Climbing the Water Ladder

Multiple-use water services for poverty reduction

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Barbara van Koppen, Stef Smits, Patrick Moriarty, Frits Penning de Vries, Monique Mikhail and Eline Boelee

IRC CGIAR Challenge Program on WATER & FOOD IWMI International Water Management Institute MUS

Executive Summary

Multiple-use water services offer an effective route to improve livelihoods

Rationale, aim and methodology

Multiple-use water services (MUS) has emerged as an approach to water services better suited to meeting people's multiple needs in peri-urban and rural areas of low- and middle-income countries. Agriculture-based livelihoods depend on water in many ways. Of course, water is needed for drinking, sanitation, cooking, personal hygiene, laundry and general cleaning. It is also needed in many small-scale or domestic enterprises including livestock watering, horticulture, crop irrigation, tree growing, fisheries, pottery, brickmaking, arts, butchery, car washing, ice-making and for ceremonial purposes.

Water professionals in NGOs, the domestic water sub-sector, various productive sub-sectors and knowledge centres have increasingly become aware that the single water uses enshrined in the mandates of their organisations do not reflect the practice of their clients who take water from multiple sources and use it for multiple purposes. The action research project '*Models for implementing multiple-use water supply systems for enhanced land and water productivity, rural livelihoods and gender equity*' was conducted from 2004 to 2009, aiming to overcome sectoral boundaries and to identify, test, study, and scale up opportunities for MUS.

The International Water Management Institute, IRC International Water and Sanitation Centre and International Development Enterprises established partnerships with water service provider groups in eight countries. Partners included water users and grassroots movements, local private service providers, national NGOs, governmental domestic sub-sector agencies and representatives from the productive sub-sectors, local government, and national knowledge centres. In each country, learning alliances were forged as instruments to conduct action research, learn together from experiences and scale up promising innovations. Through learning alliances, the MUS partnership was extended to 150 institutions that had experimented with, or were interested in, MUS innovation.

The first aim was to pioneer the implementation of MUS in communities and to document *de facto* multiple uses of 'domestic' systems designed for single use. Experiences from 30 sites allowed generic MUS models to be identified. The second aim was to scale up the MUS models by contributing to a supportive environment at intermediate, national and global levels. This was taken up by the learning alliances.

The action research was further structured around a jointly developed MUS conceptual framework, 'principles' that team members assumed to hold the key to implementing MUS in communities and scaling it up at intermediate and national levels. The leading principle is that livelihoods act as the main driver for water services. Access to the water people need is determined by sustainable water resources, appropriate technologies, adequate financing mechanisms and equitable institutions to manage communal systems.

MUS models

The project identified and analysed two models: homestead-scale and community-scale MUS. Homestead-scale MUS promotes household use of water for domestic *and* productive purposes to improve health, alleviate domestic burdens, and improve food security and income.

Community-scale MUS considers all uses, users, sites of use and water resources and infrastructure holistically. This integrated perspective opens new technological potential, including smart combinations of water sources; integration of existing infrastructure into new designs; and economies of scale in sharing bulk infrastructure for multiple uses. Various productive water sub-sectors operate at community level, where they are all concerned about the same water resources for the same people. With a MUS approach, the sectoral boundaries dividing single water uses can fade away, although sectoral expertise is still needed to turn water use into livelihood benefits.

A 'multiple-use water ladder' was developed to reflect linkages between a given level of access to water and the uses and livelihoods that can be derived. The ladder set 20 lpcd at and around homesteads as sufficient for basic domestic use, 20-50 for basic MUS, 50-100 for intermediate MUS and more than 100 for high-level MUS. At least 3 liters per capita per day (lpcd) should be safe for drinking. Even below basic domestic service levels, poor people prioritise water for small-scale productive activities over personal hygiene, while significant productive uses are undertaken at intermediate and high level MUS. The benefit-cost ratio of climbing the water ladder to intermediate level is favourable, and investment and operational costs can usually be paid from the income of productive purposes within three years.

Livelihoods are the road out of poverty

Climbing the water ladder to intermediate and high-level MUS requires only a small fraction of total water resources at community or basin scale, even when promoting full coverage MUS. In stressed basins, inequities in water use are substantial and re-allocation of some water by the few large-scale users seems legitimate. Within communities, the poor benefit most from such a reallocation, and they gain even more when resources are made available to gain access to infrastructure.

Our case studies confirm that water used at and around the homestead for multiple purposes brings substantial benefits to people's livelihoods. Provided services are well targeted, homestead-scale MUS is a way of achieving a more integrated set of poverty impacts than conventional water services. Homestead-scale MUS empowers women and is accessible to the poor and is likely to be the best way to use water to contribute to achieving the Millennium Development Goals (MDGs).

Establishing a supportive environment for MUS
The higher service levels needed for MUS can be provided through various combinations of technology, most of which are already commonly known. Provision comes at additional cost, and may have additional management implications, but the case studies have shown that these additional measures are achievable and that the challenges are largely off-set by increased benefits.

To scale up these MUS models, a supportive environment is needed at intermediate level to deliver on the principles of participatory planning, coordinated long-term support, and strategic planning. Enabling policies and laws are required at national level together with effective decentralisation of long-term support services. The learning alliances found institutional innovations to that end among each water service provider group on their own and in new collaborations.

Water users already implement MUS in their use of single-use systems for multiple uses, and in their efforts to integrate fragmented private and public support. NGOs have been innovating homestead- and community-scale MUS for years in response to people's needs for poverty alleviation. However, NGO projects are time bound and NGO support is not indefinite.

The domestic WASH sub-sector should welcome the widespread *de facto* productive uses of 'domestic' water as this produces considerably more livelihood benefits than would accrue under its mandate alone. Yet, service levels need to be increased to allow water users to climb the water ladder, balancing the need for at least 3 lpcd of water that is safe for drinking and provision for uses that do not need such high quality.

Productive sub-sectors already operate at community-scale for agriculture, livestock, fisheries and forestry. They can scale up MUS by integrating the homestead as a preferred site for productive and domestic uses and by tapping the potential of community-scale MUS through participatory approaches with communities and stronger collaboration with local government.

Local government is the potential pivot for MUS, where participatory planning, coordinated support and strategic planning come together. Local government needs support to implement this mandate, as its capacity is weak. Such an approach can enhance transparency in the allocation of public resources and water resources, match demand and supply and increase downwards accountability. Local government should also focus on post-construction support as communities cannot do it on their own.

Multiple uses gains multiple support
MUS implementation is being taken forward at larger scales in the project countries of Colombia, Ethiopia, Nepal, South Africa, Thailand, and India. Moreover, a growing number of initiatives across the water sector are putting MUS on the radars of professional networks, development and financing organisations, and research institutions from the domestic and productive sub-sectors and rural development

agencies. Within a few years, the global environment has become considerably more supportive of MUS.

Multiple uses and multiple sources are the main paradigm for water users, while for professionals a shift in perception unlocks new potential for better water services, especially in the light of the MDGs. Implementation of MUS is fully justified at much larger scale to further explore and release its potential.

