Multiple Use Water Services in Ghana
Scoping Study

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IRC

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Acronyms and Abbreviations

AfDB	African Development Bank
AGRA	Alliance for the Green Revolution in Africa
CapEx	Capital Expenditure
CapManEx	Capital Maintenance Expenditure
CBRDP	Community-Based Rural Development Project
COM	Community Ownership and Management
CONIWAS	Coalition of NGOs in Water and Sanitation
CWSA	Community Water and Sanitation Agency
FAO	Food and Agriculture Organization of the United Nations
GIDA	Ghana Irrigation Development Authority
GSOP	Ghana Social Opportunities Project
GWCL	Ghana Water Company Limited
IRC	International Water and Sanitation Centre
IWMI	International Water Management Institute
lpcd	Litres per capita per day
KNUST	Kwame Nkrumah University of Science and Technology
MASSMUS	Mapping Systems and Services for Multiple Uses of Water Services
MLGRD	Ministry of Local Government and Rural Development
MMDA	Metropolitan, Municipal and District Assemblies
MoFA	Ministry of Food and Agriculture
MWRWH	Ministry of Water Resources, Works and Housing
MUS	Multiple use services
NGO	Non-Governmental Organisation
OpEx	Operation and Maintenance Expenditure
RCN Ghana	Resource Centre Network of Ghana,
WRC	Water Resources Commission
WSDB	Water and Sanitation Development Board

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Executive Summary

This scoping study offers implementable recommendations to the Rockefeller Foundation for investment opportunities in multiple use water services in Ghana. The report is based on an assessment of existing MUS modalities and innovations, potential for implementation and possible barriers. The report is based on a comprehensive review of the literature from the irrigation and domestic water supply sectors, database queries and interviews with sector specialists.

MUS as *de facto* practice

The study shows that MUS is a *de facto* practice both in formal domestic and irrigation service delivery, complemented by self-supply initiatives.

In the northern belt, around half of all rural users use point sources for domestic and productive purposes. Similarly, some 50% of these people have other informal sources to complement formal supplies. Altogether, these sources provide them with what can be called a basic MUS level of service near to or at homesteads. However, there are inequities, as it is mainly people living closer to water points who can use these systems for production. In the Southern Region, formal supplies are mainly used for domestic purposes and only then to a limited extent. People in these communities often have additional sources to complement their domestic needs, in part because formal supplies underperform. Only some 20% of villagers use formal water points productively.

In small towns and cities, overall service levels are a bit higher, in part because some 20% of the people here have household connections. In small towns, service levels are equivalent to basic or intermediate MUS, even though only 30% of the population is engaged in productive activities such as small-scale commercial and industrial uses. The higher consumption can also be explained by a higher level of domestic uses. Self-supply plays a less important role as a complementary source of water in these small towns.

An emerging modality is comprised of limited mechanical schemes. These are typically boreholes with motorised pumps, an overhead tank and a distribution system with a few public standpipes, usually without household connections. This modality has the potential to offer higher service levels compared to rural point sources and provide the equivalent of basic to intermediate MUS.

The few public irrigation schemes in the country are reported to be underperforming, with current irrigated area well below the potential. There are no detailed assessments of water use and management in these schemes, let alone of multiple use practices, although it can be expected that multiple use is a *de facto* practice.

Small reservoirs, on the other hand, have been studied in much detail. Originally developed for livestock and domestic use, then rehabilitated with irrigation in mind, they are *de facto* multiple use facilities. However, this is not always reflected in the infrastructure: facilities for improved access for domestic uses, for cattle or for brick making are often lacking. Likewise, multiple uses of water are not reflected in most formal management arrangements such as Water User Associations.

Apart from self-supply for domestic uses, there are two other important self-supply modalities. Private irrigation development is the first. Over the past years there has been a rapid growth in the acreage under irrigation developed by individual farmers using technologies such as shallow wells and river pumping. The second is the reuse of wastewater or low quality water in peri-urban areas for informal irrigation, best characterised as indirect and unplanned reuse.

Bottom-up integrated planning of water services development at the local level is a limited practice. Only in integrated rural development projects is this happening, and even then single-use interventions are included.

Moving towards a planned and structured MUS approach

Moving from *de facto* multiple use practices to a more planned and structured MUS approach can be done from various entry-points. Based on existing practices, this study identified the following potential:

There are three ***domestic-plus modalities*** centred on rural point sources, in limited mechanical schemes, and in small towns. These have a high potential in terms of the number of people to be reached, with a combined total of ***3.8 million people*** in the northern belt. However, there would be a relatively small impact per person in terms of improved livelihoods, as people would only have access to basic to intermediate levels of MUS. The domestic-plus modality is relatively low risk, with total investment costs of *30-60 USD/capita*, known technologies and institutional frameworks.

The scaling pathway would be from within the domestic water supply sector, particularly the Community Water and Sanitation Agency (CWSA) as the lead government agency, where there is willingness to move towards higher levels of service, and in which multiple uses can be accommodated. These modalities can also link with the current boom in investment in water supply and could be complemented by promotion of self-supply along with domestic systems – a modality that as a stand-alone initiative would not be feasible in the short term. The recommended role of the Rockefeller Foundation is one of supporting innovation, and the documentation and sharing of knowledge through existing networks.

Among the ***irrigation-plus modalities***, the inclusion of MUS in the rehabilitation of public irrigation schemes needs to be assessed in more detail, as there is a near complete absence of information on these public irrigation systems. In fact, such a study would be a first investment opportunity. However, a first estimate shows that the maximum number of beneficiaries would not surpass *55,000* people, probably at modest per capita incremental investment costs.

There is more information on the potential for rehabilitation of small reservoirs. The potential target beneficiaries would be ***1.25 million people***, but with the potential of higher impact per capita. The condition for realizing this impact is that irrigation development effectively takes place and is sustained. However, this modality presents many risks, as can be seen in the current levels of under-performance and poor sustainability of dams. As there are relatively large investments planned in this sector anyway, Rockefeller Foundation could decide to top up these investments and strengthen planning approaches with a view towards a more participatory approach that takes account of multiple uses. Incremental investment costs would start somewhere between *30-60 USD/capita*. Both modalities would best be implemented through consortia with GIDA and its donors, although there is room for NGO involvement as well.

Bottom-up integrated water resources planning has low potential in the short term to reach scale. Although the total number of beneficiaries is ***1.5-1.8 million people***, it would rely heavily on the capacity of local government and others for effective participatory planning, a capacity which is limited at the moment, and not backed up by a policy mandate. Only within the scope of specific projects could this modality be tested and developed, but even then the potential to reach scale will be limited. Elements of this modality can be included in the domestic-plus modalities and in the rehabilitation of small reservoirs.

Complementary self-supply can be supported, but a prerequisite is that institutional frameworks for self-supply be clarified. Although there is scope for this modality, it is not ready to be implemented yet. The Rockefeller Foundation could support a process towards the development of institutional frameworks for self-supply.

Self-supply for irrigation as a priority has high potential given the current growth of private irrigation, the potential for motorised pumping and the potential number of irrigators of 1.85 million. As this is largely driven by market forces, the scaling pathway would mainly consist of strengthening market supply chains and training. Rockefeller Foundation's role could be one of supporting the development of market mechanisms and supply chains.

Promoting peri-urban agriculture through improved ***reuse of wastewater*** (and other low quality open water sources) represents a complex intervention with unclear impacts. The total number of direct beneficiaries is small at ***10, 000 farmers***, but with many indirect beneficiaries, including urban consumers and urban dwellers with poor access to sanitation and wastewater management services. The intervention would be complex, as it would require engagement in broader issues of urban sanitation and wastewater management. This is only an investment opportunity if there is interest in investing in the broader sphere of urban sanitation and wastewater management.

Based on risk assessments, this study concludes that domestic-plus, rehabilitation of small reservoirs and self-supply for irrigation present the best direct investment opportunities for maximum impact. The other modalities of rehabilitation of public surface irrigation schemes, complementary self-supply and local integrated water resources planning might become feasible opportunities over time, but they need more study. Promoting peri-urban agriculture through improved reuse of wastewater is only an investment opportunity of interest if the broader issue of sanitation and urban wastewater management is included.

1. What is MUS?

Multiple-Use water Services (MUS) is a participatory approach that takes the multiple domestic and productive needs of water users who take water from multiple sources as the starting point of planning, designing and delivering water services. The MUS approach encompasses both new infrastructure development and rehabilitation as well as governance.

MUS emerged in the early 2000s when professionals from the water sub-sectors, in particular the domestic water, hygiene and sanitation (WASH) sector, and the irrigation sector began to see the untapped potential of providing water beyond the confines of conventional single-use mandates (Moriarty *et al.*, 2004). Cross-sectoral action-research documented in more than 100 cases of MUS innovation in over 20 countries (www.musgroup,net; Van Koppen *et al.*, 2009), economic analysis (Renwick, 2007), and policy dialogue in national and international forums, such as the World Water Forums in Mexico (2006) and Istanbul (2009), have confirmed this potential (Figure 1). Focussing on where sub-sector interests overlap leads to single-use sectors better achieving their own mandates while generating additional benefits. MUS offers three main advantages compared to single-use water service delivery models: 1) more livelihoods improvements, 2) more environmental sustainability, and 3) strengthened integrated water resource management (IWRM).

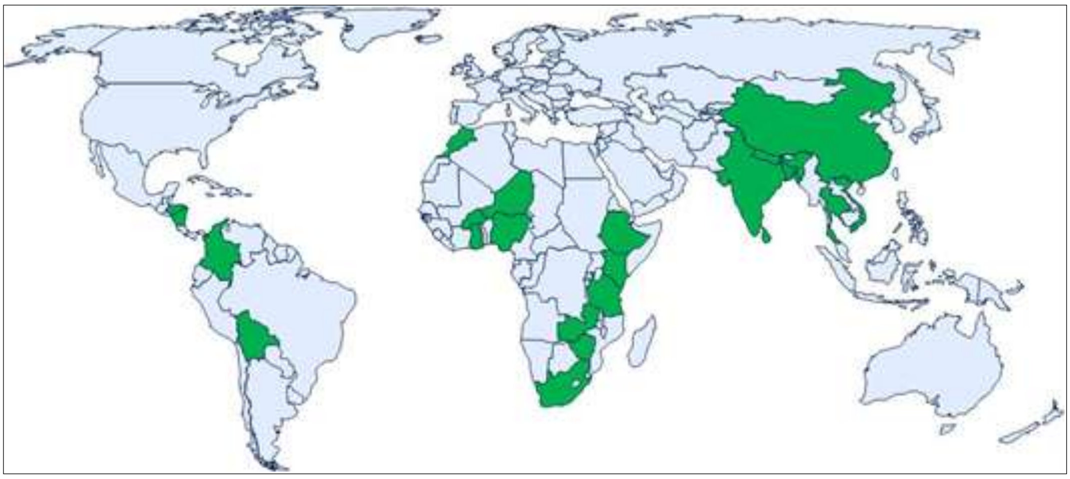

Figure 1: Countries where MUS has been applied

Livelihood returns

In terms of livelihood improvements, MUS concurrently improves health, food security, and income, and reduces women's and girls' drudgery, especially among the poor in rural and peri-urban areas where their multi-faceted, agriculture-based livelihoods depend in multiple ways on access to water. Livelihood benefits mutually reinforce each other. Thus, MUS gives "the most MDG per drop" (Renault 2008). Livelihood benefits tend to be more durable because participatory planning empowers communities to articulate their own priorities, thus enhancing ownership and willingness to pay for services. From the domestic sector perspective, adding income opportunities improves the ability to pay, hence, MUS unlocks new financing streams.

Livelihood returns from MUS investments are also more durable because they are holistic. People in many rural communities have practiced their own forms of 'integrated water resource development and management' for self-supply for many generations. Similarly, every water manager of a system designed for a single use has come to realize that people use a system for more than one purpose, planned or not. Prohibiting these other-than-planned *de facto* uses, for example by declaring such uses illegal, has typically been in vain. MUS turns the problem of unplanned uses into an opportunity to leverage investments, avoid infrastructure damage from unplanned use, and generate broader livelihood returns.

Environmental sustainability and justice

In terms of environmental sustainability and water efficiency, MUS recognizes that people use and re-use conjunctive water sources in ways that optimize, for them, the efficient development and management of rain, surface water, soil moisture, wetlands, and groundwater, and other related natural resources within their local environment. Even within the homestead, households can use up to nine different water sources, as found in Thailand (Penning de Vries and Ruaysoongnern 2010) Local knowledge and coping strategies for mitigating seasonal and annual climatic variability by combining multiple sources is at the heart of community resilience. Such efficiency and resilience will become ever more important as the impacts of climate change become more visible.

The MUS focus on the poor puts people and multiple uses at centre stage instead of casting allocation issues in terms of monolithic 'use sectors' that fail to differentiate between vested interests and multiple small-scale uses for basic livelihoods. Instead, MUS considers the distribution of water use by individuals, each with multiple water needs. Quantification of the distribution of water use is revealing. In rural South Africa, for example, 0.5 percent of users use 95 percent of the water resources. More than doubling current estimated water access by every rural user from 116 to 277 litres per capita per day would require the 0.5 percent large-scale users to share only six percent of their current water uses (Cullis and Van Koppen 2007). Focusing on the poor, MUS especially safeguards poor people's rights to water, food and livelihoods and their fair share of the resource in quantitative terms, and exposes poor people's greater vulnerability to unsafe water in qualitative terms.

A focus on community integrated water management

Last but not least, in opening up new livelihood and environmental opportunities, MUS recognizes that the natural intersection of multiple uses and multiple sources starts locally, at household and community level. MUS is bottom-up IWRM, starting with local users as clients and active participants instead of 'aid recipients'. MUS complements past IWRM efforts in two new ways. First, while IWRM tended to be a 'push' from the top-down (e.g. by establishing basin organizations), MUS is a 'pull' for integration from below, where human well being and water resources are integrated.

Second, past IWRM efforts tended to prioritize governance over infrastructure development. The 's' in MUS stands for "services" in the sense of reliably ensuring the availability of water in certain quantities and qualities, at certain times, and at a certain sites, during the full project cycle and after the construction phase. Services result from the appropriate balance between sustainable infrastructure investments and water governance. Infrastructure investments to harvest and store water in the rainy season for use in the dry season increase the pie of available water resources for all. This win-win solution reduces competition for water in open basins where there are still uncommitted water resources available for development. Yet, in many IWRM debates that focused on sharing an inevitably limited pie, this solution tended to be ignored. Obviously, infrastructure development is a precondition to improve access to and control over water for the 'have-nots', even if that implies that the 'haves' need to save water when basins are closing.

Key questions

In the light of these untapped livelihood, resource and integration opportunities, the key question is: How can scaling up be accelerated? The question has two sides: first, what are the barriers and constraints that currently limit the scaling up of MUS and what is their comparative importance? (e.g., financing, governance, policy, awareness, implementation capacity); and, second, what are the opportunities for scaling up MUS modalities in terms of scaling pathways, overcoming challenges, and potential key partner institutions? These are the questions the Rockefeller Foundation posed to the International Water Management Institute (IWMI), in collaboration with the International Water and Sanitation Centre (IRC).

Geographic focus

The geographic focus of the scoping study is five countries where IWMI and IRC see strong potential for scaling up MUS modalities: India and Nepal in Asia, and Ethiopia, Ghana, and Tanzania in Africa (linked to the Alliance for a Green Revolution in Africa). The answers to these questions are presented in five stand-alone country reports and one synthesis report. The present country report discusses the findings in Ghana.

The research objective and questions are elaborated next. This is followed by an analysis of empirical MUS related research in Africa and South Asia with the aim to further conceptualize scaling up of MUS for investigation in the five countries and to enable a structured synthesis of the results. The section on theory of change discusses four MUS modalities and related scaling pathways, i.e. "what" can be scaled up. The chapter concludes with a section on the practice of change, i.e. "how" MUS has been scaled in the past, and can continue to be scaled up through networking.

Study objective and questions

Objective

The objective of this study is to conduct country-specific research on the barriers that limit the scaling up of a multiple use services modalities to water management, the comparative importance of these barriers, and possibilities for overcoming these challenges for poor and vulnerable people in South Asia and Africa.

Research questions

- What are the different MUS modalities that have emerged, and how are they related to specific scaling pathways?
- What are the most important barriers limiting greater adoption of these modalities?
- What specifically could be done to overcome these barriers?
- What specific organizations are well placed to overcome these barriers?
- What geographic conditions would be most suitable for scaling up each kind of MUS model?

- What kinds of policy incentives are needed in each case?
- What kind of capacities and skills need to be built?
- What kind of information dissemination and engagement/partnership building needs to occur?
- What is the optimal sequencing of interventions needed to enable broader scaling up?

Theory of change: MUS modalities and scaling pathways

We define scaling up MUS as: better institutionalization of more robust MUS modalities and achieving a wider geographic spread. For people in rural and peri-urban communities, multiple uses from multiple sources is already a wide spread practice. The holistic development and management of multiple sources for multiple uses continues, both as multiple uses of systems designed for a single-use, and also as self-supply, whereby users themselves invest in the development and management of water sources for multiple purposes. These practices are often informal, sometimes without formal institutions even knowing about them. For people in many communities, the notion of "MUS" is an articulation of what they do every day.

Scaling up MUS is primarily a matter of institutional transformation of water services delivery by government agencies, NGOs, financing agencies and donors, who conventionally structure their respective policies and water development programs into isolated and vertical sub-sectors (Van Koppen *et al.* 2009). Each sub-sector focuses on and budgets for the development of services for a single use, which is the sector mandate. This is often accompanied by pre-determined technologies and related management structures. Sub-sectors structure their accountability to tax payers and other financers by justifying their budget allocations according to their performance on a single livelihood dimension such as improved health through safe water for domestic uses, or improved health through nutrition, or food security, or income. Formal professional training in colleges and universities is structured along similar lines. This compartmentalization, with vested professional interests, is the main reason for single-use services, and, hence, the main barrier that MUS proponents have sought to overcome.

The 'theory of change' adopted by most MUS proponents was to gradually channel existing institutions and financing streams towards MUS as a win-win strategy to better meet sector mandates while generating additional benefits. Accordingly, MUS proponents started addressing sectoral divides in essentially four ways or four "MUS modalities" as shown in Table 1. This gradual channelling allows for leveraging of existing human, technical, institutional and financial resources.

