Snow's findings, the cholera outbreak ended (http://matrix.msu.edu/~johnsnow/images/online_companion/chapter_images/fig12-5.jpg; material is in the public domain).

An example in the RiPPLE programme is the use of maps to investigate the sustainability of water points in Menge woreda, Benishangul-Gumuz region. Here, as in many other parts of Ethiopia, many water points fail in the dry season, or have significantly reduced yields which cannot meet demand. Often the main evidence for this failure is a hand pump that has stopped working, and the conclusion is that poor hand pump maintenance is to blame. However, plotting the failing wells over a map of the hydrogeology illustrates that many of the unsustainable wells are located on poor or unproductive aquifers. It is therefore likely that the failure of the wells in the dry season may be more to do with the low availability of deeper groundwater in these wells, than with the maintenance of the hand pumps.

Figure 2.5: The sustainability of water points related to aquifer productivity for three woredas in Benishangul-Gumuz

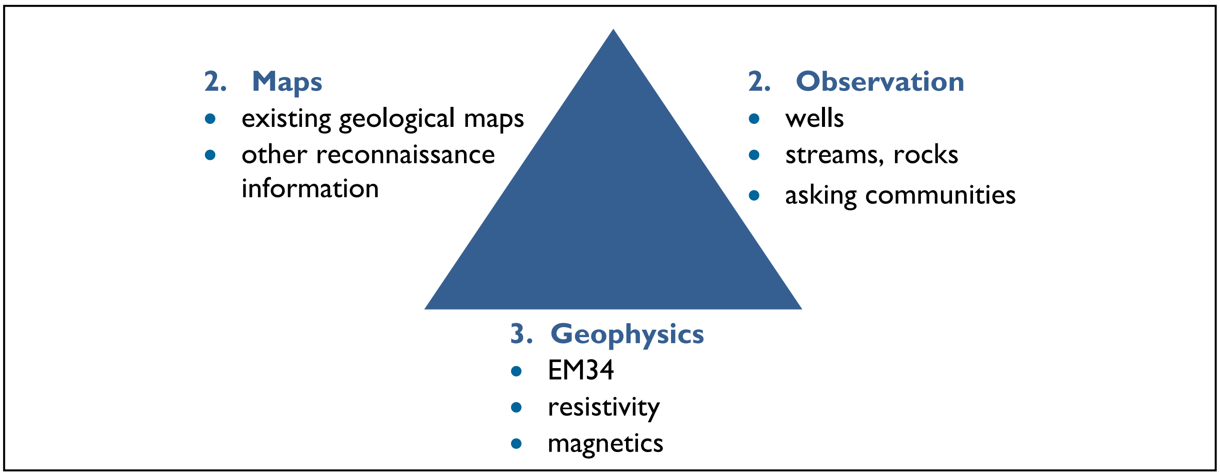


This analysis has a direct impact on potential interventions. If the breakdown of handpumps is a symptom of low groundwater yield, then the increased supply of spare parts may only be partially successful. Better to concentrate efforts on finding higher yielding supplies.

2.3.3 Implementation of projects

Relevant detail on local conditions can help improve the siting and design of water points in projects and programmes. Mapping can help form part of the process of gathering relevant information. For many aspects of water point development, such as choosing the appropriate technology for the environment (e.g. surface water or groundwater supply; deep borehole or shallow well), and siting individual water points, a triangulation approach is often most effective (MacDonald et al. 2005). Map information (i.e. prior knowledge) is combined with new observation and scientific survey information to help understand the water resources in a community and then inform water supply choices (Figure 2.6).

Figure 2.6: Maps form part of the triangulation approach used to help match the water supply intervention to the environment



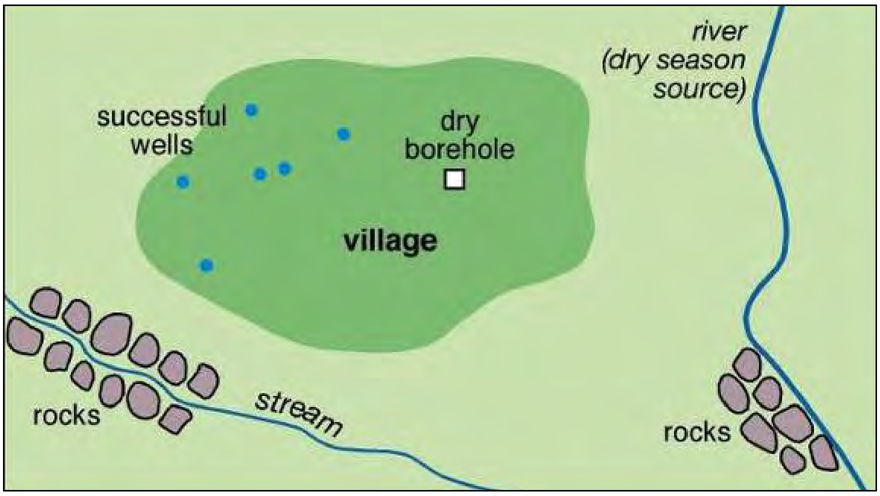
(MacDonald et al. 2005)

Good information on water resources can help increase the yield and sustainability of new sources. For example, detailed groundwater potential maps in a geologically difficult area of Nigeria helped local government staff use the most appropriate techniques for siting wells and boreholes and make decisions about how deep to drill and which type of water point to construct.