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Abbreviations, acronyms, and terms

AGRITEX	Dept. of Agricultural Engineering, and Technical Services, Zimbabwe
Altiplano	Highlands of Bolivia
AQUACOL	Association of Community-based Water Supply and Sanitation Service Providers of Colombia
ASC	Agriculture Service Centre, Nepal
AWARD	Association for Water and Rural Development, South Africa
CARs	Corporación Autónoma Regional, Colombia
CBO	Community-Based Organisation
CC	(sub)Catchment council, Zimbabwe
Centro AGUA	Centro Andino de Gestión y Uso del Agua
Cinara	Instituto de Investigación y Desarrollo en Agua Potable, Saneamiento Básico y Conservación de Recursos Hídricos, Colombia
CMA	Catchment Management Agency, South Africa
CVC	Corporación Autónoma Regional del Valle del Cauca, Colombia
CPWF	Challenge Program on Water and Food
CPWF-MUS	Challenge Program on Water and Food – Multiple Use Water Services Project (CP28)
CRS	Catholic Relief Services
DADO	District Agriculture Development Office, Nepal
DDC	District Development Committee, Nepal
DLSO	District Livestock Services Office, Nepal
DNP	Departamento Nacional de Planeación, Colombia
DTO	District Technical Office, Nepal
DoI	Department of Irrigation, Nepal
DoLIDAR	Department of Local Infrastructure Development and Agricultural Roads, Nepal
DWAF	Department of Water Affairs and Forestry, South Africa
DWSS	Department of Water Supply and Sewerage, Nepal
DWSSC	District Water and Sanitation Sub Committee, Zimbabwe
FAO	Food and Agriculture Organization
FWN	Farmer Wisdom Network, Thailand
GDP	Gross Domestic Product
Gram panchayat	Village level local government body, India
ha	hectares
HCS	Hararghe Catholic Secretariat, Ethiopia
HDI	Human Development Index
IDE	International Development Enterprise
IDEI	International Development Enterprise, India
IDP	Integrated Development Plan, South Africa
IFAD	International Fund for Agricultural Development
INGO	International Non-Governmental Organisation

IRC	IRC International Water and Sanitation Centre, Netherlands
IRWSSP	Integrated Rural Water Supply and Sanitation Programme, Zimbabwe
IWMI	International Water Management Institute, Sri Lanka
JAC	Junta de Acción Comunal, Colombia
Kebele	A local government layer in Ethiopia
KfW	German Development Bank
L	litre (abbreviation capitalised to avoid confusion with the figure 1)
lpcd	litres per capita per day
lphd	litres per household per day
LSC	Livestock Service Centre, Nepal
m	metres
mm/yr	Millimetres per year
MUS	Multiple-use services (in the context of water services)
NAC	National Action Committee, Zimbabwe
NCU	National Coordination Unit, Zimbabwe
NDP	National Development Plan, Thailand
NGO	Non-Governmental Organisation
NRI	Natural Resources Institute
NWA	National Water Act, South Africa
ODA	Official Development Assistance
ODI	Overseas Development Institute (UK)
OTB	Organización Territorial de Base, Bolivia
PA	Peasant Association, Ethiopia
PAAR	Programa de Abastecimiento de Agua Rural, Colombia
PDA	The Population and Community Development Association, Thailand
PRA	Participatory Rural Appraisal
RIDA	Resources Infrastructure Demand and Access assessment method
RiPPLE	Research Inspired Policy and Practice Learning in Ethiopia and the Nile region
RWSS	Rural Water Supply and Sanitation Programme, Zimbabwe
RWSS	Rural Water Supply and Sanitation, Maharashtra, India
SEMAPA	Servicio Municipal de Agua Potable y Alcantarillado, Bolivia
SIMI	Smallholder Irrigation and Market Initiative,
SNNPR	Southern Nations, Nationalities, and People's Region, Ethiopa
SWELL	Securing Water to Enhance Local Livelihoods, South Africa
UMP district	Uzumba Maramba Pfungwe district, Zimbabwe
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VDC	Village Development Committee, (in both Colombia and Nepal)
VWSC	Village Water and Sanitation Committee, India

WES WG	Water and Environmental Sanitation Working Group, Zimbabwe
WHO	World Health Organization
Woreda	District, Ethiopia
WSP	Water Services Provider, South Africa
WSP	Water and Sanitation Program (of the World Bank)
WUA	Water User Associations, Nepal
WUC	Water User Committee, Nepal
Zilla parishad	District Council, India

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The structure of this book

This book outlines the outcome of action research undertaken over a period of five years in 30 study areas in eight countries.

Chapter 1 presents the background and rationale to the CPWF-MUS project, '*Models for implementing multiple-use water supply systems for enhanced land and water productivity, rural livelihoods and gender equity*'. It outlines how single-use provision has increasingly come to be seen as part of the problem to providing sustainable water services that can improve livelihoods, and how multiple-use services play a significant role in poverty reduction. Chapter 1 sets the conceptual framework for MUS and details the principles at community and at intermediate and national levels that were agreed at the outset of the project as essential for the effective delivery of MUS.

Chapter 2 presents the context and detailed activities of the project, starting with an overview of the 30 study areas, water services, predominant technologies, and the main focal points of the learning alliances. Chapter 2 illustrates the diversity of the countries and the diversity in domestic-plus, irrigation-plus or full MUS approaches, in the character of the water service provider groups driving the learning alliances, in technologies, water services institutions and water resources endowments, and in socio-economic trends. The detailed background and project activities of CPWF-MUS in each country are discussed. Readers interested in generic findings, can skip the detailed country descriptions and move on from Section 2.1 to Chapters 3 and 4.

Chapter 3 discusses the results from the case studies of how to implement MUS on the ground in communities and identifies generic MUS models at homestead- and community-scale. Case studies are analysed according to the principles set out in Chapter 1, and the validity of the multiple-use water ladder is tested. The evidence is examined in the light of the expectation that homestead-scale MUS is the most effective way of using water to contribute to the dimensions of wellbeing, as stipulated in poverty definitions, and therefore to meet the Millennium Development Goals.

Chapter 4 discusses the results of action research into how to create a supportive environment for scaling up MUS models at intermediate, national and global levels. Ultimately, such an environment should provide all water users in rural and peri-urban settings with the sustainable multiple-use water services that they need. Chapter 4 reports on the methodology, findings, outcomes and impacts.

Conclusions and recommendations are drawn in Chapter 5, particularly for MUS models and particularly related to efforts to improve livelihoods. Chapter 5 ends with a set of recommendations for each of the key actors in the MUS process.

The book ends with a comprehensive list of references. For an overview of all publications in English and some in Spanish, see website http://www.musproject.net/musproject.

In comparative tables in this book, unless otherwise stated, the country sequence is in ascending national GDP, starting with the poorest country first, viz. Ethiopia, Nepal, Zimbabwe, Bolivia, India (Maharashtra), Colombia, Thailand, South Africa.

1 Introduction

1.1 Background and rationale

1.1.1 Introduction

Since the early 2000s, multiple-use water services have emerged as a new approach to water services in rural and peri-urban areas in low- and middle-income countries. The concept of multiple-use services (MUS) is based on the truism that people use water from multiple sources for multiple uses. People's demand is multi-purpose. Yet, water services are usually provided by 'domestic' or 'irrigation' or 'fisheries' sub-sectors for a single use only. The structuring of the public water sector according to single-use mandates leads to 'projects' that operate in parallel with each other, even when they serve the same user at the same site. MUS moves beyond these narrow sector boundaries and seeks to align water services with people's multiple needs for the integrated resource water.

The challenge of bridging the gap between people's water needs and water services provision was taken up by the action research project '*Models for implementing multiple-use water supply systems for enhanced land and water productivity, rural livelihoods and gender equity*', supported by the Challenge Program on Water and Food (referred to in abbreviated form as CPWF-MUS). Envisaging multiple-use services as a promising new approach, the project sought to expand and deepen knowledge of what MUS is and could be in a range of different contexts. Its aims were two-fold: identifying how MUS could best be implemented in communities and how MUS models identified in communities could be scaled up to ensure better services for, in principle, everybody. This book synthesises the experiences of CPWF-MUS. It is written for anyone interested in providing water services to improve the livelihoods of water users in rural and peri-urban settings, including policy makers, engineers, planners, financers, social mobilisers, community activists, private water service providers, or academics.