The following description of the four MUS modalities is the 'ideal-typical' case. The precise content, relevance, current robustness and scaling potential greatly differ by country. Differences among and between modalities are a function of the entry point. They are not mutually exclusive but overlap and mutually support each other. Each modality contributes knowledge and resources to the common pool, which renders the whole more than the sum of the components. Ultimately, for example, the community-based MUS modality, in which community members articulate and negotiate the public water services they prioritize, would encompass all other three.

Table 1: MUS modalities

MUS modality	Priority setting	Implicit priority use and site	Primary investors in infrastructure and funding earmarks	Primary scaling partners
Domestic-plus	WASH –sector, including local government, line agencies and NGOs	Domestic, near homesteads	Sub-sector, funding earmarked for domestic and some other uses, specific service levels, and often to a limited set of technologies; co-investments by users	WASH sector, with support for productive uses; sector working groups, and research centres, in learning networks
Productive-plus	Agricultural line agencies (irrigation, fish, livestock, trees), NGOs	The single productive use of the line agency, siting where appropriate	Sub-sector, funding earmarked for specific productive and some other uses; often a limited set of technologies; co-investments by users	Agricultural line agencies and NGOs, with support for drinking water quality and other domestic needs; sector working groups, and research centres, in learning networks
Self-supply MUS	Users	Multiple uses, siting where appropriate	Users, limited by available technology choice	NGOs and private sector for technology supply, with support for drinking water quality, other domestic uses, productive uses and government support for market support, regulation; sector working groups, and research centres, in learning networks
Community-based MUS	Users	Multiple uses, siting where appropriate	Government or NGOs, with less earmarking of funds or with convergence; co-investments by users	Local government, with support of NGOs and line agencies; multiple sector working groups, and research centres, in learning networks

Domestic- and productive-plus modalities

The first two modalities are known as domestic-plus and productive-plus. Those who pursue these modalities work to scale up from within their own water sub-sector by widening the scope of public investments for their mandated single use to encompass other uses. Sub-sectors often subsidize capital investments in infrastructure, while communities are usually responsible for operation and maintenance. In +plus modalities, the implicit priority for either water for domestic uses near homesteads or crops in fields (or fisheries, or livestock watering) continues to be set by sub-sector professionals, not local users. Planning and budgeting from the top-down and a narrow range of options continues to be the norm. Planning remains 'formal' in the sense of strong involvement of government and public donors and NGOs closely collaborating with government.

However, in the +plus modalities, the sub-sectors open up their mandate. This tends to happen in a step-wise fashion. The subsequent steps from single-use to multiple-use progress from: ignoring or denying non-planned uses or declaring illegal to: turning a blind eye on these uses ("not my job") to: implementing marginal practices on the ground to accommodate multiple uses to: accommodating *de facto* multiple uses at management level to: fully integrating multiple uses from multiple sources in planning, design and use (Renault 2010). Especially in the WASH and irrigation sub-sectors, these +plus modalities have developed into fairly robust scaling models.

These steps were supported by valuation studies that identified the range of *de facto* uses and calculated the returns (Meinzen-Dick, 1997; Bakker *et al.*, 1999; Renwick 2001). In +plus approaches, the water sub-sectors are investors interested in all returns on their investments, instead of investors who may go so far as to criminalize livelihood returns only because they were not planned.

A strong argument in favour of +plus modalities is that relatively small incremental investment costs generate major livelihood benefits and avoid damage caused by unplanned uses. The benefit-cost ratio of these incremental investments is high, as confirmed by the in-depth financial evaluation of both domestic-plus and irrigation-plus scenarios conducted by Renwick (2007).

The domestic-plus modality builds on the water services ladder. While the WASH sector assumes that water quantities at higher service levels are still primarily, if not exclusively used for domestic uses, empirical research confirms that poor rural and peri-urban users in agrarian societies use and re-use water for livestock and other productive uses well below even basic service levels (see Figure 2). Similarly, studies have shown how higher service levels in terms of quantities, nearby availability and reliability lead to more productive uses. Hence, domestic-plus consists of providing higher levels of service, roughly doubling or tripling current supplies.

As domestic-plus modalities maintain a priority for meeting people's domestic and sanitation needs near to or at homesteads or residential areas, productive uses also tend to concentrate there. This site is especially relevant for women, who tend to have a stronger say over income from productive activities around their homes than from distant household production. Further, for the land-poor, sick and elderly, the homestead may be the only place where they are able to use water productively. Thus, the relatively small incremental improvements to domestic water supply systems result in relatively high benefits from small-scale productive uses, principally backyard gardening, livestock and home-based industries. Renwick (2007) calculated that intermediate MUS service levels of MUS at 50 to 100 litres per capita per day generate income which allows repayment of the infrastructure investment and operational costs within 6 months to 3 years.

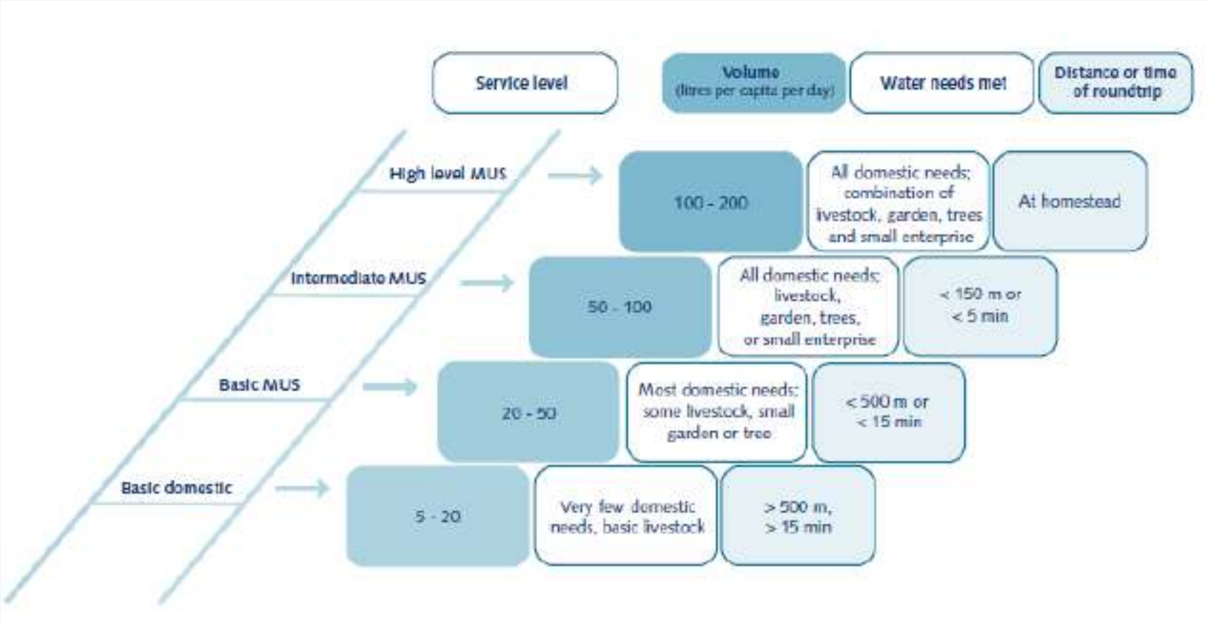

Figure 2: The domestic-plus water ladder (Renwick, 2007; Van Koppen *et al.*, 2009)

At any step on this service ladder, at least 3-5 liters per capita per day should be safe for drinking and cooking. This quantity of safe water is important for domestic water supplies, and for the many situations in which people drink water from other sources. Higher quantities of water of lesser quality for personal hygiene and sanitation are equally important for health (Van der Hoek *et al.* 2002). Scaling up domestic-plus happens mostly via the WASH sector, increasingly in collaboration with local governments.

The **irrigation-plus modality** most frequently applied in India, Vietnam, and China, is the FAO Mapping Systems and Services for Multiple Uses (MASSMUS) methodology for the modernization of large-scale irrigation systems. Relatively small incremental improvements are added on to existing irrigation infrastructure, which mostly improve access to surface water (cattle entry points, washing steps, small diversions for laundry, bridges, roads, etc.). Conjunctive use of seepage for groundwater recharge for irrigation and domestic uses are considered in planning for lining canals or not. In areas where canal water is the main source of water, water is supplied year-round and reservoirs are filled for residential areas. MASSMUS has specific domestic water and gender modules. MASSMUS makes many recommendations that can be applied to small-scale schemes as well, but they have not been systematized into a robust MUS modality as yet.

Other productive-plus modalities

The fisheries sector also conducted research on the better integration of fish and other products into water bodies, e.g. dams or irrigated fields as a 'productive-productive' approach (Nguyen-Khoa *et al.*, 2005). Ancient and modern small village reservoirs have been operated and studied from various productive and domestic entry points, including irrigation, fisheries, forestry, livestock and domestic uses (Palanisami and Meinzen-Dick, 2001; Venot *et al.*, 2011). Documentation and implementation of these productive-productive and productive-domestic approaches is still fragmentary. With more consolidated effort and coordination they could well crystallize into robust MUS modalities.

Scaling up irrigation-plus and other productive-plus modalities is largely through technical line agencies and NGOs. Line agency collaboration with local government tends to be underdeveloped.

User-driven MUS

In the user-driven and community-based modality, water users define the water systems they need for their multiple uses. Government agencies and NGOs avoid setting a priority for any water use, or a specific technology. These approaches are more recent and most are still being piloted.

"Self-supply for multiple uses" is the one user-driven MUS modality. Here, users themselves invest in most infrastructure capital costs, often on an individual or household basis, although some communal arrangements may be included. Examples are self-financed wells, pumps, water harvesting techniques, gravity flows, drilling options, and water quality point-of-use treatment devices. Users decide about the purchase, installation and uses, which are often multiple. Scaling up self-supply is largely through market-led supply chains which are often highly effective and sustainable. Public sector support can focus on things like technological innovation, market development for supply chains, credit for purchase, and awareness raising.

The second user-driven MUS modality is **"community-based MUS"**. In this modality, government or NGOs fund the bulk of mainly communal infrastructure construction or rehabilitation costs, but the choice of the technology, siting, and lay-out is in the hands of the community. Community members, including women and marginalized groups, are empowered to articulate their needs and demands, access information, and make choices regarding their assets and resources. This MUS modality applies the general principles of community-based natural resource management (CBNRM) to water resources. (Water sub-sectors divides probably contributed to the delay in adopting community-based management compared to land or forestry resources for example). Community-based MUS can be implemented on a project basis or align with the global trend toward decentralization of decision-making of public support through local government, or as a combination of both. An example of the latter is the SADC/Danida supported IWRM Demonstration Projects in five SADC countries (SADC/Danida 2009a and 2009b).

Integration in local government is important because local government agencies are permanent institutions, which not only provide a potential solution for financial and institutional sustainability of communal water systems, but also offer considerable scope for nation-wide scaling. Decentralized decision-making through local government about the allocation of public resources can lead to community-based MUS without any explicit intention, but as a result of a community's own prioritization for improving the use of multiple sources for multiple uses. This is the case, for example, in India's Mahatma Ghandi National Rural Employment Guarantee Scheme (MG-NREGA), as elaborated in the India country study.

In scaling through local government or through programs interacting more directly with communities, the major challenge is to match bottom-up needs with top-down state and other funds. Institutional support should facilitate participatory planning, ensure inclusion of women and marginalized peoples, and build capacity for making informed choices to articulate long lists of community needs into priority-ranked, time- and budget-bound undertakings, or small 'bankable projects'. These projects are meant to be matched with available top-down financing streams. This can be achieved either by loosening some of the strings on financing and removing or modifying single-use and single-livelihood constraints, or by converging parallel financing streams and pooling them into one project.

In community-based MUS, communities plan and solicit external support based on their overview of all multiple uses and multiple sources for their livelihoods. At this level they can tap efficiencies of developing infrastructure for multiple uses and combining and managing multiple conjunctive sources, which saves funds. Also, communities can negotiate their water needs *vis-à-vis* the needs of other users in the same watershed and at higher levels. Inter-basin transfers may also warrant negotiation. They can formally voice their concerns through local government agencies, up to watershed, district and higher levels as the issue at stake requires, without depending on the top-down establishment of new governance layers like watershed and basin organizations where the more vocal social groups tend to dominate. In this way, community-based MUS is the lowest appropriate level for pro-poor IWRM.

The practice of change: MUS networking

The 'theory of change' of scaling via one of the four modalities or a combination thereof is one side of the coin. The other side is the 'practice of change'. In the past, MUS innovation and scaling was primarily the result of the effective crafting of networks of MUS proponents from local to global level into communities of practice or learning alliances, primarily through the global MUS Group (see www.musgroup.net). A 'right mix' provides for well-informed and rigorous evidence-based innovation, in which next generic lessons and local specificities are continuously identified. The same network also ensured continuous dissemination and advocacy of this evolving body of knowledge. Such a network also brought the 'right mix of people' together, encompassing water users organizations and professionals from the different sub-sectors; academics, policy makers, and implementers; experts at the lowest local level up to national and global levels; donors and financing agencies and government officials. This scoping study also analyses such past innovation and networking and recommends partners for future networking to implement the high-potential MUS scaling pathways.

2. Geographic focus: Ghana

This report covers the findings of the study in Ghana. Ghana was selected as a scoping study country because it is a focus country of AGRA (Alliance for a Green Revolution in Africa), an initiative also supported by the Rockefeller Foundation. Besides, it is a country where multiple use practices were thought to have emerged, particularly in the dry Northern part of the country, also the focus region of AGRA.

Ghana has a total land area of 239,460 km^2, most of which is relatively flat and dominated by the Volta River catchment (Figure 3). The country can be roughly divided into three climatic and vegetation zones. The Southern Coastal Region is hot and humid, but with a modest rainfall of some 800 mm/year. This is a savannah zone.

The middle region is a tropical rainforest zone with high rainfall. The northern belt becomes successively drier, the further north one goes. Rainforest makes place for deciduous forest and savannah.

Figure 3: Regions of Ghana.
Source: Wikipedia

The 2008 population was recorded as 23.4 million with an average annual growth rate of 2.2% between 2002 and 2008 (World Bank, 2009). Most of the population is found in the coastal and middle region where most cities and towns are found, and where infrastructure is relatively well-developed. Population density is much lower in the North.

After independence in 1957, Ghana experienced a turbulent start as an independent state, with a series of irregular transfers of executive power. However, with the 1992 Fourth Republican Constitution and the return to constitutional rule in 1993, the country has settled into more stable development, marked by four peaceful elections. Amongst others, the constitution has also provided a framework for decentralisation.

There are currently (2011) 170 Metropolitan, Municipal and District Assemblies (MMDAs). Each Assembly has a Chief Executive, who is appointed by the President and has to be approved by at least two-thirds of the members of the Assembly. In addition the country is divided into ten administrative regions which serve as a level for providing planning and support from deconcentrated government agencies – including domestic water, irrigation and agriculture.

The result of the political stability is a country which out-strips most of its regional neighbours in economic growth rates and human development index (UNDP, 2009). In 2008 Ghana recorded its highest economic growth rate of 7.3%, which subsequently dipped to 4.7% in 2009 only to rise to an estimate of above 10% in 2011. Ghana had a GDP of 1,480 USD/person (ppp) in 2009 (World Bank 2010). Subsistence agriculture accounts for 35% of GDP and employs 55% of the work force, mainly small landholders. Commercial crops such as cocoa are a key part of this.

Poverty rates have been dropping from 51.7% of the population in 1991/2 to 39.5% in 1998/99 and further to 28.5% in 2005/6 (GSS 2007). This decline has led to a reduction of the absolute numbers of poor from around 7.9 million in 1991/92 to 6.2 million in 2005/6[1] despite population growth of approximately 8.4 million in the same period. The percentage of rural population living below the poverty line has decreased from 64% to 39% over the same period. Nevertheless, there is a marked South-North poverty gradient – with, with the North being significantly poorer than the South.

As the Government's budget (revenue and expenditure) for the period 2004 to 2008 has gone up, its dependence on ODA has reduced, but not equally in all sectors. Both the water supply and irrigation sectors remain heavily donor dependent.

Methodology

The report is based on data that were collected through the following means:

Interviews with key informants. For each of the pre-identified models, key stakeholders were defined, and in-depth interviews with them were held. The list of interviewees and their contact details can be found in Annex A.

Review of (grey) literature. Even though Ghana has some experience with MUS in the past, documentation of these experiences is extremely limited. That is, few documents frame their analysis in terms of multiple use of water, although they definitely deal with the topic. Exceptions to this include the work by TREND (2006) and Adu-Wusu (2008) and Venot *et al.* (2011). Relatively more resources were available on domestic supplies and the reuse of wastewater and small reservoirs. We have re-analysed those through a MUS framework. Relevant documents are listed in the reference list and duly referred to in the text.

Review of statistical information. Various datasets were reviewed to draw on quantitative information, particularly for service levels. The WASHCost project has developed a dataset on service levels and costs in rural and small town areas in three districts from the three main climatic zones: Ketu South in the Volta Region (coastal strip), Bosomtwe in the Ashanti Region in the middle region and Gonja East in the drier northern belt. Much of this is captured in Moriarty *et al.*, 2011. But for the purpose of this study additional queries were made to this dataset.

[1] This is based on an upper poverty line of GH¢370.9 per annum

Structure of the report

The findings first present the extent to which MUS is included in formal service delivery, as it shows the extent to which these formal service delivery models already consider water for multiple uses. This is followed by MUS in informal water management modalities, discussing the extent to which users complement the formal service delivery models, or develop their own multiple sources for multiples uses. These are then used to identify potential and barriers for different MUS initiatives. Finally, conclusions and recommendations for investment opportunities are provided.

3. Multiple use of water in formal service delivery models

A first step in assessing potential MUS models was a review of the various formal service delivery models in Ghana and the extent to which these formally cater for multiple uses. This is considered necessary to assess how these could eventually become entry points for MUS. Formal service delivery models are assessed for domestic and irrigation services as well as for water resources development and management more broadly. What is 'formal' and 'informal' is broadly defined according to the stronger (formal) or lesser (informal) role of the government or NGOs collaborating with government in infrastructure investments and management. Specific differences in each sub-sector will be detailed in the respective sections.