Figure 2.7: Local government staff in Nigeria using a map to assess the groundwater potential in a community.

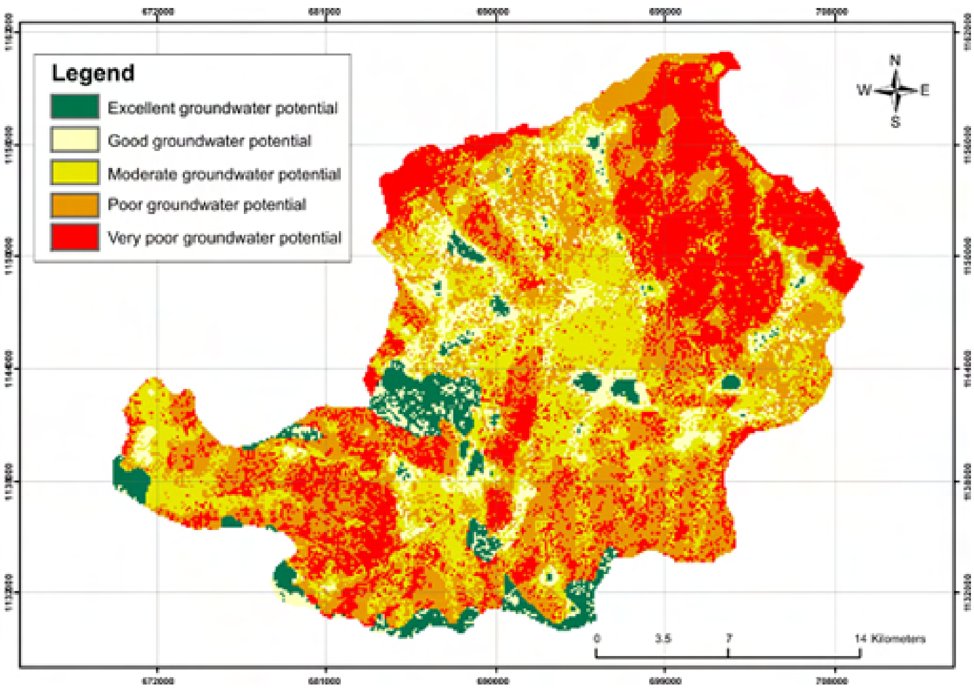
Detailed maps of communities can also be important in making water supply interventions more effective. These maps (often created by the communities themselves) can present useful local knowledge on: where potential contaminant sources are (such as burial grounds or latrines); the population distribution and major paths; and locations of high water demand (Figure 2.8). The exact location of new water points can then be targeted to areas where they are accessible and less susceptible to contamination.

Figure 2.8: An example of a community map illustrating the water sources used by a community



A detailed map of groundwater availability in the River Tumet catchment, Benishangul-Gumuz region was developed within the RiPPLE programme (Lemacha 2008). A range of input factors, including fracture densities, geology, depth of weathering and drainage densities were combined to give an estimate of the likelihood of finding groundwater through drilling or well-digging (Figure 2.9). This map was developed for WaterAid and woreda staff to help inform ongoing drilling and well digging, and inform which techniques are appropriate in different parts of the woreda.

Figure 2.9: Groundwater potential for the Tumet catchment, Ethiopia.

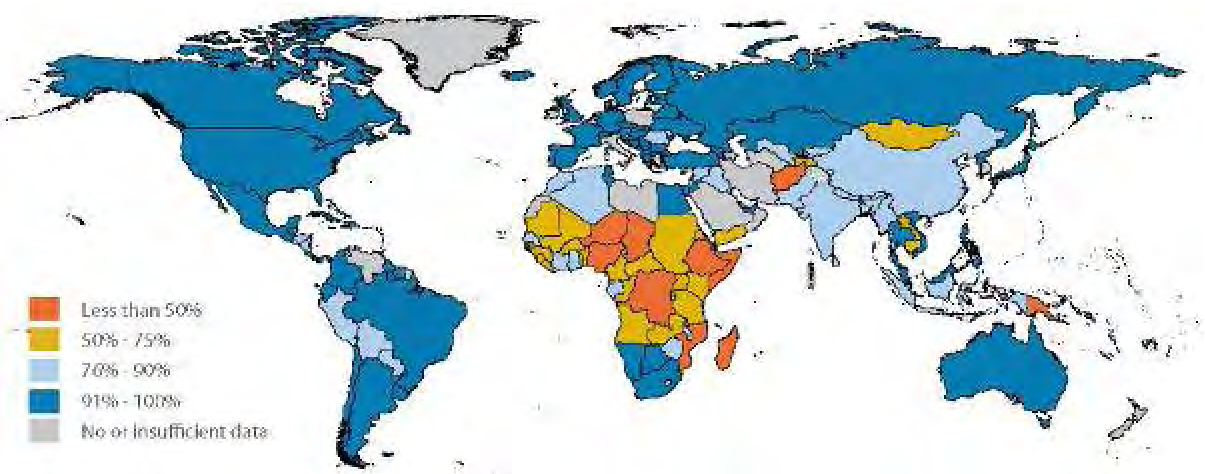


(Lemacha 2008).

