Executive Summary

1. Background

2. Findings: Costs and benefits

3. Findings: Poverty Impacts

4. Findings: Market Mapping

5. Opportunity Action Areas

6. Strategic considerations for implementation

1.1 Definitions

1.2 Purpose and Hypotheses

1.3 Research Goal and Methodology

1.4 Caveats and Limitations

1.5 Knowledge Gaps

1.1 Definitions

Water services

Water service is defined as the provision of water of a given quality, quantity and reliability at a specified place. The definition emphasizes outputs—what people receive—rather than infrastructure that are implied by such terms as 'water supply scheme' or irrigation scheme'. In this study, water service levels provide the architecture for evaluating costs and benefits and market opportunities. Different levels of water service support differing levels of domestic and productive activities.

Single-use

Single-use approaches involve design, finance and management of water services for a single intended use, such as for irrigation or domestic purposes. In actuality people often use the water supplied for multiple purposes—with possible consequences for human health and sustainability. Single-use approaches are the standard model of water service delivery.

Multiple-use

Multiple-use approaches involve planning, finance and management of integrated water services for multiple domestic and productive uses based on consumer demand. Recognizing the predominance of sector-based services and differences in service delivery models, our typology includes two types of multiple-use services—domestic+ and irrigation+. Domestic+ approaches involve provision of water services for domestic as well as productive activities. Irrigation+ approaches involve provision of water services for irrigation as well as domestic and non-irrigation productive activities.

1.2 Purpose and Hypotheses

Purpose of the study

The purpose of this study is to help inform prospective investments in the water sector by 1) evaluating whether or not multiple-use water services are a good investment compared to single-use services in terms of poverty impacts, cost-benefit ratios and sustainability, and 2) determining whether there is a potential market for such services in South Asia and sub-Saharan Africa.

Hypotheses

The study tested three basic hypotheses.

Hypothesis 1

Null: The net benefits of multiple-use approaches are greater than those of single-use approaches

Alternative: The net benefits of multiple-use approaches are the same or less than those of single-use approaches.

Hypothesis 2

Null: Multiple-use approaches more comprehensively address the multi-dimensional aspects of poverty than single-use approaches.

Alternative: Multiple-use approaches *do not* more comprehensively address the multi-dimensional aspects of poverty than single-use approaches.

Hypothesis 3

Null: The potential market for multiple-use approaches is large.

Alternative: The potential market for multiple-use approaches is small.

1.3 Research Goal and Methodology

Goal and Questions

Study Goal: The goal of this study is to help inform prospective investments in the water sector by assessing the potential of multiple-use water services to sustainably meet the water needs of the poor.

Research Question One: What are the incremental costs and benefits of multiple-use approaches over single-use approaches?

Research Question Two: Where do multiple-use approaches apply and who are the main beneficiaries?

Methodology

Develop a framework for multiple-use services that defines service levels

Assess incremental costs, benefits and poverty impacts of multiple-use approaches for different market entry points (domestic and irrigation) for commonly observed activities that have a proven potential to generate income and to enhance livelihoods, health and social equity.

Evaluate the potential market for multiple-use water services by entry point (such as domestic+, irrigation+, multiple-use by design) and number of potential beneficiaries and their socioeconomic characteristics.