Water resources development and management

Ghana's total actual renewable water resources are estimated to be 53.2 billion cubic meters per year, equivalent to availability per capita of about 2,500 cubic meters per year. Of this total, actual water withdrawals constitute only about 1.8% of total renewable water resources (Namara *et al.*, 2010), reflecting the limited level of water resources development in the country. There is a strong North/South rainfall gradient, with most major water infrastructure located in the south and southwest. According to the Africa Infrastructure Country Diagnosis, Ghana by African standards has quite extensive water resource infrastructure and some pockets of irrigation (AICD, 2010).

At the level of basins, multi-purpose infrastructure is a common feature. In fact, many of the interviewees understand MUS to refer to large-scale multi-purpose infrastructure, such as reservoirs and dams that serve hydropower, formal and commercial irrigation and sources for urban water supply. In this study we focus mainly on MUS at the lower levels of scale of villages and households.

The Water Resources Commission (WRC), which is responsible for integrated water resources development and management, has so far focused mainly at the higher levels of scale of basins, dealing with issues of transboundary river basin management and multi-purpose infrastructure. Local level water resources development has not been on its agenda. Attempts to decentralise move ahead slowly as regional basin officers have now been appointed for two sub-basins only. Although districts are represented at this level, it is not likely that the kind of local level planning needed for MUS will transpire in the short term under this kind of human resources capacity and institutional arrangement.

Domestic water supply

Ghana's domestic water supply sub-sector is led by the Ministry of Water Resources Works and Housing (MWRWH) as the main government body responsible for the formulation of policies and strategies for the water sector as well as resource mobilization, co-ordination of budgets, monitoring and evaluation and facilitating inter-sectoral and sub-sector coordination. Its Water Directorate was established in 2004 as a division within the MWRWH to coordinate, monitor and evaluate all the activities of key sector institutions operating under the auspices of MWRWH.

The sector follows a number of relatively well-defined service delivery models, defined as an agreed description of a type or level of service, the system providing the service, and the management model including the functions and legal instruments necessary for the model to function (based on Lockwood and Smits, 2011). These are differentiated for rural areas, small towns and big cities, each with their own target service levels and institutional arrangements. A detailed overview of these is provided by IRC and Aguaconsult (2011) and by Adank *et al.* (2011 forthcoming). There are four broad groups of service delivery models. These are:

- Community management models, as the main model for rural areas and small towns;
- The utility model, applied in urban areas;
- Small-scale private models, also present in urban areas, particularly the peri-urban fringes, but these are not formally recognised; and
- Self-supply, which is not a formally recognised model although it is present both in rural and urban areas.

The community management and utility models can be described as the 'formal' or 'officially recognised' models. The community management model serves an estimated 34% of the population with water supply, whereas the utility model serves 32%. Another 14% follows other service delivery models, whereas an estimated 20% of the population remains unserved (IRC and Aguaconsult, 2011). For these two models, the institutional arrangements and typical service levels are presented, and based on an assessment made of their potential for MUS. Small-scale providers are included in the section on utilities. Self-supply, as an informal model, is elaborated in the next section. Unless indicated otherwise, this information is drawn from IRC and Aguaconsult (2011).

Community management models

The national norm for rural water supplies is the Community Ownership and Management (COM) model, and is applied as such in the National Community Water and Sanitation Programme. COM is based on communities forming community-based management committees or boards to oversee the operation, maintenance and management of the water service. However, within this model the Metropolitan, Municipal and District Assemblies (MMDA) retain formal ownership of assets. New systems are implemented by the Community Water and Sanitation Agency (CWSA) in collaboration with the MMDA, although funding typically comes from donors.

Two variations of the COM model can be identified in the Community Water and Sanitation Agency (CWSA) guidelines (2010), namely Small Towns Water supply and Small Communities Water Supply. NGOs follow a similar modality although in the details of the standards of service levels they may deviate from the formal CWSA model. NGOs represent an estimated 10-20% of turn-over in the sector.

Small town water supply serves settlements with a population range of 2,000 to 50,000, and generally takes place through small town piped schemes with mechanised boreholes, surface water treatment or protected springs. The service level is either basic point-source or (in about 20% of cases) household connections. Systems are managed by a Water and Sanitation Development Board (WSDB). The WSDB and its technical staff operate and maintain the water supply system and carry out the administration. The employees are paid by the WSDB through revenue generated from the operation of the system. Nkrumah *et al.*

(2011) show that there are wide variations of capital expenditure per capita for the small town and rural piped schemes in three regions of the country, with quartile ranges of between USD 30-95, with a median of some USD59/capita. The most expensive schemes are in the lower population density areas because of the lower possibility to achieve economies of scale.

Small Community Water Supply serves communities with populations between 75 and 2,000 (CWSA 2010) and generally takes place through point sources (boreholes and hand dug wells with manually operated pumps). In these communities, WATSAN Committees are the norm as the main management model. Typical capital costs are USD30/capita. Communities are expected to pay for operation and maintenance expenditure (OpEx), and mostly do so on an *ad hoc* basis, i.e. they contribute funds whenever there is need for a repair, but do not have established tariffs or saving mechanisms. Arrangements for capital maintenance expenditure (CapManEx) are poorly defined, and in reality are either taken up by CWSA or not at all, leading to a high level of non-functional boreholes of around 30% (IRC and Aguaconsult, 2011).

Within small community water supply, limited mechanical schemes form an emerging model. These are systems applied in villages making the transition from rural to small town with populations of around 1,000 inhabitants. It consists of replacing hand pumps on boreholes by motorised pumps, and then adding a small distribution system consisting of a polyethylene tank with a few standpipes. This is done mainly on high yielding boreholes. In terms of management, these schemes still follow the rural model of WATSAN committees. So far, a total of some 90 schemes have been developed. As they tend to build on prior investments in rural point sources, data exist only on incremental costs, which are estimated to be around USD4-5/capita.

Under COM, implementation is supposed to be the responsibility of the MMDAs, supported by CWSA. However, as most funding comes from CWSA, they play the major role in implementation of new systems and rehabilitation works. It is also the responsibility of MMDAs (as owner of assets) to provide support services to the community management body in the form of both managerial and technical backstopping. Support services include trained area mechanics and the establishment of spare parts networks. According to the CWSA Sector Guidelines (CWSA 2010), the CWSA acts as the facilitator and regulator, providing guidelines and setting standards, and providing back-up professional support to MMDAs. In practice, however, the direct support role to the community is often fulfilled by or shared with CWSA. This form of post-construction support mainly serves point sources rather than small town systems. However, recent research shows that the budgets are so low that effective support is limited (Nyarko *et al.*, 2011).

Service levels and their potential for multiple-use

CWSA, in a sector investment study, (MAPLE Consult/WSMP - 2010), reported a coverage rate in improved water supply of 57% in rural areas (including small towns). However, according to a 2008 Demographic and Health Survey (GSS, GHS, and ICF Macro, 2009), the percentage of the rural population with sustainable access to an improved water sources was 76.6%[2]. This difference is related to how coverage is calculated.

The basic service levels for rural point source systems has been clearly defined in the CWSA guidelines and consist of the provision of 20 lpcd through an improved water source within 500 meters, and with certain criteria of reliable water quality and crowding[3] (see Moriarty *et al.*, 2011). Therefore, it falls in the category of *basic domestic* according to the MUS ladder developed by Renwick *et al.* (2007) and Van Koppen *et al.* (2009). In small towns, the same design norm is applied, but in practice in newer small-towns the per-capita availability is well above this as they are normally designed by taking 10 years population growth in into account. In small towns the option also exists to provide an equivalent of 60 lpcd for those households which have household connections (Moriarty *et al.* 2010). This would reflect a level at which a basic to intermediate level of MUS can take place. In the limited mechanical schemes, there are no defined service levels yet, but because of high yielding boreholes, such schemes may provide similar service levels as in small towns.

The CWSA regulations do not limit water to domestic uses only. In fact, in their design calculations they take into account that an estimated 20% of the users will use water for commercial use. In fact, the interviews with senior staff of CWSA show that they are supportive of people using water for these uses, as long as they pay their water tariffs.
As the design norms are so clearly defined, there is little room for participation of communities in planning and decision-making on the water supply services. The type of technology is largely pre-defined by the population size, as are the service levels.

Actual service levels are different from these theoretical levels. A survey among users of point sources in the rural areas of three districts in different regions of the country found that even though 96% of people in the communities had access to some level of improved water service, only 23% accessed a service level equal to or higher than the basic level as defined by CWSA. Seventy-three percent of the people surveyed had access to a service that was below CWSA standards (Moriarty *et al.*, 2011). Crowding is the main factor affecting below-standard service delivery.

With respect to productive uses of water, it was found that in Bosomtwe and Ketu South, where alternative sources for these uses are plentiful, only 4 and 18% of the rural users used formal sources productively, mainly for small commercial uses. In contrast, in the drier East Gonja district in the northern belt, 50% of the users used point sources for productive uses.

In East Gonja, one can also see that around half of the population does have levels of access to formal water sources that allow for basic or intermediate levels of MUS. The figure below shows that even taking into account that water use – particularly in the North – there is a strong seasonal pattern, the upper quartile water use was certainly enough to sustain some MUS in both Northern and Ashanti regions.

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[2] The difference between these rates is essentially due to their provenance: CWSA calculates coverage by counting the systems it provided and multiplying these by a design population; GSS by asking users (in a sample) where they get their water.

[3] A measure of the number of people that share a water point.

Detailed assessments of the people who use water productively show that they have average consumption levels of around 65 lpcd. Having seen in the previous table that crowding is a limiting factor, it probably means that people can access an amount of water that is adequate for multiple use of water, but that they have to spend relatively large amounts of time fetching it because of high levels of crowding. People living close to water points have better access and hence use more water than the people living further away.
All in all, this means that the potential for providing water for multiple uses through rural point sources is low, if design norms only seek to provide a basic level MUS. The reality of sub-standard service delivery means that part of the population which lives close by can access levels of service that are enough to meet productive needs. People living further away cannot. In those areas, productive needs may be met through alternative supplies, as will be expanded upon in the next chapter.

Examples of how point sources are used for production are through add-ons such as cattle troughs. Anecdotal evidence exists that sometimes these are added, but field work confirmed that these are exceptions rather than the rule, as they do not form part of standard CWSA designs. Another way of using point sources productively is by having

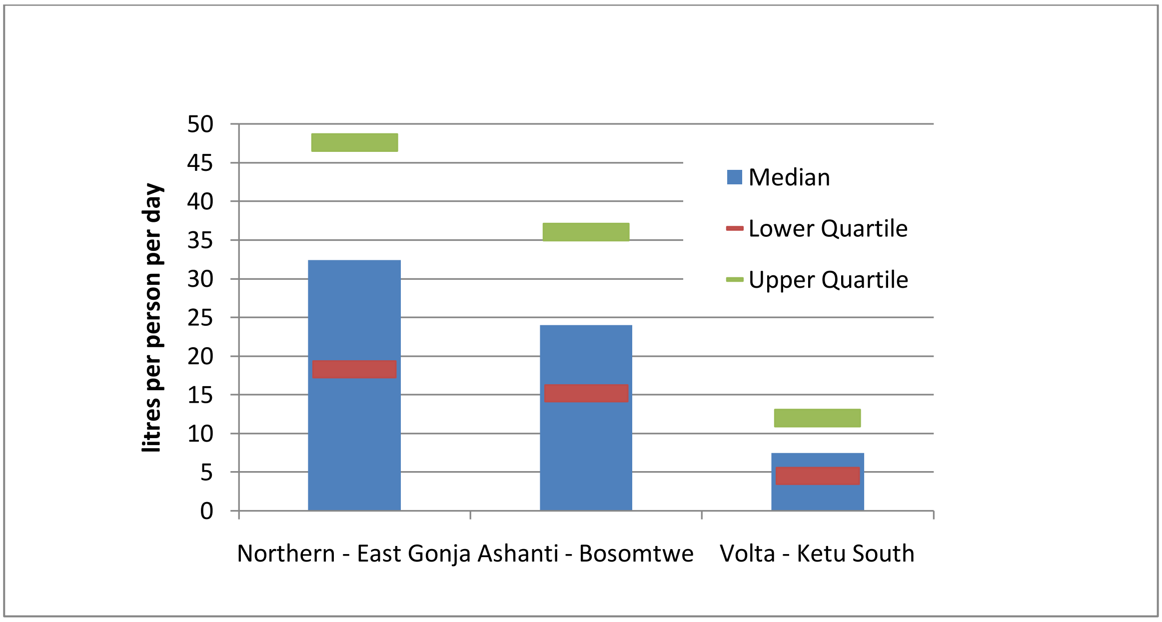

Figure 4: Volumes of water used from formal water sources in the dry season

community gardens at high yielding water points. These have been observed in the Upper East regions where groundwater is plentiful. Finally, individual users may fetch a bit of extra water for productive uses, particularly those who live close to the point source.
A similar assessment of service levels and water use was made of four small town water supply systems. This assessment showed that 59% of users in these towns had service at the basic level. Forty-one percent fall below this, and therefore have a sub-standard service level (Moriarty *et al.*, 2011). In these small towns, quantity was a limiting factor and not crowding or distance. Still, average consumption from the formal sources is around 28 lpcd, but with 30% of people in the small towns actually using more than 40 litres a day.

Part of this higher consumption can be explained by productive uses, in which around 10% of the population is engaged. These are mainly non-land based productive uses, such as small businesses, like food vending and hair salons. In addition, the higher consumption may also be associated with higher levels of use for other domestic uses, such as for water toilets or showers. A possible limitation on productive uses in small towns is tariffs. In small towns, users pay a tariff which is adequate to cover O&M costs. Therefore, users may only want to use water for productive uses where the value generated by the water exceeds the costs by a large margin, hence, the use mainly for high value commercial uses. Low value uses like gardening and livestock may be catered for through alternative sources under self-supply, which will be elaborated in the next section.

All in all, this means water supplies in small towns provide people with the possibility of service levels up to the basic level of MUS. So far, no studies have been done on actual service levels obtained in the limited mechanical schemes, as they form a relatively new type of service delivery model. But as the design service levels are higher than in rural point sources, it can be expected they will have a level of multiple use that is in between rural and small town, thereby allowing for a basic level of MUS.

Utility service delivery model and small-scale independent providers

This is the main service delivery model for urban water supply in Ghana. A para-statal utility, Ghana Water Company Limited (GWCL), has responsibility for the planning, construction, and overall operations and management, including finances of the water services to the population within its area of operation. This model is currently applied in about 87 water systems, mainly cities and medium size towns across the country. The water systems under this arrangement include surface water treatment plants and mechanised boreholes with overhead tanks and distribution networks. The types of connection provided include household connections, yard taps, and standpipes.

In line with the Government's private sector participation (PSP) plan in urban water delivery, GWCL contracted out the operation and maintenance of their systems to Aqua Vitens Rand Ltd (AVRL), a South African/Dutch private company that operates under a management contract with GWCL to manage the production and distribution of water for urban areas. The ownership of the assets remains with GWCL. GWCL is responsible for overall planning, managing and implementation, while AVRL, the operator, is responsible for the production and distribution of water for domestic, public, industrial and commercial uses in the urban areas across all the ten regions of Ghana.

The definition of peri-urban area falls between the urban and rural definitions, thus creating a challenge for the sector, where many of these areas are similar to small towns, but are not formally defined as such. Many peri-urban areas are supposed to be served by GWCL but are not because the utility has not been able to extend its networks to them. Partly as a result of the institutional gaps in peri-urban areas and partly as a result of generally slow progress in extending urban water services, a number of other formal and informal actors have emerged to fill the demand, broadly referred to as Small Scale Providers (SSPs), such as water tanker operators, small scale independent producers and domestic vendors. They typically provide water to low-income areas. They access their supply through GWCL's network, which acts as an intermediate service provider, or from private boreholes. This type of service provision arrangement is mostly found in peri-urban areas.

Service levels

Design parameters for water supply systems served by GWCL depend on the size of the town or city and the type of population. For example, in Accra GWCL uses design norms ranging from 60 lpcd for low-income areas to 138 lpcd for high income areas (GWCL, 2006). In other towns and cities, design norms range from 35 lpcd in the smallest towns to 95 lpcd in bigger ones (Adank and Tuffuor, 2011 forthcoming). For households relying on public standpipes, a design norm of some 20 lpcd is used in most towns. Because of intermittent supplies and losses in the water distribution network, actual access is different. A study in Accra revealed that access there is between 43 and 60 lpcd in the low income areas and between 75 and 120 lpcd in high income areas. A key consideration in these differential design norms is the need to respond to demand. It is to the benefit of the utility to supply more water to clients who demand it. Catering to those demands also makes sense for the utility.

Of particular relevance for this scoping study is the use of water by small entrepreneurs, such as food vendors, owners of hair salons, and farmers and livestock owners. Various studies have looked into this, including Adank *et al.*, 2011, Abraham *et al.*, 2007 and Raschid-Sally *et al.*, 2008. There are few estimates of how many small entrepreneurs there are in cities like Accra. In terms of urban farmers, Obuobie *et al.* (2006) estimate there are in total about 50-70 hectares being cultivated in Accra. This total is distributed over 80,000 tiny backyards (often just a few plantains and chickens) involving nearly 60% of Accra's houses.

A study among small entrepreneurs (Abraham et al, 2007) shows that they may use between 30-40 lpcd for small industries, drawing on water from the GWCL network. The amounts provided, the differential design norms and the desire of the utilities to sell as much water as possible, allow small-scale entrepreneurs to access sufficient water for their needs. However, this is limited in two ways. First and foremost, there is the unreliability of supplies. To deal with this, people need to make sure they have adequate storage tanks. They may also buy water from private vendors or get water from neighbour's taps. This water tends to be more expensive. Abraham *et al.* (2007) found that around 40% of interviewed entrepreneurs get water from these sources for their businesses.

In addition, there are the costs of water, as users are supposed to pay the full tariff. When GWCL supplies are intermittent, the costs of alternative supplies may be even higher. Abrahams concludes that in some cases, entrepreneurs spend an amount on water that is around 30% of the income they generate. This most likely leads to people using the domestic supply system for high value uses which can earn back their expenditures. For uses that demand a lot of water but have more modest returns per liter, such as agriculture, use of open water sources, including streams polluted with wastewater, become a viable option. This will be elaborated in the next section.

In conclusion, productive use of water in urban areas follows a similar pattern as in small towns, where general service levels are low, but higher than in rural areas. Differentiated service levels and the desire of the utility to meet different demands allow people to use water for production when they want to do so. Because of the urban setting and the cost of accessing water from either formal piped supplies or informal private service providers, these productive uses are limited to high value commercial uses in the informal sector. Low end productive uses are met through alternative open water sources.