2.3.4 Advocacy

Maps are a powerful tool for advocacy. The clear and intuitive way in which complex information can be communicated allows stories to be easily told and messages to be relayed quickly and powerfully. This can happen at all scales, from within woredas to country wide and even globally. One of the maps most often used for advocacy in WASH is a global map of access to safe water supplies (Figure 2.10). This map immediately conveys the message that Africa is the area where WASH efforts must be focussed to give the biggest global impact.

Figure 2.10: Global drinking water coverage in 2006



Source: From WHO 2008

WaterAid has used district-level water point maps to show the difference in service provision across a district in several of its country programmes (Welle 2007). In West Africa, mapping is linked to an initiative to localise the Millennium Development Goals (MDGs) in water and sanitation from the national to the local level. Local governments have used the results of the mapping approaches to lobby for additional funding for the sector, and citizens have used them to pressure their representatives for additional supplies.

An example of a national advocacy map is the Ethiopian fluoride map developed within RiPPLE. This map shows concentration of fluoride in groundwater across the country, making it easy to understand the potential scale of the problem, and why it needs to be taken seriously in Ethiopia (see Figure 2.11). The map was developed from collaboration between several institutions. As well as the practical applications of the map, the *process* of map making helped to strengthen collaboration between stakeholders.

Another typical example of a map for advocacy purposes is a map showing access levels to services at sub-district level. Within RiPPLE, maps showing the location and functionality of water points for Mirab Abaya and Alaba woredas were produced (Figure 2.12). By plotting a 1.5 km radius buffer round each working water point it is possible to see which areas are without service. This map is a powerful illustration of inequity in provision of working sources across woredas. The clustering of non-functional sources, however, indicates that attempts at service provision have consistently failed in some areas, and the reasons behind this should be investigated.

Figure 2.11: Fluoride concentrations in groundwater across Ethiopia

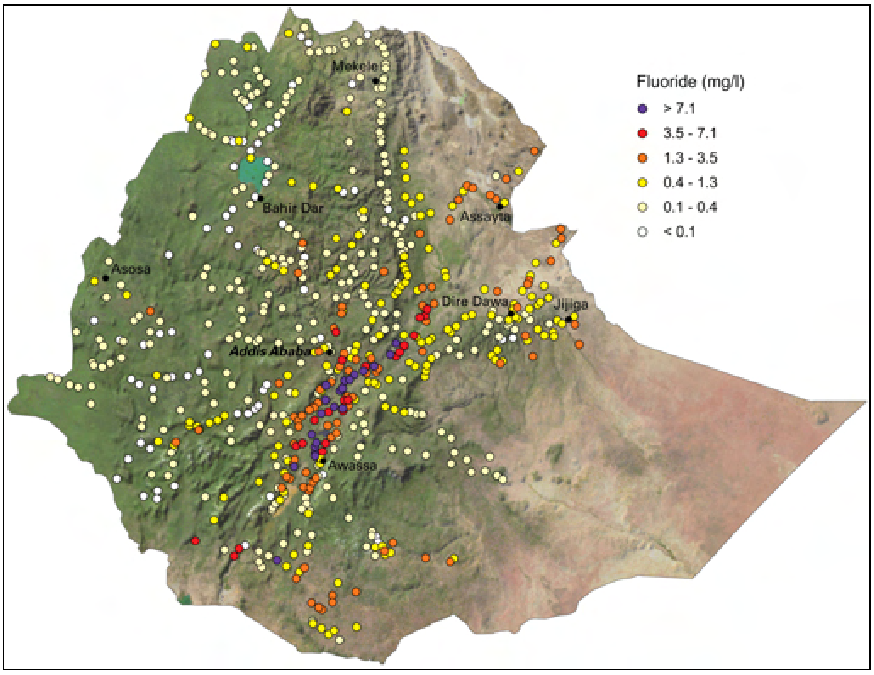
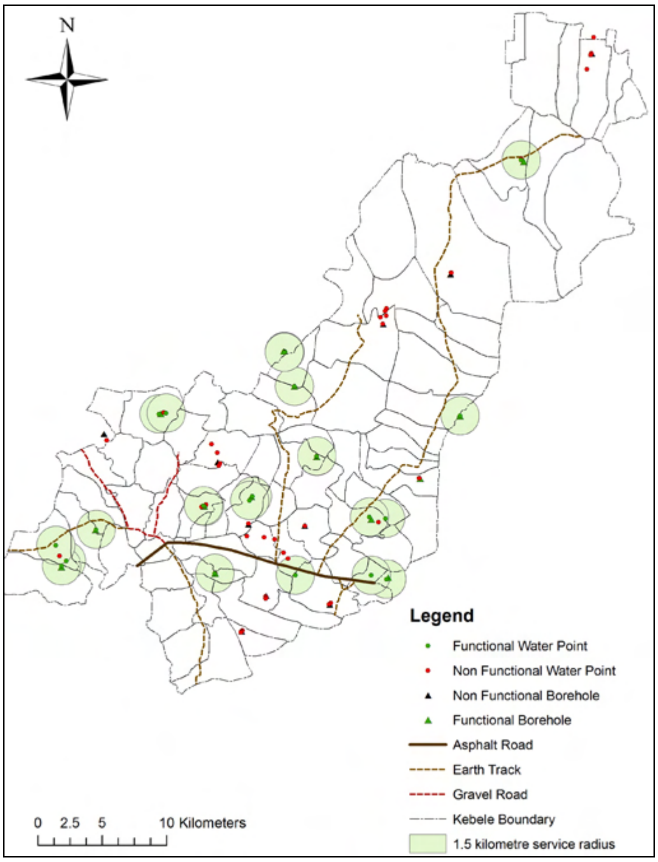