Identify potential opportunity areas

1.3.1 Framework: Water Service Levels

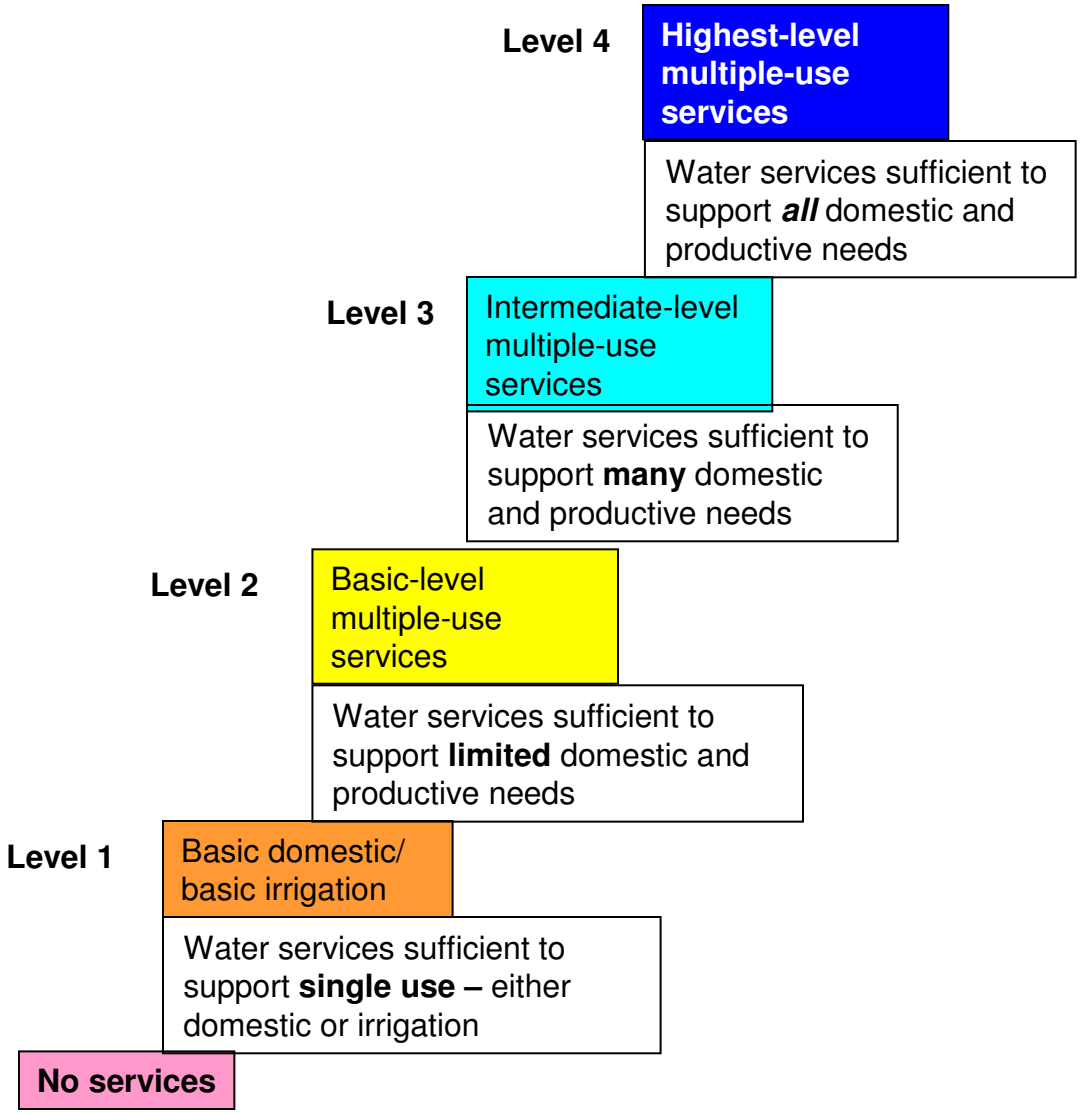
The research team developed a framework of service levels for analyzing the incremental benefits and costs of different water service approaches.

Building on the definitions of "no service" and single-use "basic domestic" and "basic irrigation" services, the research team defined three additional levels of water services required to support varying levels of both domestic and productive uses.

Each different service level represents changes in two or more of four variables: quantity, quality, distance and reliability.