Irrigation and agricultural water management

Formal irrigation is underdeveloped in Ghana, and what has been developed is under-performing, as recognised in the National Irrigation Policy (MoFA/GIDA, 2011). According to the Policy there are around 500,000 hectares of irrigable land in Ghana, yet only around 15,000 hectares are irrigated through formal systems. Formal irrigation is defined to include those systems that are developed by the government through its Ghana Irrigation Development Authority (GIDA), possibly with funding from donors, that follow either a joint-management (agency and community) model, or are community-managed, but with an established body, i.e. the Water Users Association (WUA) (Namara *et al.*, 2010).

Systems developed by NGOs, but following the WUA model, would fall under this definition. The definition of formal irrigation does not include irrigation through self-supply where individual farmers or groups of farmers develop and manage their own sources of water for irrigation and other productive uses, which will be elaborated in the next section. Based on the typology of Namara *et al.* (2010), the following categories of formal irrigation schemes can be distinguished:

- **Public surface irrigation systems** using a joint-management approach. There are 22 irrigation schemes presently under this category. These schemes are operated and maintained by GIDA or Irrigation Company of the Upper East Region (ICOUR). The schemes can be further classified into seven subtypes based on the source of surface water, the type of power used for abstraction, conveyance and distribution of water, and the in-field water application technology (Namara *et al.*, 2010). The different schemes are described in Namara *et al.*, 2010.
- **Small reservoir-based community-managed irrigation systems.** These are developed by GIDA or private construction companies, often supported by external donors, or sometimes directly by donors. They are aimed at being managed by users through WUAs.
- **Large scale commercial irrigation schemes**, deriving from reservoirs, often through multi-purpose dams, to supply water to large-scale plantations for bananas or pineapples. These are not included in this study.

Public surface water systems

The total number of farmers in the 22 schemes is 10,848, covering a potential area of about 14,699 ha of which only 8,745 ha (59.5%) are developed for irrigated farming (Namara *et al.*, 2010). The status of the irrigation infrastructure is poor, due to limited operation and maintenance, as recognised in the National Irrigation Policy (MoFA/GIDA, 2011). Due to inadequate or deteriorated facilities at the various project sites, the actual land area under cropping has been dwindling. These systems follow a joint management model where GIDA manages the main infrastructure and users carry out local water management tasks through their WUAs. There is little information on the details of current service delivery arrangements, or about how multiple use of water is considered in service delivery.

Photo 1: Domestic use of irrigation scheme. Photo: MoFA/GIDA, 2011

The National Irrigation Policy seeks to improve the productivity of these systems using means such as strengthening service delivery and irrigation management transfer. Even though this policy recognises the fact that such multiple uses exist, even by means of a picture of domestic uses of an irrigation scheme (see Photo 1 below), the strategies in the policy do not refer to the inclusion of multiple uses to improve service delivery. Supporting the policy, there are plans underway to rehabilitate some of these schemes. Discussions were held between the World Bank, the USAID Ghana Office and the Ministry of Food and Agriculture, but there are at an early stage.

Small reservoirs

Many studies have been done on these small reservoirs (see for example the website of the Small Reservoirs Project - SRP, 2011). Some of these studies focus on hydrology and irrigation potential (e.g. Faulkner *et al.*, 2008; Liebe *et al.*, 2005) but with cursory attention to their use for other purposes. Other studies have specifically focused on multiple use practices (see for example Adu-Wusu *et al.*, 2008, Mbinji, 2010, Rakstyte, 2011 and Venot *et al.*, 2011 forthcoming).

Characterisation of small reservoirs

Namara *et al.* (2010) classify small reservoirs in Ghana into two sub-groups namely, small dams and dugouts. Venot *et al.* (2011 forthcoming) define the former as having earth dams of less than 7.5 meters high that can store up to 1 million cubic meters. They sometimes have a downstream adjacent irrigated area generally covering less than 50 hectares.

Dugouts are smaller rainwater harvesting structures, located in depressions that have been further excavated (either manually or with machinery) to impound more water, but often dry up during the dry season (Venot *et al.*, 2011 forthcoming). Dugouts tend also to be smaller in surface area and volume of water they impound, and the number of beneficiaries they serve. Unlike small dams, dugouts have no irrigation infrastructure, such as intake structures or canals, but water is applied to land by buckets. Dugout development tends to have been focussed more on making a source of water available for livestock or even domestic uses, and where irrigation takes place either via buckets or direct pumping (Namara *et al.*, 2010), as dugouts have no distribution infrastructure to manage water, as can be seen in Photos 2 and 3.

Photo 2: Abstracting water from small reservoir using pumps. Photo: Eric Ofosu

The small reservoirs are particularly prevalent in the northern belt of Ghana, whereas dugouts are widely spread throughout the country. As there is no registry of small dams, and definitions of small dams and dugouts are not uniform, different authors report different numbers. A survey by GIDA-MOFA from 2008 yielded the figures in Table 1. IWMI (2009), as quoted in Rakstyte (2010), showed in a survey that there are 350-400 small reservoirs in the three northern belts. After further investigation, Venot *et al.* (2011) estimated a total of 1,011 small dams in the country, around half of which are located in the northern belt. This yields an estimated 375,000 irrigators, assuming 75 irrigators per reservoir in the northern belt.

Table 4: small reservoirs and dugouts in Ghana (GIDA-MOFA, 2008, quoted in Namara *et al.*, 2010)

No.	Region	Number of small dams	Number of Dugouts	Total small dams and dugouts	Cultivated area (ha)
1	Greater Accra	35	218	253	120.0
2	Upper West	84	54	138	712.0
3	Upper East	149	129	278	895.0
4	Eastern	75	115	190	438.0
5	Volta	167	136	303	103.0
6	Central	23	265	288	342.0
7	Ashanti	22	219	241	677.0
8	Western	50	783	833	820.0
9	Brong-Ahafo	50	289	339	1,360.0
10	Northern	131	398	529	649.0
	Total	786	2,606	3,392	6,116.0

Small reservoirs development

Many of the existing small reservoirs were developed decades ago, initially to meet livestock needs, or sometimes even domestic needs, although they lacked any treatment facilities. Over the last several decades, many have been rehabilitated with irrigation purposes in mind. In addition, new ones are being developed, mainly through donor-supported projects such as the World Bank's Village Infrastructure Project (VIP), the IFAD supported Upper West Agricultural Development Project (UWADEP) and Land Conservation and Smallholder Rehabilitation Projects (LACOSREP 1 and 2) (Venot *et al.*, 2011), also for irrigation as primary purpose. Venot *et al.* (2011) estimate that between 1995 and 2009, 222 small dams were constructed, of which 82 were in the three northern belts, while at least another 80 dams were rehabilitated. The International Fund for Agricultural Development (IFAD) and the Africa Development Bank (AfDB) plan to invest a further USD30 million by 2015 to build or rehabilitate an additional 50 small dams (Venot *et al.*, 2011). Namara *et al.* (2010) also indicate that most recent projects that promoted small reservoir development managed only to rehabilitate existing dams rather than develop new acreage under irrigation. The National Irrigation Policy (2011) has an ambition to develop more irrigable land, but does not provide details regarding how new small dams and dugouts could play a role in this endeavour.


Photo 3: Cattle drinking and bathing at a dugout outside Tamale. Photo: Stef Smits

Birner (2008) describes a typical intervention cycle for the development or rehabilitation of small dams. This study, complemented with the ethnography of intervention processes by Venot *et al.* (2011) and by our interview results, allows us to identify the following steps:

- Most small reservoir development and rehabilitation efforts are initiated by donors. They ask GIDA and District Assemblies to come up with proposed sites.
- Formally, the District Assembly, together with community leaders, identifies the need for reservoir construction or rehabilitation, and requests are made to GIDA. In many cases, however, political considerations influence the identification of sites. GIDA assesses the site and funding request. These recommendations may then be reviewed by the donor to decide on a selection of dams to be developed or rehabilitated.
- Following this decision, a more detailed assessment and planning stage begins. Various interviewees recognise that this has often been a top-down planning exercise, constrained by resource limitations and the conditions of external funding. Designs are often prepared in Accra, with little local input into the process.
- Construction is usually tendered out to contractors. The extent to which tenders follow a participatory process in reservoir development is fairly limited, and depends on the quality and experience of the contractor.


Photo 4: Children fetching water for irrigation of vegetable plots at a dugout outside Tamale. Photo: Stef Smits

Birner (2008) notes the poor control over the quality of the works, often resulting in sub-standard quality of the construction works. Birner particularly notes the lack of accountability to local communities and District Assemblies. The poor quality of design and construction work is also mentioned by Venot *et al.* (2011 forthcoming, and Venot *et al.*, 2011). Both Birner (2008) and Venot *et al.* (2011) point to many weaknesses in the overall intervention cycle, offering possibilities for corruption and weak accountability. Also NGOs, including Plan Ghana, Action Aid and the Red Cross, have developed projects like this. Adu-Wusu *et al.* (2008) describe the intervention cycle followed by Plan Ghana. One notices here a higher degree of user participation in the planning process than in the standard GIDA process. The actual development is usually contracted out, with the

Photo 7: Brick moulding at the site of one of the dams developed by Plan Ghana.
Photo: Gabriel Adu-Wusu

NGO having a supervisory role, which may have a beneficial impact on the quality of the construction works.

While documents like the Ghana Poverty Reduction Strategy indicate that such reservoirs should be conceptualised for various purposes, specifically irrigation, livestock and domestic supplies, in the design process of the recent reservoir rehabilitation and development efforts, a single-use perspective dominates. Most designs plan for irrigation only as they are done by GIDA. In the end, few include infrastructure for livestock, such as cattle troughs or domestic uses, such as filtration galleries and standpipes. Reasons for the inclusion or exclusion of infrastructure for other uses depend on a number of factors:

Conditions put by donors. Interviewees refer to the fact that some donors put specific emphasis on the reservoirs, e.g. that they are only for productive uses. Some NGOs have a more open approach. Adu-Wusu *et al.* (2008) describe a case of dams developed by the NGO Plan Ghana that included infrastructure for livestock watering, although not for domestic uses, as seen in Photo 5.

Presence of existing infrastructure for domestic uses. If infrastructure for domestic services already exists, reservoir rehabilitation projects will not include a component for domestic uses. But, if no infrastructure exists yet for domestic water supply, it does not necessarily get included in rehabilitation plans. The interviews show that this is assessed on a case-by-case basis. The Kulbi Reservoir in the northern belt is currently undergoing rehabilitation. As part of the rehabilitation, a filtration gallery is being included to cater for domestic uses. Curiously, CWSA, as the agency responsible for rural water supply, is not at all involved. Interviewees report that instead of including domestic supply infrastructure in the reservoir design, boreholes are installed in the irrigable command area. This is considered a safer option than the complex treatment of surface water from dams.

Photo 5: Cattle at a constructed cattle trough at one of the reservoirs developed by Plan Ghana.
Photo: Gabriel Adu-Wusu

Institutional mandates. The mandate of the GIDA in developing reservoirs is for promoting irrigation development. Although individual staff may be open to accommodating other uses, this is not a standard practice. This means that there are no structured methodologies for including other uses in planning, design and development. It is left to the discretion of staff members and contractors to see whether and how these other uses can be included.

Poor participation by communities in the planning processes. This has been mentioned by various interviewees as one of the causes for limited inclusion of multiple uses of water. When designs are done in Accra or in the regional offices and participation of users is limited, it is unlikely that issues of multiple use of water will be considered. Given the poor quality of design and construction, any use will be limited, let alone multiple uses of water.

The costs of the development and rehabilitation of new dams differ from site to site. Venot *et al.* (2011) make a detailed assessment of the costs and cost drivers of these dams. Median costs of new reservoir development are around 300,000 USD/dam and for rehabilitation works around 100,000 USD/dam. This means that most dams have an investment cost of between 5,000 and 10,000 USD/hectare of irrigated land (Venot et al, 2011). Ofosu (2011 forthcoming) reports costs of 25,000 to 40,000 USD/hectare of irrigated land for small dams developed by NGOs.

Management of small dams

Once a system has been developed, a community-based management arrangement is made through a Water Users Association (WUA). The WUA is responsible for day-to-day operation and minor maintenance, including fencing of reservoirs, cleaning canals, and distribution of water. The WUA typically has a non-paid valve operator who is responsible for operation of the earthen or cement canals. WUA members pay what is called a 'due' to contribute to these minor operation and maintenance costs. However, these dues are so small that they are effectively meaningless, and financial management has often been poor (Rakskyte, 2010). Users contribute with labour, for example for canal cleaning.

Responsibility for major maintenance and rehabilitation works including capital maintenance such as desilting of dams and repairs to the reservoir and canals is less clearly defined. Some interviewees refer to the District Assemblies, others to GIDA, as the responsible body for major repairs. In reality, major maintenance only takes place on an *ad hoc*, project-based manner when GIDA has access to donor or government funds. As one of our interviewees said, it follows the build-neglect-rebuild approach, without any major maintenance happening.

Photo 6: Breached dam wall of a small reservoir in Upper East Region. Photo: Eric Ofosu

As a result of both poor development process and management arrangements, technical sustainability of small reservoirs is weak. A detailed study of reservoirs in the Upper East region showed that of the 16 reservoirs surveyed, 7 cultivated the irrigable area fully, 4 cultivated the area only partially, and 5 were not functioning at all (Ofosu, 2011 forthcoming). Another study by Birner (2008) found no irrigation activity in 59% of small dams in the Upper East region. One of the reasons given was that the irrigation infrastructure was never developed. The same study found active WUAs in only a quarter of the studied dams. Similar data were found by Mbinji (2010), who reports that the most common reasons for underperformance include siltation, the breaching of dam walls (see Photo 6), and lack of irrigation infrastructure. These are all issues which would require major capital maintenance to address. One response to this is that individual farmers pump directly from the reservoirs rather than using the gravity-fed irrigation infrastructure.

In spite of the design for irrigation, these dams are used for various purposes. Adu-Wusu *et al.* (2008) relate that dams developed by Plan Ghana were also used for fishing and non-consumptive domestic uses such as bathing and laundry. Sometimes, they were even used for drinking and cooking, although this is considered unsafe. Boelee *et al.* (2008) found that similar small dams across the border in Burkina Faso are often used for drinking in the absence of formal supplies, with corresponding negative health effects. Various interviewees confirmed this practice where formal supplies are lacking. Brick-making is a common activity found around dams, and Adu-Wusu *et al.* (2008), indicate that even commercial contractors fetch water from dams for construction activities, at a fee paid to the WUA.

Some uses are relatively easy, even when not planned for. These include:
Non-consumptive uses, such as fishing, laundry and bathing do not require additional water, and mostly do not lead to conflicts. Even when people do not drink water from these dams, there may be health risks, such as schistosomiasis, guinea worm and river blindness. Detailed assessments of these risks do not exist for Northern Ghana. But in Burkina Faso, similar dams are associated with an increase of transmission of schistosomiasis.

Use of water for cattle can be more problematic, not so much because of the quantities they use but because of the infrastructure requirements it poses. Cattle require relatively small amounts of water compared to irrigation. Mbinji (2010) reports that in two small reservoirs he studied, in times of scarcity water was reallocated from irrigation to cattle by farmers themselves. Interviewees mentioned cases where reservoirs are fenced because some people fear that open access for cattle to reservoirs may lead to siltation. Also cases are reported of cattle trampling earthen canals when drinking. Accommodating water for cattle would thus require dedicated cattle troughs at appropriate locations.

Brick making should not be difficult to accommodate in terms of access, but interviewees mentioned conflicts because of the quantities of water used. In some cases, irrigators fear that this will reduce water available for irrigation, as it is a use not taken into account in the design of the capacity of the dams. Moreover, it is felt that it may lead to siltation of dams, leading to lower storage capacity.

Catering for drinking and cooking needs is probably the most complex one to accommodate when a reservoir is not designed for such uses. Surface water sources like these dams are unsafe for drinking and cooking. Boelee *et al.* (2008) report on the negative health effects of using water from dams for drinking and cooking. A potential measure of dealing with this problem is household water treatment. This will be elaborated further in chapter 4.

In practice, most uses can still be accommodated in the existing reservoirs, even though they are designed primarily for irrigation in the recent wave of rehabilitation and development. The satisfaction of those who use reservoirs for other uses than irrigation is relatively high. Venot *et al.* (2011 forthcoming), report that although many reservoirs are in fact not used for irrigation at all, people are satisfied with their use for cattle and other uses. In the same report Venot also notes that small-scale water users (e.g. poor people, youth, women, fishers) tend to give higher satisfaction scores when irrigation activities are little developed. Conversely, they face difficulties in reaping direct benefits when intensive cultivation becomes the main goal. Mbinji (2010) found similar data.

Table 5: Perceived benefits by users of small reservoirs in Northern Ghana (Venot *et al.*, 2011 forthcoming)

Upper East Region		**Upper West Region**	
Type of benefits	**Frequency of answer**	**Type of benefits**	**Frequency of answer**
Basic benefits			
Increased water availability	72%	Improved health	68%
Improved access to domestic water	65%	Bathing	67%
Improved food security	54%	Improved food security	62%
Social benefits			
Recreation (mainly children)	37%	Enhanced women's position	67%
Improved relations in the community	36%	Free time for children for schooling	50%
No need to migrate to look for water	35%	No need to migrate to look for water	47%
Economic benefits			
Improved water availability for livestock	77%	Improved water availability for livestock	62%
Enhanced productive activities	59%	Enhanced productive activities	63%
Alternative productive activities	53%	Enhance women's economic security	50%
Environmental benefits			
Limit floods	26%	Limit floods	54%
Improved "atmosphere of living"	18%	Swamp drainage/groundwater recharge	49%
Improved greenness and biodiversity	18%	Improved greenness and biodiversity	63%

The focus on the single use of irrigation is also reflected in management arrangements. Rakstyte (2010) shows how, ideally, a WUA should be made of the different types of user groups, including irrigators, fishers and livestock owners. In reality, these are mainly associations of irrigators (Rakstyte, 2010), with no formal representation of other uses. In these cases, irrigation is the only use that is regulated, because of the sheer volumes involved and management requirements. The exclusion of other uses from the WUA was not necessarily a problem for everybody and Rakstyte (2010) identified various other mechanisms through which other uses could articulate their needs and resolve conflicts over management of the reservoir. These mechanisms work because boundaries between user groups are not clear: irrigators may also own cattle and use the reservoir for domestic purposes. Even where groups were more clearly defined, such as irrigators only, irrigators didn't see the need to exclude other uses, but followed an open access principle. In cases of conflict, other institutional arrangements were followed to address conflicts, for example, through traditional leadership. But this is not always the case. In another example, the WUA prohibited fishers from fishing from the dam, as the need for year-round storage reduces water availability from the reservoir for irrigation (Ofusu, personal communication). Also, women's needs for domestic uses, like doing laundry, may be marginalized.