1.1.2 Towards Multiple-Use Services

Multiple uses from multiple sources versus single-use mandates

Water professionals have become increasingly aware over the past 20 years of the gap between their professional single-use backgrounds and the practice of communities. Their mandates to provide water services primarily for one single end use – domestic use, irrigation, livestock or fisheries – did not match the realities and water needs of their clients, who invariably used multiple sources for multiple uses. Communities with diversified agriculture-based livelihoods depend in many ways upon water, especially in rural and peri-urban settings in low- and middle-income countries. A livelihood comprises 'the activities, the assets and the access that jointly determine the living gained by an individual or household' (Carney, 1988). Communities use water for an array of domestic and productive uses, including drinking, cooking, cleaning, bathing, laundry, sanitation, livestock, crop irrigation, horticulture, tree growing, fuel wood and fodder production, fisheries, pottery, brickmaking, small-scale food processing and butchery, and for other water-dependent enterprises and ceremonies. All these uses are vital for their wellbeing. To meet these needs, they often draw upon multiple sources of water. For them, it is obvious and normal to use water from multiple sources for multiple uses. Single uses, like rain on mono-cropped fields, are the exception.

In contrast, water services are organised according to sub-sectors that carve out one single end use as a priority, if not an exclusive water use. This priority end use becomes the sub-sector's mandate. Mandates, in turn, greatly influence the entire structuring of the sector, including job descriptions, performance indicators and upward reporting requirements. Top-down financing streams from national and global levels are also earmarked accordingly. The production and reproduction of these single-use foci in the education system perpetuates this pattern over the generations. Indeed, this single use view of water becomes a professional paradigm of how to perceive the world and act accordingly (Moriarty, 2008).

Most notably in the domestic and irrigation sub-sectors, the single-use mandate is often linked to an assumption that there is one single site where this use takes place. Thus, the domestic sub-sector focuses on homesteads[1] and sites as near as possible to homesteads. Obviously, this is the preferred site for using water for domestic purposes. The irrigation sector focuses on water end use by plant roots in fields. Once, these fields were assumed to be grouped into shared irrigation schemes. More recently, however, greater attention has been paid to irrigation and agricultural water management infrastructure used by individuals, including mechanised and manual groundwater pumps, water harvesting or soil moisture retention techniques. However, the question of whether these fields are near to the homestead has received less attention. Indeed, all water sub-sectors focus on their particular end use, and no sub-sector holistically considers the entire 'water and landscape' picture in communities or sub-basins, with its spatial layout of multiple water sources, multiple users and multiple uses at various sites, the 'arenas in which humans interact with their environments on a kilometres-wide scale' (Coward, 2008).

Domestic-plus and irrigation-plus

Professionals became aware of this gap, because they began to observe that systems designed for one single water use were used for multiple purposes in an unplanned way, and so became *de facto* multiple-use systems. 'Irrigation' systems are used for drinking, bathing, washing, cattle watering, small enterprises, fisheries, or irrigation (Yoder, 1983; Silliman and Lenton, 1985; Meinzen-Dick, 1997; Boelee et al., 1999; Renwick, 2001) . Roads for monitoring canals became trading routes (Lee, 2008). Systems planned for drinking water and other domestic uses are used for cattle watering, irrigation and a range of other small-scale productive uses (Lovell, 2000; Moriarty et al., 2004). While some unplanned uses were absorbed by the system, others caused damage to infrastructure or deregulated planned water allocation

1 In this book, we use 'homestead' to mean the home and the immediately surrounding land used by the family. 'Household' relates to the people living at the homestead. The household may have access to water for irrigation or other purposes in fields away from the homestead, which is therefore household-use but not homestead-use water.

schedules. However, measures to prevent unplanned uses, e.g., by forbidding and declaring those uses as 'illegal', were ineffective.

Professionals started to appreciate the improvements that these unplanned uses brought to all four main water-related dimensions of livelihood wellbeing: freedom from drudgery, health, food production, and income. For uses that did not damage infrastructure, these livelihood benefits came at no cost other than the changing perspectives of water professionals. "First you would see someone irrigating some tomatoes, and you would say that he is wasting water. Now, you see the same situation, but from the perspective of the user, and you would say that he is making a good and economic use of water" (Johny Hernández, technician from SANAA Honduras, personal communication).

Academics from both the domestic and irrigation sub-sectors corroborated the benefits of this new perspective. Various studies were undertaken to assess the 'added' value of benefits from unplanned uses (Meinzen-Dick, 1997; Perez de Mendiguren, 2004; Renwick et al., 2007). The health and hygiene benefits of using irrigation water for domestic uses received particular attention (Meinzen-Dick, 1997; Van der Hoek et al., 2001; Boelee et al., 2007; Renwick et al, 2007).

Armed with this new understanding, the sub-sectors started proactively enhancing accessibility to water with the double aim of stimulating the livelihood benefits and avoiding damage and disturbance to the systems. They adapted their designs with 'add-ons'. Irrigation designers constructed washing steps or cattle entry points in irrigation canals. To encourage fisheries and other aquaculture, connectivity was improved and dead storage (below which water would not run off) guaranteed in reservoirs, streams and even at field level for crop-fish systems, where a crop such as rice can be grown and fin fish or prawns farmed in the same field (Nguyen-Khoa, Smith, Lorenzen, 2005). Domestic systems were equipped with cattle troughs, washing slabs, and sometimes a communal garden. In these ways, for limited extra cost, the uses and corresponding livelihood benefits were augmented. We call water services that maintain the primary mission of their own sector, but accommodate uses beyond the sector's mandate 'irrigation-plus' or 'domestic-plus' water services (Van Koppen et al., 2006).

Towards multiple-use water services

Despite this trend towards recognising the benefits from multiple use, there was hardly any cross-sectoral collaboration until the early 2000s. Each sub-sector tried to address other uses within its own domain. Gradually realisation grew that many more opportunities for better service delivery could be unlocked through a more comprehensive approach to the planning and design of new or rehabilitated infrastructure. The logical next step was taken. Practitioners and researchers from both the domestic and irrigation sub-sectors began to innovate, collaborating in a global endeavour to achieve 'multiple-use water services' or 'MUS'. In 2003, in Colombia, the University research unit Cinara organised a Latin American symposium '*Usos Multiples de Agua*'. In the same year, a global International Symposium on '*Productive water uses at the household level*' was organised in South Africa, by the IRC International

Water and Sanitation Centre, the Department of Water Affairs and Forestry (DWAF), the Natural Resources Institute (NRI), and the International Water Management Institute (IWMI) (Moriarty et al., 2005). In 2004, an invitation from the Challenge Program on Water and Food (CPWF) to forge innovative partnerships for impact-oriented research allowed these partnerships to be pursued through the CPWF-MUS action research project.

1.2 The CPWF-MUS Project and conceptualisation of MUS

1.2.1 Composition and research focus

The project '*Models for implementing multiple-use water supply systems for enhanced land and water productivity, rural livelihoods and gender equity*' (CPWF-MUS) was composed of partners from the domestic and irrigation sub-sectors and included both implementing and academic organisations. All the partners were pioneers in overcoming sectoral boundaries and in implementing and scaling up domestic-plus, irrigation-plus or multiple-use water services, or in research on this. The International Water Management Institute (IWMI), the lead institution, had worked for years on non-irrigation uses of large irrigation systems and health. IRC International Water and Sanitation Centre had worked on productive uses of domestic water systems. The International Development Enterprise (IDE) in collaboration with Winrock International had started implementing 'hybrid' systems in Nepal and India (Polak et al., 2004). Homestead ponds and integrated farming were being adopted at scale in Thailand (Ruaysoongnern and Penning de Vries, 2005). In South Africa, the benefits of *de facto* multiple use 'domestic' systems had been assessed and a methodology was pilot-tested on 'Securing Water to Enhance Local Livelihoods' (SWELL) by the NGO AWARD, supported by IRC (Perez de Mendiguren, 2004). In Zimbabwe, NGOs had been active in developing homestead-based technologies for multiple uses (Robinson et al., 2004). In Ethiopia, the Catholic Relief Services (CRS) actively stimulated 'multiple sources for multiple uses' in its water projects.

