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# Economic Analysis of Benefits and Costs: Multiple Uses Water Services Project supported by the Challenge Programme on Water and Food

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# Acronyms

| | | |
|---|---|---|
| B-C Ratio | : | Benefit-Cost Ratio |
| CINARA | : | Institute for R&D in Water Supply, Environmental Sanitation and Conservation of Water Resources |
| CPWF | : | Challenge Program on Water and Food |
| FANRPAN | : | The Food Agriculture and Natural Resources Policy Analysis Network |
| FAO | : | Food and Agriculture Organisation |
| IDE | : | International Development Enterprise |
| IFAD | : | International Fund for Agriculture Development |
| IWMI | : | International Water Management Institute |
| IRC | : | International Water and Sanitation Centre |
| LAs | : | Learning Alliances |
| MOU | : | Memorandum of Understanding |
| MUS | : | Multiple Use Service |
| MUS Project | : | Multiple Use Water Services (MUS) Project |
| NGO | : | Non-Governmental Organisation |
| NPV | : | Net Present Value |
| PPP $I | : | Purchasing Power Parity International Dollars |
| SIMI | : | Smallholder Irrigation and Market Initiative |
| SWELL | : | Securing Water to Enhance Local Livelihoods |

# Executive summary

## Introduction

The Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) contracted the Center for Agriculture Research and Development (CARD) to undertake the economic analysis of the benefits and costs of the MUS Project with the principal aim of drawing lessons from the project's experience with regard to achieving developmental impacts through research as well as providing basis for addressing "efficiency and effectiveness" questions of multiple-use approaches over single-use approaches. The analysis was conducted at the request of the Challenge Program on Water and Food (CPWF) "CPWF Adoption and Cost-Benefit Analysis Project" against the background that the MUS Project, implemented in eight countries since 2004, had identified considerable change/impact at local, national and even global levels in terms of adoption of the concept of supplying water to meet multiple needs.

The analysis of benefits and costs in this report was meant to build on the Winrock study whose analysis centered on the incremental benefits, poverty impacts and costs of multiple use approaches relative to single use approaches. While the Winrock study provided useful and important information and guided the identification of benefits and costs of the MUS Project, the analysis in this report also uses the technical approach for evaluating research and advocay projects. The use of the latter approach is due to data limitations as a result of the research nature of the MUS Project. The analysis focuses on the extent of influence the MUS Project appeared to have had on the changes/impacts observed in the basins/countries rather than whether the MUS Project directly produced the observed results. The analysis merely relates the MUS Project activities with the results reported in the five basins by examining the benefits that have accrued or are likely to accrue in the future that would not have happened without the CPWF project investment support.

## Key Findings

**MUS Project Activities, Outputs and Costs**: Analysis of project activities, outputs and costs shows that the MUS Project was primarily a research and advocacy project, such that presentation of costs on an incremental basis and by water service level has been limited. Over a period of three years, the MUS Project invested about US$1.6 million in activities that promoted stakeholder engagement and action research to influence policy and practice through Learning Alliances (LAs) coupled with Action Research. Although the level and focus of the MUS Project activities differed from country to country, in sum, the activities attempted to, among other things:

- promote shared learning from experiences through "Learning Alliances" in some countries and globally;
- use action research to enhance lesson-learning and create evidence for use in advocacy;
- use training to enhance understanding and skills development;
- use workshops to share lessons and advocate for change in policies and strategies; and
- engage globally in advocacy at international forums through 'global strategic partners' or 'global learning alliance'.

Through these activities, the MUS Project promoted its central advocacy goal of bringing widespread ownership and understanding of the multiple-use concepts among community implementers, practitioners, researchers, policy makers and activists to create opportunities and platforms for scaling up. The alliance members shared a common desire to address an underlying problem of providing water supplies that better meet the livelihood needs for poor families in rural and peri-urban areas.

**MUS Project Benefits**: Although this report does not quantify the benefits of the MUS Project on an incremental basis and by water service level, it is evident that the Project generated direct and indirect benefits. The direct benefits of the MUS Project are as follows:

**(i) Experiment Space and Proof:** The MUS Project provided the opportunity and space to experiment and prove the MUS approach as well as generate experiential learning. For instance, implementation of the MUS Project provided proof for effective use of very small water sources through the MUS approach in Nepal.

**(ii) Community Motivation and Increased Knowledge/Awareness:** The learning alliance workshops, meeting and visits provided motivation for knowledge acquisition, awareness of various issues such as water conservation and skill building of community members. Bolivia's experience (among others) provides useful extension of local knowledge on the use of community-managed water supply systems for multiple uses and the contribution of these activities to livelihoods.

**(iii) Coordinated Platform for Self-Actualisation and Local Wisdom Networks:** The LA under the MUS Project played a key role in coordinating the interaction among the different actors related to the topic of water, thereby adding momentum to related developments which occurred prior to the MUS Project in some countries. For instance, prior to the MUS Project, farmers and farmer groups in Thailand developed own LAs among themselves (Local Wisdom Networks) and were able to revive indigenous knowledge for development that facilitated faster learning in their own farms and technology transfer through field visits. The added momentum through the MUS Project has resulted in the continuing sustainable agricultural development, new bottom-up plans and policies using learning alliances that forge horizontal and vertical partnerships for development from community to national levels, and mobilization of farmers and multiple development partnerships with National Policy in Thailand.

**(iv) Changed investment and approach:** In Bolivia, multiple use systems are thriving in the peri-urban Cochabamba due to lack of top-down planning, with strong bottom-up development supported by laws that empower local development committees in defense of local water systems.

The indirect benefits relate well with those in the Winrock study, and occurred as a result of the changes in behaviour (policies, investment) brought by the MUS Project through LAs. The change in behaviour facilitated upscaling of MUS schemes both within and beyond the eight countries. For example, the application of MUS approaches resulted in great expansion of vegetable production in such countries as Nepal, thereby increasing incomes. In addition, increased production, opportunities for income generation and incomes have resulted in improved health in such countries

as Ethiopia. Further, time saving for water collection as a result of MUS water storage at household level for access at all times resulted in women allocating more time for agricultural production, thereby increasing the consultation and joint decision-making between men and women for farm activities in such countries as Nepal. Finally, increased income, social mobilization, cohesion and community ownership from the onset of the system design and construction that the project process had brought ensured the likely improved sustainability in such countries as Nepal. The MUS Project likely facilitated and contributed to the continued achievement of the benefits related to incomes, health, gender equity and improved sustainability.

**Analysis of MUS Project Investment and Benefits**: The *ex ante* analysis in this report extends from the conclusive observation that the experiential learning through LAs and the influence in change of behaviour will continue to be pronounced in facilitating uptake and replication after the Project, thereby providing space for sharing ideas and information among basins as well as continued upscaling of MUS schemes. The analysis uses critical and transparent assumptions, including different rates of upscaling among countries based on population size as well as information in the Winrock study. Based on the critical assumptions, the analysis estimates that the number of people involved in MUS schemes among the five high potential areas and both within and beyond the eight countries will increase from nearly a million to about two million over a period of ten years. Consistent with the findings of the Winrock study, this will be achieved through higher and additional capital investment of about US$53.8 million with resource allocations for recurrent costs of about US$12.6 million on an annual basis for ten years. The additional costs are for hardware, software and recurrent costs, and are intended to facilitate the continued upscaling of MUS schemes both within and beyond the eight countries.

Also consistent with the findings of the Winrock study, the high costs in additional investment result in significantly higher income benefits, indicating that MUS activities by some stakeholders and/or partners will continue to generate positive impacts and that additional investment in the five potential areas identified by the Winrock study is worthwhile. The income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years. The results of the analysis in this report are illustrative since the activities can be scaled up or down depending on the number of beneficiaries per available resources.

## Conclusion

With its primary objective of contributing to the achievement of an enabling environment, the MUS Project enhanced understanding of MUS thereby facilitating change in behaviour (policies, investment, etc.,) and upscaling of MUS schemes both within and beyond the eight countries. The MUS Project has contributed significant influence in augmenting the efficiency and effectiveness levels of multiple-use approaches over single use approaches.

The benefits and costs of the MUS Project in this report have not been assessed on an incremental basis using the water ladder. However, with an investment of about US$1.6 million over a period of three years, the MUS Project generated direct and indirect benefits. The direct benefits included provision of experiment space and experiential learning. The indirect benefits relate well with those in the Winrock study, and occurred as a result of enhanced understanding of MUS that facilitated changes in behaviour (policies, investment) upscaling of MUS schemes both within and beyond the

eight countries. Consequently, the MUS Project has facilitated and contributed to higher incomes and investment, improved health, gender equity and social equity, and improved sustainability.

The MUS Project has provided an 'engine' for uptake and replication through the Learning Alliances. It is expected that the influence in change of behaviour will continue to facilitate uptake and replication after the Project. Based on critical assumptions, the MUS Project will continue to generate significant benefits, and the activities can be scaled up or down depending on the number of beneficiaries and available resources. As many as two million people will benefit from MUS schemes over a period of ten years, with higher and additional capital investment of about US$53.8 million and annual outlays of about US$12.6 million in recurrent costs. The costs appear to be high, but investing in the five high potential areas recommended by the Winrock study is worthwhile given that income benefits are significantly higher than costs, with positive NPV and B-C Ratio greater than 1 for a period of ten years.

# 1.0 Introduction

## 1.1 Background

Poor rural and peri-urban households in developing countries need water supplies for basic domestic uses, including drinking, cooking, washing and cleaning. The predominance of the agricultural sector in developing countries implies that these households also rely on access to irrigation water to grow field crops. In both cases, water is traditionally supplied by a subsidised water sector, but with different and specific focuses on either a basic domestic need or a productive use such as promotion of food security (Butterworth et al., 2008). Consequently, water development and delivery services at these sector levels have conventionally been skewed for single-use designs, financing and management, thereby "officially" dividing provision of water services into such sectors as domestic, irrigation, livestock, fisheries and aquaculture (Van Koppen et al., 2006).

However, practical experience shows that households normally use these sector water schemes/projects for multiple purposes and multi-faceted livelihoods[1] -- over and above the uses singly and restrictively considered in original plans and designs. For instance, households productively utilise water from single-use 'domestic' schemes at a small-scale in and around the homestead for activities like backyard gardening, raising livestock, fishing, food processing and micro-enterprises (Butterworth et al., 2008). Similarly, households also utilise water from single-use 'irrigation' schemes for a wide range of household needs such as drinking, washing, bathing as well as a range of income-generating activities. Thus, contrary to the conventional single-use designs, households practically integrate their water needs at the household and community levels, and rely on a mixture of sources of water often for multiple uses.

Despite the practical behaviour of households in integrating their water needs for multiple purposes, policy-makers and staff of water agencies often ignore, or even prohibit this practice (Moriarty et al., 2004). As a result, other sector uses are 'officially' precluded through the specialised designs for single-use purposes in the respective sectors. For instance, domestic water-supply schemes may ban the use of water for production activities or that the supply may be too little for any additional uses above the most basic domestic needs[2]. Likewise, irrigation schemes may ignore the need for domestic or household-level production activities[3]. Consequently, the '*de facto*' and 'unplanned' additional uses of single-use systems for multiple purposes have caused inevitable problems, including health risks, damage to hardware/infrastructure, unmet water service demand/water shortages and conflict between users[4].