WUAs tend to receive support only from extension workers from the Ministry of Food and Agriculture (MoFA) on agronomic aspects, but not on broader irrigation issues, let alone on water use for multiple purposes. The exclusion of other users from the WUA also limits revenue for the WUA. Mbinji (2010) reports that in a case of two small reservoirs, the WUA does not levy a charge to others water uses such as livestock owners because it is difficult to regulate as cattle come from different communities and use only small amounts.

In conclusion, even though most small reservoirs have been mainly rehabilitated for irrigation, in fact they are used for various other productive uses and non-consumptive domestic uses. Some of these can be easily accommodated without additional infrastructure development and minimal adjustments to management arrangements. Others, particularly livestock water and use for drinking and cooking do require both additional infrastructure and along with that, their representation in management arrangements.
More importantly, the entire sustainability of these reservoirs needs to be critically examined. Poor planning and design, combined with the lack of definition of responsibilities for major maintenance make this a precarious technology, leading to poor sustainability and under-performance.

Water in integrated rural development projects

District Assemblies, as the lowest level of government, have so far do not have a clearly articulated role in water resources development. Their main role is in sub-sectoral plans, particularly the District Water and Sanitation Plans. The quality of these plans is weak. Although nominally participatory, they are carried out by consultants working to tight schedules. At most, they end up as a list of communities where water supply projects could take place, but do not providing specifics on water needs, expected service levels, or technology choice. These broad district plans do not offer much scope for adding a multiple use component. That is best done at the level of specific projects.

In addition, districts are responsible for local rural development more broadly. Various interviewees concede that such integrated rural development initiatives could provide an entry point for MUS. The only mechanism through which this is happening is through dedicated integrated rural development projects. Examples of these that were reviewed include Ghana Social Opportunities Project (GSOP) and the Community-Based Rural Development Project (CBRDP), both implemented under the Ministry of Local Government and Rural Development (MLGRD). These rural development projects had water components. The main opportunity for MUS is that they offer options to the community as to which type of water facility they need and do not come with predefined mandates. Remarkably, when the types of facilities were selected, they followed largely the single-use specifications of the line agencies for water supply and irrigation, as described before, yet small reservoirs took several uses into account. One of the disadvantages of this approach is that these are projects with a limited duration in time and a limited geographic scope. They are not institutionalised, but rather seek institutional collaboration with line agencies for the development of specific facilities.

4. Informal approaches to multiple sources for multiple uses

Against this background of formal service delivery, users have developed their own approaches to supply themselves with water. Self-supply is understood as the development and management by individuals of a water source for either domestic, productive or multiple uses. Fetching raw water from streams or scoop holes is not considered part of the definition of self-supply. Self-supply implies an element of improvement compared to fetching raw water. If the uses of water include domestic purposes, a further distinction needs to be made between those sources that are an improvement compared to raw water, but are still considered unimproved sources by the standards of the Joint Monitoring Programme, such as an unprotected shallow well, or capturing a stream using hosepipes, and ones that are considered 'improved', such as rainwater harvesting or protected shallow wells (WHO/UNICEF, 2010).

Self-supply starts with the gradual improvement of a traditional practice but it can sometimes also be the reaction of individuals to the lack of adequate formal water services or underperformance of services where these exist (Sutton and Smits, 2011). In the latter case, self-supply is often a complement to formal services, such as a rainwater harvesting tank which is used as back-up supply in case the formal supply fails. Self-supply is of particular relevance under the concept of multiple sources for multiples uses, whereby users start combining various sources for the different needs they have in different periods of the year. In some cases, the self-supply system is the only water to which users have access, and then one source meets multiple needs.

The following forms of self-supply for multiple uses can be identified:

- Self-supply as a complementary source of water, where households develop water sources to complement formal domestic water supply services or irrigation systems; and
- Self-supply as a stand-alone option, where households develop a source to meet all their needs, not relying on formal supplies.

This study looks at three cases where self-supply is practiced largely for a single use. But, these single uses may fit into the broader practice of multiple sources for multiple uses. Because they do hold significant potential we still discuss them as part of this study.

- Self-supply for irrigation in rural areas;
- Self-supply for irrigation in large cities and reuse of wastewater; and
- Improving rainfed agriculture.

Self-supply as complementary source of water

It is common that households complement their formal domestic supplies through self-supply, using technologies such as open hand-dug wells and rainwater harvesting. An analysis of the WASHCost database shows that 50-90% of respondents in the survey districts use informal sources of water along with their formal supplies (see Figure below). Users mix informal and formal sources for both productive and domestic uses. However, the use of multiple sources for multiple uses is much more common in rural villages than in small towns. In small towns, the average is 44% of respondents reporting the use of informal sources, whereas in villages it is 76%.

There is also a marked difference in their use between the North and the wetter districts in Ashanti and Volta regions. In the Ashanit and Volta regions, the informal sources are used mainly for domestic uses, whereas in the North they are used to complement both domestic and productive needs because of insufficient rainfall. Also in the North, the use of formal sources for productive uses is more common. Yet, despite the use of informal supplies being more common in East Gonja, the total amount used is much less at an average of 11 lpcd, whereas in the wetter districts the amount is around 22-26 lpcd. In small towns, the average amounts used from informal sources is also less at around 9.5 lpcd.

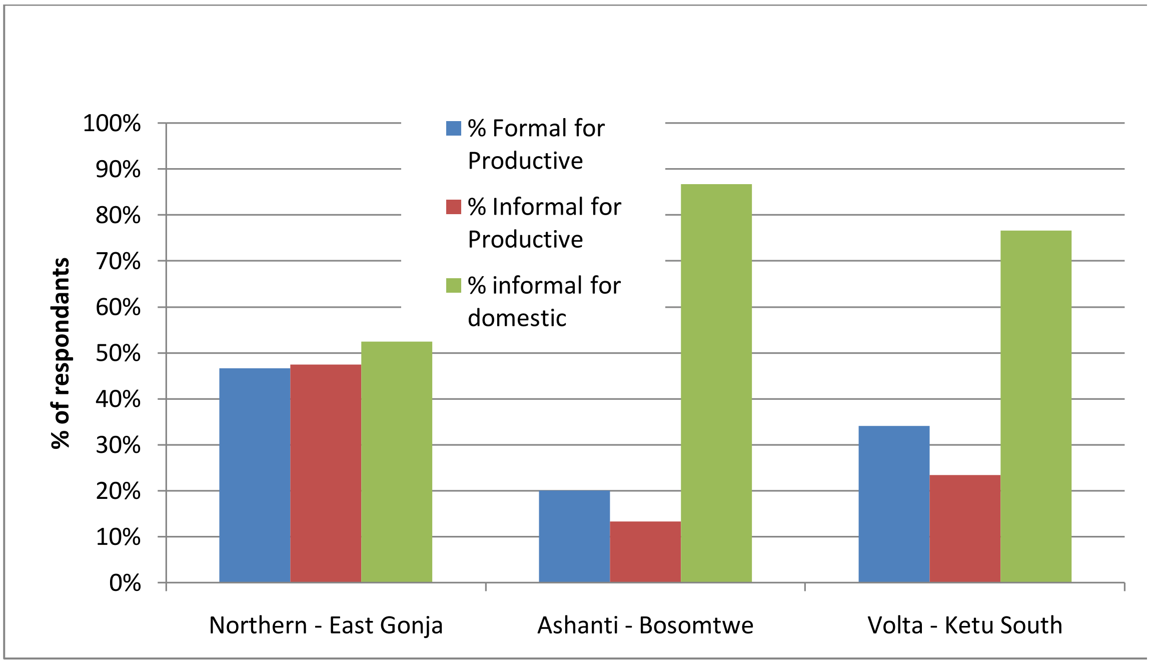

Figure 5: Use of informal additional supplies by families who have also formal sources of supply

Combining these data on informal supplies with the earlier figures on formal supply lead us to conclude the following:

- In the drier northern belt, there is a more sustained use of formal water points for both domestic and productive uses at levels of basic MUS. A relatively high percentage of users combine this with water from other sources, although at a low level, to meet domestic and productive needs.
- In the wetter regions, people use their formal water points to a minimal level, probably only for high quality uses, like drinking and cooking. They meet all their other domestic needs largely from other sources. They also use these other sources for productive needs, but at a relatively low level. This is probably due to the fact that there is less need for irrigation and livestock, and uses are more focused on commercial uses.

Household water treatment is a potential self-supply option to complement cases where people only have access to raw water, for example from small reservoirs or other irrigation facilities, or unimproved sources. A range of household water treatment methods are available that combine a relatively good performance in treatment with an affordable level of costs, such as ceramic filters (Green, 2008). However, their uptake and sustained use without further support has failed (Green, 2008). Experiences of WASH sector organisations like UNICEF with household water treatment in a broader sense (i.e. not specifically linked to MUS) so far have had mixed results. Few households purchase them on their own account, nor do they replace the systems or parts once they break after they have obtained them from a project.

Of the over 1,000 households surveys captured in the WASHCost database, only 8 reported that they have some form of water treatment, most simply by boiling it and only a few have a household filter. As Clasen (2009) states in his overview of trends in household water treatment globally, this method still falls short of meeting the actual need, and there is little evidence that a transition to rapid scaling up can be reached, not even with more resources. Ghana is no exception to this trend. Clasen's study offers a number of strategies to accelerate scaling up, including developing market-based supply chains for middle income groups, free or highly subsidized provision for the poorest families, and addressing policy barriers.

Assessing whether these measures are all in place in Ghana goes beyond the scope of this study, but a rapid glance indicates that many of the conditions are unmet. Even if work would start to address these measures in the short term, it would take a long time before effective household water treatment would reach a significant level of scale. This means that household water treatment is not a feasible option as a complementary technology for multiple uses of water in the short term. Further support for the creation of an enabling environment for household water treatment could be an area of interest to development partners, such as the Rockefeller Foundation.

Self-supply as stand-alone option for multiple uses

There are few conclusive studies on self-supply for domestic or multiple uses as a stand-alone option, i.e. where people do not have access to formal sources but only use self-supply.

Cases exist where wealthier individuals invest in mechanized boreholes with overhead tanks for household use. Over time, these can become small business, where the original investor starts selling water to neighbours by adding household connections. Eventually, this becomes a case of a small private supplier, which was discussed in chapter 3.
Some organisations have promoted self-supply as a stand-alone option for low-income households, and have tried to improve these options so that they are safe for drinking water at least. Most of the relevant work has been done by WaterAid and partners on rope pumps for shallow wells, of which now several thousand have been installed. This has been documented in some case studies (see for example Drouin, 2004; WaterAid, 2004). These reports highlight the potential for water supply as well as for irrigation. However, the piloting has been fraught with problems and their technical sustainability is questionable.

Photo 8: Farmer abstracting water from a private dug-out. Photo: Eric Ofosu

In a first round of pilots in the early 2000s, over 2000 rope pumps were installed, but sustainability was found to be low, in part due to design errors. Recently, some new initiatives have been undertaken to pilot rope pumps, but only 98 rope pumps of the new design have been installed over the period since then, and only as part of NGO-funded projects, reflecting the limited scaling up by users themselves (Bamuah *et al.*, 2011 forthcoming). Some NGOs, particularly WaterAid, advocate for the adoption of the rope pump as an officially recognised pump technology in Ghana. This has not happened yet.

Self-supply for irrigation uses

Namara *et al.* (2010) identify a number of informal ways in which irrigation is developed in Ghana. The three main categories of informal irrigation are:

- Private small dams and dugouts. This is similar in type of technology but very different in the approach to the formal reservoirs mentioned earlier. Basically, it is wealthier individuals who develop such infrastructure and use it for profit, often using motorised pumps. This is not detailed further in this study, as there is little documented experience and there are few such systems as they require major investment.
- Individual (or groups of) farmers using groundwater to irrigate fields. Further differentiation is based on the type of technology such as boreholes, permanent and temporary wells.
- River-lift irrigation schemes, where individual farmers or groups of farmers pump water directly from rivers or open water bodies. This may include direct pumping from reservoirs.

Photo 9: Farmer abstracting water from an in-field shallow well for irrigating his plot.
Photo: Eric Ofosu

The use of groundwater for agriculture through self-supply initiatives is an important trend in the Ghanaian irrigation sector, even though these are old traditions in certain parts of the country. Namara *et al.* (2010) identify different sub-typologies of groundwater irrigation namely, seasonal shallow-well systems, permanent shallow-well systems, shallow-tube well systems and communal borehole systems, each of these confined to specific agro-ecological, socioeconomic and institutional (mainly land tenure) settings. Shallow wells have been mainly developed in fields and along rivers, from where water is lifted, mainly with rope and buckets, but sometimes with hand- or foot-pumps, to deliver it to crops.


Photo 10: Farmer abstracting water from a permanent shallow well to irrigate his garden. Photo: Eric Ofosu

Permanent wells are often found closer to a homestead, as these are permanent structures (Namara *et al.*, 2010). According to Ofosu (personal communication) these also tend to be used more for multiple uses, not only irrigation, because they are close to the homestead.
Tubewells and boreholes are equipped with motorised pumps and because of their high yield tend to be used for crop irrigation. There is little data on the extent of individual groundwater irrigation in Ghana. But case studies in specific areas indicate that it is probably common. GIDA-MoFA (2008) indicates that in one of the districts where wells are common already over 1,000 hectare are under irrigation from over 34,000 wells.

A number of programmes have tried to promote such individual irrigation development, particularly in the Volta region. But the initial investment costs of lifting devices, and afterwards energy costs prove to be a limitation. Unlined shallow wells cost USD30, but permanent wells cost around 150 USD/well (Ofosu, 2011 forthcoming), mainly due to the cost of lining. Assuming an average irrigated acreage of 0.02 ha, permanent wells have an equivalent cost of 7,500 USD/ha, similar to the per hectare costs of small reservoirs. Additional lifting devices, such as treadle pumps, cost 80-110 USD (Ofosu, 2011 forthcoming). Tubewells and boreholes are less common as they require even higher initial capital investments by farmers.


Photo 11: Diesel pump to abstract water from the river. Photo: Eric Ofosu

Lift irrigation from rivers and open water bodies by individuals is a growing practice in certain areas of the country, particularly around small reservoirs (see Photo 11), in the tail-end of formal irrigation systems, and in peri-urban areas. Direct pumping from small reservoirs may be much more significant than gravity-flow irrigation downstream of the reservoir. Farmers use diesel or petrol pumps to lift water to irrigate individual fields or supply a group of fields. In some cases, groups of farmers have received support from bodies such as the Ministry of Food and Agriculture or GIDA to develop their schemes. In the few studies on informal irrigation, no reference is made to multiple uses. But probably the extent of this is limited as it is mainly applied to fields, and not at or around the homestead where other uses may take place.

Together, these various forms of self-supply for irrigation are a main driver for irrigation development in Ghana. In 2009, the estimated number of diesel/petrol pumps was nearly 170,000 (Namara, 2010). Ofosu (2011 forthcoming) estimates that over the period 2005-2010, the irrigated area in the Whilte Volta Basin has increased by 5.6% per year. Most of this was due to private investment in irrigation, as the area under irrigation around small dams and public irrigation schemes remained more or less stable or even decreased slightly. Drivers for this rapid growth in self-supply for irrigation include: growth of markets for vegetables, poor performance of the public irrigation schemes, the possibility to gradually improve technology levels (from shallow wells with buckets to permanent ones and up), and improved access to credit and farming inputs (Ofosu, 2011 forthcoming).

Self-supply in irrigation in large cities: waste water re-use

Photo 12: Sprinkler irrigation of vegetable plots, with water from an open drain in Kumasi.
Photo: Stef Smits

Another informal irrigation practice is the reuse of wastewater for vegetable farming in the outskirts of the three major cities of Accra, Kumasi and Tamale. This practice has been extensively studied by the International Water Management Institute (IWMI) and others. Agodzo *et al.* 2003; Keraita and Drechsel, 2004; Raschid-Sally *et al.*, 2008; Obuobie *et al.*, 2006 provide a broad overview of this practice in Ghana. In addition, there are a number of in-depth studies looking into specific aspects of wastewater reuse, such as water quality and health and environmental risks, many of which are referred to in these studies in more detail. In addition, there have been various studies into the status of sanitation and wastewater management in cities (E.g. Adank *et al.*, 2011), which lies at the basis of the reuse practices. In general, the situation can be described as one in which farmers have developed informal irrigation practices drawing water from drains and open sources that over time have become polluted with wastewater because of severe limitations with sewers and wastewater treatment, a situation that can be classified as indirect and unplanned reuse according to the typology by Scott *et al.* (2004). Although this may have health and environmental risks, it can also provide farmers crops with additional nutrients. The situation is different for each of the three cities.

In Accra the two central sewer systems are not operational and of the 35 institutional treatment plants, only four are functioning (Adank *et al.*, 2011). Most wastewater is disposed of in soak-away storm drains and by throwing it into the street or compound. Some of this water infiltrates into groundwater aquifers, and some flows to the sea through the storm drainage system. Even if the treatment facilities were fully functional, the current (2007) capacity for liquid waste treatment is far below the estimated wastewater production (Adank *et al.*, 2011). Abraham *et al.* (2007) and Raschid-Sally *et al.* (2008) estimate that a total of about 100,000 m^3 per day of wastewater is generated, of which some 10% is re-used by farmers (based on Abraham *et al.*, 2007). In the city and its

Photo 13: Fetching water from a wastewater drain for growing vegetables in the outskirts of Tamale.
Photo: Stef Smits

peri-urban areas, a total of nearly 1,000 ha are cultivated with vegetables and maize. It is estimated that 800-1,000 farmers earn an income from this activity (Obuobie *et al.*, 2006). Farmers capture their irrigation water from urban drains, the contents of which vary from raw wastewater to storm water diluted wastewater. Few farmers use partially 'treated' wastewater' from the maturation pond of the stabilization pond treatment system belonging to one of the military camps.