Thus, national partnerships were forged in eight countries that fall within the benchmark basins of CPWF: Bolivia, Colombia, Ethiopia, Maharashtra-India[2], Nepal, South Africa, Thailand and Zimbabwe (Figure 1.1). In each country, one or two national partners led the action research, also involving a wider group of stakeholders through what became known as learning alliances. Within these eight countries, 30 study areas were selected for case studies. A study area could be one community, a group of communities in e.g. a district or sub-basin, or a group of communities who had adopted a similar type of technology. Again, the criterion for the selection of communities was their involvement or interest in MUS.

The composition of CPWF-MUS, based on the criterion of being engaged in MUS prior to the project led to a great diversity across the countries and cases. In this

2 We mainly refer to the state level for India, because the state is comparable in terms of population to the size of nations elsewhere.

global exploratory phase for action research, this diversity was welcomed. It permitted learning about the locally-specific characteristics of MUS on the one hand and generic features with general validity across the cases, countries, and basins on the other hand.

There were two central research questions for CPWF-MUS. For all partners already engaged in studying, testing or implementing domestic-plus, irrigation-plus or MUS (as 'MUS champions') there was little doubt about the answer to the question '*why* MUS?' MUS was to overcome the counterproductive impacts of sector boundaries so as to deliver better services. More relevant were the '*how to?*' questions: first, '*how to*' implement multiple-use water services at community level and, second, '*how* to' go to scale. We defined 'going to scale' as, ultimately, reaching everybody with the water services they need, so we aimed for 100% coverage of MUS in low- and middle-income countries.

Figure 1.1. The eight countries of CPWF-MUS

1.2.2 Defining MUS

Water services

Coming from very different backgrounds, we tried to find a common understanding and definition of MUS (and coined its abbreviation). We also tried to pin-point what is new and what is not new about MUS and where precisely the unlocked potentials of MUS lie.

We defined MUS as

'a participatory, integrated and poverty-reduction focused approach in poor rural and peri-urban areas, which takes people's multiple water needs as a starting point for providing integrated services, moving beyond the conventional sectoral barriers of the domestic and productive sectors' (Van Koppen et al., 2006).

The 'S' in MUS stands for 'services', because the overarching goal was to unlock new potentials for better services by governmental, non-governmental and private water service providers for improved multi-faceted livelihoods in peri-urban and rural areas. Developing and testing such services would allow well-informed policy recommendations to be developed. MUS is about services for people rather than particular water systems.

A 'water service' is defined as 'the sustainable provision of water of a given quality and quantity at a given place with predictability and reliability'. Services have hardware and software components. Hardware components of water services concern infrastructure or technology – and include issues such as technology availability, spare-parts, engineering skills, or water resources assessments. Software refers to all the non-hardware related issues, such as support for institution building (leadership, rule setting and enforcement), water allocation and conflict resolution. Linkages to other services that enhance the benefits of water use, such as hygiene education or marketing support, are other important components. Services are not time- and location-specific 'projects' that close after an infrastructure construction or rehabilitation phase. Services are continuous and cater for post-construction technical and institutional support. Services imply accessibility to everybody, in principle; MUS should certainly reach the poor and marginalised. Multiple-use water 'services' refer to this sustainable holistic supportive environment to meet people's multiple water needs.

For services to be sustainable and to reach everyone, a range of stakeholders must fulfil various complementary roles. The actors in this supportive environment are the various water service provider groups: users, NGOs, domestic sub-sector, productive sub-sector, local government, and knowledge centres. Support is enhanced by searching for complementarities and synergies that lead to ever more robust networks of relationships of trust between beneficiaries or clients and service providers. Water users are the most important actors and pull the various support components together according to their integrated needs. They can support themselves, e.g. through farmers groups or community-based organisations (CBOs). Although a service can be maintained by water users and village specialists like water guards or water vendors at household or community level, government, NGOs and private service providers are vital to strengthen a supportive environment at larger scale. Government and NGOs in particular can invest in expensive infrastructure often with longer-term benefits. They can act as a utility, facilitator, catalyst, innovator, loan provider, or a combination of these. Government agencies are key for scaling up, because they have a mandate to reach all citizens. Government is also in the best position to provide after-care support or, in short, to ensure that projects become services. Moreover, most international water agencies and rural development organisations work through governments. While governmental line agencies tend to specialise and provide compartmentalised support, local government has the mandate to integrate services.

People before resources at the lower scales

In defining what is new about MUS, questions of scale and integration are important. MUS fills a gap to provide people-focused water services at smaller scales. Unlike

Integrated Water Resources Management (IWRM) which focuses on the water resource itself, MUS starts with people and their uses and needs for water and aims for greater wellbeing and socio-economic development. While IWRM focuses on higher aggregate scales of sub-basins, countries and transboundary basins – where it is well recognised that water resources are used by many users for many purposes – MUS focuses on the direct interface between service providers and water users at the lowest levels and from there, upwards to address the higher aggregate levels of service provision. Moreover, IWRM tends to emphasise regulations or other methods of sharing a limited available water resource, while MUS seeks to develop water and to increase the amount for all, particularly for the poor. This is not to deny that the global call for IWRM definitely stimulated an exploration for options for better integration. However, MUS integrates where integration matters most by meeting people's multiple water needs from multiple integrated sources.

MUS seeks to improve people's access to water, which often boils down to improving infrastructure to develop water. Infrastructure planning and design for multiple uses is not new at the highest levels of water development and management nor at the lowest levels among informal communities, but these insights have not yet fully trickled down from the top, nor trickled up from the bottom. Water professionals recognise that water is used for multiple purposes in very large-scale infrastructure development – large-scale dams have always been designed for multiple purposes (Lee, 2008). At that level, it is inconceivable to plan one set of infrastructure for domestic use, one for irrigation, one for hydropower, and so on. Designers of large-scale surface water irrigation systems in arid and semi-arid areas of Pakistan or Morocco also accommodate domestic and livestock uses into their designs. In these areas canal water is the main source of surface water and, through seepage, groundwater. Pakistan's large-scale irrigation schemes have village reservoirs for domestic uses (diggi) and cattle ponds (Jehangir et al., 2000). Morocco's irrigation systems have been designed to divert water to urban centres and even for community and homestead storage in cisterns known as metfia and jboub (Boelee et al., 2007).

Yet, this integrated perspective tends to fade away when moving down to lower levels of smaller-scale water services. Only in the provision of village storage, as in the thousands of small multipurpose reservoirs in Zimbabwe, Ghana, Burkina Faso and elsewhere, do professionals recognise multiple uses (Senjanze et al., 2008). For all other water services at this level, designing for single uses remains the norm.