To reflect fundamental differences in water service provision, our typology includes separate service level definitions for "domestic-plus" and "irrigation-plus" approaches. In general, domestic+ approaches involve increasing the quantity and reducing distance between source and homestead. Irrigation+ approaches involve reducing distance between source and homestead and improving quality

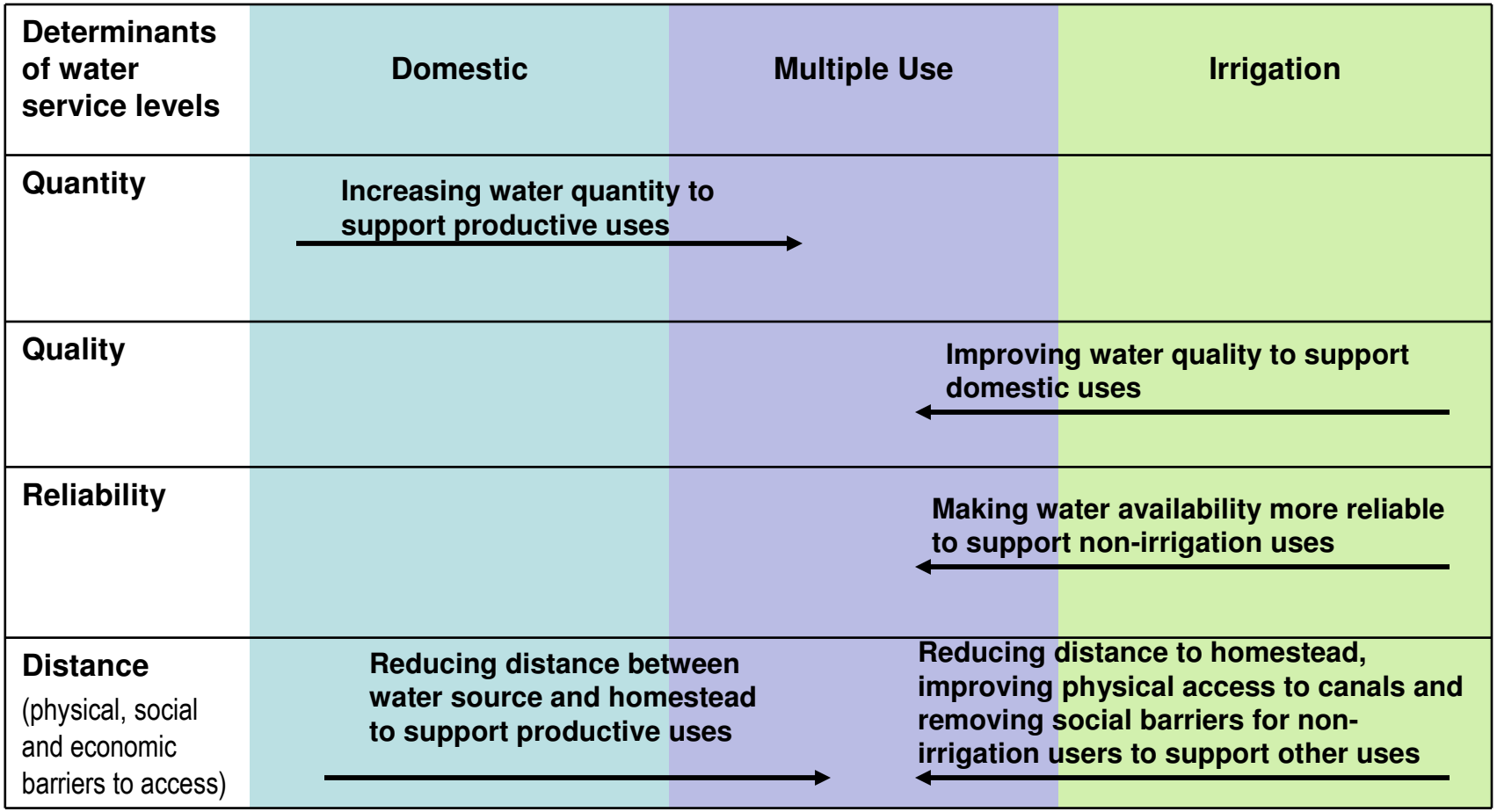
See sections 1.3.3 and 1.3.4 for service level definitions



1.3.2 Water Service Levels Required to Support Multiple Uses

For existing domestic services, supporting multiple uses requires increasing water quantity and reducing the distance to the source.

For existing irrigation services, supporting multiple uses requires improving water quality to support domestic uses, improving reliability, and reducing distance from source to homestead and other access barriers.