Obuobie *et al.* (2006) reports that in Kumasi there are about 41 ha in the urban area under vegetable irrigation, while its peri-urban area has more than 12,000 hectares under irrigated vegetable farming. The main sources of water are polluted rivers and streams (for 70% of the farmers), and only few use raw effluent from the sewage treatment plant or directly from drains. In addition, there is extensive use of shallow dug wells on valley bottoms, especially in the urban area, even though these may also be contaminated.
In Tamale the situation is different. There is no stream passing through the city and the groundwater table is low. Hence, most cultivation is done along wastewater drains and broken sewers and near other open water sources like dams. Obuobie *et al.* (2006) report that 52% of farmers use polluted sources.

Improving rainfed agriculture

Apart from irrigation development, there are also other initiatives in agricultural water management, particularly in improving water use in rainfed agriculture. For example, AGRA is focusing on better soil moisture management. These are relevant initiatives from the perspective of promoting multiple sources for multiple uses. Improving rainfed agriculture becomes a way of strengthening multiple use as a complementary source of water, although this practice is not normally seen as a MUS strategy in itself.

Another link with improved rainfed agriculture involves the recharge of groundwater for different uses. As groundwater is developed, groundwater recharge for extractive uses becomes more important. Improving soil water moisture management remains important in any irrigation effort.

5. Feasibility of MUS modalities

The previous sections have shown that on the one hand, there are situations of *de facto* use of formal domestic and irrigation systems for multiple uses, and on the other, there are self-supply initiatives to complement formal single-use supplies with water from other sources to cover people's multiple water needs. To our knowledge, there are no scaled up MUS-by-design initiatives or experiences in Ghana. The few MUS pilots can best be explained in terms of any of the existing practices, mainly to the development of small dams and reservoirs, but taking multiple use more explicitly into account.

MUS modalities therefore fall into two broad groups: 1) formalizing and strengthening *de facto* multiple use practices, and 2) further promoting self-supply and community-based planning modalities. The former group can be further sub-divided into domestic-plus and irrigation-plus modalities. This leads us to the following MUS modalities.

Domestic-plus modalities

A first group of entry points for MUS is through the domestic sector. The following specific domestic-plus models are identified:

- **Communal productive uses of point sources in rural areas**. This would involve using the point sources that provide a basic level of domestic uses to their full capacity, by having for example communal cattle troughs or a community garden in the case of high yielding boreholes.
- **Productive uses of domestic piped systems** in small towns and urban areas. This would focus particularly on the informal commercial and industrial uses, building on the momentum in the sector to develop more small-scale piped networks where service levels allow a basic level of MUS.
- Upgrading point sources in rural areas to **limited mechanical schemes**. This practice involves equipping high yielding boreholes with motorised pumps and even small distribution networks, and thereby fundamentally changing the technology. The practice is gaining popularity in Ghana as rural villages become bigger. Various rural water supply programmes plan to use this model. It contains space and room for including MUS, both for agricultural uses and small commercial uses.

Irrigation-plus modalities

From within the irrigation sector only two MUS model have been identified:

- **Inclusion of MUS in the rehabilitation of public irrigation systems.** As discussions are ongoing to rehabilitate public irrigation systems, more uses can be accommodated in these efforts.
- **Rehabilitation and retrofitting small reservoirs for multiple uses**. As part of the ongoing effort to rehabilitate small reservoirs, more uses can be accommodated in these efforts. Whether that can lead to the inclusion of all possible uses remains to be seen.

Community-based planning modalities

The third MUS modality is community-based planning, which does not take a specific sectoral entry point.

- Full local **integrated water development and planning**. This consists of developing and implementing local water plans that can include water interventions for any type of use according to users' needs.

Finally, the fourth MUS modality is the promotion of self-supply, or the creation of conditions in which users can invest in and develop their own water sources, either as a stand-alone option for all their needs, or to complement other formal water sources. This can be further sub-divided as:

- **Promoting complementary self-supply** for productive and domestic uses along with formal supplies. This would consist of efforts to complement formal supplies for domestic uses, with other alternative sources both for complementary domestic and other productive uses. This may eventually also include self-supply as a stand-alone option for multiple uses, though the potential for this is not clear at this time.
- **Supporting self-supply for irrigation as a priority**. This is included as a potential MUS model because it can complement the development of water sources for productive uses. When they are sited on distant fields, water uses are primarily for crops. However, some of the self-supply options can also cover other domestic and livestock and other productive needs. Self-supply encompasses privately adopted soil and water conservation and lifting devices from surface and groundwater.
- Promoting peri-urban agriculture through improved conditions around **reuse of wastewater**. This informal practice is likely to grow. Most importantly, around this practice is the improvement of conditions under which it takes place in an integrated way: from improving sanitation in cities, to better management of sewers and drains, and the gradual increase in treatment facilities, to improvements in the hygienic management of wastewater.

The next sections elaborate each of these MUS models in more detail. We provide for each of them a short description of what the model entails in terms of the technology, the service level and the type of MUS that can be accommodated. The feasibility of the models are then assessed in terms of the number of beneficiaries, with reference to policy and legal, institutional, technical, financial and water resources aspects. Based on this, a proposed entry point for a scaling pathway is identified. The final section of this chapter summarises the models and makes an overall feasibility assessment.

Communal productive uses of point sources in rural areas

Description of the modality

The communal productive uses of point sources follows the current rural point-source service delivery practice of providing a basic level of service (20 lpcd) using the COM management model, but with a number of add-ons that allow for communal productive uses, specifically adding cattle troughs or a community garden when there are high yielding boreholes. Referring to the MUS ladder, it would mean that productive uses will remain limited to a few cattle or a community garden. Individuals who may live a bit closer to the borehole may be able to fetch some water to water a vegetable plot or undertake some brick-making activities.

Potential target group of beneficiaries

There are an estimated 27,000 boreholes in Ghana, serving an estimated 8.4 million people. In theory, the potential of this MUS model is high. However, in the middle and southern zones, open water sources are plentiful and can better cater for these uses. Besides, there is less need for water for water from boreholes because of high rainfall. Limiting the potential target group to the northern belt would yield some 2 million people, who currently already have access to such point sources, and 1.6 million people who would still need to get access through communal boreholes with hand pumps. The total potential target group is therefore estimated at some 3.6 million people.

It should be noted that of these people those living closer to point sources might benefit more than the people living further away. Crowding and sub-standard service delivery pose a risk that the entire target group of beneficiaries cannot be reached.

Policy, legislation and regulation

Current policy and regulations of the CWSA neither promote nor hinder the productive use of hand pumps. This model can thus be applied without any major change in policy. Only changes at the level of the project cycle and detailed regulations may be needed as will be elaborated below.

Water resources implications

Because of the minimal amounts of water involved, there is no expected impact on water resources, nor would water resources limit this practice, as so few water resources are developed in the country as a whole. The only possible limitation is in cases where the yield of boreholes themselves is limited due to hydrogeological conditions.

Institutional arrangements

This modality would follow the existing institutional arrangements for domestic uses under COM, as explained in chapter 2. However, it would require some agencies to widen their mandates: WATSANs may need to establish local regulations or by-laws on the use of the water point by cattle or community gardens and ensure some level of equity between those living nearby and people living further away. CWSA would need to include the participatory planning and design of these add-ons at community level into their planning cycle so that the right kind of add-ons can be identified. Interviewees from CWSA do not see this as a limitation.

Also in the ongoing support by CWSA and District Assemblies, they may need to widen their focus in supporting WATSANs managing water points for these uses.

To ensure that technical staff of the CWSA at all levels indeed consider these uses in planning, design and support of facilities, it is recommended to include community level productive uses into the various project guidelines as the main modality of institutionalising these changes. Based on pilot experiences, senior CWSA staff have indicated their willingness to do so.

As most investments in the domestic water supply sector are actually covered by different donors, who largely follow CWSA guidelines, specific agreements may be reached with those donors to include a multiple-use component in projects.

Costs and financing

The incremental costs of this modality compared to the standard domestic model lie primarily in the additional capital costs of the add-ons. Current total capital costs for standard boreholes with hand pumps stand at some 30 USD/capita. The incremental cost of a cattle trough is probably equivalent to a few cents per capita and can most likely be included in the budgets of CWSA and its donors. Given these small incremental costs, setting up specific co-financing mechanisms is not required. Wear and tear on hand pumps will increase as they are used more for uses, but that increase will be minimal.

The advantage of this model is that it may be able to easily draw on the current investment boom in rural water supply. An estimated 10 million USD are spent on a yearly basis on rural point sources.

Technical issues

The technical issues for this model are also minimal. They will not require any change in the hand pump technologies currently in use in the sector. However, it does not open up much choice in technology selection to communities. The main difference lies in providing communities with options for certain add-ons. For those options, standard designs will need to be elaborated and included in the project cycle. As they are sometimes already used, developing standard should not be problematic.

One major drawback to take into account is the low level of performance in sustainability of point sources. Although including MUS into rural point sources may improve sustainability, it must be taken into account that a significant fraction of water points are likely to be unsustainable or underperform.

Scaling pathways

This modality assumes that the main scaling pathway is through the government institutions responsible for domestic rural water supply, i.e. the CWSA, the District Assemblies and their various programmes. We see this pathway as having the highest potential because of the sheer size of these programmes and the current funding levels for rural water supply. Size and funding, combined with the willingness of CWSA to adopt a multiple use approach, gives this pathway a high potential for scaling up. Specific agreements may need to be made with the respective donors of current and future programmes. Even though they follow CWSA guidelines, they may put certain conditions on the use of their funds.

According to interviewed senior CWSA staff, the scaling pathway should start with a pilot project, in which communal MUS are systematically included in the various steps of the project cycle to identify whether and which add-ons are needed, then implemented and included in the management arrangements. Lessons from a pilot can then be identified and taken up in the CWSA guidelines. Once these lessons are incorporated into the guidelines, the modality can be taken to scale.

Eventually, this model can also be adopted by NGOs and projects that fund rural water supply services. However, for reaching scale and buy-in, it is considered best if the designated government agency, i.e. CWSA, leads the piloting processes. For broader buy-in, it is important that the piloting is accompanied by a process of structured learning involving other domestic sector agencies. The domestic sector has a number of thematic working groups, in which interested agencies participate. We recommend a dedicated working group on this topic, if a piloting process were to start, or include it in one of the existing working groups. Furthermore, it would need to be accompanied by sharing and learning on the piloting experiences using other mechanisms, particularly through the Resource Centre Network (RCN) of Ghana, a body tasked with information sharing in the domestic water supply sector, and CONIWAS (Coalition of NGOs in Water and Sanitation), the umbrella organisation of NGOs working in the water supply and sanitation sector.

Productive use of piped systems

Description of the modality

Productive use of piped systems would follow the current practice of providing higher levels of services through piped systems in small towns and urban areas. It will not differ in any major way from the current service delivery model in those areas. At most, it may involve a further gradual increase in service levels over time, and a further differentiated adjustment of design service levels according to specific local needs. A second component of this model should be the increase in performance of these systems, to make sure that the design levels of services are actually received.

In this way, users in small towns and urban areas would be able to receive the service level they need, probably hovering around the level of basic or even intermediate MUS. The type of productive uses in this model would mainly be domestic commercial and industrial activities, such as food vending, food processing and cottage industries. In towns in the northern belt, it may even include some water use for livestock or garden plots.

Potential target group of beneficiaries

There are a total of 416 small town systems covering some 2 million users. Even though in theory all could be benefitting, not all would want to use formal supplies for productive uses. As shown earlier, currently some 10% of the population is using formal supplies for commercial uses. By improving the formal supply system, it could probably increase to some 30% of small town inhabitants wanting to engage in small commercial activities, thereby narrowing the target group to 400,000. Although a productive use of piped systems would be applicable throughout the country, its highest potential will be in the dry part of the coastal zone and the northern belt[4], where people have less access to alternative sources. The total target population in the northern belt would be around 120,000 people.

In urban areas, we would look mainly at the low income strata as the overall target group of this modality. However, no differentiated statistics could be found for this group.

Policy, legislation and regulation

For small towns, a productive use of piped systems modality would be concurrent with the CWSA policy to gradually improve service delivery and service levels in small towns, and their current emphasis on small town supplies. In addition, it is seen as a way of promoting the sale of water to users, and thereby generating more revenue for the WSDBS. Specific water use regulations may need to be developed for such areas.

For urban areas, more work may need to be done on the policy and regulation side. As discussed, cities already cater for differentiated demand. Particularly for the low income strata, target design levels may need to be adjusted upwards, and further regulations developed for this kind of informal commercial use. This might be the outcome of a piloting process.

[4] The northern 'belt' consist of three administrative regions: Northern belt, Upper East Region and Upper West Region. The term 'belt' includes all three regions,

Water resources

The main limiting factor for a productive use of piped systems model may be the infrastructure in place to capture resources, e.g. reservoirs of larger cities and their intake and transport infrastructure may be limiting if there is a further growth in water demand.

Institutional arrangements

A productive use of piped systems modality would follow the existing institutional arrangements for small town water supplies with involvement of CWSA, District Assemblies and WSDBs. However, it would imply that they are willing to expand their mandates: WSDBs may need to establish local regulations or by-laws on the use of higher levels of service, and CWSA would need to review their planning and design criteria. Also in the ongoing support by CWSA and District Assemblies, they may need to widen their focus in supporting WSDBs managing water systems.

The biggest institutional bottleneck in small towns will lie in the gradual improvement of performance in water service delivery. As shown in the previous chapter, actual service delivery lags behind the standards set. Crowding could be reduced by having more water points. In addition, many WSDBs have problems with performance issues such as O&M, financial management and tariff collection. Strengthening performance of the WSDBs is much needed, but will require a closer engagement with the institutional development of the WSDB themselves.

In urban areas, the institutional entry point would be GWCL and its operator AVRL.
As most investments in the domestic water supply sector are actually covered by different donors, who largely follow CWSA guidelines, specific agreements may be reached with those donors to include a MUS component in projects.

Costs and financing

MUS would most likely not require any incremental costs for infrastructure development. Only if design service levels are gradually increased will costs increase. How much that increment will be will differ from case to case, as the spread of actual capital investment costs is high.

However, incremental costs will be needed for the institutional development and strengthening of WSDBs. No data exist on what these costs would be.
It may also benefit from the current boom of investment in water supply.

Technical issues

The adoption of a productive use of piped systems MUS modality is technically straightforward, as it uses the existing technologies and designs. Eventually, adjustments may be made, for example, by increasing the design quantity supply or the percentage of household connections in a piped system. None of these adjustments would represent a major challenge or change in technology.

Scaling pathways

The main scaling pathway is through the government institutions responsible for small town water supply, i.e. the CWSA, the District Assemblies and their various programmes, and urban water supply, i.e. GWCL and its operator AVRL. We see GWCL as having highest potential because of the sheer size of these programmes and the current funding levels for small town water supply. This, combined with openness of CWSA to a multiple use approach, gives this pathway a high potential for scaling up.

A similar piloting approach as for communal point sources would be needed. The more complex part of the scaling pathway would be the institutional development of the WSDBs and strengthening their overall performance to ensure that the design service levels are actually delivered, as this would go beyond the limited remit of an MUS approach. Specific programmes may need to be established for the institutional development of small town water supply, possibly to accompany targeted MUS projects.

There is less scope for NGO involvement as NGOs tend to focus more on rural areas. But where NGOs are interested in supporting small town water supply, it could follow a similar approach as outlined for the communal productive use model. The same applies to the learning and sharing component outlined in the previous section.

Limited mechanical schemes

Description of the modality

The limited mechanical systems modality consists of upgrading of point sources in larger rural communities, replacing hand pumps on high yielding boreholes with motorised pumps, and complementing these with small distribution networks of public standpipes, but without household connections. In addition, limited mechanical systems may have add-ons like cattle troughs and community gardens, similar to the point sources model.

The level of service to be provided would be between 20-60 lpcd, achieving the possibility of a basic to intermediate level of MUS. Limited mechanical systems may be accompanied by the types of communal productive use infrastructure as outlined in the communal productive use of point sources modality. The type of productive use would include both informal commercial use and gardens and livestock. People living closer to standpipes may have homestead level productive uses, although this use could be limited if water points are too crowded.

Potential target group of beneficiaries

The target group is limited to those communities which already have point sources with high yielding boreholes and which are big enough to move from point sources to a limited mechanical scheme. No detailed assessment has been made of the villages that fall in this category. Rough estimates indicate that the existing number of 90 limited mechanical schemes could easily be doubled in the next few years. That would imply some 90,000 beneficiaries, assuming an average of 1,000 persons per scheme.

Policy, legislation and regulation

Limited mechanical schemes are a relatively new service delivery model, which has not been fully elaborated in policies, legislation and regulations. However, in general terms, the model aligns well with the government's approach to improve service delivery and their focus on bigger villages and small towns. In that sense, there are no policy or legislative limitations. In addition, it is seen as a way of promoting the sale of water to users, and thereby generating more revenue for the WSDBs.

Water resources implications

The limited mechanical systems model has similar water resources implications as the communal point sources model. The only possible limitation is in cases where the yield of boreholes is limited due to hydrogeological conditions.

Institutional arrangements

Limited mechanical systems would follow the existing institutional arrangements for domestic uses under COM for rural areas and small towns. However, it would imply that institutions involved in this expand their mandates.

To ensure that technical staff of CWSA at all levels are prepared to consider these uses in planning, design and support of facilities, we recommend including this type of productive use into the various project guidelines as the main modality for institutionalising it. Senior CWSA staff have indicated their willingness to do so based on pilots.

Costs and financing

Unlike the other two domestic-plus models, limited mechanical systems come at a more significant incremental cost, as it means a jump in the service level being provided and a fundamental change of technology. The incremental costs are estimated to be around 4-5 USD/capita. Compared to the original costs of point sources of some 30 USD/capita, this is a 13-16% increase. However, it can also be seen as a step towards the further development of a small piped scheme.

In addition, there will be incremental costs for the institutional development of the WSDB or WATSAN that would be operating the scheme, as it also means a significant change in the way services are managed. Many point source users do not pay a monthly tariff, but pay a contribution if and when repairs are needed. In a limited mechanical scheme, payment is done on a pay-as-you-go basis, for example payment by bucket of water fetched. This requires more formal accounting and management of fees. It may also involve a more professional management and operation of the system, as it may require a pump operator. No data exist on the incremental costs for the software support costs of making the transition to a more professional service provider, but these are likely to be significant and over a longer period of time.