Informally, among water users themselves, from the lowest levels upwards, multiple uses from multiple sources are the norm. Since time immemorial, rural and peri-urban communities have abstracted, stored and conveyed water to their preferred sites of use and re-use; to homesteads (for multiple use) and to cropping and grazing lands (often also for multiple use). Communal storage systems, natural and human-made, are invariably for multiple use. Well-documented age-old examples of such infrastructure designed for multiple use include the cascading village tanks in South Asia (Palanisamy and Meinzen-Dick, 2001) and farmer-managed irrigation systems in the mountainous Andean region of Latin America and in Nepal (Yoder, 1994;

Boelens et al., 1998). Thus, the 'multiple-use, multiple source' logic guided informal community-based water resource development. The expansion of infrastructure by communities to improve control over rainwater, surface water streams, ponds, lakes, wetlands, and groundwater for longer periods of the year is gradual. New investments are grafted upon existing hardware and software, which often become sunk costs (an earlier investment that is useful and does not have to be costed when deciding on current improvements). Water claims can last for generations. Intricate collective water management arrangements evolve, in which the management and prioritisation of multiple uses from multiple sources is taken as a fact-of-life. Community arrangements are dynamic and responsive to the many changes, such as population growth, new groundwater technologies, output market opportunities, or booming water markets for small vendors in the rapidly urbanising areas (Van Koppen et al., 2007). Communities also respond to 'modern' threats, as the massive spontaneous groundwater recharge movement in India did in the face of groundwater over-abstraction (Shah, 2007). Informal water arrangements can extend across national boundaries, as is the case for pastoralists who follow water and grazing lands. These communal arrangements for integrated management of multiple water sources for multiple uses enshrine resilience and coping mechanisms to survive in harsh ecological and climatic conditions – precious wisdom with growing climate variability and unpredictability.

Yet, this wisdom never 'trickled up' to external service providers. In MUS, which attempts to incorporate this wisdom, people's land- and waterscapes, and their plans and priorities for incremental improvement, are taken as the starting point as new arrangements are grafted upon existing ones. Thus, MUS is genuinely participatory community-based natural resource management. At this level, between water users at the lowest aggregate levels and large-scale water development and management at the highest levels, opportunities can be taken; opportunities that are usually missed because of single-use structured service provision.

In the course of CPWF-MUS, we realised that further refinement of scales represented a useful alternative to guide water service provision. Instead of single uses, service provision can systematically consider multiple sites of end uses and various scales of natural and human-made water resources abstraction, storage and conveyance in communities' land- and waterscapes. Two scales of MUS appeared especially important: community-level and homestead-scale MUS. Water services at these two scales offer significant new potential but have mostly fallen through the cracks because of the structure of the water sector.

In fully-fledged community-scale MUS, people are the entry point and water services are planned and designed for all water needs at preferred sites, irrespective of any sectoral bias. Community-scale MUS becomes relevant when there are communal systems for homestead-scale MUS or communal systems that provide direct access to surface water bodies for multiple use, such as village reservoirs or systems that supply water to fields. One can also find more than one communal system: entire networks of natural and human-made infrastructure where multiple water sources are managed to convey water for multiple or single end uses. Surface irrigation systems and fisheries interventions typically operate at this scale in one or more communities or sub-basins. Even if sectoral biases influence the initial planning and design of irrigation systems, over time *de facto* uses of the systems and add-ons may transform irrigated areas into systems of community-scale integrated water management. Community-scale MUS is also applied in rapidly expanding peri-urban areas, where informal dwellers use water for multiple purposes. Urban agriculture and small-scale enterprise by an estimated 800 million farmers contribute 15-20% of the world's food needs (Smit et al., 1996).

Other water interventions applied this approach, in addition to CPWF-MUS. Examples are the UNDP Community Water Initiative (www.undp.org), Catholic Relief Services in India and Ethiopia, and the SADC/Danida IWRM Demonstration projects (Houmoller and Kruger, 2008).

Homestead-scale MUS: the most effective way to use water to contribute to all MDGs?

We hypothesised that homestead-scale MUS also holds great unlocked potential, especially in light of global efforts to use water to reduce poverty and enhance gender equity. Homesteads vary from small back-yards in peri-urban areas to extensive areas around scattered dwellings. Our hypotheses are linked to the way in which homestead-scale MUS contributes to the Millennium Development Goals (MDGs). These holistically highlight the many ways in which water relates to the livelihoods of the poor (www.unmillenniumproject.org). In brief, homestead MUS contributes to:

1. Eradicating extreme poverty by improving food production and incomes at and around homesteads;
2. Achieving universal primary education by alleviating the burden on children in fetching water or herding cattle and by ensuring good sanitation at school;
3. Promoting gender equality by reducing women's excessive domestic chores and improving access to water for productive purposes for both women and men;
4. Reducing child mortality by enhancing health and income for child care;
5. Improving maternal health, by reducing women's domestic chores and improving access to water for productive purposes;
6. Alleviating HIV/AIDS, malaria and other diseases, by reducing burdens of water fetching, avoiding dehydration, accommodating higher hygiene requirements, allowing nearby food production and income generation by the sick and their dependents;
7. Ensuring environmental sustainability and reducing the proportion of people without access to safe drinking water by using and re-using multiple water sources for multiple uses for higher efficiency, and by prioritising water for domestic and basic productive uses for greater equity.
8. Developing a global partnership for development, in which water for multiple purposes is recognised as pivotal for poverty eradication.

In fact the livelihood benefits from interrelated water uses are even greater than the sum of these MDG dimensions of wellbeing would suggest. The benefits of multiple water uses reinforce each other over the generations in a virtuous circle that helps people to climb out of poverty. Healthier and better nourished people are more productive. Higher incomes allow higher spending on health care and for reinvesting in water technologies. Alleviating unpaid domestic chores by women frees up time for income-generating activities. Reducing the time that girls spend fetching water and boys spend on cattle herding to distant water points breaks the intergenerational poverty cycles due to absenteeism from school, lack of skills and early marriage. Improved wellbeing, in turn, enhances user satisfaction with public services, so improving both their ability and willingness to contribute financially or otherwise to the systems.

The promotion of homestead-scale cultivation is not new. Agricultural and social welfare programmes have long promoted it and shown that production can be significant (FAO, 2004). In much homestead production, energy foods are more important than vegetables and fruits (Hoogerbrugge and Fresco, 1993). In fact, homestead-scale cultivation can provide up to 58% of a family's daily energy intake, and the welfare and health benefits from increasing vitamin and mineral intake make this much more significant than 'kitchen gardening'. Production is diversified by raising poultry and ducks and by breeding goats, sheep and cattle and fish-farming, all of which require little space. Better water facilities for animals closer to home significantly improve animal health and, depending on the gendered organisation of work with livestock, it alleviates the tasks of boys, men or women. Land productivity can be significantly higher than when grazing distant fields because of these multiple enterprises. Moreover, the homestead offers better opportunities for intensification, thanks to the ready availability of labour, the ability to recycle water and nutrients, (including nutrients from human excreta in homestead fish ponds); and protection against vandalism.

Homestead-scale production strengthens people's resilience when faced with external shocks from climate change, increasing food prices or volatile economies. Activities are diversified and can be swiftly changed. For food producers, higher food prices imply higher incomes if new markets can be accessed, while expenditure can be saved by using homestead produce for family consumption. The latter is even more important for poor people who are net food buyers in urban and rural areas, who suffer most from high food prices because they spend a much larger proportion of their income on food.

Although it is difficult to generalise, the better off and men may have other production opportunities elsewhere, but this is less so for the poor and women. Homestead-scale production is intrinsically pro-poor (FAO, 2004). It accommodates those with limited land-resources or with limited capacity to work distant land, such as the elderly, youth-headed households, and victims of malaria, HIV/AIDS, and other illnesses. For them, homestead production is often the only option. Larger homesteads with more secure tenure are emerging as a highly effective form of land reform to alleviate poverty, for example in land reform by the Indian state of Karnataka and in the Government of India's more recent policies (Hanstad et al., 2004). In times of stress, whether caused by nature or by humans, homestead production can be taken up immediately. It is one of the few modes of production that is open for the poor and non-poor alike, so long as services are targeted to the poor.