1.3.3 Domestic+ Water Service Levels Defined

Service level	Overview	Quantity (lpcd)* *Per capita*	Quantity for productive use at *household* level	Needs met and multiple use potential
Highest-level multiple uses	**House and yard connections** Access: at homestead Quantity: > 100 lpcd Quantity: Improved source Reliability: daily	>100	>475	Sufficient for domestic needs Not all but in some combination: Sufficient for livestock Sufficient for gardening (~50m^2 – >200m^2) Sufficient for many small-scale enterprises
Intermediate-level multiple uses	**Improved source very close to home**. Access: < 5 minutes roundtrip, < 150m Quantity: 40 – 100 lpcd Quality: improved source Reliability: daily	40-100	175 – 475	Sufficient for basic domestic purposes Not all but in some combination: Sufficient for livestock (7 – 17 cows) Sufficient for gardening (~25m^2 – 200m^2) Sufficient for some small-scale enterprises
Basic multiple uses	**Improved source, easily accessible** Access: < 15 minutes roundtrip, < 150-500m; Quantity: 15-50 lpcd Quality: improved source Reliability: daily or storage	15 – 50	50 – 280	Sufficient for basic domestic purposes Not all but in some combination: Sufficient for some livestock (15 goats/8-10 cows) Some gardening, especially with re-use(~10-100m^2) Some small-scale enterprises
Basic domestic	**Improved source** Access: up to 30 minutes roundtrip, < 1km Quantity: 10-25 lpcd Quality: improved source Reliability: daily or storage	10-25	25 - 100	Sufficient drinking and cooking Hardly sufficient for basic hygiene Not all but in some combination: Insufficient for cleaning house Possibility for re-use for horticulture and very limited livestock (chickens or goat)
No service	**Unprotected or distant improved sources** Access: > 30 minutes roundtrip, >1 km Quantity: < 5 lpcd Quality: unimproved source Reliability: daily	< 10	<25	If improved source, may be sufficient for drinking and cooking but too distant Insufficient for basic hygiene

*lpcd = liters per capita per day

1.3.4 Irrigation+ Water Service Levels Defined

Service level	Overview	Quantity (lpcd) *Per capita*	Quantity at homestead for domestic & productive use at *household* level	Needs met and multiple-use potential
Highest-level multiple uses	**Access**: household connections or storage **Quantity**: 50-200 lpcd extra allocation for multiple uses **Quality**: good drinking water (5-10 lpcd) through individual home water treatment **Reliability**: daily	50-200	250-1000	Sufficient for domestic needs Sufficient for livestock Sufficient for home gardening Sufficient for fisheries Sufficient for small-scale enterprises
Intermediate-level multiple use	**Access**: under 150m or 5 minutes roundtrip **Quantity**: 50-200 lpcd extra allocation for multiple uses **Quality**: good drinking water (2-5 lpcd) through individual home water treatment **Reliability**: daily or storage	50-200	250-1000	Sufficient for basic domestic purposes Sufficient for livestock Sufficient for some home gardening Sufficient for fisheries in canals and reservoirs Sufficient for small-scale enterprises
Basic multiple use	**Access**: dependent on infrastructure; under 1 km or <30 minutes roundtrip **Quantity**: 10-100 lpcd extra allocation for multiple uses **Quality**: suitable for irrigation **Reliability**: according to irrigation storage but flexible because of storage	10-100	50-500*	Inadequate quality for drinking Partially sufficient for basic hygiene (canal use) Sufficient for livestock Sufficient for limited home gardening, if water is easily accessible Sufficient for fisheries in canals and reservoirs Sufficient for small-scale enterprise
Basic irrigation	**Access**: dependent on infrastructure **Quantity**: based on crop requirements and plot size **Quality**: suitable for irrigation **Reliability**: access to, and availability for non-irrigation uses not formalized	Per irrigation requirements and plot size	<50	Inadequate quality for drinking, sufficient for cooking Partially sufficient for basic hygiene (canal use) Sufficient for livestock, but access may be difficult Hardly sufficient for small-scale enterprises Non-consumptive uses such as laundry water mills accommodated

*At the Basic Multiple Use service level, additional water is made available at shared communal facilities rather than at the homestead.