Limited mechanical systems may be applied within the current investment boom in rural water supply. CWSA staff already see the potential to apply this model in commissioned rural water and small town water supply programmes.

Technical issues

This model implies a fundamental change in technology for the community. This is a process that needs to be adequately supported and communities must be able to make informed decisions on this, as it also affects issues such as tariff payments. Yet, the technology is not complex. For MUS, further work may need to be done to come to standard designs that take into account higher levels of service and communal add-ons.

Scaling pathways

The scaling pathway is through the government institutions responsible for domestic rural water supply, i.e. the CWSA, the District Assemblies and their various programmes, and urban water supply, i.e. GWCL and its operator AVRL. However, the scaling pathway should start with a more systematic study of current experiences with these limited mechanical schemes as they have not been documented in depth as yet. This documentation can be followed by pilot projects in which multiple uses are systematically included in the steps of the project cycle to move from rural point sources to limited mechanical schemes, and then included in the CWSA guidelines.

There is less scope for NGO involvement as they tend to focus more on rural areas. Where NGOs are interested in supporting small town water supply, they could follow a similar approach as outlined for the communal productive use model. The same applies to the learning and sharing component outlined in the previous sections.

Rehabilitation of public surface water irrigation schemes

Description of the modality

The rehabilitation of public surface water irrigation modality consists of developing both infrastructural and institutional adjustments to small public surface water irrigation schemes as part of planed rehabilitation effort to better accommodate multiple uses of water. The specific interventions that will be done will be system-specific and depend on the extent to which different uses are already adequately included in the operations of small reservoirs. The final objective is to ensure that as many uses as possible of public irrigation schemes are facilitated by the infrastructure and included in the institutional arrangements for management.

Which specific uses would need to be better addressed remains uncertain, as no comprehensive assessments exist for multiple use of irrigation schemes. It can be assumed that they will include: crop irrigation, as the current extent of irrigation is below potential; facilities for livestock to access water; possible access to water for homestead productive uses; and, access to improved water supply where irrigating communities do not yet have adequate supply.

Potential target group of beneficiaries

The target group for this modality is in principle all users of irrigation systems and a wider group of people in communities in and around command areas. Namara *et al.* (2010) estimate that there are 10,848 farmers using irrigation systems, which would translate into an estimated community of around 55,000 individuals (assuming 5 persons per household).

Policy, legislation and regulations

The rehabilitation of public surface water irrigation model is in line with the National Irrigation Policy, which seeks to dramatically increase the irrigated area and improve service delivery of irrigation systems. However, the policies are silent on the extent to which multiple uses can be included, and hence present neither opportunity nor limitations. The only use that may be more difficult to include into this model is the development of formal drinking water supply infrastructure, as that would be outside the institutional mandate of GIDA.

Water resources

The rehabilitation of public surface water irrigation model would not envisage further development of water resources, but rather a more efficient use of existing infrastructure and resources. Total water resources use would remain more or less the same, but its use and management would be better regulated.

The model would assume the development of local regulations on water use within the command area for the different uses. These uses need to be custom-made, depending on the exact needs that are currently unmet. Doing so would require detailed demand assessments to facilitate decision-making on local regulations. Competing claims between user groups will probably be more about accessing the infrastructure and less so about the amounts used.

All the above implies that when rehabilitation of public irrigation systems is done, a duly participatory approach is followed in which all water demands around the dams are assessed and taken into account in the design. The Mapping Systems and Services for Multiple Uses of Water Services approach developed by the FAO (Renault, 2010) for large-scale canal irrigation may be used and adjusted for this purpose.

Institutional arrangements

The rehabilitation of public surface water irrigation model assumes a big step in development of institutional arrangements around management of the public irrigation systems. At the lowest level, it would imply strengthening WUAs and other relevant local organisations to represent different uses. It may follow the ideal model presented earlier of an inclusive WUA, or follow other local arrangements. This in turn requires that the intervening agents, particularly GIDA and contractors, dedicate due attention and resources to local institutional development. This would probably require specific terms of reference for rehabilitation efforts.

Such a possibility at this early stage is difficult to assess. Once WUAs are functioning, they would need support from different agencies in managing water. That support would need to go beyond the current support from MoFA, which provides only agronomic information, and would also include support from other line agencies.

Costs and financing

No data exist on the incremental costs of infrastructure development for multiple uses. Whereas rehabilitation costs for irrigation purposes may be high, the incremental costs of including other uses will be minor.

However, the actual incremental cost will be a function of the need for a more intensive participatory process of planning, design and establishment of local institutional arrangements and support. Such processes take time and resources, but are more likely to result in more sustainable use of small reservoirs and thereby offer a higher cost-benefit ratio.

A major limitation of the rehabilitation of public surface water irrigation model lies in the operational costs, particularly the capital maintenance costs. As discussed earlier, basic operations can be done via *ad hoc* community mobilization. However, with the lack of adequate capital maintenance arrangements, this model is not likely to be sustainable, with or without multiple uses of water.

Technical issues

The key opportunity and challenge here lies in the required technical additions to equip the existing public surface schemes for multiple use. Specific infrastructure for cattle watering, for example, can be easily accommodated, although they do require standard designs. The main technical complexity lies in the possibility of including infrastructure for domestic water supply. Basically three options exist for doing this:

- Adding boreholes or wells with hand pumps in the command area. This may go beyond the mandate of GIDA and can probably be done only when coordinated with CWSA.
- Adding an infiltration gallery to take surface water to potable level and facilitate access through sprouts for domestic use. This would require developing standard designs that can be considered in rehabilitation efforts.

- Promoting household water treatment technology. This may fall outside the mandate and expertise of GIDA. Given the current experiences with household water treatment in the country, this may not be a sustainable solution

Scaling pathway

The scaling pathway for this modality would have to be via GIDA, probably with external donor funding. A first step would have to be a detailed assessment of the current multiple use practices in these schemes and the extent of possible improvement. FAO's MASSMUS approach could be used for this. More specific recommendations can be given as input to the discussions and negotiations between GIDA and donors for rehabilitation efforts, and their inclusion in terms of reference for pilots. The next step would be piloting MUS interventions in one or more of the existing irrigation schemes. This would need to be accompanied by a strong research and learning component to ensure that lessons are captured and included in the standard intervention cycles. Whether there is openness and space in such programmes remains to be seen, as they often have rigid timelines and less space for experimentation.

Rehabilitation and retrofitting small reservoirs for multiple uses

Description of the modality

Rehabilitation and retrofitting small reservoirs consists of developing both infrastructural and institutional adjustments to small reservoirs as part of ongoing rehabilitation efforts to better accommodate multiple uses of water. Specific interventions will be site-specific and depend on the extent to which different uses are already included in the operations of these small reservoirs. The final objective is to ensure that as many uses of small reservoirs are facilitated as possible by the infrastructure and included in the institutional arrangements for management.

Compared to the domestic-plus modalities, the livelihoods impacts may be more significant in terms of the irrigable area that can be put to use, livestock attended to, or other uses facilitated. The exact impact will need to be defined on a case-by-case basis.

Potential target group of beneficiaries

The target group for this modality is all users of small dams; we do not include dugouts as they do not have infrastructure to regulate water use. For the whole of Ghana, that would imply some 1,100 reservoirs, but given the focus of most organisations on the northern belt, the target group would be limited to the users of the 500 or so reservoirs in that part of the country. Assuming some 2,500 people using a small reservoir directly and indirectly (Venot *et al.*, 2011 forthcoming), this comes down to 1.25 million people, made up of irrigators, domestic users, and livestock owners. The number of potential irrigators would be somewhere around 37,500, assuming an average of 75 irrigators per small reservoir.

Policy, legislation and regulations

This modality is in line with the National Irrigation Policy which seeks to dramatically increase the irrigated area and improve service delivery of irrigation systems, although it doesn't differentiate between small dams and other smallholder irrigation. Policies are silent on the extent to which multiple uses can be included. In the view of interviewees from agencies such as GIDA, this modality would fit well into the existing policy framework. The only use that may be more difficult to include is the development of formal drinking water supply infrastructure at small reservoir sites, as this would start going outside the institutional mandate of GIDA.

Water resources

A study by Ofosu (2011) reports that under different scenarios of irrigation development, water resources would not be a limiting factor for development of small reservoirs. This modality, in most cases, would take rehabilitation of small dams approach, whereby total water resources use would more or less remain the same, but its use and management would be better regulated.

Rehabilitation and retrofitting would assume the development of local regulations on water use from small reservoirs for various uses. These need to be tailored, depending to match the demands of users around each small reservoir. As current experiences show, these can be partially derived from existing practices, but further forecasting of uses may be complex. Reservoir users would need third party support to facilitate decision-making on local regulations. It is not likely that the current top-down oriented approach can facilitate such decision-making. Most likely, there will be competing claims with irrigators the biggest users. Competing claims between user groups will probably be more about accessing the infrastructure and less about the amounts used, although there may be issues on how to use the storage space effectively.

All the above implies that when rehabilitation is done, a participatory approach is followed in which all water demands around the reservoirs are assessed and taken into account in the design. Under the current top down interventions, this is not likely to happen and may constitute a barrier for the implementation of this modality.

Institutional arrangements

This modality assumes a big step in development of institutional arrangements around reservoir management. At the lowest level, it would imply strengthening WUAs and other local organisations to represent different uses in the management structure. It may thereby follow the ideal modality presented earlier of an inclusive WUA, or follow other local arrangements. This would require that intervening agents, particularly GIDA, contractors and District Assemblies, dedicate attention and resources to local institutional development. Under the current top-down intervention approach, this is not likely to happen and may constitute a barrier for this modality.

Once WUAs are functioning, this implies that they need to get support from different agencies in managing water beyond the current support from MoFA, which is mainly only on agronomic aspects, as well as support from other line agencies.

Costs and financing

No data exist on the incremental costs of infrastructure development for multiple uses as compared to the current practices of irrigation. Total basic costs of rehabilitation are some 100,000 USD/reservoir. The most expensive incremental cost would be the development of complementary domestic water supplies, either through boreholes or filtration galleries, the number of which depends on pre-existing water supply facilities, but can be assumed to represent an incremental cost of 30-60 USD/capita. In addition, there are the costs of smaller infrastructure components such as cattle troughs and access points for brick makers and fishers.

However, the actual incremental costs lie in the need to have a more intensive participatory process of planning, design, and establishment of local institutional arrangements and support. Such processes take time and resources. Compared to the short intervention processes now, the costs may increase significantly. Having said that, such processes may result in more sustainable use of small reservoirs and thus in a higher cost-benefit ratio.
It must be noted that investments in small reservoirs are only merited where irrigation development actually takes place. As Venot *et al.* (2011 forthcoming) describe, in many cases, people are satisfied with just having reservoirs for domestic and livestock uses and only minimal irrigation development. If reservoirs are really only used for those uses, they are an extremely expensive way to provide water—a total per capita cost of over 300 USD/capita, compared to the 30-60 USD/capita for point sources of small town piped supplies. It should be considered only where groundwater development or permanent streams are unavailable. This is likely to be the case only in the northern belt, and not the Upper West and Upper East Regions, where groundwater is more accessible. From the

viewpoint of financial viability, this means that small reservoirs should have irrigation as a primary purpose with other uses as additions.

A major limitation of this modality lies in the operational costs, particularly the capital maintenance costs. Basic operations can be done through *ad hoc* community mobilization. However, with the lack of adequate capital maintenance arrangements, this modality is not likely to be sustainable, with or without multiple uses of water.

Technical issues

The key opportunity and challenge for this modality lies in the required technical additions to equip small reservoirs for better multiple use. Specific infrastructure for cattle watering, for example, can be easily accommodated, although they do require standard designs. The main technical complexity lies in the possibility to include infrastructure for domestic water supply. There are three basic options:

- Adding boreholes or wells with hand pumps in the command area. This may go beyond the mandate of GIDA to include hand pumps and can probably be done only when coordinated with CWSA.
- Adding a infiltration gallery to treat reservoir water to potable level and facilitate access through sprouts for domestic use. This has been tried in a number of cases. It requires developing standard designs for the technology so that it becomes part of the GIDA package.
- Promoting household water treatment technology. This may fall outside the mandate and expertise of GIDA. Given the current experiences with household water treatment in the country, this may not be a sustainable solution

Scaling pathway

Unlike the domestic-plus modality, the scaling pathway is less clear. Two options exist:

Via NGOs. NGOs claim to have more experience and expertise in participatory approaches required to include multiple uses in reservoir rehabilitation and development. Pilot projects may be developed with NGOs to develop a standard intervention cycle that takes multiple use into account, and to standard designs for the various uses. The disadvantage of this modality is that these intervention cycles may not be in line with GIDA procedures and processes for planning and design, and hence be less scalable.

Via GIDA, through donor-funded projects. Future investments are likely to come from donors and will be channelled via GIDA. Pilot projects can be included in the terms of reference where the inclusion of multiple uses is specified. This needs to be accompanied by a strong research and learning component to ensure that lessons are captured and included in the standard intervention cycles. Whether there is openness and space in such programmes remains to be seen, as these often have tight time paths and less space for experimentation.

Local integrated water resources planning and development

Description of the modality

Local integrated water resources planning and development consists of developing local water plans based on a participatory planning process with communities and their subsequent implementation. These water plans may have single use infrastructure components, such as a borehole for drinking water supply, or for multiple use, like a small reservoir. The planning would be done without any pre-defined sectoral boundaries, and be limited only by available budgets and community needs and capacity to operate and maintain their services.

Potential target groups of beneficiaries

In theory, this modality can be applied in any community or district. However, priority would be in those communities where there are known large unmet water needs. Knowing that some 30% of the population has no access to domestic water services, it would benefit at least 3 million people. Again, the northern belt would be a priority region, as it is likely that, apart from domestic uses, there will be other unmet water needs. The total population that can benefit from this would be 1.5 million people.

Policy, legislation and regulation

At the moment, such open-ended local water planning is not backed up or supported by any legislation. In the domestic sector, District Assemblies are supposed to develop District Water and Sanitation Plans, with water and sanitation as primary entry points. In the rehabilitation of small reservoirs, similar plans may be made but with irrigation as the entry point. Yet, there is no supporting policy for broader water plans. The lack of any supporting policy does not mean that this modality cannot be followed, but it is not likely to be initiated by any government body. This would be a major limitation for scaling up. However, elements can be applied in the sectoral planning processes to help open up the scope of these plans.

Water resources

The idea is that communities assess their available water resources, their needs and try and match the two by identifying infrastructure and services they would need to make use of those resources. Because of the localised level, their impact at basin scale is probably negligible, and the plans would address priorities and competition at the local level.

Institutional arrangements

It is not clear what institutional arrangements would be needed. Interviewees point to the following:

- Dedicated integrated rural development projects, such as CBRDP. These are so far the only projects where this modality is applied. These projects identify water needs, and then draw on sectoral expertise and designs to develop water sources according to these needs. This arrangement has as the limitation that it is not institutionalised in any long-term service delivery plan.
- District Assemblies. Ideally, districts should develop integrated development plans for their area of jurisdiction. However, as there is no such a thing as a district water plan, only sectoral plans, it is not likely that districts will adopt this practice.

- Water Resources Commission. Various interviewees consider the WRC should promote this modality. However, the WRC is highly centralised and this modality would require strong local level presence, requiring also capacity on the ground.

Probably in the medium- to long-term, District Assemblies together with the WRC may develop this modality further, but not in the short term.

Costs and financing

The costs of infrastructure development will be similar as to those developed through line agencies. The main cost effectiveness of the modality lies in the fact that multiple benefits are derived from investments in infrastructure. Institutionally, this follows the process only once, reducing in theory the overhead and transaction costs.

Technical issues

Even though this modality will identify needs for multiple uses, the technologies through which to provide uses will be largely conventional. Few adjustments will be needed.

Scaling pathway

Given the lack of clear policy back-up, and limited capacity of the main government agencies tasked with integrated water development, the only viable scaling pathway in the short term is through NGOs and integrated rural development projects. Some of these are already operational (e.g. CBDRP). The scaling pathway would therefore start with identifying and sharing lessons from these experiences more widely. A next step would be promoting these lessons more widely among other NGOs and projects for further scaling up. However, given the relatively small role of NGOs, it is not likely that these will scale up to a significant level.

Promoting complementary self-supply

Description of the modality

Promoting complementary self-supply consists of promoting the development of self-supply alongside formal supplies to complement domestic and other productive uses. This may eventually include self-supply as a stand-alone option for multiple uses, although the potential is not clear at this moment, and no assessment is made here of that potential. By combining formal supplies with self-supply, the combined service level to which users have access will increase. Extrapolating from the findings of WASHCost, it can be expected that in the Southern Region of the country, this would mainly be for domestic uses as shown earlier, and in the northern belt for both additional domestic and productive uses. The total service level to which users have access would increase to an intermediate level of MUS or higher. It would allow families to combine sources of different quality, quantity and cost to meet their needs.

Household members would invest most in the development of these alternative sources, although they may be partially subsidised. The most likely technologies to be promoted would include shallow wells, rainwater harvesting and open water sources, but also means to develop them, particularly low-costs drilling. This modality is thus mainly one of promotion and not direct investment. It must be noted that this model may be combined with various other domestic-plus modalities to increase total access to water.

Potential target group of beneficiaries

The potential target group consists of all those users who already have some level of access to water services, as self-supply is likely to be a complementary source only. Already a large group of people do have alternative sources, and it can be safely assumed that alternative sources that are easily accessible are already being used or can be without additional support. We would be focusing on families and communities where some additional support would be needed to develop alternative sources, particularly in the northern belt.

There are some 4 million people in the northern belt, of whom 2.5 million already have access to some formal supplies. Out of this potential target group of 2.5 million, around half already have developed informal sources alongside their formal supplies, hence, the potential target group is 1.3 million people. In addition, there are 1.5 million people currently without formal supplies. As they would get access to formal supplies over time, they would also complement those with self-supply and can therefore be added to the potential target group as well, leading to a grand total of 2.8 million people.

Policy, legislation and regulations

Self-supply is not a formal service delivery model in Ghana (IRC and Aguaconsult, 2011), and there are no specific policies or regulations that endorse, promote or regulate it. For this modality to be scaled up, supporting policy will be needed. Piloting can inform policy development processes.