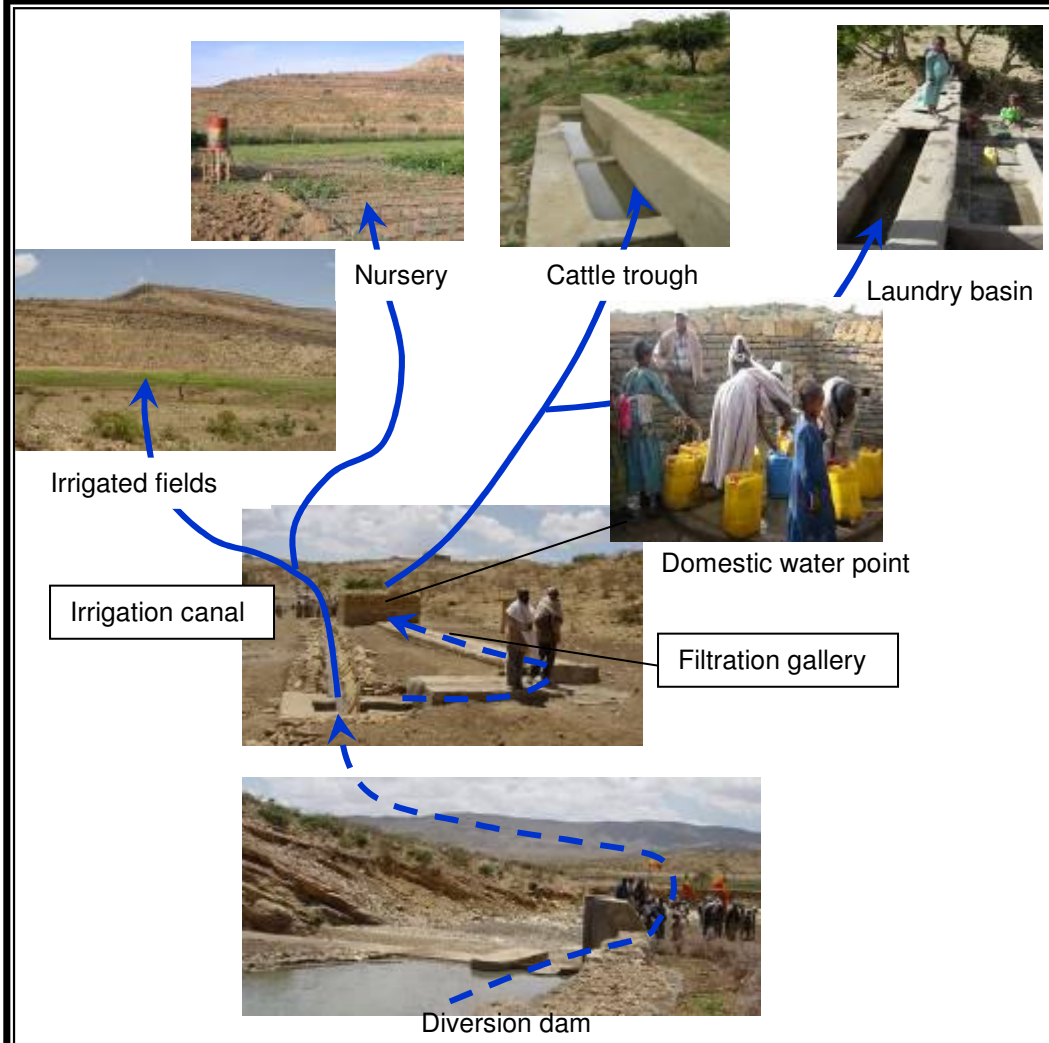
### 1.1.1 The Multiple Uses Water Services Approach

There is increasing evidence that the simple objective of providing water for multiple uses through the integration of households' water needs offers significant opportunity to better improve the wellbeing of poor rural and peri-urban households. The multiple use service (MUS) approach attempts to take advantage of this opportunity by departing from single-use systems and incorporating poor people's *de facto* multiple uses of water services to improve the wellbeing of poor

[1] Barbara van Koppen, Significant Change Stories
[2] Water Policy Briefing, Issue 18
[3] Ibid
[4] Ibid

households. The approach recognises that people's needs are integrated and are part and parcel of their multifaceted livelihoods (Van Koppen et al., 2006), all of which need to be incorporated into water system designs so as to have more impact on poverty and increase the sustainability of services. Thus, the MUS approach is consumer-oriented, takes people's multiple water needs as a starting point, and involves planning, finance and management of integrated water services for multiple domestic as well as productive uses. Below is a practical illustration of the MUS approach in Ethiopia.

**Illustrative Practical MUS Approaches in Ethiopia** (Photos: Eline Boelee & Michiko Ebato)




The MUS approach hypothesises that a more integrated, multiple-use approach can maximize the health benefits and productive potential of available water supplies, leading to increased incomes, improved health and reduced workloads for women and children. In addition, multiple use systems are more likely to be sustainable as users benefit more from them, have a greater stake in them, and are more willing and better able to pay for them. Thus, the benefits of MUS approaches include

improved well-being due to improved access to facilities and increased incomes from income-generating activities; gender equity through reduced burden on women's and children's activities and increased access to productive opportunities; increased willingness to pay for water services due to higher utility; increased ownership and improved sustainability; higher water productivity; and improved health due to increased access to water for cooking, consumption and hygiene. In sum, MUS approaches are seen to be more economically efficient, socially equitable and environmentally sustainable (Van Koppen et al., 2006) in improving the wellbeing of societies.

### 1.1.2 The Multiple Use Water Services Project

The need to address the perceived institutional failure by policy-makers and staff of water agencies to integrate people's multiple use of water services was the key rationale for the Multiple Use Water Services (MUS) Project (Butterworth et al., 2008). Supported by the Challenge Program on Water and Food (CPWF), the Project attempted to fill the gap between the broadly encompassing definition of the MUS approach and the provision of a clear idea on how to provide such services in practice and how these services perform in different contexts (Stef Smith et al., undated).

The MUS Project carried out Action Research and Learning Alliances (LAs) in five major river basins[5] and eight countries[6] in Africa, Asia and Latin america, with the hypothesis that MUS "approaches alleviate rural and peri-urban poverty more effectively" than single-purpose water supply systems. Since the start of the Project in 2004, the Project attempted to produce an integrated overview by gathering information and comparing the different experiences with the MUS approach in each of the five basins. Apparently, the attempt identified considerable change/impact of the MUS Project at local, national and even global levels in adopting the concept of supplying water to meet multiple needs. Box 1 below presents significant change stories as reported by Project Leaders. These positive developments, on one hand, provide an opportunity for assessing project outcomes and impacts on poverty and livelihoods as well as issues related to wider adoption and implementation. On the other hand, designing infrastractural 'add-ons' for existing single-use system as well as designing new and fully-fledged multiple use water services systems to meet multiple needs of water users require incremental and higher costs, respectively (Renwick et al., 2007). Thus, the incremental benefits and costs of the Project need to be analysed as basis for addressing "efficiency and effectiveness" questions of multiple-use approaches over single-use approaches as well as inform any decisions related to scaling up and out.

It is in view of the foregoing that the Challenge Program on Water and Food (CPWF) "CPWF Adoption and Cost-Benefit Analysis Project" requested the Food Agriculture and Natural Resources Policy Analysis Network (FANRPAN) to carry out an assessment of the impacts of the MUS Project. FANRPAN, a network that includes researchers from 12 countries in Southern Africa as well as links to international universities and research centers, engaged the Center for Agriculture Research and Development (CARD) to undertake the economic analysis of the benefits and costs of the MUS Project as part of the overall impact evaluation task of the Project.

[5] (Andes [Colombia], Indus-Ganges [Nepal], Limpopo [South Africa, Zimbabwe], Mekong [Thailand], and Nile [Ethiopia])
[6] Bolivia, Colombia, Ethiopia, India, Nepal, South Africa, Thailand and Zimbabwe

**Box 1: Significant Change Stories**

**Classification:** Technical
**Name of Person Reporting:** Barbara van Koppen
**Project / Theme / Basin:** PN28 / Theme 2 / Andes, Indus Ganges, Limpopo, Mekong, Nile
**Date when the change occurred:** Since inception phase of the project
**Place where the change occurred:** Colombia, South Africa, Zimbabwe, and Thailand

**The Story:** Conventional water development was sector based (either domestic or irrigation) but water users normally use schemes for multiple purposes and multi-faceted livelihoods. PN 28 showed evidence of community-level cases of multiple use water services. It was clear that planning and design of water services for multiple needs of the poor can improve wellbeing. Women's participation in planning also enhances institutional and financial sustainability of multiple use water services, and improves water efficiency and equity at low incremental cost. The governments of Colombia, South Africa, Zimbabwe, and Thailand have taken up recommendations of PN28 and have adapted a national policy towards planning and implementation of multiple water uses. The government of South Africa has drafted national guidelines for multiple water use services and is testing these in pilot-projects with local governments. In Zimbabwe there is a proposed law incorporating MUS.

Dialogue with global water sector leaders in both domestic and productive sectors and with national and local partners has led to uptake or strengthening of multiple-use approaches (World Water Forum IV, WSP, IFAD, global NGOS, Winrock, GWP, ICID, Stockholm Water Week, Gates Foundation, etc). Other impacts are implicit and not necessarily documented, but not less effective, such as:
The allocation by WWF4 of a topic Session on MUS in a highly competitive process
Joint policy briefs e.g. GWP reports how MUS is now more widely seen as IWRM
There are high-level discussions in Colombia (with Ines Restrepo) on water quantity norms for 'domestic' schemes. However, changing laws can last longer than the duration of the project.
In Nepal, high-level irrigation engineering officials said in meetings that they will "close their eyes" if an irrigation scheme is used for domestic purposes. This is an informal commitment that is not easy to document, but may be much more effective than a change in the Zimbabwean water law!
The Thai government has embraced the multiple-use water tanks and other investments for homestead production by the Farmer Wisdom Network, (which is supported by the MUS project) for the national economic sufficiency policy. We are documenting this process, but, in general, governments do not like to be told by others what they have to do, so any documentation of change has to be much more subtle. In fact, our approach with 'Learning Alliances' is exactly to create ownership and fully adapt according to national stakeholders' commitments
The project has been invited to the Collaborative Council on ('domestic') Water Supply--another key player taking up the concept, and IFAD is also showing more interest in the project.

**Why is the story significant?**
Implementation of multiple-use water services approaches alleviates rural and peri-urban poverty more effectively.
It highlights the extent of collaborative efforts pertaining to MUS. To date there are many written advocacy papers and joint publications on MUS approaches.

**What were the critical factors that led to the change?**
- Strategic partnership between domestic and productive water sectors to jointly identify obstacles to sector-based planning and untapped synergy of cross-sectoral collaboration
- The common CPWF action-research framework shared among projects for cross-basin comparisons across eight countries

**What were the constraints?**
Limited capacity and institutional space to implement participatory planning for identification of local-specific water needs, building ownership, and upscaling

**What are the future implications for action (e.g., future research), if any?**
Further action research from local to global level to corroborate advocacy and develop upscalable participatory water planning and design approaches.