1.3.5 Methodology: Analysis of Benefits, Costs and Poverty Impacts

The research team used to the following process to analyze the costs and benefits of multiple-use approaches compared to single-use approaches (see Annex B for further details on the methodology).

Step 1: Assess type and extent of uses supported at each service level. To assess incremental benefits, the research team identified the most common types of uses observed and extent supported at each water level, drawing from existing studies and field observations, which were validated through interviews with experts in the field.

Step 2: Estimate income generated from productive uses by service level. At each service level, the team calculated the potential income generated from home gardens, livestock and small-scale enterprises using the following process:

a) Reviewed literature to identify estimated returns by activity area.
b) Standardized estimates to common units to allow comparison, including currency conversion to 2004 purchasing power parity international dollars (PPP $I).
c) Estimated average returns per activity using standardized estimates gleaned from the literature.
d) Calculated potential income generated from livelihood activities at each service level, estimating mean income generated by the extent of the activity supported at each service level for varying levels of productivity and seasonality of production.
e) Validated income estimates by activity and service level by cross-checking with available estimates from the literature, where possible, and with experts in the field.
f) Converted household-level income estimates to per capita estimates to make comparable to cost data.
g) Estimated incremental income benefits by taking the difference between income generated at each service level.

Step 3: **Estimate costs by service level and technology** using the process outlined below. Estimated costs include hardware, software and annual recurrent costs.

Hardware

- Selected technologies for the cost analysis based on prevalence of use by rural populations in South Asia and sub-Saharan Africa[1], potential to support multiple-use services and availability of data. Domestic+ technologies evaluated include: Networked piped systems, communal boreholes with hand pumps, hand-dug wells, and infrastructure add-ons such as livestock troughs, lifting devices and community gardens. Irrigation+ technologies include: large-scale irrigation systems and infrastructure add-ons to support domestic and productive activities such as livestock troughs, cattle crossings, bathing facilities, canal steps, communal and household storage, home water treatment.

[1]The rationale for selection is described in annex B.

1.3.5 Methodology: Analysis of Benefits, Costs and Poverty Impacts (cont.)

Step 3: **Estimate costs by service level and technology, cont.**

- Identified per capita hardware costs for selected technologies in rural South Asia and sub-Saharan Africa for both new services and incremental upgrades based on literature review supplemented with limited primary data collection and expert consultations.
- Standardized estimates to common units to allow comparison, including currency conversion to 2004 purchasing power parity international dollars (PPP $I).

Software costs

- Software costs for domestic systems are typically on the order of 10% of hardware costs. Based on the ongoing multiple-uses research, the International Water and Sanitation Centre estimates that total software cost (technical assistance and program support costs) for multiple- use approaches could be on the order of 30-50% of hardware costs. This estimate is corroborated by evidence from Winrock and IDE's implementation of over 60 multiple-use by design systems in Nepal where total software were on the order of 40-50%. For the purposes of the financial analysis, we assume 40%.[1]

Recurrent annual costs:

- Recurrent annual costs include operation and maintenance, source water protection and capital maintenance fund. (See Annex B for details on recurrent cost calculations)

Step 4: Calculate cost-benefit ratios

- Cost-benefit ratios for new services and incremental upgrades were calculated assuming a discount rate of 10% where costs equal the per capita hardware and software investment costs in year 1 less the present value of the stream of annual per capita mean income benefits net of annual per capita recurrent costs (operation and maintenance, source water protection and capital maintenance fund) over the useful lifetime of the infrastructure.

Step 5: Calculate repayment periods

- Repayment periods were calculated based on the period of time it would take to cover hardware and software costs based on estimated average annual financial benefits less annual recurrent costs.

Step 6: Conduct sensitivity analysis

- To evaluate how variations in net returns might influence the results, benefit-cost analysis was conducted under four net income scenarios ranging from conservative (25% of potential income) to optimistic (100% of potential income).