Water resources

The amounts to be harnessed via complementary self-supply will be small, even when scaled up. Only locally there may be water resources issues to consider, for example when users share open water bodies. Also, water quality may need to be considered when linking resources to possible uses.

Institutional arrangements

Under self-supply, it is clear that individual households, or at most groups of households, are responsible for the development of the source and its subsequent management. No dedicated organisations are required. What is less clear are the institutional arrangements. There are several options:

- Some self-supply arrangements may be promoted by projects or NGOs. For example, rainwater harvesting as a complementary source is being promoted by various NGOs and projects, as are rope pumps.
- Market-based mechanisms. Literature on self-supply also refers to market-based mechanisms to promote self-supply (e.g. Sutton and Smits, 2011), under which families are encouraged to develop their own supplies
- Promotion through agencies responsible for domestic water supply. CWSA, WATSANs and the WSDBs may encourage their customers to develop their own sources to complement formal supplies. However, it is not likely that this can happen easily, as it would mean cutting out their own customer base.
- Promotion via agencies responsible for broader development and water resources management. Various interviewees see a role here for the WRC and the District Assemblies. However, the WRC is currently too centralised and under-capacity to take up this role. District Assemblies, because they are decentralised, could play a role, but interviewees point to the generally weak capacity of the District Assemblies.

For this modality to take off, the institutional arrangements need to be more clearly defined, as some arrangements may counteract each other. For example, the promotion of market mechanisms may be offset by projects that partially subsidize household options.

Cost and financing

Any self-supply development will require a certain level of investment, which, for an individual household, may be considered high. At this time, there is little life-cycle cost data on self-supply options that can be used to assess their viability. There will be a cost for the establishment of market mechanisms or promotion mechanisms, which would need to be covered through projects or grants.

Technical issues

Looking at the current experiences with rope pumps and rainwater harvesting as two main examples of self-supply technologies, there is still a need for further technological development to improve their performance and bring their costs down. This will need structured pilots, learning and adaptation.

Scaling pathway

The first step is to clarify institutional arrangements for promoting self-supply as a complementary source. It is also possible to have different scaling pathways for different self-supply options such as rope pumps and rainwater harvesting. A dedicated working group on self-supply could be established at sector level organisations with experience in promotion of self-supply or household technologies who would set out one or more pathways. A combination of project, NGO, and market based approaches is likely to work. It is less likely that in the short term either dedicated domestic water supply agencies, the District Assemblies or the WRC will be able to lead this scaling pathway.

Supporting self-supply for irrigation as priority

Description of the modality

Supporting self-supply for irrigation as a priority is farmer-driven. It consists of creating market conditions to further encourage farmers to invest in their own (groundwater) development for irrigation, and possibly other uses. Specifically, it would entail promoting supply chains for cheap motorised pumping technologies, which includes after-care, informing and building the capacity of farmers and extension workers to operate and maintain pumps, creating loan facilities, and providing extension support for farmers to start and expand irrigating their fields (Namara, 2011).

Pumps installed near homesteads are likely to be used for multiple purposes, but in distant fields they are likely to be used primarily for crops. This modality would be complementary to other modalities.

Potential target group of beneficiaries

The potential target group is estimated at 1.85 million households with a potential irrigated area of 2.35 million hectares, both in the Southern coastal zone and in the northern belt (Namara, 2011).

Policy, legislation and regulations

In principle, the National Irrigation Policy supports this modality as it seeks to dramatically increase irrigated area, which is not likely to happen with public funds only. Promoting self-supply is needed to meet the policy objectives of increasing irrigated area. However, the policy does not provide any indications of how to reach out to this group of potential irrigators. The water resources regulations, if enforced, would limit the practice because farmers would have to register their water use, even if they irrigate less than 1 hectare. In practice, this regulation is not enforced.

Water resources

Ofosu (2011 forthcoming) looked at different scenarios for irrigation development in the White Volta basin. If the current growth rate of 5%/year in private irrigation continues up to 2025, that would still be sustainable in terms of groundwater, although progressively deeper wells would need to be drilled. Impacts on surface water would be minimal. Only if the rate of growth increased further, will there be trade-offs between surface and groundwater sources and groundwater levels will permanently drop. Whether these results can be extrapolated to other parts of the country is not known, but it is likely that in most of the country there is still substantial scope for water resources development at sustainable levels.

Institutional arrangements

This modality would require working on different market development mechanisms to promote self-supply, such as establishing supply chains, ensuring support for repair, informing and training farmers and extension workers on the quality of different pump types and proper use of the pumps, providing loans for capital investments, and general extension on irrigated farming. It is unlikely that GIDA will have the capacity in the near future for such types of activities. Dedicated projects such as those in the Volta region may be better equipped to develop such arrangements. In the absence of dedicated promotion mechanisms, scaling up will probably be at the same pace as at present.

As it is a modality based on individual farmers, it would not require elaborate local institutional arrangements. In some areas where many individual farmers share an open water source or aquifer, support may be given to establishing associations of users to deal with competition and cooperation.

Costs and financing

This modality is based on farmers paying the full upfront investment costs as well as the operational costs. The unit costs depend on the complexity of the technology, ranging from simple shallow wells with a foot pump, to boreholes with motorised pumps. The main challenge will be to create market conditions which bring these costs down. In addition, the modality requires an investment in creating markets. This will probably need to be done as part of project grants.

Technical issues

There is already an existing range of technologies as described in Namara *et al.* (2010), but there is further scope in promoting awareness of these technologies. There is scope Also to improve supply chains, for example, in after sales support. There is ample scope to work on improving drilling technologies to bring down the costs of borehole development. A number of donors have been providing assistance through pilot projects (see Namara *et al.* 2010).

Scaling pathway

The scaling pathway is fundamentally market-based: farmers will scale up if and when their investments in water development can be earned back through their production. For this market mechanism to start functioning, an initial effort will be needed to make the markets work, by promoting supply chains, promoting self-supply options, bringing down the costs of technology and providing loans, for which dedicated market development projects will be needed. They may need to be accompanied by projects to improve agronomic practices to improve yields.

Promoting peri-urban agriculture through improving conditions for the reuse of wastewater

Description of the model

Promoting peri-urban agriculture assumes that most water needs for peri-urban agriculture around the 3 cities of Accra, Kumasi and Tamale would have to be met from open water sources, which is most likely to be low water quality. The basic objective would be to reduce health and environmental risks of wastewater and other low quality water irrigation. Because of the complexities in the current reuse practices, this modality would imply an integrated approach that looks at interventions along the entire sanitation and wastewater chain as per the recommendations for a multi-barrier approach (Drechsel *et al.*, 2010) and may include any of the following: improving sanitation in cities, development and improved management of sewers and drains, gradual increase in treatment facilities, improvements in farmers' practices in the hygienic management of wastewater, and better handling of irrigated produce in the food processing chain.

Although examples exist of each of those components along the chain, fully integrated sets of interventions along the chain are rare. Farmers in other cities also engage in peri-urban agriculture as well, but the open water sources are much less polluted. In these cities, informal peri-urban agriculture is similar to what has been described earlier on promoting self-supply for irrigation more generally. This modality focuses particularly on low quality water and wastewater.

Potential target group of beneficiaries

The target group consists of all wastewater farmers in Accra, Kumasi and Tamale. This includes an estimated 10,000 farmers cultivating around 13,000 hectares. There may be other indirect benefits for other stakeholders. For example, improving sewers and drains may provide a positive impact for all people who live in their surroundings. Urban consumers would benefit indirectly as the food they consume would be freer of health risks and cheaper as it is locally produced.

Policy, legislation and regulations

The National Irrigation Policy has clearly defined objectives to improve the conditions of wastewater farmers and identified strategies, hence, this modality has a strong policy backing. In addition, there are various initiatives to improve sanitation and wastewater management, as also articulated in various policies.

Water resources

The level of complexity of this modality is high. Many wastewater farmers depend on drains both engineered and natural. Changes in sanitation and wastewater infrastructure may alter these courses and even take water sources away from farmers. Also the patterns and origins of pollution are complex. It would require an integrated urban water management approach to first understand the situation and then develop solutions, as for example identified in Adank *et al.* (2011).

Institutional arrangements

More complex than water resources are the institutional issues related to wastewater farming. Interventions along the sanitation and wastewater chain will require the involvement of urban authorities, line agencies, farmers, donors, and many others. A multistakeholder approach will be required (see Smits *et al.*, 2009; Adank *et al.*, 2011) to do the integrated interventions that are needed.

Costs and financing

The costs involved in this modality will depend largely on the scale of intervention. Sanitation, sewerage development and wastewater treatment are hugely expensive undertakings, some of which are part of existing donor-funded programmes. And even those are too small compared to the need. Smaller specific interventions can be identified that involve little additional costs, ranging from repairing a drain to training farmers in hygienic practices.

Technical issues

The technical challenges are also large, particularly with respect to the major urban infrastructure, or the lack thereof, around sewers and drains. Few examples exist in the country where wastewater is treated in a sustainable manner. This is an area that needs more research and development

Scaling pathway

Given the size and complexity of the entire sanitation, wastewater and reuse chain, a realistic scaling pathway should be based on parts of the chain and probably in a limited pilot area. Within the limits of a pilot area, actions can be identified to improve wastewater management practices and implemented and will provide lessons that can be applied more widely.

Discussion: Comparative feasibility of the different MUS models as investment opportunities

Table 6 summarises the proposed MUS models in terms of potential impact and the costs involved. Based on these figures, we conclude that all domestic-plus approaches have a **high potential to reach large numbers of people but with small per capita impact**. The per capita impact would be relatively small in terms of improved livelihoods, as people would only have access to basic to intermediate levels of MUS, although even a health impact through improved access to water supply would be important.

The domestic-plus approaches are relatively low on risk, with low investment costs, known technologies and institutional frameworks. The general poor performance and sustainability, particularly of the rural point sources, is a major risk. The scaling pathway is relatively straightforward as there is willingness on the part of domestic water supply agencies to gradually improve service levels, and there is a high level of investment in this sector. Domestic-plus modalities can all be combined with the promotion of self-supply.

The rehabilitation of public irrigation schemes has an **unknown potential that merits further assessment**. The near complete absence of information on public irrigation systems makes it difficult to give a balanced assessment as an investment opportunity. The fact that donors and GIDA are discussing rehabilitation efforts after many years of neglect indicates that there is some interest in revitalizing irrigation schemes. Including multiple uses of water could be done, and probably at reasonable incremental costs. More detailed assessments would be needed to provide more insight into what those costs might be. In fact, a first investment opportunity in this domain would be the funding of such studies to inform discussions on rehabilitation of irrigation schemes.

Rehabilitation of small reservoirs has a **higher potential impact but with higher risks**. The scaling pathway for small reservoirs can reach fewer people than the domestic-plus approaches, but with the potential of higher impact per capita. The condition for realizing this impact is that irrigation development takes place effectively and is sustained. If irrigation does not take off as expected, and the reservoirs only provide water for domestic and other uses, the per capita investments would be extremely high. Only when no other water sources are available should small dams be considered. The risks of this approach are exacerbated by the current top-down planning practices, and above all by the poor track-record of sustainability and the lack of arrangements for capital maintenance. The major argument in favour of this investment opportunity is that these investments will happen anyway through various donor-funded projects. Rockefeller Foundation could decide to top up these investments and strengthen planning approaches with a view towards a more participatory approach that takes account of multiple uses.

Table 6: Comparison of potential impact and costs of MUS modalities

MUS modality	Potential number of target beneficiaries	Per capita impact	Per capita costs (USD/capita)
Domestic-plus			
Communal productive use of point sources	3,6 million	Basic level of MUS	30 USD plus minor incremental costs
Productive use of piped schemes	120,000	Basic to intermediate level of MUS	Mainly for institutional development
Limited mechanical schemes	90,000	Basic to intermediate level of MUS	30 USD plus incremental costs of 4-5 USD/capita
Irrigation-plus			
Rehabilitation public irrigation schemes	55,000	To be defined in more detail, and will be scheme specific	Full rehabilitation costs will be high, but incremental costs of including MUS are likely to be minor
Rehabilitation and retrofitting of small reservoirs	1.25 million of which some 37,000 irrigators	High impact if and when irrigation takes place	100.000 USD/dam Per capita costs depend on the type of uses included
Community MUS			
Local integrated water resources planning and development	1.5 million	Depends on type of infrastructure to be developed	Similar to costs of domestic or irrigation development. Probably cost savings
Self-supply			
Promoting complementary self-supply	2.8 million	Intermediate to high level of MUS	No data
Supporting self-supply with priority for irrigation	1.85 million	High	Depends on specific technology, plus costs of supply chain development
Promoting peri-urban irrigation through reuse of wastewater	10,000 farmers, large number of indirect beneficiaries	Unclear	Depends on scale and type of intervention

The approach of local integrated planning has **low potential in the short term**, although this may increase over time. It relies heavily on the capacity of local government and others for effective bottom-up participatory planning, a capacity which is severely limited at the moment. Only within the scope of specific projects could this approach be tested and developed, but even then the potential to reach scale will be limited. Only in the medium to longer term, as this capacity develops, will it become a more viable option. Elements of local integrated planning can be included in the domestic-plus models and in the rehabilitation of small reservoirs.

Promoting self-supply to complement formal sources of domestic supplies has **potential as a complementary approach**. A key limitation is that, at this time, there is no clear scaling pathway due to a lack of definition of institutional responsibilities *vis-à-vis* this model. It may be an investment opportunity to help developing frameworks and supply chains. A specific area would be household water treatment.

Self-supply for irrigation as a priority has a **high potential**. The potential of this approach is probably high, as the costs per hectare are well below those for small reservoirs. The scaling pathway is through the market and specific interventions that help create the market conditions necessary for this approach to take off.

Promoting peri-urban agriculture through improved reuse of wastewater (and other low quality open water sources) represents a **complex intervention with unclear impact**. The impact is unclear as the total number of direct beneficiaries is small, but high when considering the indirect beneficiaries, including urban consumers of crops produced with wastewater and urban dwellers with poor access to sanitation and wastewater management services. The intervention would be complex, as it would require engagement in broader issues of urban sanitation and wastewater management, where institutional complexities are high and investment costs would be high.

6. CONCLUSIONS AND A WAY FORWARD

Although in Ghana much water-related research and development has been done, most has not been framed in terms of multiple use of water. This scoping study has revealed that in formal domestic and irrigation service delivery, water is used to some extent for *de facto* multiple uses. The extent of this is far below the potential of a more structured MUS approach. In addition, there are many self-supply initiatives by household members to access water to complement formal services for domestic uses, irrigation and multiple uses. Moving from *de facto* practices to a more planned and structured MUS approach requires a mix of modalities, including working within the sectoral mandates of the domestic water supply and irrigation sectors, promoting self-supply through market mechanisms and more participatory integrated water planning and development.

Combining modalities has led us to the identification of nine MUS models, each with its own feasibility assessment. Of these, the three domestic-plus models, rehabilitation of small reservoirs, and self-supply for irrigation present the most direct and readily available investment opportunities. The caveat must be made that both domestic systems and small reservoirs present sustainability problems, which a more participatory approach under MUS alone is unlikely to fully solve.

The other approaches of rehabilitation of public surface irrigation schemes, local integrated water resources planning, and complementary self-supply might become feasible opportunities over time, but they would require more research, institutional development and strengthened capacities. The approach of promoting peri-urban agriculture through improved reuse wastewater is only an investment opportunity of interest if the broader issue of sanitation and urban wastewater management is included. A tenth investment opportunity is the development of institutional capacity within the Ghana water sector for MUS. All MUS models would benefit from structured learning, action-research and clarifying institutional roles. These initiatives should be seen as cross cutting investment opportunities to support all MUS models.

Consortia for the scaling pathways

Taking the MUS modalities forward requires working with sector organisations through several consortia. Based on the interviews, the consortia below are identified for the three MUS modalities with high immediate potential, as well as for the tenth cross cutting model. For each consortium, potential partners are suggested as well as a possible role for the Rockefeller Foundation within each. Without further research, it would not be desirable to define consortia for the other MUS models.

The **domestic-plus approaches** would all require a partnership with CWSA and the other actors in the domestic water supply sector, such as the District Assemblies, WATSANs, WSDBs and possibly GWCL, depending on the specific focus (urban, small town, limited mechanization schemes and rural). In addition, partnerships should include donors and funders who channel their investments via CWSA. One role the Rockefeller Foundation could play in such a consortium is in providing additional funding for infrastructure development. Due consideration needs to be given to the added value of investing as there are numerous investments in play. More value could be added if the Foundation plays a role in promoting and supporting MUS innovations. Examples of this would include funding pilot projects for the high potential modalities. We would recommend expanding the consortium to include existing working groups and learning platforms in the sector, notably the RCN Ghana and CONIWAS, as they are mandated to play just such a role.

The **rehabilitation of small reservoirs** would involve a smaller consortium as there are fewer stakeholders involved. GIDA would be the key partner, as would its principal donors. Possibly NGOs could join this consortium. In this consortium, there is probably more added value in providing support to infrastructure development, as the amount of funding is much lower than in the previous set of approaches. Rockefeller could play a role in supporting and promoting innovation and the documentation and learning. To our knowledge, there are less clearly articulated fora and mechanisms for piloting, learning and sharing in the irrigation sector in Ghana as of yet. There would be added value if the Rockefeller Foundation could support the establishment and development of learning platforms and networks around irrigation, building on the research by IWMI, AGRA, IFAD and others.
It is not clear with whom consortia can be built for promoting **self-supply for irrigation**. GIDA would be an obvious partner, although it has little experience in promoting self-supply. There may be other donors who might be interested to join this initiative. This requires more in-depth discussions. Here, Rockefeller's role would be one of mobilizing and possibly even providing technical expertise on how to develop supply chains and market mechanisms for self-supply. This would not entail a role in investing directly in infrastructure or equipment or providing subsidies.

There remains the cross-cutting investment opportunity of supporting **institutional development for MUS**. This includes, on the one hand, the target partners, particularly the government agencies: CWSA, GIDA the WRC and at decentralised level the District Assemblies, and on the other hand, organisations and networks with a mandate for activities such as training, institutional change, learning, research and networking. Some of these have been discussed for the three high potential models. Others may exist. Such a consortium may also include funders in the water sector. Rockefeller's role would be one of mobilizing and providing technical expertise on institutional development, or financing such activities. It would not necessarily include investments in direct water development, although this could be part of certain pilot activities. A specific point to consider is the linking of Ghanaian consortia on MUS to the international MUS Group.

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