1

Economic analysis is generally about encouraging the efficient use of resources to improve the social wellbeing of society (income and consumption). It is a set of formal, quantitative methods used to compare alternative strategies with respect to their resource use and their expected outcomes. In this analysis, it is about the efficiency and effectiveness of single-use vis-à-vis multiple-use approaches of water project designs in improving the wellbeing of society. The analysis aims to draw lessons from the Project's experience with regard to achieving the related developmental impacts through research. The analysis examines the impacts of the MUS Project in more depth in selected instances, trying to understand the 'pathways' from the project to these impacts, and ultimately identify lessons for design of future research and CPWF projects. In assessing the benefits and costs of the project, the primary focus is on the benefits that have accrued or are likely

to accrue in the future that would not have happened without the CPWF project investment support.

The analysis was intended to build on the comprehensive Winrock analysis report (Renwick et al., 2007) and some of the reports produced by the CPWF-supported MUS Project in order to quantify/estimate benefits and costs wherever possible to-date and into the future based on critical assumptions. Specifically, the analysis has quantified the MUS Project investment and has endeavoured to estimate the benefits and costs in the future. Annex A contains the detailed TORs for the Economic Analysis. The specific tasks under the Economic Analysis included to:

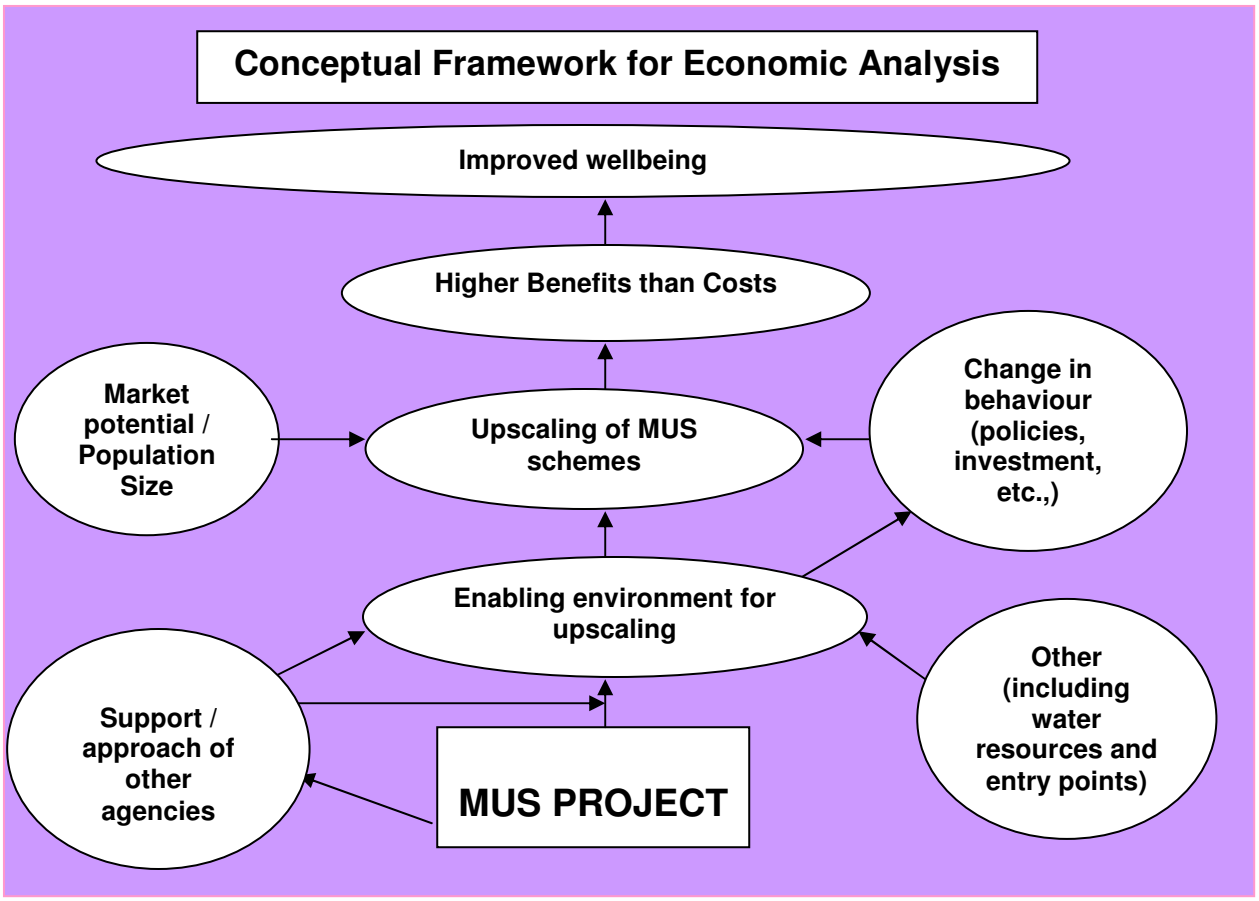
1. Review relevant documents, including the Winrock study, key project reports, data on project costs and other documents on the benefits and costs of MUS;
2. Consult with the Project Leader and other project implementers to obtain their views and suggestions;
3. Prepare a work plan and methodology for review by Doug Merrey, MUS Project Leader and CPWF personnel;
4. Analyse the benefits and costs of the MUS Project;
5. Prepare and submit draft report;
6. Finalize and submit the draft final report based on feedback from reviewers.

## 1.3 Conceptual Framework

Economic analysis involves assessing the overall impacts of a project on improving the economic welfare of the citizenry and/or society. As such, the conceptual framework of the analysis in this report is guided by the MUS Project's objective of contributing towards achievement of an enabling environment for scaling up MUS schemes, the support and behaviour/approaches of other agencies, the market potential/population size for upscaling, and finally the associated incremental benefits and costs both now and in the future. Below is a diagrammatic representation of the conceptual framework of the economic analysis in this report.

First, the analysis looks at how the MUS Project was designed to contribute to an enabling environment for upscaling MUS schemes that generate more impact on poverty and increase the sustainability of services at relatively higher incremental benefits than costs. Second, the MUS Project did not operate in a vacuum and its design and implementation could as well be affected by the different approaches adopted by other agencies promoting MUS schemes. However, any changes in behaviour (policies, investment, etc.,) brought by the MUS Project both within and beyond the eight countries contributed towards achievement of an enabling environment, thereby allowing and facilitating upscaling of MUS schemes. Third, the extent of facilitating some upscaling of MUS schemes by the MUS Project depended on the size of the potential market (users) in proportion to the population size and other factors including water resources and entry points. Finally, any benefits generated by the MUS Project to-date will continue to pronounce themselves over time in the future[7], thereby contributing to improved wellbeing of society.

[7] The MUS Project has ended, but In Colombia, CINARA continues to work in the promotion of MUS as an alternative to improve livelihoods, including MUS as an integral part of the Water Management according to Diana Marcela Cordoba




## 1.4 Outline of the report

The methodology used for the conduct of the economic analysis follows this introduction. Following the methodology is an outline of the MUS Project activities, costs and benefits, in turn, followed by the analysis of projected activities, costs and benefits of the MUS Project before concluding.

# 2.0 Methodology

## 2.1 General approach

The Economic Analysis in this report primarily relied on review of documents, including the Winrock study, key project reports, and data on project costs and other documents available on the web (http://www.musproject.net). In addition, the analysis also relied on consultations with the Project Leader and other project implementers to obtain their views and suggestions on the analysis. In order to fulfil the objectives of the assignment as well as ensure that the assignment is conducted in a logical manner, the general approach followed four inter-related activities as follows:

| | |
|---|---|
| Activity 1 | Review of Documents and Data Collection |
| Activity 2 | Analysis and Organisation |
| Activity 3 | Preparation of Draft Report |
| Activity 4 | Report Finalisation and Submission |

## 2.2 Technical approach and design

The original design of the analysis was to build on the technical approach in the Winrock study, whose analysis of costs and benefits focused "largely on the financial (rather than economic) costs and benefits of single-use and multiple-use approaches" (Renwick et al., 2007). Thus, the use of this technical approach required the availability of a refined breakdown of MUS Project costs to estimate the benefits of MUS schemes. However, due to data limitations (See section 2.3 below) as a result of the research nature of MUS Project activities (See section 3.1 below), the use of the Winrock study's technical approach in this report has been limited. While the Winrock study provided useful and important information and guided the identification of benefits and costs of the MUS Project, the analysis in this report of benefits and costs also uses the technical approach for evaluating research and advocacy projects (See Patton, 2008 and Box 2 below). The focus in this report is on the extent of influence the MUS Project appeared to have had on the change/impacts observed in the basins/countries rather than whether the MUS Project directly produced the observed results. In other words, the analysis merely relates the MUS Project activities with the results reported in the five basins in comparison with the findings of the Winrock study.

**Box 2: The Standard Applied to Advocacy Evaluation**

It is worth noting the distinction in evaluation between attribution and contribution. Attribution is a research concept that involves proving that *a* causes *b*. Patton argues that the straightforward notion of cause-effect works well for simple, bounded, and linear problems in such research as pharmaceutical research where randomized control trials are conducted comparing a drug with a placebo to establish whether the relief of symptoms can be directly attributed to the drug. However, this does not work well for understanding complex systems where a variety of factors and variables interact dynamically within the interconnected and interdependent parts of the open system.

Under such circumstances, a complex contribution analysis is conducted instead of trying to render a simple cause-effect conclusion. Where attribution requires making a cause effect determination, contribution analysis focuses on identifying likely influences. Contribution analysis, like detective work, requires connecting the dots between what was done and what resulted, examining a multitude of interacting variables and factors, and considering alternative explanations and hypotheses, so that in the end, an independent, reasonable, and evidence-based judgment is reached based on *cumulative evidence*. From a contribution perspective, the question becomes how much influence the project appeared to have had rather than whether the project directly produced the observed results.

Source: Michael Q. Patton, 2008

## 2.3 Limitations of the Economic Analysis

In assessing the overall impact of a project on improving the economic welfare of the citizens, economic analysis is often confined to the country or geographical location concerned. It is carried out in conjunction with financial, social, technical, institutional, and environmental analysis prior to project appraisal, and when necessary, throughout the project cycle. Thus, economic analysis has

geographical and timing features which posed significant challenges for the analysis of the MUS Project. First, the MUS Project has already ended. Second, the MUS Project was complex in terms of multiple partners and multiple regions. Moreover, other stakeholders also promoted the same model. Thus, a formal cost-benefit analysis of the impacts of the MUS Project is limited in this report.

The economic analysis was meant to, wherever possible, build on the Winrock study whose assessment centered on the incremental benefits, poverty impacts and costs of MUS approaches relative to single use approaches. Further, the assessment in the Winrock study was done at different entry points (domestic and irrigation) for commonly observed activities with a proven potential to generate income and to enhance livelihoods, health and social equity. However, as outlined in section 3.1 below, the MUS Project was primarily a research and advocacy project whose activities cannot be represented fully by water service level. The Project basically promoted MUS concepts across basins through learning and sharing ideas on how to go about MUS approaches, and had limited cases of developing and testing technological models.

On the benefit side, the information available in various project reports cannot be disaggregated by commonly observed productive uses of home gardens, livestock and widespread small scale enterprises. On the cost side, MUS Project activities requiring incremental and higher costs related to hardware and designing infrastractural 'add-ons' for existing and new multiple use water services systems, if any, were very minimal. As such, the analysis of benefits and costs is skewed for the contribution analysis of evaluating research and advocacy projects. From a contribution perspective, the analysis focuses on the extent of influence the MUS Project appeared to have had on the change/impacts observed in the basins/countries. The analysis merely relates the MUS Project activities with the results reported in the five basins. As such, contrary to the analysis in the Winrock study, the analysis in this report might have a slight bias towards under-estimating costs and over-estimating financial benefits given the significant involvement of other stakeholders in promoting the MUS model.