1.3.6 Methodology: Analysis of Non-financial Benefits, Costs and Poverty Impacts

Poverty Impacts

To capture non-financial benefits and impacts on poverty of improvements in water services, the study analyzed a series of global poverty surveys and approximately 40 credible research studies. Drawing on the sustainable livelihoods framework, assessments were made of the non-financial incremental benefits and poverty impacts of multiple-use water services vs. single-use services in terms of four key factors known to impact poverty: food security, health and nutrition, vulnerability/ livelihoods diversification, and social equity and empowerment (Ravnborg et al. 2007). The potential poverty impacts of home gardens, livestock, small-scale enterprises and domestic uses of irrigation water for each factor were qualitatively ranked (low, medium, high). To accurately reflect the incomplete nature of the available evidence, the research team utilized a ranking system for key findings based on the quality, quantity and consistency of available supporting data:

- **Well supported**: significant number of high quality studies that consistently provide corroborating evidence
- **Partially supported**: number of high quality studies, or numerous studies with partial data, which provide consistent but only partially corroborating evidence
- **Inconsistent evidence**: inconsistent findings from studies
- **Anecdotal evidence**: observed but not well studied or documented

1.3.7 Methodology: Evaluation of the Potential Market for Multiple-use Services

The research team used to the following process to estimate the potential market for multiple use services (see annex B for further details on methodology)

Market entry points—domestic and irrigation systems. The research team identified and evaluated two market entry points for reaching the rural poor in sub-Saharan Africa and South Asia**:**

Domestic+. The study evaluated the potential for providing multiple-use water services through domestic water service models, either by providing new services for a portion of the **440 million people** without services or by upgrading existing systems for a portion of the **1 billion people** with services.

Irrigation+. The research evaluated the potential for upgrading existing irrigation systems to support multiple uses through incremental improvements for a portion of the **450 million people** living in irrigated areas of South Asia and sub-Saharan Africa.

Identifying high potential markets. The research team used the following process to identify high potential markets for multiple-use services:

Step 1: Assess potential markets based on existing service levels using available global data sets, including remote sensing, to identify attributes of water services (quantity, quality and distance) for populations by country based on market entry point (irrigation or domestic) and current service level.

Step 2: Disaggregate potential markets by technology/water source for water service levels using available global data sets.

Step 3: Identify markets with highest potential using results from cost and benefits analysis.

Step 4: Assess socioeconomic characteristics of households in these markets to determine if they could benefit from multiple-use services (e.g., characterized by poverty and malnutrition but with the necessary assets (land and livestock) to make productive use of water. This analysis relies on Demographic Health Survey Wealth Indices data for 23 countries in South Asia and sub-Saharan Africa, which provided information on sources of household water (by technology), sanitation facilities, household assets (such as livestock and land), health indicators and gender equity.

1.4 Caveats and Study Limitations

Scope of the study

- This study is the result of a four-month intensive effort aimed at conducting a broad scoping exercise for South Asia and sub-Saharan Africa focused on: (1) the incremental costs and benefits of single- vs. multiple-use services, and (2) the potential size of the market. Given the macro scope, results should be considered as "indicative" rather than "universal."

Analysis of costs and benefits

- Benefits and costs were calculated based on observations from the field, and were conservatively estimated, which may result in a slight bias towards over-estimating costs and under-estimating financial benefits. As indicated above, the International Water and Sanitation Centre estimates that supporting software costs for multiple-use approaches, to achieve impact at scale, will range from 30-50% of hardware costs, in comparison to 10% typically estimated for single-use systems. In this study, software costs were estimated at 40%. All financial costs and benefits are stated in **per capita** 2004 International PPP $I.
- Within a particular location, benefits and costs depend on a range of context-specific factors. For example, financial benefits vary based on household assets, complementary inputs, know-how, access to finance and markets as well as supporting local, intermediate and national institutional environment. Even within a given location, these factors also influence the distribution of benefits across different types of households. As with benefits, actual costs for services, both hardware and software, vary based on context-specific factors, including water availability, type of technology, cost of materials, level of services, population served, implementation and management capacity, and institutional environment.
- The study focuses largely on the financial (rather than economic) costs and benefits of single-use and multiple-use approaches. Valuation of economic benefits and costs, such as those related to health, food security and nutrition, labor and social equity were beyond the scope of the study. However, the analysis of poverty impacts does provide an indication of economic and other non-financial benefits and costs and can serve as a foundation for future research.