Homestead-based production is also intrinsically gender- and age-equitable. Compared to distant field production in many areas, homestead-scale farm production enhances women's say over the fruits of their labour. On distant land, men more often decide whether to consume or sell the produce and how to spend the money earned, even when most labour power is provided by their female kin. Women's say is also stronger nearer the homestead in fuel wood and fodder production, small food-based enterprise like beer brewing or catering and handicrafts. And this greater say by women over produce and income benefits family welfare more than when men are in control. As proven in numerous studies, women spend a larger proportion of their production and income for family welfare than men do (Von Braun et al., 1987; Agarwal, 1994; Safiliou, 1994). Indeed, this literature underpinned our hypothesis that homestead-scale MUS is the most women-friendly form of water services in poor areas.

CPWF-MUS addressed the issue of water provision for homestead-cultivation. Most above-mentioned studies flag the problem of water availability as an important constraint during the dry season or dry spells, but the overall implications for the water sub-sectors combined are hardly ever traced. Only few social welfare projects or integrated water projects, such as handpump projects in water abundant West Bengal, have been designed to bring sufficient water for domestic and productive uses (Mishra and Van Steenbergen, 2002). MUS on the other hand seeks to mainstream homestead-scale multiple use and to reach everyone. If the positive livelihood impacts of MUS are not contradicted by the CPWF-MUS case studies, it becomes even more likely that the hypothesis is valid: homestead-scale MUS is the most effective way of using water to contribute to all the MDGs.

1.3 Innovation methodology: Learning alliances and MUS conceptual framework

1.3.1 Learning alliances for science-based innovation and scaling up

At the start of the project in 2004, implementation of MUS on the ground was still new. The only methodology available to study how to implement MUS in communities and to scale up MUS was by innovation and learning-by-doing. Across the eight countries, CPWF-MUS adopted a two-pronged innovation strategy conforming to the project goals. The first step was to implement, test and analyse models for MUS that performed better than single-use services. The second step was to scale up these MUS models by creating a supportive environment of sustainable service delivery at scale among intermediate, national, and global water services providers.

The best way to ensure scaling up was not just through global academic 'experts' but to include implementing agencies, local practitioners and policy makers. For this we established learning alliances. These are 'a series of interconnected multi-stakeholder platforms at different institutional levels (national, district, community, etc.), aiming to speed up the process of identification, development and scaling up of innovations' (Moriarty et al., 2005; Smits et al., 2007). Learning alliances were the vehicles for learning, awareness raising and scaling up lessons learnt. So, from the outset, MUS partners forged strategic partnerships among water users and private water services providers, NGOs, governments and knowledge centres (Penning de Vries, 2007). About 150 institutions or persons became active members of learning alliances; many more participated to a lesser extent by attending workshops or similar events. Most learning alliance members committed themselves to longer-term collaboration than allowed for by the short-term CPWF-MUS project time and resources.

In implementing the two-pronged innovation strategy of the project, the learning alliances identified multiple-use models on the ground, mainly derived from analysis and documentation of pilot implementation of innovative multiple-use systems, but also from *de facto* multiple uses of single-use systems. In each country, the sample of cases was generally broad and diverse enough to justify a certain generic validity and synthesise best practices into 'models' of multiple water use services at homestead- and community-scale. Chapter 3 synthesises this country evidence into global generic models of homestead- and community-scale MUS.

These generic models, in turn, became the focal point for the other step of the innovation strategy: scaling up innovation among service providers at intermediate, national and global levels. Scaling up at each of these levels was based on a strategic institutional analysis of the organisations and their mandates. This analysis further guided the composition of the learning alliance and steered its activities. The learning alliances raised awareness about the MUS models and their untapped potential. Even within the short time-frame of CPWF-MUS, some decision-makers and professional opinion leaders incorporated MUS into intermediate level planning and programmes in national policy, legislation, programme formulation and follow-up research, and also into global programmes. Even when there were no direct changes in policy and practice, many new insights were generated by the trials and critical reflection on how best to overcome sectoral boundaries and to create a supportive environment for MUS. The results, outcomes and impacts of this process of learning about institutional innovation by doing are presented in Chapter 4.

1.3.2 The MUS conceptual framework

CPWF-MUS developed a conceptual framework to structure the learning process for cross-site, cross-country, and cross-basin comparison of findings. In the remaining sections of this chapter we present the framework in detail, both because it has intrinsic value and also because it provides the analytical structure for the remainder of the book.

In developing the conceptual framework CPWF-MUS followed the 'learning wheel' methodology and Jürgen Hagmann facilitated its development and follow-up. A learning wheel attempts to identify the conditions that are the most critical to achieve the envisaged goal. In this case, the goals were successful implementation of MUS models on the ground with scaling up at intermediate, national, and global levels. The conditions to achieve this, or 'MUS principles' were identified on the basis of team members' expertise and literature, and these principles are outlined in the next two sections. The resulting 'learning wheel' is relevant for researchers and implementers alike, because it allows knowledge to be generated on 'how to' realise the necessary conditions for change. So in any local situation, implementers can check whether and how conditions that should be in place, *are* in place, and, if not, what can be done to stimulate them. The local teams in the 30 study areas and the learning alliances decided on which sub-sets of principles to focus. Overall, each principle is addressed in at least three or four sites, but often in many more or in all study areas. The MUS learning wheel itself is a living document (Van Koppen et al., 2006). Figure 1.2 shows the framework as used in the project.

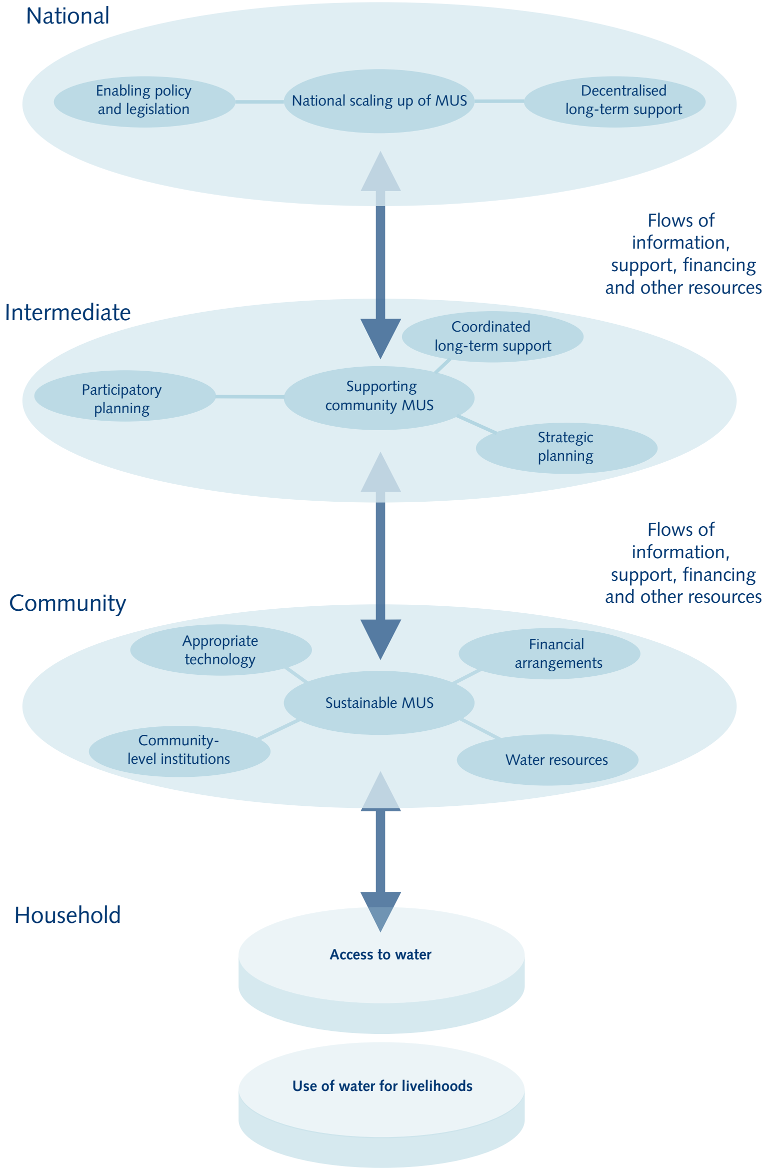

Figure 1.2. Framework for MUS, showing the principles used in the CPWF-MUS project