Figure 2.12: The location of functioning water sources in Alaba woreda

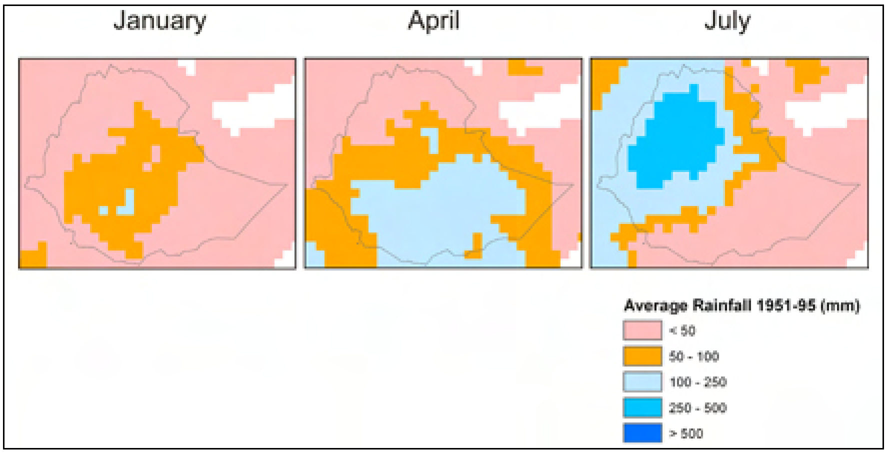


With 1.5 km radius buffer around each water source, illustrating the areas of the woreda which are more than 1.5 km from a working source.

2.3.5 Monitoring

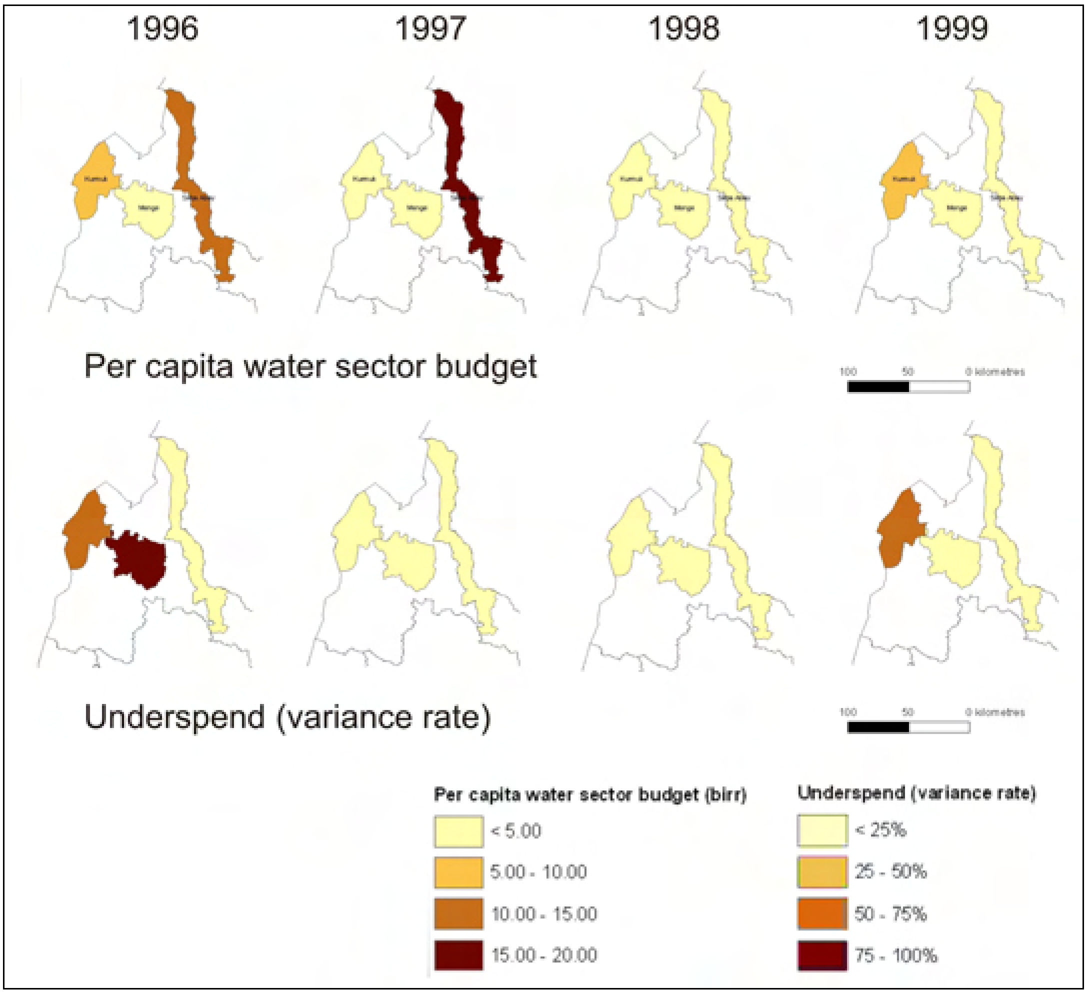
Mapping also supports monitoring and evaluation (M&E) within WASH. Maps are well suited to illustrate spatial change over time. Monitoring implies that data is collected repeatedly and differences are compared over a period of time (this is what makes monitoring different from analysis, as discussed above). Maps are frequently used like this for displaying physical data – for example, changes in rainfall from season to season in Ethiopia (Figure 2.13). Maps are an excellent way of communicating and summarising these sorts of data, since other methods, such as tables, would rapidly accumulate too much text, and be difficult to decipher. Socio-economic monitoring data, for example poverty indicators, are also beginning to be displayed and communicated more frequently using maps.