Notwithstanding these limitations, the analysis in this report provides considerable information and evidence that the MUS Project contributed significant influence in augmenting the efficiency and effectiveness levels of multiple-use approaches over single use approaches through the Project's objective of contributing towards achievement of an enabling environment for upscaling MUS schemes. The analysis forms an informed basis for any future decisions and efforts in pursuit of scaling up and out of MUS approaches by some stakeholders and/or partners.

# 3.0 MUS Project Activities, Costs and Benefits

The MUS Project had two objectives: (i) *New knowledge* aimed at generating and synthesizing existing knowledge into innovative, practical and tested models, tools and guidelines that can be used to produce quantifiable positive impacts from multiple-use water services delivery, including food security, income, work load, health and well-being of the poor, particularly of women and children, HIV/AIDS victims and child headed households, and (ii) *Capacity building* aimed at engaging, informing, preparing and strengthening the capacity of project partners and of other participants, including professionals and policy makers from the domestic and productive water sectors in Non-Governmental Organisations (NGOs), government, financing institutions, private sector, and

development organizations to jointly promote wider implementation of multiple-use water supply systems.

The first objective had platforms of stakeholders in its focus, using the Learning Alliance (LA) as its key approach. Working through a partnership of professionals from the productive and domestic water sectors, and from the research and implementation communities, the project used learning alliances to develop locally-specific innovations and build capacity for scaling up, thereby seeking to improve poor people's food security and health, reduce unpaid workloads, alleviate poverty, and enhance gender equity. Formed at both national and local levels, the learning alliances represented partnerships between practitioners, researchers, policy makers and activists aimed at sharing insights and concerns among stakeholders, providing a platform to discuss and decide on integrated uses of water, and bringing widespread ownership of the multiple-use concepts for scaling up. The second objective supports the first by focusing at end users of water and used Action Research as its main approach.

The following sections provide an outline of the activities undertaken, costs incurred and the likely and potential benefits under the MUS Project.

## 3.1 Project Activities

Developing and testing technological models was the original focus of the MUS Project[8]. However, during its first year, the project leaders recognised the importance of stakeholder engagement and the need to influence policy and practice through Learning Alliances (LAs) (See Box 3 below). Consequently, the MUS Project shifted its approach from a traditional 'research to development' paradigm to adoption of a stakeholder engagement and action research focused approach. The alliance members shared a common desire to address an underlying problem of providing water supplies that better meet the livelihood needs for poor families in rural and peri-urban areas. Working in an action research mode, the members worked on this underlying problem and contested and evolved together potential solutions in order to generate mechanisms for addressing institutional constraints and encouraging institutional learning so as to bring about appropriate change in behaviour for adopting and upscaling MUS schemes. Thus, the MUS Project brought together a group of international and national research agencies with international and local NGOs focused on implementation that spanned the irrigation and domestic water supply sectors. The group shared an interest in finding ways to provide water services that better supported the livelihoods of rural and peri-urban families in five benchmark basins of the Challenge Program on Water and Food in eight countries.

It must be noted that the level and focus of project activities differed from country to country, reflecting differences in institutions linked to specific types of multiple use systems[9] as well as differences in the approaches[10] of the agencies involved (Butterworth, et al., 2008). For instance, while there were very few "MUS schemes" implemented in South Africa except for those done by the NGO working with the Project, there were a lot of MUS schemes in Thailand ('Mekong basin').

[8] The original plan was based on the idea that researchers would do 25 or so case studies as basis for promoting adoption

[9] (i) 'domestic' systems also providing productive water (domestic +), (ii) 'irrigation' systems improved to also meet domestic and small-scale productive needs, and (iii) household level systems lacking communal level infrastructure (self supply).

[10] (i) private sector with a more market driven approach, (ii) governments working at scale but through their departmental silos, and (iii) non-governmental organisations often able to take a more integrated approach

**Box 3. Two common types of structured stakeholder engagement in research**

A Learning Alliance is a series of interlinked stakeholder platforms from a given innovation system that seeks to improves impacts and up-scaling through involvement of research users and other key stakeholders at all stages of more demand-led research. Through working on the agreed underlying problems, and contesting and evolving together potential solutions through action research, mechanisms to address institutional constraints and enhance institutional learning are given more attention than in traditional research approaches. Typically the members represent diverse organisations and roles.

A community of practice refers to the process of social learning that occurs when people who have a common interest in some subject or problem collaborate over an extended period to share ideas, find solutions, and build innovations. It refers as well to the stable group that is formed from such regular interactions. Communities of Practice have become associated with knowledge management as people have begun to see them as ways of developing social capital, nurturing new knowledge, stimulating innovation, or sharing existing tacit knowledge within an organization. Usually members are peers or have fairly similar functions.

Source: Butterworth, et al., 2008

In Zimbabwe, the impact of the MUS Project on improvement in management could not be verified because the Project did not go as far as implementation (Manzungu, 2008). These differences suggest that any benefits in South Africa and Zimbabwe will potentially accrue in future if governments do adopt the policy and actually implement it, whereas the benefits in Thailand can be traced somewhat now. The differences also suggest different levels of influence in change in behaviour and level of adoption and upscaling MUS schemes within and beyond the eight countries. Despite these differences, common activity features are traceable across countries/basins that conclusively point to the fact that the MUS Project attempted to:

- promote shared learning from experiences through "Learning Alliances" in some countries and globally;
- use action research to enhance lesson-learning and create evidence for use in advocacy;
- use training to enhance understanding and skills development;
- use workshops to share lessons and advocate for change in policies and strategies; and
- engage globally in advocacy at international forums e.g. workshops for analytical framework and synthesis and global upscaling activities through 'global strategic partners' or 'global learning alliance'[11].

The common activity features above as well as the key outputs[12] reported in most country reports provide evidence that the MUS Project was primarily a research and advocacy project that made use of action research to further its central advocacy goal of bringing widespread ownership and understanding of the multiple-use concepts among community implementers, practitioners, researchers, policy makers and activists to create opportunities and platforms for scaling up. Thus, there was a lot more experiential learning through the LAs than technological transfer[13], implying limited and minimal activities related to hardware and designing infrastractural 'add-ons' for existing single-use system as well as designing new and fully-fledged multiple use water services systems. Consequently, there is a consensus among the participants in such countries as Colombia that the application of the MUS approach has not been fully demonstrated due to a lack of technological

[11] Stockholm Water Week presentations, World Water Forum (WWF4), ICID-seminars, GWP/TEC events, MUS Group activities with IFAD, FAO, Council, participation in Winrock-IRC-IWMI research, and sensitization of CPWF itself, etc)
[12] Diana Marcela Cordoba (2008) lists case studies, guidelines and materials and training courses as the principle project outputs in Colombia. Project Leaders have country reports and output and budget data by country
[13] The Project never financed any construction according to Project Leaders

innovation and pilot sites such that the expectations of some of the partners that sought to learn 'how'[14] to implement a MUS approach have not been fully addressed (Cordoba, 2008).

## 3.2 Project Costs/Investment

This section provides the quantity of investment made under the MUS Project that allowed accomplishment of the activities summarized in 3.1 above and the output reported in some country reports. According to the table below, the MUS Project invested about US$1.6 million for activities (cost items) that confirm the research and advocacy nature and focus of the MUS Project.

| TABLE 1: MUS PROJECT RESOURCES BY ACTIVITY | | |
|---|---|---|
| **MUS (Global)** | Description | Amount (US$) |
| 027-01-00-MUL-PR-M711 | Synthesis[15] | 252,732 |
| 027-01-00-MUL-PR-M119 | Staff Time | 283,975 |
| 027-01-00-MUL-PR-M610 | Collaborators[16] Expenses | 821,763 |
| 027-01-00-MUL-PR-M810 | Indirect costs | 99,640 |
| **MUS (Global) Total** | | **1,458,110** |
| **MUS Ethiopia** | | |
| 027-01-02-MUL-PR-M119 | Staff Time | 56,444 |
| 027-01-02-MUL-PR-M170 | Consultancy | 2,203 |
| 027-01-02-MUL-PR-M211 | Local travel | 7,092 |
| 027-01-02-MUL-PR-M311 | Supplies | 10,362 |
| 027-01-02-MUL-PR-M570 | Workshops | 6,700 |
| 027-01-02-MUL-PR-M551 | Capacity Building | 4,000 |
| 027-01-02-MUL-PR-M610 | Partners (MKU & ILRI) | 18,660 |
| 027-01-02-MUL-PR-M810 | Indirect cost | 15,586 |
| 027-01-02-MUL-PR-M910 | Contingency (inc. OH) | 18,194 |
| **MUS Ethiopia Total** | | **139,240** |
| **MUS Overall Total** | | **1,597,350** |
| Source: Project Leaders | | |

[14] rather than learn 'why' the MUS approach

[15] The synthesis includes workshops of the entire project team -- two in South Africa in 2004, one in Netherlands in 2005, and one in Mexico in 2006

[16] Collaborators funds were for documentation and analysis by national researchers for basin activities

The following table presents data on collaborators funds by basin/country:

| TABLE 2: COLLABORATORS FUNDS USING ORIGINAL CATEGORISATION AND/OR ALLOCATIONS[17] | | |
|---|---|---|
| **Basin/Country** | **Item** | **Amount (US$)** |
| IDE/IGB | MOU on agreed amount at start | 88,406 |
| | Liaison Scientist[18] | 35,888 |
| | Lump sum for basin activities | 68,357 |
| IRC-Limpopo | MOU on agreed amount at start | 114,331 |
| | Liaison Scientist | 35,888 |
| | Lump sum for basin activities | 68,357 |
| IRC Andes | MOU on agreed amount at start | 50,366 |
| | Liaison Scientist | 35,888 |
| | Lump sum for basin activities | 68,357 |
| KKU Thailand | MOU on agreed amount at start | 28,094 |
| | Liaison Scientist | 35,888 |
| | Lump sum for basin activities | 68,357 |
| Mekelle/Nile | MOU on agreed amount at start | 19,345 |
| | Liaison Scientist | 35,888 |
| IWMI Ethiopia | Lump sum for basin activities | 68,357 |
| | | |
| **Total** | | **821,763** |
| Source: Project Leaders | | |

The table below presents the 2006 – 07 budget data for selected basins/countries.

| TABLE 3: 2006-07 BUDGET FOR SELECTED BASINS/COUNTRIES | | |
|---|---|---|
| Basin | Country/Location | Amount (US$) |
| Andes | | 116,570 |
| | Colombia | 36,175 |
| | Bolivia | 32,145 |
| | IRC | 45,500 |
| | IMWI | 2,750 |
| Indo-Ganges | | 98,860 |
| | India | 41,380 |
| | Nepal | 46,980 |
| | Global | 10,500 |
| Nile | | 105,225 |
| | Ethiopia | 85,225 |
| | MKU | 20,000 |
| Source: Project Leaders | | |

[17] The Project was reorganized in 2006, with budget adjustments and reduced duration given the new end date of December 2007 (Boelee et al., 2006). The original total for collaborator funds was US$801,438 allocated among the items in the table above. As the original proportions remained quite similar following the change in 2006, the table depicts allocations using similar proportions.
[18] National researcher for documentation and analysis

As Tables 2 and 3 show, MUS Project costs differed from country to country[19], reflecting different levels of Project activities and focus by country. While the global partners (IRC, IDE, IWMI and to some extent Khon Kaen) coordinated basin activities, they were also active at global level. As such, impact beyond the eight countries is through these global activities.