1.3.3 Community-level principles

The ensemble of the five principles at community-level constitutes the 'homestead- and community-scale models for MUS' that we hypothesised to be more effective in improving livelihoods for water users in rural and peri-urban areas than single-use approaches (see Figure 1.2). In CPWF-MUS, the definition of 'community' is related to water resources, referring to a group of households that share water or that belong to a similar water planning and administration area or to a hydrological area. For all practical purposes, individual on-site homestead or field-based technologies are managed individually and independently, unless there is severe scarcity. A community can also refer to the households, villages or larger entities who share one or more communal systems. This communal system may be connected to a larger network of natural or human-made surface streams and storage bodies, which in turn impact on groundwater recharge and use. In such cases, a community refers to a number of hamlets, villages, administrative units, or even sub-basins.

Five principles were identified as conditions for successful multiple-use services that can improve livelihoods[3].

i) Livelihoods should be the starting point for MUS

The driving principle that water services should be based on livelihoods refers to the need to take people's multiple water needs at preferred sites as the starting point of water services delivery. Instead of one single end use, MUS providers should be guided by a desire to achieve multi-faceted livelihood benefits from multiple water uses. Important water-related livelihood dimensions are health, freedom from domestic chores, food for family consumption and income. Water can also have negative livelihood impacts, in particular through water-related diseases, or through the need for excessive labour or monetary costs of accessing water. Livelihoods are gendered, in that the positive benefits are distributed differently between women and men and the negative impacts are also felt differently. There are also differences between rural or peri-urban areas and between crop cultivators, cattle owners, or small-scale entrepreneurs.

Water use is a contributing factor to livelihood benefits and often a controlling factor when access to water is limited. However, the full benefits are also dependent on accompanying factors, such as sanitation and hygiene education or agricultural extension and soil conservation, or veterinary services. Water use depends on having physical access to water, which in turn depends on a combination of the four other principles listed below. These principles (appropriate technologies, financing facilities, equitable institutions for managing communal systems, and sustainable water resources) make community-scale MUS possible. We understand a 'water service' to be a bundle of these four principles, comprising the hardware and software that, taken together, provide a given type and level of service.

3 The application and validity of five principles in the case studies are analysed in Chapter 3.

To conceptualise the link between (livelihood-driven) water use and water systems that provide physical access to water for homestead-scale MUS, we both borrowed and critiqued the widely used ladder of water service levels in the domestic sub-sector (WHO, 2008). This ladder assumes that water quantities up to 100 litres per capita per day (lpcd) at and near homesteads are exclusively used for domestic purposes. However, we hypothesised that it would be more realistic to recognise that water is used for productive purposes alongside domestic uses as soon as water quantities exceed the 20 lpcd that Howard and Bartram (2003) define as 'basic domestic'. With larger quantities, the extra water would increasingly be used for productive purposes. Accordingly, we redefined service levels as 'basic domestic', 'basic MUS', 'intermediate-level MUS' and 'high-level MUS'. We also supposed that availability of water is related to the labour or technology required to bring water sufficiently near to homesteads. Figure 1.3 presents this proposed multiple-use water ladder (Van Koppen and Hussain, 2004). By classifying the CPWF-MUS case studies according to this ladder, it is possible to corroborate (or not) this link between multiple water uses and access to water.

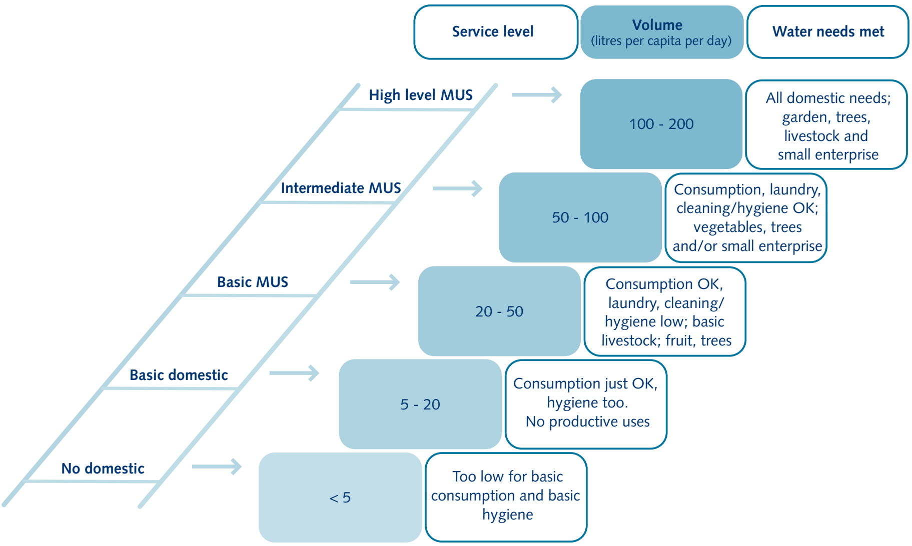

Figure 1.3. The multiple-use water ladder as an adjustment to the conventional ladder of the Joint Monitoring Programme

ii) Appropriate technologies are used to deliver appropriate access to water

Technologies or infrastructure are the hardware in water systems. A wide range of different technologies exist to facilitate access to a certain quantity and quality of water. Technologies can be classified as (a) on-site individual homestead or field-based technologies that do not require communal sharing; (b) communal point-source systems (sources shared by a community but without a distribution network, such as a borehole with a handpump); (c) communal systems for abstraction and storage with distribution networks to public standpipes, homesteads, or fields. Technologies can be added to or upgraded 'incrementally', for example through the addition of elements like drip irrigation, sprinklers, cattle watering troughs or washing slabs. Water treatment technologies may also be needed for certain uses. Identifying the correct technology for a given context means performing a complicated balancing act between people's need for water, their ability to pay, their ability to maintain a system, the existence of supporting institutions outside the community and so on. A technology is appropriate if it can do its job in an effective, efficient, equitable and sustainable manner.

iii) Financing facilities need to be in place to allow the construction and sustained operation and maintenance of multiple-use services

Financing mechanisms define who contributes how much to different types of costs (investment, operation and maintenance, replacement costs). Funds can come from users, from the state, from donors or from a combination of these sources. When users are not able to cover the financial requirements placed on them, their access may be limited in the short or long term. An important issue in MUS is whether and how income from productive activities can enhance cost recovery, how financial contributions are related to differential water consumption patterns, and how equity can be achieved.

Financing facilities are underpinned by the benefit-cost ratios of multiple-use systems. For these calculations, CPWF-MUS used results from a global study on MUS by Winrock International, in collaboration with IRC, IWMI, and other partners (Renwick et al., 2007). This study was the first to make a financial analysis of global cases and also used the multiple-use water services ladder. CPWF-MUS case studies were included in that analysis.

iv) Sustainable institutions are required to ensure continued access to communal systems

This principle refers to the software arrangements within communities in processes of planning, design, construction, operation and water distribution, tariff setting, repair and maintenance, and rehabilitation for multiple uses. Community management of rural water supply[4] has become the paradigm for public rural water supply over the past decades (Schouten and Moriarty, 2003). In the irrigation sector 'participatory irrigation management' has also become the common management model (Shah et al., 2002; Faurès et al., 2007).Community institutions may exclude certain users from access or limit or facilitate access through software arrangements. Particularly important for MUS is to understand how community institutions shape the access level for different groups in the community, such as women and men or livestock keepers and crop farmers. Managing and prioritising differential water uses, in particular domestic uses, are important issues.