Figure 2.13: Average rainfall across Ethiopia in selected months



In an example from RiPPLE, preliminary maps illustrating variations in financial data between woredas were developed. Some examples are shown in Figure 2.14. These maps are based on information on water sector budgets collected by the RiPPLE Finance team from Bureau of Finance and Economic Development (BoFED) and Bureau of Water, Energy Resources and Mining Development (BoWERMD) for Benishangul-Gumuz region. The team analysed the variance in capital and recurrent water sector budget, and the underspend rate, for each of four woredas in the region over the most recent Ethiopian financial years. The maps clearly illustrate not only the large discrepancy in budget between the study woredas for the year shown, but also the changing variations in underspend rate among the woredas. By displaying this information on maps instead of in tables or on charts, the pattern of variance between different woredas is easier to see and to communicate to stakeholders.

Figure 2.14: The per capita water sector budget and the underspend (variance rate) in that budget in three woredas in Benishangul-Gumuz for Ethiopian Financial Years 1995-1999.



3 Practical challenges to WASH mapping in Ethiopia

Despite the obvious benefits of using maps within the WASH sector, maps are not widely used in Ethiopia. Perhaps the main reason for this is a lack of clarity about how maps can be of assistance, what type of map is fit for purpose, and the process of gathering information to develop maps. We hope that the framework developed in the previous chapter helps to bring clarity about when maps can be of assistance, and how to develop fit for purpose approaches. As discussed, maps are only part of the process of turning data into knowledge. They form the useful step of turning data into more readily interpreted information. However, to truly increase knowledge, they must be used.

There are practical obstacles to be overcome both in developing maps, and also in them being taken up and used by those who would benefit from the information. These practical challenges can be:

- Technical e.g. lack of quality data; capacity constraints (lack of hardware, software, skills and experience).
- Operational e.g. lack of communication (maps produced at a national level are not effectively distributed at regional level); lack of structures and clarity of responsibility.
- Governance-related e.g. lack of incentives for using maps as inputs for planning, implementation and monitoring of policy.

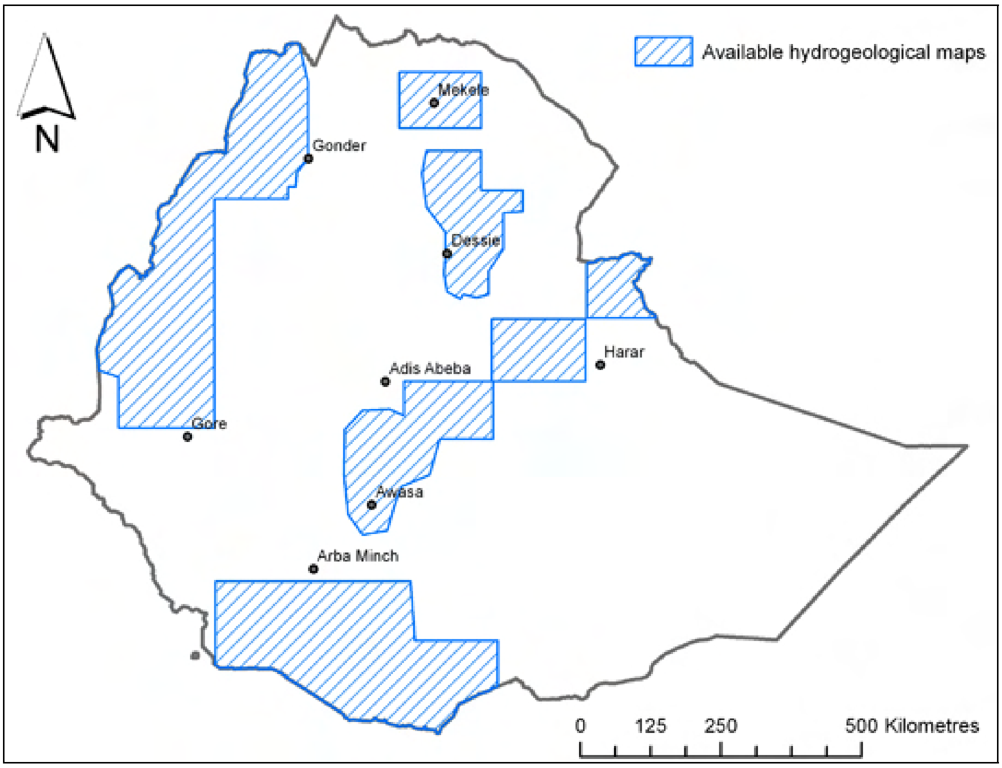
Below, we explore a number of practical challenges that RiPPLE encountered during mapping activities in Ethiopia followed by reflections on how to overcome them. The information is gathered from various RiPPLE reports (MacDonald et al. 2007; Ó Dochartaigh et al. 2007, Ó Dochartaigh et al. 2008).