The table below presents the amount of resources invested under the MUS Project on an annual basis.

**TABLE 4: MUS Project: Breakdown of Costs by Global and Ethiopia Component (US$)**

| **MUS Global** | | **Total Budget** | **Actual Up to 2005** | **Actual 2006** | **Balance Bgt 2007** |
|---|---|---|---|---|---|
| 027-01-00-MUL-PR-M711 | Synthesis | 252,732 | 149,099 | 71,247 | 32,386 |
| 027-01-00-MUL-PR-M119 | Staff Time | 283,975 | 196,375 | 47,600 | 40,000 |
| 027-01-00-MUL-PR-M610 | Collaborators Expenses | 821,763 | 258,533 | 259,006 | 304,224 |
| 027-01-00-MUL-PR-M810 | Indirect costs | 99,640 | 56,284 | 17,072 | 26,284 |
| **Total** | | **1,458,110** | **660,291** | **394,925** | **402,894** |
| | | | | | |
| **MUS Ethiopia** | | **Total Budget** | **Actual Up to 2005** | **Actual 2006** | **Balance Bgt 2007** |
| 027-01-02-MUL-PR-M119 | Staff Time | 56,444 | | 39,944 | 16,500 |
| 027-01-02-MUL-PR-M170 | Consultancy | 2,203 | | 703 | 1,500 |
| 027-01-02-MUL-PR-M211 | Local travel | 7,092 | | 2,092 | 5,000 |
| 027-01-02-MUL-PR-M311 | Supplies | 10,362 | | 362 | 10,000 |
| 027-01-02-MUL-PR-M570 | Workshops | 6,700 | | | 6,700 |
| 027-01-02-MUL-PR-M551 | Capacity Building | 4,000 | | - | 4,000 |
| 027-01-02-MUL-PR-M610 | Partners (MKU & ILRI) | 18,660 | | | 18,660 |
| 027-01-02-MUL-PR-M810 | Indirect cost | 15,586 | | 7,720 | 7,866 |
| 027-01-02-MUL-PR-M910 | Contingency (inc. OH) | 18,194 | | | 18,194 |
| **Total** | | 139,240 | - | 50,820 | 88,420 |
| | | | | | |
| **Overall Total** | | **1,597,350** | **660,291** | **445,744** | **491,315** |

Source: Project Leaders

## 3.3 Project Benefits

This section provides the likely influence and benefits that the MUS Project appeared to have had on the change/impacts observed in the basins/countries. As such, it is important to recapitulate on

[19] The level of investment in the learning alliances was around USD20-25000 per country per year -- generally for the research activities (like case studies and also facilitation of the process, communication activities and organization of workshops) of local partners leading the learning alliance

the generally perceived benefits of the MUS approach, which have been outlined in several documents in support of the hypothesis that a more integrated, multiple-use approach can maximize the health benefits and productive potential of available water supplies – leading to increased incomes, improved health, reduced workloads for women and children and improved sustainability.

Since the analysis in this report uses the information and wherever possible the technical approach of the Winrock study, it is also important to recapitulate on the key findings of the Winrock study, which evaluated investments in multiple-use water services relative to single-use services in terms of poverty impacts, cost-benefit ratios and sustainability and determined the potential market for such services in South Asia and sub-Saharan Africa. In order to analyze the incremental benefits and costs of different water service approaches, the Winrock study used a framework of water service levels defined in Annexes B and C, including "no service", single-use "basic domestic" and "basic irrigation" services, basic level multiple-use services, intermediate level multiple-use services, and highest-level multiple-use services. The water service levels describe the relationship between access characteristics and the water needs that can be met in the form of a water ladder (Van Koppen and Hussein, 2007). For existing domestic services, supporting multiple uses involved increasing water quantity and reducing the distance to the source under a "domestic-plus" (domestic+) approach. For existing irrigation services, supporting multiple uses involved improving water quality to support domestic uses, improving reliability, and reducing distance from source to homestead and other access barriers under an "irrigation-plus" (irrigation+) approach.

The key findings of the Winrock study with regard to costs and benefits are, first, that while multiple-use services cost more than single-use services, they generate greater income and poverty impacts. Second, the intermediate multiple-use service level optimizes benefits (including poverty impacts) relative to costs for new services and most upgrades in the domestic sector. Third, while upgrading from the basic irrigation to the basic multiple-use service level optimizes financial benefits relative to costs, upgrading to the intermediate multiple-use service level optimizes poverty impacts, including substantial health benefits in areas without domestic water services. Finally, income generated by multiple-use services can enable repayment of initial and ongoing costs for some service levels and technology options, making multiple-use services more likely to be sustained.

### 3.3.1 Direct benefits

The MUS Project generated direct benefits as follows:

**Experiment Space and Proof:** The MUS Project attempted to fill the gap between the broadly encompassing definition of the MUS approach and the provision of a clear idea on how to provide such services in practice and how these services perform in different contexts. Thus, although the application of the MUS approach may not be illustrated in such countries as Colombia (Cordoba, 2008), but above all, the MUS Project provided the opportunity and space to experiment the approach and generate experiential learning. For instance, stakeholders in Nepal generally argued that most of the economically feasible water sources had already been exploited and that there was little room to find feasible sources in the hills. However, implementation of the MUS Project showed that there were very small water sources that had not yet been utilized, thereby providing proof for effective use of very small water sources through the MUS approach (Mikhail et al., 2007).

**Community Motivation and Increased Knowledge/Awareness:** MUS Project investment through the learning alliance workshops, meeting and visits motivated people in such countries as Colombia through information and evidence shared which improved people's perception and facilitated introduction of 'new' MUS approaches (Butterworth et al., 2008). The motivation facilitated knowledge acquisition, awareness of various issues[20] such as water conservation and skill building of community members through multiple trainings and planning, formation/evolution of user groups, production and negotiation of allocation agreements in such countries as Nepal. The result has been that the relevant community now automatically thinks of integrating multiple uses of water resources in Nepal (Mikhail et al., 2007), with domestic needs taking first priority. In addition, conflicts among users (including married couples) have been reduced. In Bolivia, the result has been useful extension of local knowledge on the use of community-managed water supply systems for multiple uses and the contribution of these activities to livelihoods (Butterworth et al., 2008). In South Africa, better understanding on the role of water in people's livelihoods has extended an appreciation of how the livelihood role of water is shaped by access to water -- a crucial basis for planning for water services (Cousins et al., 2007). In Colombia, the LAs have resulted in considerable capacity building for local stakeholders (Butterworth et al., 2008). In Zimbabwe, the MUS Project provided awareness and enhanced understanding of the MUS concept by providing some members with 'stronger conceptual framework through which to analyze their own experience' in terms of approaches used and technological options for MUS and its introduction in some organizations (Manzungu, 2008).

**Coordination Platform for Self-Actualisation and Local Wisdom Networks:** In Thailand, self-actualization of farmers' situation, assessment of the lessons learnt as well as identification of potential alternatives and solutions to their predicament preceded the MUS Project. Developing own LAs among themselves (Local Wisdom Networks), farmers and farmer groups in Thailand were able to revive indigenous knowledge for development that facilitated faster learning in their own farms and technology transfer through field visits. Thus, the introduction of LA under the MUS Project played a key role in coordinating the interaction among the different actors related to the topic of water, thereby adding momentum to related developments which occurred prior to the MUS Project in Thailand. As such, the Project provided some trigger mechanism for increased interest in these earlier developments. The results have been the continuing sustainable agricultural development, new bottom-up plans and policies using learning alliances that forge horizontal and vertical partnerships for development from community to national levels and mobilization of farmers and multiple development partnerships with National Policy in Thailand[21] (Sawaeng Ruaysoongnerm, 2005). In addition, the local and national experiences are likely to be extended to regional, basin sub-regions in Laos, Cambodia and Vietnam through networks development[22].

**Changed investment and approach:** The emphasis of the MUS approach through specific activities of the MUS Project, including the development and hosting of a short course on Integrated Water Resources Management with strong focus on MUS, resulted in formulation of new projects in Colombia (Butterworth et al., 2008). Although changing laws was likely to require more time than the duration of the Project, there are high-level discussions in Colombia on water quantity

[20] The LA in Colombia enabled participants to learn about the different issues of access to water that are present in rural zones and their influence on the development of livelihoods according to Cordoba (2008)

[21] The Thai government has embraced the multiple-use water tanks and other investments for homestead production by the Farmer Wisdom Network supported by the MUS Project (Box 1)

[22] www.musproject.net/page/337 --some evidence that the MUS Project will continue to create space for sharing ideas and information among basins

norms for 'domestic' schemes[23] (Cordoba, 20008). In Bolivia, multiple use systems are thriving in the peri-urban Cochabamba due to lack of top-down planning, with strong bottom-up development supported by laws that empower local development committees in defense of local water systems (Butterworth et al., 2008). A specific district has adopted a policy of investing in multi-purpose water systems only as a result of a learning alliance on multiple uses of water in eastern Ethiopia (http://www.musproject.net/page/1590). In Thailand, the MUS Project raised awareness and facilitated learning among farmers on best practices in farm level MUS (Garden, 2008), thereby facilitating the transformation, changed approach as well as the incorporation of local actions into national policies, agendas and the development of a mega project in Thailand (Mekong basin) (Sawaeng Ruaysoongnerm, undated). In addition, several single use approaches have transformed into integrated development in Thailand (Sawaeng Ruaysoongnerm, undated), and water supply for small gardens and livestock is included alongside domestic use in Bolivia (Butterworth et al., 2008). Again, in Thailand, positive changes in approach included the continuing improved water resource collection efficiency, changes in production practices and relating technologies from mono-cropping to integrated production system of agroforestry, integrated farming system, and diversified cropping system, improved land carrying capacity and rehabilitation of degraded land.

### 3.3.2 Indirect benefits related to the Winrock study

The MUS Project has also apparently generated indirect benefits which relate well with those in the Winrock study as follows:

**Higher Incomes and Investment:** The application of MUS approaches in Nepal resulted in great expansion of vegetable production (Mikhail et al., 2007), thereby increasing incomes. In Thailand, direct and indirect household income is estimated to have increased by at least 2-3 times or even 10 times in intensive production systems to as high as 5,000 US$ annually, with easier loan repayment, debt reduction, increased saving and further re-investment in water storage structures (Sawaeng Ruaysoongnerm, undated). In Cochabamba in Bolivia, non-domestic uses of peri-urban water supplies were found to generate significant additional incomes (Duran et al., 2005). The MUS Project has likely facilitated and contributed to the continued achievement of these income benefits.

**Improved Health:** In Ethiopia, increased production, opportunities for income generation and incomes have resulted in improved health (www.musproject.net/page/337). In Nepal, health improvements were through increased hygiene, sanitation, improved nutrition (Mikhail et al., 2007). In Thailand, improved health and education for family members were due to better income, food and living environment (Sawaeng Ruaysoongnerm, undated). The MUS Project has likely facilitated and contributed to the continued achievement of the benefits related to heath.

**Gender Equity and Social Cohesion:** In Nepal, time saving for water collection as a result of MUS water storage at household level for access at all times resulted in women allocating more time for agricultural production, thereby increasing the consultation and joint decision-making between men and women for farm activities (Mikhail et al., 2007). In addition, the community nature of the MUS approach allowed inclusiveness of all households and sexes, including those even with a small land area as well as women who simultaneously took advantage of the new technologies. The MUS

[23] Barbara van Koppen, Significant Change Stories (Box 1)

Project likely facilitated and contributed to the continued achievement of the benefits related to gender equity.