Technology choices

- The study included only single-source technology options. In reality, the poor often use multiple sources for multiple uses. However, estimating the incremental costs associated with an amalgamation of technology packages was beyond the scope of the current study. Further research is needed to identify the most promising bundles of technologies/systems that could cost-effectively meet the poor's demand for multiple-use services and more efficiently leverage available developed and undeveloped water supplies. This research should include analysis of surface and rooftop rainwater harvesting as well as options for utilizing nearby unprotected sources for productive activities such as with treadle pumps.

1.4 Caveats and Study Limitations, cont.

Poverty impacts

- The analysis of poverty impacts relies on the best available evidence that the team was able to locate and includes a mix of macro-, meso- and micro-level studies. Macro-level studies include data analysis and policy and institutional evidence, especially related to land and livestock, by reputed research institutions such as the International Water Management Institute and the International Livestock Research Institute. Approximately 40 micro- and meso-level credible research studies provide the basis for much poverty impact analysis. Many of these studies are site specific. Where possible, we attempted to find a range of corroborating evidence for and against poverty impacts. Given the incomplete nature of the available evidence, the research team utilized a ranking system for key findings based on the quality, quantity and consistency of available supporting data (as described above).

- Poverty impacts are expected to vary among different household types based on assets; socioeconomic, cultural and structural characteristics; and other context-specific factors. However, due to data limitations and the macro scope of the study, an analysis of the distribution of benefits and costs among different households has not been conducted.

Market analysis

- The analysis of potential opportunities relies on best available macro data sets, including data from the Joint Monitoring Program (JMP), World Health Organization Health Survey and Demographic Health Survey, and Global Irrigated Area Mapping Project.

- The JMP data on coverage estimates rely, in part, on national surveys that have varying definitions of access to safe drinking water. As a result, JMP data on coverage rates for safe drinking water have been criticized for being too low, in some cases, and too high in others. Country-level statistics do not capture data on reliability of sources; they fail to account accurately for non-functionality. In addition, they provide little information about quality at source or quality consumed, which means the “improved” water may not actually be safe for human consumption. Given inherent limitations of such macro data, the size of potential markets should be considered as “order of magnitude” estimates. Detailed country and local-level studies are needed to further these estimates

- In addition, the Global Irrigated Area Mapping data do not capture small-scale irrigation systems, which are most prevalent in sub-Saharan. Further research is needed to identify the extent of small-scale irrigation systems in sub-Saharan Africa and opportunities for multiple-use services.

- The report outlines key enabling factors to achieve the market potential. Given the macro focus of the study and data limitations, an analysis of these enabling conditions was beyond the scope of the study. Investment decisions should carefully consider the enabling environmental and how it may influence outcomes.

1.5 Key Knowledge Gaps

The research team a number of key knowledge gaps through the research process, including:

For cost and benefit analysis

- Reliable data on software costs for multiple uses.
- Identification of the most promising bundles of technologies/systems that could cost-effectively meet the poor's demand for multiple-use services and associated costs

For poverty impact analysis

- Consistent and specific data on the range of non-financial benefits and costs of multiple-use water services.
- Data on the differential poverty impacts for different household types based on assets; socioeconomic, cultural and structural characteristics; and other context-specific factors

For market analysis

- Extent, location and characteristics of small-scale irrigation systems (<1000 hectares) in sub-Saharan Africa.
- Information on demand for multiple-use services and willingness of the poor to pay for such services.

For implementation

- Country- and district-level information on wider enabling environment for South Asia and sub-Saharan Africa, including policies, institutional abilities, local water governance, investment potentials and poverty priorities.
- High quality data and analysis from a number of locations on the sustainability of multiple-use services
- Appropriate financing models to make services affordable and feasible for poor households, with the poorest households likely to require subsidies. More research is needed to identify appropriate financing models—at both the community and household levels.