3.1 Data availability

Data relevant to WASH (Box 2.1) generally comprise physical information (such as maps of topography, rivers, geology and hydrogeology); information on WASH services (such as the location and functionality of existing and improved schemes); and socio-economic data (such as roads, communities, population distribution and density).

However, much relevant data are not available. Some physical data have yet to be collected. For example for many parts of Ethiopia the hydrogeology has not been mapped at sufficient detail to give any more than a rough indication of rock type (Figure 3.1). To make better data available is a major task. A proposal (EGRAP) to map geology and groundwater resources across Ethiopia to a scale useful for regional planning (1:250 000) put the cost at approximately US $30 million (EGRAP 2006). However, improved mapping techniques and the availability of satellite and remote sensing data mean that geological and hydrogeological mapping of selected areas (for example, of a few priority woredas) can be carried out rapidly and relatively cheaply if experienced personnel are used.

Figure 3.1: The availability of hydrogeological maps for Ethiopia. There is no basic hydrogeological information for much of the country.



Data on WASH systems is collected at different administration levels, but data collection is often ad-hoc, with no clear strategy for what or how it should be collected. This can often be due to a combination of budgetary and operational constraints and until recently no agreed M&E strategy. For example, in many regions it is the responsibility of the woreda water desk to collect data on the existence, location, characteristics and functionality of developed water schemes. In practice, however, there can be confusion about how regularly this data should be collected (e.g. quarterly or annually?), because of a lack of clarity in the relationship between woreda and regional government. A water desk's allocated budget or other resources may also be insufficient to allow it to collect the data: for example, the water desk officers have no transport to enable them to visit water schemes to collect information.

There are several schemes in Ethiopia to try to address these gaps in WASH data. At a sector multi-stakeholder forum in 2007, improving sector monitoring was identified as the top priority for the sector. A number of initiatives have been underway in 2008 to develop an improved and more integrated system of monitoring information on water supply, sanitation and hygiene between the water, health and education sectors. Several initiatives are also now in progress to facilitate woreda inventories of relevant WASH information, and will be investigated in ongoing RiPPLE activities. A key issue to address here is making sure that data are collected in a manner that is useful for the purpose in hand.

3.2 Data accessibility

In addition to problems collecting new data, there can be difficulties in collating existing information and making it accessible. Awareness and accessibility issues can occur at all levels and scales. Three examples encountered by the RiPPLE mapping team are discussed below.

Federal level information: While developing the groundwater availability map of Benishangul-Gumuz region, a set of recent paper hydrogeological maps was purchased from the Ethiopian Geological Survey in Addis Ababa. Copies of these maps could not be found in Benishangul-Gumuz, and few people in the region were aware of their existence. Once they knew of their existence, however, there was much demand for the information.

Information from woredas: At the other scale, there are data available within some woreda offices that would be of wider use if collated and put into a useful form. In Menge woreda, Benishangul-Gumuz for example, local staff had useful monthly data on functionality of water schemes, written in a log book. This information was useful, and could form the building block for further monitoring and analysis.

Information from NGOs: An ongoing issue is the availability of records on water points constructed by NGOs, but separate from state institutions. Here there can be information, but it is often not shared with others and therefore not widely used. Encouragingly, the RiPPLE mapping team found several examples of good data sharing between NGOs and state in Benishangul-Gumuz region. However, information sharing still remains the exception, and often NGOs remain suspicious of government requests for information.

3.3 Data management

Effective data management is key to successful mapping, as well as more generally to the success of any organisation and its activities. Currently in Ethiopia there is often a lack of clear mechanisms within and between government and non-governmental organisations for data management – for storing, sharing, and using data. Even where there are clear arrangements, they may not be followed due to budgetary or other constraints, and they may not be enforced.

Lack of data home: There is often no identifiable home for data within an organisation, whether in digital or in paper form, and no formal system for sharing data and information. Many government departments do not have active formal information storage systems, such as a library of reports, or a store of water scheme records. This leads not only to difficulties in managing data within bureaus, but in sharing information and communicating between bureaus. In Benishangul-Gumuz region, this confusion and lack of coordination recently resulted in duplicated spatial information on water points being collected three times: once by BoFED, once by BoWERMD and once by a private company hired by WaterAid. One of the main issues here in terms of the government sector is the general lack of any institution with the capacity and incentive to champion data sharing. The most obvious candidate is BoFED, but in Benishangul-Gumuz region at least, BoFED faces significant challenges related to lack of capacity, resources (time and money), management support, and integration with other bureaus.

Digital data management: There is often a lack of appropriate skills and awareness among key staff, so that they cannot make the most effective use of digital technology, even where it exists. For example, technical experts in the Benishangul-Gumuz BoWERMD who were carrying out a survey of water schemes in Assosa zone were expected by their manager to enter the collected data into Microsoft Excel. However, because they had never received any training in Excel, and had very limited experience in using it, they could not make the most effective use of the software. The data were safely entered, but in a format that prevented any statistical or graphical analysis of the data, or the export of data to GIS to create maps. This restricted the use to which the data could be put, and meant that anyone wishing to carry out further data analysis needed to spend extra time re-formatting the data. The difficulty was not just a lack of training and experience in the technical staff, but also by their managers, who were similarly unaware of the full potential of Excel, and more widely, of GIS.