**Improved sustainability:** In Nepal, increased income, social mobilization, cohesion and community ownership from the onset of the system design and construction that the project process had brought ensured the likely improved sustainability (Mikhail et al., 2007). In Thailand, the initiation of revolving funds for infrastructure development such as ponds, water use systems and mushroom houses developed and provided sustainable support to the local initiatives and actions (Sawaeng Ruaysoongnerm, undated). The MUS Project likely facilitated and contributed to the continued achievement of the benefits related to improved sustainability.

# 4.0 Analysis of the MUS Project Benefits and Costs

The research nature of the MUS Project limited the assessment of incremental benefits and costs by water service level. As such, the outline of benefits in the preceding sections merely assessed the extent of influence the MUS Project appeared to have had on the direct and indirect change/impacts observed in the basins/countries in relation to the key findings of the Winrock study.

The MUS Project adopted and promoted Learning Alliances (LAs), which are a series of connected stakeholder platforms, created at key institutional levels (typically national, intermediate and local/community) and designed to break down barriers to both horizontal and vertical information sharing, thereby speeding up the process of identification, development and uptake of innovation (Moriarty et al, 2005). The central premise of the Learning Alliance approach is that, by giving as much attention to the *processes* of innovating and scaling up innovation as is normally given to the subject of the innovation itself, barriers to uptake and replication can be overcome. As such, the Learning Alliance emerged in the MUS Project as a means to scale up and adapt research results, as well as develop strategic research and capacity building in such countries as Colombia (Cordoba, 2008). Thus, the activities and investments outlined in sections 3.1 and 3.2 above ought to bring changes in behaviour in terms of policies and investment. Further, the change in behaviour ought to have facilitated the identification, development and uptake of innovation through the adoption and promotion of the Learning Alliances by the MUS Project. This facilitation ought to have led to more upscaling, thereby allowing an assessment of benefits on an *ex ante* basis.

Key important points are, however, noteworthy. First, although it has not been possible to quantify the level of influence, it is clear that the MUS Project resulted in change in behaviour[24] (policies, investment, etc.,) in almost all the eight countries. Through the LAs, innovation and experiential learning provided an 'engine' for uptake and replication within the context (institutional, financial) of a given country or region, making the innovation suitable for quick uptake. Second, the change in behaviour across countries occurred and facilitated an upscaling of MUS schemes at different degrees, with higher degrees of influence possibly in Nepal and Thailand, and limited degree in Colombia, South Africa, Bolivia and Ethiopia. Finally, the experiential learning and enhanced understanding of the MUS approach through LAs will continue to facilitate uptake and replication

[24] The governments of South Africa, Zimbabwe, Colombia, Nepal, and Thailand may in future adapt a national policy towards planning and implementation of multiple uses. There are draft policy guidelines for MUS in South Africa and a proposed law is said to have general reference to MUS in Zimbabwe (Box 1 and Manzungu, 2008).

after the Project, thereby providing space for sharing ideas and information among basins as well as continued upscaling of MUS schemes globally[25].

The analysis in this section is done on the basis of a set of critical and transparent assumptions. The analysis of benefits assumes that the MUS Project ended with some positive contribution towards achievement of the objective of contributing to an enabling environment for upscaling MUS schemes, including policies and potential investments, entry points for implementation approaches to scale-up, and institutional readiness at local, intermediate and national levels (Renwick et al., 2007). It is assumed that the Project brought changes in behaviour (policies, investment, etc.,) in all the eight countries, but to varying degrees[26], thereby allowing and facilitating upscaling of MUS schemes, also at varying degrees.

Consistent with the varying levels of project activities as well as the different degrees of change in behaviour and influence, three sets of countries are assumed, with proportional shares of target population in 2008 as follows:

- 0.1%[27] of the total population have been positively affected in the countries with highest degree of change in behaviour and upscaling (Nepal and Thailand);
- 0.06% of the total population have been positively affected in the countries with limited degree of change in behaviour and upscaling (Colombia, South Africa, Bolivia, Ethiopia); and
- 0.04% of the total population have been positively affected in the remaining countries (India and Zimbabwe).

Beyond 2008, it is expected that the experiential learning through LAs will continue to facilitate uptake and the continued upscaling of MUS schemes. As noted above, however, the degree of uptake and upscaling of the MUS schemes will be limited by several factors, including technological designs[28]. Thus, the increase in number of people served by the MUS schemes is assumed to increase conservatively by 10 percent in each of the eight countries covered beyond 2008. Finally, impact beyond the eight countries will be generated by the global activities[29] listed in section 3.1 above. It is also assumed that upscaling of MUS schemes beyond the eight countries will occur in South Asia and sub-Saharan Africa as identified by the Winrock study[30] at 0.01%[31] of the potential market in 2008. The number of people served by the MUS schemes beyond the eight countries is assumed to increase also conservatively by 5 percent beyond 2008.

[25] With involvement of key players taking up the concept. For instance, the Project had been invited to the Collaborative Council on ('domestic') Water Supply, and IFAD also showed interest in the MUS Project (Box 1)

[26] Due to different levels and focus of activities among countries

[27] This is based on the target population for the Smallholder Irrigation and Market Initiative (SIMI), which pre-existed and in conjunction with, the successful cases of MUS schemes/projects in Nepal occurred. The Project had a computed target population of 0.08% of total population in Nepal; the population shares for the other sets are arbitrarily set from this basis.

[28] For instance, in Nepal (the case of Senapuk MUS Project), while the previous scheme had been a great improvement over walking to the spring for water, and output was sufficient in quantity and quality to meet daily domestic water needs at that time, the 0.2 liters per second (lps) flow rate that the Dumkilla provides became inadequate for the 50% increase in number of households in Senapuk by 2003 (Mikhail et al., 2007)

[29] WWF4, presentations in Stockholm, ICID-seminars, GWP/TEC events, MUS Group activities with IFAD, FAO, Council, participation in Winrock-IRC-IWMI research, sensitization of CPWF, etc

[30] Based on an analysis of current service levels, technologies, benefits and costs, the Winrock study identified a large potential market above a billion people for multiple-use approaches and a five high potential opportunity action areas in South Asia and sub-Saharan Africa

[31] Conservative proportional share relative to those assumed in the eight countries

The analysis of costs in this section recognises that the MUS Project that is being evaluated has essentially ended. As such, the Project's annual costs since 2005 have been converted to their present values in 2008 using the discount rate of 10% as used by the Winrock study. It is assumed that the MUS Project so far covered all the five potential areas as recommended by the Winrock study in research and advocacy activities but at different levels in the eight countries according to level of influence, using proportional shares listed above across the three sets of countries. Beyond 2008, it is assumed that any MUS activities by some stakeholders and/or partners will shift the focus from research and advocacy to implementation with additional costs in hardware, software and recurrent costs in order to facilitate continued upscaling of MUS schemes both within and beyond the eight countries.

The computation of additional costs and potential benefits beyond 2008 is done using the information on the high potential areas recommended by the Winrock study (See Annexes D and E), the computed target population[32] over a period of ten years[33] and financial data in the Winrock study. It is assumed that MUS Project activities to-date will result in automatic adoption and change in behaviour in the eight countries. As such, the target population for upscaling of MUS schemes in these countries is equally distributed among the five high potential areas[34]. However, additional investment for upscaling of MUS schemes beyond the eight countries is distributed proportional to the efficiency and effectivessness of a particular potential area based on the benefit-cost ratios in the Winrock study. As such, the target population for upscaling of MUS schemes in the five potential areas beyond the eight countries will be proportional to respective benefit-cost ratios in the Winrock study in the ratio 6:5:4:3:2. Annex F contains the estimated target population within and beyond the eight countries.

The estimation of income and costs in the Winrock study used standardised estimates to common units to allow comparison, including currency conversion to 2004 purchasing power parity international dollars (PPP $I). Since the PPP describes the long run behaviour (4 -10 years) of exchange rates, no further conversions were necessary in this analysis. As such, the levels of future investment and income benefits in the potential areas merely depend on the number of people to be covered using the financial data provided in the Winrock study.

## 4.1 Analysis of Investments and Income Benefits

Building on the assumptions above, this section assumes that the number of people involved in MUS schemes among the five high potential areas and both within and beyond the eight countries will increase from about 757,805 in 2008 to 1,706,306 in ten years (See Annex F). This requires an additional capital investment of about US$53,795,200 and annuity payments of about US$12,640,200 in recurrent costs for ten years. The additional costs are for hardware, software and recurrent costs to facilitate continued upscaling of MUS schemes both within and beyond the eight countries.

The result of the overall analysis in this report indicates that the MUS Project will continue to generate positive impacts and that additional investment in the five potential areas identified by the

[32] Based on national population data in Annex F
[33] The assumed furthest period the computed PPP in the Winrock study remains valid
[34] On the basis of automatic adoption and change in behaviour influence by project activities

Winrock study is worthwhile. As shown in the table below, the income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years.

| Projected Costs and Income Benefits for All Opportunities (US$) | | | |
|---|---|---|---|
| | | Financial Result | |
| Item | Per Capita (Winrock) | NPV | B-C Ratio |
| Capital Investment | 11 – 110 | 226,533,333 | 2.68 |
| Recurrent cost/yr | 1 – 19 | | |
| Total Cost | 12 – 124 | | |
| Annual Income | 25 – 62 | | |

### 4.1.1 Specific Analysis for Opportunity 1

This section assumes that the number of people involved in new piped multiple-use services for currently unserved at the intermediate service level both within and beyond the eight countries will increase from about 151,600 in 2008 to 341,300 in ten years. The specific activities involve provision of new water services from networked piped systems at the intermediate multiple-use service level with communal standposts (< 150m, <5 minutes roundtrip, 40-100 lpcd) in order to meet all drinking and domestic needs, plus a combination of home gardens (25-200 $m^2$), livestock, and many small-scale enterprises (food processing, construction, etc.). This requires an additional capital investment of about US$14,468,000 and annuity payments of about US$4,158,600 in recurrent costs for ten years. The result of the analysis in this section indicates that the MUS Project will continue to generate positive impacts and that additional investment in this potential area is worthwhile. As shown in the table below, the income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years.

| Projected Costs and Income Benefits for Opportunity 1 (US$) | | | |
|---|---|---|---|
| | | Financial Result | |
| Item | Per Capita (Winrock) | NPV | B-C Ratio |
| Capital Investment | 105 | 41,661,043 | 2.03 |
| Recurrent cost/yr | 19 | | |
| Total Cost | 124 | | |
| Annual Income | 61 | | |

### 4.1.2 Specific Analysis for Opportunity 2

This section assumes that the number of people involved in upgrading existing domestic piped systems to intermediate multiple uses service level both within and beyond the eight countries will increase from about 141,570 in 2008 to 325,750 in ten years. The specific activities involve increasing the density of communal standposts from an improved source to within <150m of households (5 minutes roundtrip), adding some yard taps and increasing quantity to provide reliable access to 40-100 lpcd, and providing technical and managerial support for improved community management and productive activities in order to meet all drinking and domestic needs and a combination of home gardens (25-200 $m^2$), livestock and most small-scale enterprises. This requires an additional capital investment of about US$10,810,800 and annuity payments of about US$3,101,490 in recurrent costs for ten years. The result of the analysis in this section indicates that

the MUS Project will continue to generate positive impacts and that additional investment in this potential area is worthwhile. As shown in the table below, the income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years.