Staff turnover: Information (whether reports or raw data) is often stored in individuals' offices, as hard copies on their shelves or as digital files on their computer hard drives, and when these people leave the organisation through retirement or moving on to another job, it is very easy for information to get lost. High staff turnover in government departments is a recognised problem in Ethiopia because of its consequences in terms of loss of essential skills. It also has major consequences in terms of loss of essential data.

Lack of incentives: Underlying poor data collection, analysis and data storage is the lack of incentives for institutes and staff to carry out these activities. The data are not necessarily used by those who carried out data collection, and reporting of the data is not seen to be linked to any activity or response. Two factors are important in Ethiopia to help incentivise data collection, storage and use: (1) the implementation of the new M&E strategy developed and approved for the WASH sector which gives a mandate for these data to be collected; and (2) developing methods that allow data to be directly and immediately useful for woreda staff in their ongoing work.

The WASH sector could learn lessons from the Bureau of Education, which has a formalised questionnaire which is filled in every year by the school, collated at woreda level and sent to the regional bureau, where it is entered into bespoke software. This type of approach, with clear lines of responsibility and a well defined methodology for data collection and storage, is a good one for the WASH sector to learn from.

3.4 Making maps

One of the key challenges to making and using maps, and the one that is most often quoted, is a lack of appropriate GIS skills. However, this is a wider problem than just a lack of GIS skills: it is about the capacity for spatial thinking, or the willingness and ability to begin to think about data in a spatial way. Therefore, in partnership with increasing technical and computer skills for using GIS, there should be increased exposure of WASH professionals to the benefits of mapping. This can then have an impact on the way WASH professionals handle data, for example in spreadsheets such as Microsoft Excel or in digital databases such as Microsoft Access. Spreadsheets can often be sufficient tools for data handling and for preparing and exporting data to GIS. The implementation of new M&E systems for the WASH sector is an opportunity for new robust and easy to use systems to be developed.

Lack of computing capacity: Although computers are becoming more common in government organisations, they are still not widely available to all staff even at regional level, and training in using even standard software packages, such as Microsoft Excel, let alone more specialist packages such as GIS, is rare. Technical experts in sector bureaus are therefore ill-equipped to carry out spatial analysis of their own data using GIS. However, it is wrong to simply assume that there is a general lack of GIS expertise. Even in Benishangul-Gumuz (a region that is by Ethiopian standards small and has few specialists) there were a number of officials in different departments that had previously undergone GIS training. In a focus group discussion, it emerged that problems with using these skills were related to planning and governance of the sectors. Participants identified the high turnover of staff and a lack of communication between BoFED and sector bureaus as obstacles towards effectively using mapping in the region.

Mapping being technically focused: In most cases in Ethiopia, therefore, GIS analysis is carried out by specialist units within government (such as GIS/RIS units in BoFED) or by private consultancies. This segregation of mapping activities means the users of maps are not involved in their design, and the data collectors are not involved in map making, with resulting mismatches and confusion. In many cases, there also appears to be little non-digital spatial analysis using existing paper maps. The reasons for this may be linked, as mentioned above, to a lack of awareness, incentive, leadership, skills, experience and funds. The fact that GIS training tends to be technical rather than problem-centred is one possible issue here.

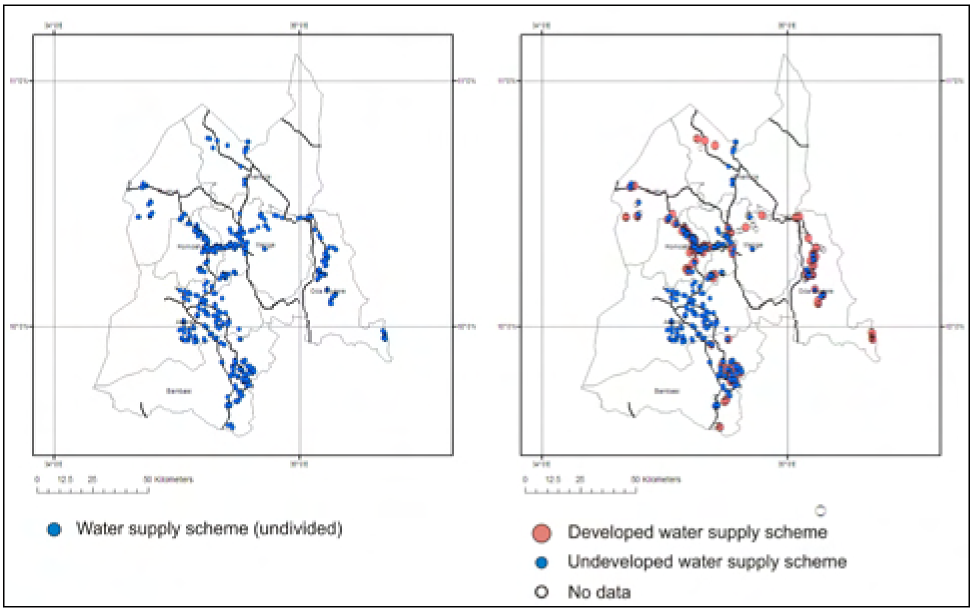
Experience in the RiPPLE programme indicated the importance of distinguishing between information generators, information interpreters, and different levels of users. When considering spatial thinking it is helpful to distinguish between those who collect the data (e.g. engineers locating water points in the field with GPS units); shallow users (e.g., those who can use an interpreted, thematic map); deep users (e.g. those who can add new data to a GIS and interpret it to create new thematic maps); and developers (e.g. those who design and set up spatial databases and GIS applications). In the Ethiopian WASH sector most stakeholders have the potential to be shallow users, able to use and understand maps effectively; and a significant minority have the potential to be skilled deep users who with some more practical training could become very effective at manipulating and adapting existing maps. The developer's role can be filled by a small number of skilled professionals, either within the WASH sector, or hired in as consultants. The key is for developers to be in close contact both with information generators and with all users.