| Projected Costs and Income Benefits for Opportunity 2 (US$) | | | |
|---|---|---|---|
| | | Financial Result | |
| Item | Per Capita (Winrock) | NPV | B-C Ratio |
| Capital Investment | 84 | 48,546,001 | 2.60 |
| Recurrent cost/yr | 15 | | |
| Total Cost | 99 | | |
| Annual Income | 62 | | |

### 4.1.3 Specific Analysis for Opportunity 3

This section assumes that the number of people involved in upgrading services to basic multiple use service level through communal add-ons to support multiple uses (boreholes with hand pumps) both within and beyond the eight countries will increase from about 146,570 in 2008 to 333,500 in ten years. The specific activities involve increasing the density of communal standposts from an improved source to within <150m of households (5 minutes roundtrip), adding some yard taps and increasing quantity to provide reliable access to 40-100 lpcd, and providing technical and managerial support for improved community management and productive activities in order to meet all drinking and domestic needs and a combination of home gardens (25-200 $m^2$), livestock and most small-scale enterprises. This requires an additional capital investment of about US$3,331,100 and annuity payments of about US$851,260 in recurrent costs for ten years. The result of the analysis in this section indicates that the MUS Project will continue to generate positive impacts and that additional investment in this potential area is worthwhile. As shown in the table below, the income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years.

| Projected Costs and Income Benefits for Opportunity 3 (US$) | | | |
|---|---|---|---|
| | | Financial Result | |
| Item | Per Capita (Winrock) | NPV | B-C Ratio |
| Capital Investment | 25 | 23,774,165 | 3.65 |
| Recurrent cost/yr | 4 | | |
| Total Cost | 29 | | |
| Annual Income | 25 | | |

### 4.1.4 Specific Analysis for Opportunity 4

This section assumes that the number of people involved in upgrading existing household hand-dug wells to the intermediate multiple use service level through well protection and improved lifting devices both within and beyond the eight countries will increase from about 156,570 in 2008 to 349,000 in ten years. The specific activities involve well protection, wherever necessary, to improve water quality for drinking and domestic needs and improved lifting devices to increase the quantity

available for productive uses, and private sector to support value-chains that produce and market low-cost pumps and drip kits in order to meet all drinking and domestic needs, plus a combination of home gardens (25-200 $m^2$), livestock and many small-scale enterprises (food processing, construction, etc.). This requires an additional capital investment of about US$14,518,200 and annuity payments of about US$3,373,900 in recurrent costs for ten years.

The result of the analysis in this section indicates that the MUS Project will continue to generate positive impacts and that additional investment in this potential area is worthwhile. As shown in the table below, the income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years.

| Projected Costs and Income Benefits for Opportunity 4 (US$) | | | |
|---|---|---|---|
| | | Financial Result | |
| Item | Per Capita (Winrock) | NPV | B-C Ratio |
| Capital Investment | 102 | 48,701,478 | 2.37 |
| Recurrent cost/yr | 15 | | |
| Total Cost | 117 | | |
| Annual Income | 61 | | |

## 4.1.5 Specific Analysis for Opportunity 5a

This section assumes that the number of people involved in upgrading existing irrigation systems to basic through communal add-ons to support livestock both within and beyond the eight countries will increase from about 80,790 in 2008 to 178,400 in ten years. The specific activities involve communal add-ons to accommodate livestock (cattle troughs and crossings) and domestic uses (laundry slabs and washing rooms). This requires an additional capital investment of about US$807,850 and annuity payments of about US$115,500 in recurrent costs for ten years. The result of the analysis in this section indicates that the MUS Project will continue to generate positive impacts and that additional investment in this potential area is worthwhile. As shown in the table below, the income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years.

| Projected Costs and Income Benefits for Opportunity 4 (US$) | | | |
|---|---|---|---|
| | | Financial Result | |
| Item | Per Capita (Winrock) | NPV | B-C Ratio |
| Capital Investment | 11 | 35,205,823 | 21.54 |
| Recurrent cost/yr | 1 | | |
| Total Cost | 12 | | |
| Annual Income | 52 | | |

## 4.1.6 Specific Analysis for Opportunity 5b

This section assumes that the number of people involved in upgrading existing irrigation systems to intermediate service levels through improved home communal and home water storage to support domestic and non-irrigation productive uses both within and beyond the eight countries will increase from about 80,790 in 2008 to 178,400 in ten years. The specific activities involve improving

communal water supply to provide domestic water with home water treatment as well as to support home gardens, livestock and small-scale enterprises. This requires an additional capital investment of about US$8,078,500 and annuity payments of about US$1,039,400 in recurrent costs for ten years. The result of the analysis in this section indicates that the MUS Project will continue to generate positive impacts and that additional investment in this potential area is worthwhile. As shown in the table below, the income benefits are significantly higher than costs, with a positive NPV and B-C Ratio of greater than 1 for a period of ten years.

| Projected Costs and Income Benefits for Opportunity 4 (US$) | | | |
|---|---|---|---|
| | | Financial Result | |
| Item | Per Capita (Winrock) | NPV | B-C Ratio |
| Capital Investment | 110 | 28,644,823 | 2.95 |
| Recurrent cost/yr | 9 | | |
| Total Cost | 119 | | |
| Annual Income | 61 | | |

# 5.0 Conclusions

The analysis in this report quantifies the MUS Project investment to-date, and based on critical assumptions, estimates future benefits and costs. With its primary objective of contributing to the achievement of an enabling environment, the MUS Project has resulted in change in behaviour (policies, investment, etc.,) and facilitated upscaling of MUS schemes both within and beyond the eight countries. The MUS Project contributed significant influence in augmenting the efficiency and effectiveness levels of multiple-use approaches over single use approaches.

The MUS Project has primarily promoted MUS concepts across basins through learning and sharing ideas on how to go about MUS approaches, and had limited cases of developing and testing technological models. Although the benefits and costs of the MUS Project have not been assessed on an incremental basis using the water ladder, the analysis in this report concludes that with an investment of about US$1.6 million over a period of three years, the MUS Project has generated direct and indirect benefits. The direct benefits included provision of experiment space and experiential learning. The indirect benefits relate well with those in the Winrock study, and occurred as a result of the changes in behaviour (policies, investment), which in turn, facilitated upscaling of MUS schemes both within and beyond the eight countries. Consequently, the MUS Project likely facilitated and contributed to the continued achievement of benefits related to higher incomes and investment, improved health, gender equity and social equity, and improved sustainability.

The report invariably concludes that the MUS Project provided an 'engine' for uptake and replication through the Learning Alliances. Extending from this conclusion, it is expected that the influence in change of behaviour will continue facilitate uptake and replication after the Project, thereby providing space for sharing ideas and information among basins as well as continued upscaling of MUS schemes. Based on critical assumptions, the analysis estimates that as many as two million people will benefit from MUS schemes over a period of ten years, with higher and additional capital investment of about US$53.8 million and annual outlays of about US$12.6 million in recurrent costs. While the costs appear to be high, investing in the five high potential areas recommended by the Winrock study is worthwhile. Illustratively, the income benefits are

significantly higher than costs, with a positive NPV and B-C Ratio greater than 1 for a period of ten years. Thus, any MUS activities by some stakeholders and/or partners will continue to generate significant benefits, and the activities can be scaled up or down depending on the number of beneficiaries and available resources.

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## Annexes

### ANNEX A: TERMS OF REFERENCE

The Food Agriculture and Natural Resources Policy Analysis Network (FANRPAN) has been requested to carry out an assessment of the impacts of the MUS Project by the CPWF. The purpose is to learn lessons from the project's experience with regard to achieving developmental impacts through research. The MUS Project has been selected because it has identified considerable change at local, national and even global levels in terms of adoption of the concept of supplying water to meet multiple needs, rather than imposing single-purpose designs. The evaluation is intended to examine these impacts in more depth in selected instances, try to understand the 'pathways' from the project to these impacts to the extent this is possible, and identify lessons for design of future CPWF projects.

Assessing costs and benefits of research projects is notoriously difficult. Assessing the benefits and costs of the MUS Project is especially difficult because of the complexity of the project in terms of its multiple partners, multiple regions, and the fact that others have also been promoting the same model, i.e., multiple use water services. Winrock has recently attempted to analyze the benefits and costs of promoting MUS globally (Renwick, et. al., 2007, "Multiple Use Water Services for the Poor: Assessing the State of Knowledge," Winrock International: Arlington, VA). This analysis is quite comprehensive, and it is unlikely we can add further value by analyzing the benefits and costs of MUS *per se*. However, building on that report and some of the reports produced by the CPWF-supported MUS Project, it may be possible to estimate the benefits and costs of the project to date, and project into the future making some critical assumptions. This is the task proposed here. It must be carried out in close association with the other tasks, because these will attempt to identify the linkages, if any, between Project activities and outputs, and MUS outcomes. The specific terms of reference for this component are as follows:

1. Review the Winrock study and other documents on the benefits and costs of MUS.
2. Review key project reports and also the data on project costs (to be provided by the CPWF to FANRPAN for use in this project)
3. Interview the Project Leader and other project implementers to obtain their views and suggestions.
4. Prepare a work plan and methodology for review by Doug Merrey, MUS Project Leader and CPWF personnel.
5. Carry out the analysis and prepare a draft report.
6. Finalize the report based on feedback from reviewers.
7. Submit the draft final report.

**ANNEX B: DEFINITION OF DOMESTIC+ WATER SERVICE LEVELS**

| 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 | House and yard connections<br>Access: at homestead<br>Quantity: > 100 lpcd<br>Quantity: Improved source<br>Reliability: daily | >100 | >475 | Sufficient for domestic needs<br>Not all but in some combination:<br>Sufficient for livestock<br>Sufficient for gardening (~50m2 – >200m2)<br>Sufficient for many small-scale enterprises |
| Intermediate level multiple uses | Improved source very close to home.<br>Access: < 5 minutes roundtrip, < 150m<br>Quantity: 40 – 100 lpcd<br>Quality: improved source<br>Reliability: daily | 40-100 | 175 – 475 | Sufficient for basic domestic purposes<br>Not all but in some combination:<br>Sufficient for livestock (7 – 17 cows)<br>Sufficient for gardening (~25m2 – 200m2)<br>Sufficient for some small-scale enterprises |
| Basic multiple uses | Improved source, easily accessible<br>Access: < 15 minutes roundtrip, < 150-500m;<br>Quantity: 15-50 lpcd<br>Quality: improved source<br>Reliability: daily or storage | 15 – 50 | 50 – 280 | Sufficient for basic domestic purposes<br>Not all but in some combination:<br>Sufficient for some livestock (15 goats/8-10 cows)<br>Some gardening, especially with re-use(~10-100m2)<br>Some small-scale enterprises |
| Basic domestic | Improved source<br>Access: up to 30 minutes roundtrip, < 1km<br>Quantity: 10-25 lpcd<br>Quality: improved source<br>Reliability: daily or storage | 10-25 | 25 - 100 | Sufficient drinking and cooking<br>Hardly sufficient for basic hygiene<br>Not all but in some combination:<br>Insufficient for cleaning house<br>Possibility for re-use for horticulture & very limited livestock (chickens or goat) |
| No service | Unprotected or distant improved sources<br>Access: > 30 minutes roundtrip, >1 km<br>Quantity: < 5 lpcd<br>Quality: unimproved source<br>Reliability: daily | < 10 | <25 | If improved source, may be sufficient for drinking and cooking but too distant<br>Insufficient for basic hygiene |

## ANNEX C: DEFINITION OF IRRIGATION+ WATER SERVICE LEVELS

| 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<br>Quantity: 50-200 lpcd extra allocation for multiple uses<br>Quality: good drinking water (5-10 lpcd) through individual home water treatment<br>Reliability: daily | 50-200 | 250-1000 | Sufficient for domestic needs<br>Sufficient for livestock<br>Sufficient for home gardening<br>Sufficient for fisheries<br>Sufficient for small-scale enterprises |
| Intermediate level Multiple use | Access: under 150m or 5 minutes roundtrip<br>Quantity: 50-200 lpcd extra allocation for multiple uses<br>Quality: good drinking water (2-5 lpcd) through individual home water treatment<br>Reliability: daily or storage | 50-200 | 250-1000 | Sufficient for basic domestic purposes<br>Sufficient for livestock<br>Sufficient for some home gardening<br>Sufficient for fisheries in canals and reservoirs<br>Sufficient for small-scale enterprises |
| Basic multiple use | Access: dependent on infrastructure; under 1 km or <30 minutes roundtrip<br>Quantity: 10-100 lpcd extra allocation for multiple uses<br>Quality: suitable for irrigation<br>Reliability: according to irrigation storage but flexible<br>because of storage | 10-100 | 50-500[35] | Inadequate quality for drinking<br>Partially sufficient for basic hygiene (canal use)<br>Sufficient for livestock<br>Sufficient for limited home gardening, if water is easily accessible<br>Sufficient for fisheries in canals and reservoirs<br>Sufficient for small-scale enterprise |
| Basic irrigation | Access: dependent on infrastructure<br>Quantity: based on crop requirements and plot size<br>Quality: suitable for irrigation<br>Reliability: access to, and availability for non-irrigation<br>uses not formalized | Per irrigation requirements and plot size | <50 | Inadequate quality for drinking, sufficient for cooking<br>Partially sufficient for basic hygiene (canal use)<br>Sufficient for livestock, but access may be difficult<br>Hardly sufficient for small-scale enterprises<br>Non-consumptive uses such as laundry water mills accommodated |

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

**Annex D: High-potential areas for action based on financial sustainability; impact on well-being, health, and social empowerment; scalability; opportunities for leverage; and testing and learning opportunities**

| Opportunity Action Area | New piped multiple-use services for currently unserved at the intermediate service level | Upgrading existing domestic piped systems to intermediate multiple uses service level | Boreholes with hand pumps: upgrading services to basic multiple use service level through communal add-ons to support multiple uses | Upgrading existing household hand-dug wells to the intermediate multiple use service level through well protection and improved lifting devices | Upgrading existing irrigation systems to basic and intermediate service levels through communal add-ons, domestic storage and water treatment |
|---|---|---|---|---|---|
| **Attribute** | | | | | |
| **Intermediate level** | • Optimized benefits relative to costs for new services<br>• Incremental income benefits sufficient to cover costs with repayment periods between 6-36 months<br>• Largest incremental income gains with average incremental income benefit of $36 (38)<br>• Most promising option for new domestic+ services with average repayment periods between 6-30 months and a minimum benefit-cost ratio of 3.4<br>• Benefit-cost ratios exceed 1 for all income scenarios | • Optimizes income benefits relative to costs | | • Best option from the basic domestic service level with highest Benefit-Cost Ratio | • Optimizes poverty impacts in upgrading from the basic irrigation, including substantial health benefits<br>• Sufficient income to repay full investment costs and recurrent annual costs within 3-30 months<br>• Income enables repayment of initial and ongoing incremental costs for irrigation+ multiple-use service upgrades<br>• Poverty impacts are maximized<br>• Attractive investment option, with income benefits sufficient to cover investment costs in 12-24 months. |
| **New MUS service** | • Intermediate level optimizes benefits relative to costs for new | • Sufficient income to repay full investment costs | | | • Financially attractive investment option, with an average repayment period |

| | | | | | |
|---|---|---|---|---|---|
| | services | and recurrent annual costs within 3-30 months | | | of 3 months. |
| **Upgrade** | | • Sufficient income to repay full investment costs and recurrent annual costs within 3-30 months<br>• Best option from the basic domestic to intermediate multiple-use service level with average repayment periods between 20-24 months and a benefit-cost ratio of 4.7 | • Best option to basic multiple-use services | • Best option from the basic domestic service level to the intermediate multiple use level | • Optimizes financial benefits relative to costs and optimizes poverty impacts for upgrading from the basic irrigation<br>• Sufficient income to repay full investment costs and recurrent annual costs within 3-30 months<br>• most financially attractive upgrade investment option from the basic irrigation, with an average repayment period of 3 months. |
| **Basic MUS** | | | • Best option for upgrading from basic domestic services | | • Optimizes financial benefits relative to costs for upgrading from the basic irrigation<br>• Sufficient income to repay full investment costs and recurrent annual costs within 3-30 months<br>• Income enables repayment of initial and ongoing incremental costs for irrigation+ multiple-use service upgrades<br>• Largest incremental income benefits with average incremental income benefit of $52 (53) |
| **Boreholes** | | | • Best option for upgrading from basic domestic services to | | |

| | | | | | |
|---|---|---|---|---|---|
| | | | basic multiple-use services with repayment period between 12-14 months and stepwise incremental benefits and costs of $25 and $29 respectively and a benefit-cost ratio of 5.2 (45).<br>• The basic multiple-use service level optimizes income benefits with repayment periods averaging 12 months. | | |
| **Hand-dug wells** | | • The intermediate multiple-use service level optimizes income benefits relative to costs | | • Best option for upgrading from the basic domestic service level to the intermediate multiple use level with repayment periods between 6-12 months and incremental benefits and costs of $61 and $117, respectively (46). | |
| **Piped systems** | | • The benefit-cost ratios exceed 1 at all income levels for upgrades to the intermediate multiple-use level and higher. | | | |
| **Capital investment costs/capita hardware and software** | $56-$105 | $84 | $25 | $39 - $102 | $10 - $110 |

| | | | | | |
|---|---|---|---|---|---|
| **Annual income net of recurrent costs (per capita)** | $41-$50 | $45 | $22 | $47-$55 | $50-$57 |
| **Benefit-cost Ratio (10% discount rate)** | 3.4-7.8 | 4.7 | 5.4 | 3.4-8.6 | 2.9 - 27 |
| **Potential Market** | 137 million (South Asia: 56 m; SS Africa: 81 m) | 185 million (South Asia: 144 m; SS Africa: 41 m) | 280 million (South Asia: 263m; SS Africa: 17m) | 74 million (South Asia: 43m; SS Africa: 31m) | 447 million (South Asia: 443m; SS Africa: 4m) |

**Source: Renwick et al., 2007**

Annex E: **Five high-potential areas for action based on evaluation of: financial sustainability; impact on well-being, health, and social empowerment; scalability; opportunities for leverage, testing and learning.**

| **Opportunity Action Area** | **Potential Market** | **Capital investment costs hardware & software (per capita)** | **Annual income net of recurrent costs (per capita)** | **Benefit-cost ratio (10% discount rate)** |
|---|---|---|---|---|
| Opportunity 1. New piped multiple-use services for currently unserved at the intermediate service level | **137 million** (South Asia: 56 m; SS Africa: 81 m) | **$56-$105** | **$41-$50** | **3.4-7.8** |
| Opportunity 2. Upgrading existing domestic piped systems to intermediate multiple uses service level | **185 million** (South Asia: 144 m SS Africa: 41 m) | **$84** | **$45** | **4.7** |
| Opportunity 3. Boreholes with hand pumps: upgrading services to basic multiple use service level through communal add-ons to support multiple uses | **280 million** (South Asia: 263m SS Africa: 17m) | **$25** | **$22** | **5.4** |
| Opportunity 4. Upgrading existing household handdug wells to the intermediate multiple use service level through well protection and improved lifting devices | **74 million** (South Asia: 43m SS Africa: 31m) | **$39 - $10** | **$47-$55** | **3.4-8.6** |
| Opportunity 5. Upgrading existing irrigation systems to basic and intermediate service levels through communal add-ons, domestic storage and water treatment | **447 million** (South Asia: 443m SS Africa: 4m) | **$10 - $110** | **$50-$57** | **2.9 – 27** |

Annex F: Country Population Data

| Country Population Data ('000) | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Country** | **Base Year Number** | **Growth Rate** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| Nepal | 27,133 | 2.25% | 29,006 | 29,659 | 30,326 | 31,008 | 31,706 | 32,419 | 33,149 | 33,895 | 34,657 | 35,437 |
| Thailand | 65,493 | 0.65% | 65,493 | 65,921 | 66,352 | 66,785 | 67,222 | 67,661 | 68,103 | 68,548 | 68,996 | 69,447 |
| Colombia | 44,400 | 1.43% | 45,035 | 45,679 | 46,332 | 46,995 | 47,667 | 48,348 | 49,040 | 49,741 | 50,452 | 51,174 |
| South Africa | 43,786 | 0.20% | 43,786 | 43,874 | 43,961 | 44,049 | 44,137 | 44,226 | 44,314 | 44,403 | 44,492 | 44,581 |
| Bolivia | 9,248 | 1.42% | 9,248 | 9,379 | 9,512 | 9,647 | 9,784 | 9,923 | 10,064 | 10,207 | 10,352 | 10,499 |
| Ethiopia | 77,100 | 2.80% | 79,259 | 81,478 | 83,759 | 86,105 | 88,516 | 90,994 | 93,542 | 96,161 | 98,854 | 101,621 |
| India | 1,130,000 | 0.01% | 1,130,000 | 1,130,134 | 1,130,268 | 1,130,402 | 1,130,536 | 1,130,669 | 1,130,803 | 1,130,937 | 1,131,071 | 1,131,205 |
| Zimbabwe | 12,383 | 0.58% | 12,383 | 12,455 | 12,528 | 12,601 | 12,674 | 12,748 | 12,822 | 12,897 | 12,972 | 13,048 |
| **Computed Target Population Data by Geographical Area and Opportunity** | | | | | | | | | | | | |
| **Geographical Area** | | | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** |
| CPWF Countries | | | 657,849 | 723,634 | 795,997 | 875,597 | 963,157 | 1,059,472 | 1,165,420 | 1,281,962 | 1,410,158 | 1,551,174 |
| Beyond CPWF Countries | | | 100,000 | 105,000 | 110,250 | 115,763 | 121,551 | 127,628 | 134,010 | 140,710 | 147,746 | 155,133 |
| **Total** | | | **757,849** | **828,634** | **906,247** | **991,360** | **1,084,707** | **1,187,101** | **1,299,429** | **1,422,672** | **1,557,903** | **1,706,306** |
| Source: Various[36] | | | | | | | | | | | | |

[36] http://www.airninja.com/worldfacts/countries/Thailand/population.htm; http://www.vivatravelguides.com/south-america/colombia/colombia-overview/population-of-colombia; http://www.airninja.com/worldfacts/countries/Bolivia/population.htm; http://ethiopia.unfpa.org/population.html; http://en.wikipedia.org/wiki/Demographics_of_India; http://www.airninja.com/worldfacts/countries/Zimbabwe/population.htm;