3.5 Interpretation of data

This issue of communication between developers and users affects private consultancies and government analysts alike. However skilled the GIS analysts, they tend not to have an in-depth technical understanding of the data to be analysed, as they are not usually WASH specialists. The gap in communication between sector experts on the one hand and GIS-experts on the other, can lead to maps conveying a wrong picture, which may even result in flawed policy decisions.

For example, an NGO in Benishangul-Gumuz recently employed a private GIS consultancy to produce new maps of water schemes across Assosa Zone, and provided them with a database of information on water schemes in order to do this. The database contained data for both developed water schemes and for undeveloped (traditional), unprotected schemes, but a breakdown in communication between the NGO and the consultant meant that this essential information was not clear. As requested, the consultant produced a map showing the distribution of water schemes but with no distinction made between developed and undeveloped sources (Figure 3.2). The NGO assumed that the map showed the coverage by developed, safe water schemes, since this was the parameter they were most interested in, and they interpreted and used it accordingly.

Figure 3.2: Two maps of water schemes in Assosa Zone.



On the left are the water schemes as mapped by a GIS consultancy. On the right, the water schemes are differentiated into developed schemes and unprotected, undeveloped schemes.

During RiPPLE's research, this confusion was uncovered and a new map produced from the same dataset with clear distinction between developed and undeveloped water schemes (Figure 3.2). The picture is very different and shows that safe water coverage is significantly lower than is suggested by the original map. This new map is now being used by the NGO. In addition, after some training activities, NGO staff are now more able to act as 'deep users', which will help ensure that any future issues of this sort come to light more quickly (Ó Dochartaigh et al. 2007).

4 Seven steps to useful maps

Mapping has many benefits for WASH, and can play a crucial role in helping WASH services be more effective. Our mapping framework highlights the important role that maps have in turning raw data into information and knowledge. However, the discussion in the previous chapter of the challenges of undertaking mapping effectively in Ethiopia highlights the need for careful planning of mapping activities. Below we suggest seven steps to consider when planning mapping as part of a WASH programme.

1. Decide what you need to do and whether a map is the best tool for the job. If it is, decide on the specific purpose of the map. Is it for planning, advocacy, implementation, analysis or monitoring? Think of maps as a fundamental tool for evidence based interventions, and part of the process of translating data to information to knowledge. Maps should not be created as an end in themselves.

2. Carry out a careful analysis of what data will be required for the mapping and whether these data are available. Some data may be available, but hard to find (see MacDonald et al. 2005 for a detailed description of how to track down relevant data). Some data may not be available, but may be easier and cheap to collect using a GPS. Other data may require specialist surveys and significant funding to create.

3. Identify who will be involved in the production and use of the map. Who will be developing the map (often this will mean building the GIS); who will be deep users of the map (able to manipulate or add data to the map or GIS); who will be shallow users (able to use and interpret the data); and who will be collecting and generating the data on which the map will be used?

4. Collect data wisely. Good data underpins effective spatial analysis and mapping. Careful planning of data collection activities – e.g. water scheme surveys – will ensure the most useful data is collected. Spending time at the early stages of planning to consider what information is needed to carry out WASH activities, and the most effective (highest quality but reasonable cost) ways of obtaining and using this data helps to ensure success.

5. Facilitate communication between users, developers and data collectors. All should be clear on the purpose of map and their role in the process. Technically minded GIS experts should not be divorced from the end users, and the data collectors must be fully aware of the importance of collecting data in a way that will be of maximum benefit to the mapping process.

6. Build capacity at all levels for developing and using maps. A planner or senior decision maker in a sector bureau or NGO doesn't need to know technical details of mapping or GIS, but should be aware of the benefits of collecting, organising and using high quality spatial data and mapping techniques. Technical experts in water supply or sanitation would benefit from practical but not in-depth training in tools such as GPS and software packages such as Excel and GIS, to give them the skills to more effectively collect, store, interpret and display the information they need. A GIS developer needs extensive technical training and experience. S/he will also be helped if other spatial data and mapping users – e.g. technical experts and planners – have a better understanding of the scope and workings of GIS, so that they can better communicate what they need.

7. Manage the data. Once collected, data storage and management should make the best use of appropriate and available technology, including paper records, spreadsheet software (such as

Microsoft Excel) and database software (such as Microsoft Access) as well as GIS. Institutional homes for different data should be identified with clear responsibilities for who collects, stores and uses different data. Plans should be put in place on how to keep data up-to-date.

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