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4 Lockwood (2004) defines four key elements of community management:

- Participation: a large cross-section of the community participates in decision-making;
- Control: the community has direct control over strategic decisions;
- Ownership: the community has a sense of ownership of the infrastructure, or partial or full legal ownership;
- Cost sharing: community members contribute to the operation and maintenance costs.

v) Community-scale MUS requires multiple water sources to be managed transparently and well and in an integrated way

This principle builds on the reality that people in rural and peri-urban areas often use and manage multiple sources for multiple uses, not only at homestead-scale, but also elsewhere. Water sources especially tend to require collective action. Multiple-use planning needs to tap synergies between the design of surface water infrastructure and surface-groundwater uses to save costs and enhance transparency compared to single-use and single-source approaches. Allocation of water (and other) resources is also a community-scale issue, in particular around decision-making about infrastructure development and who is targeted within a community. When communal systems tap into community resources, there is a need to deal with prior claims to the water and to search for and negotiate win-win arrangements with existing users. Managing dry-season scarcity also requires a response at the level of one or more communities, or sub-basin. Holistic MUS is transparent, e.g. by quantifying the distribution of (potential) water volumes for homestead-scale multiple uses by all and any excessive use (in particular for large-scale irrigation) by the few. This better informs prioritisation and mitigation measures, including avoiding water losses or tapping alternative sources. Last but not least, this is also the level to deal with water contamination, pollution prevention, and treatment to safeguard the quality of the small quantities of water required for drinking.

1.3.4 Intermediate and national level principles

The three principles at the intermediate level and the two at national levels concern the conditions that need to be in place among water service providers for the sustainable delivery of MUS at scale[5]. The intermediate level refers to service providers who are in direct contact with the communities and who provide services. As Hagmann et al. (2002) suggests, the role of these intermediate level service providers is 'to organise the demand' and 'to respond to that demand'. The role of the actors at the higher basin or national levels is 'to support the response' of the intermediate level players (Hagmann et al., 2002). They include programme managers of the intermediate level service providers, as well as policy makers, education system managers, and national representatives of international development and donor agencies and their forums. International agencies can have a strong influence but this is normally through intermediate and national level actors. Together, they constitute what should become an effective supportive environment of service provision for MUS that is able, ultimately, to provide everybody in rural and peri-urban areas with the services for multiple water uses. Conditions that need to be in place to create the supportive environment through which MUS can be scaled up at intermediate levels are three-fold:

- Participatory planning,
- Coordinated long-term support,
- Strategic planning for scaling up.

5 Findings with regard to intermediate- and national-level principles are presented in Chapter 4.

At national level, water service providers need to realise two conditions for supporting intermediate-level service providers:

- Enabling policies and laws,
- Decentralised long-term support.

i) Intermediate level water providers should be accountable through participatory planning processes to those who use the water

This principle seeks to ensure that intermediate level service providers assess current patterns of land and water use, and take women's and men's priority water needs at preferred sites as a starting point for participatory planning of new water services or for rehabilitation. Accountability should be downwards to clients or beneficiaries, who often need facilitation to articulate their authentic multiple water needs. Providers need to be able to make high-quality equitable decisions to meet this demand within available water system options, where appropriate, building on and strengthening existing infrastructure and social capital. Heterogeneity in community members' water uses and needs is transparently and inclusively dealt with, which often results in domestic water uses being prioritised. Communities' own sustainable contributions in labour, cash investments, transaction costs, and operational fees are mobilised. Communities are empowered to build long-term linkages with service providers for genuine sustainability. They learn to work with written contractual arrangements and procurement procedures with any service provider. Such participatory planning processes take time and resources at the start of projects. Over time, participatory assessments of water resources, uses and needs can develop into more articulated community water development plans.

ii) Coordinated long-term support is required at intermediate level

An enabling environment for MUS provides integrated support for people's multiple water needs. Support does not mean a top-down one-off capital injection for new construction, after which a 'project' closes, but a continuous process in tune with communities' own plans and preferences to improve water infrastructure incrementally. Support packages encompass all the necessary financial, technical, and institutional elements as well as measures, such as hygiene education or marketing support. Financially, subsidies and grants are earmarked for multiple uses. Mid-term loans are made available with realistic repayment periods. Technically, a range of water systems options is communicated, so that community members are well-informed and can select their preferred option. Siting and lay-out of infrastructure are decided by the community, with technical advice. Other technical expertise is called in as required. Institutionally, training is given on issues such as tariff setting and cost recovery, organisation, leadership and conflict resolution. A diverse range of complementary support components from various service providers are brought together to fit the locally specific needs. This requires planning processes of the various service providers and communities to be aligned.

iii) Strategic planning takes place for scaling up MUS at intermediate level

Strategic planning must be in place to ensure that innovative models of how to do MUS and how to create supportive environments at intermediate level do not remain isolated, but are scaled up at district, national and even global level. Horizontal replication of innovation can also spread amongst water users themselves through their networks, in a process sometimes labelled 'outscaling'. For scaling up, governmental and non-governmental service providers at intermediate, national and global levels are targeted and encouraged to adapt their policies and practices to contribute to a sustainable supportive environment in which MUS can reach a much larger number of communities, if not their entire target group. Local and district governments can scale up MUS innovation and extend the supportive environment by adopting the same approach in other communities in the district. Governments and (I)NGOs can scale up innovation at a wider scale in national and global programmes. Strategic planning implies forging partnerships for scaling up MUS innovations through sharing information and raising awareness about successful best practice and lessons learnt. Buy-in at national level is critical for going to scale, so strategic planning for scaling up must usually address the following two principles that specifically apply at national level.

iv) Enabling policies and laws are in place at national level
National governmental and non-governmental managers are the gatekeepers for resource allocation. National governments also build expertise through the education system. The first principle at national level addresses this unique role of government: policies and laws on water, poverty, rural development, or energy must encourage MUS in informal rural and peri-urban settings as a critical contribution to goals of rural development, poverty alleviation, Strategic Poverty Reduction Strategies and to achieving the MDGs. MUS is also put on the agenda in deliberations between governments and those international water programmes and donors that currently structure service provision according to single-use mandates. Policies and laws must also remove current legal and policy bottlenecks for implementing MUS. One major bottleneck is the earmarking of financing streams and programmes for one single use only, as manifest in the service level norms of the domestic sub-sector that provide water to homesteads for domestic uses only, or in the productive sub-sector's single-use focus. Legally, very high water quality standards hamper MUS.

v) Decentralised structures offer coordinated support
The final principle is linked to national government structuring of government line agencies and local government according to sectors, mandates, accountability structures, and resource allocation. This structure should foster integration, in line with the global trend towards decentralisation of support so that decisions on allocation are made at the levels where integrated problems require integrated solutions. Supporting MUS means that financial, technical and institutional support is available and can be called in as needed, in contrast to the tendency to decentralise responsibilities without adequate resources. This critically 'supports the response' to people's multiple water needs.

These principles of the MUS conceptual framework were articulated before the action-research began and structured our case studies and learning alliances by specifying what we wanted to learn. The action research was about how to make a reality of these principles to improve practical implementation on the ground.

2 Overview, context and focus of the country activities

2.1 Overview and diversity of all case studies

2.1.1 Overview

As mentioned in the preceding chapter, the CPWF-MUS partners selected 30 study areas in the eight countries for action research. This chapter presents the context and detailed activities in these study areas. We start with an overview of the study areas, water services studied, predominant technologies, and foci of the learning alliances in Table 2.1. This overview highlights the following diversity represented in CPWF-MUS.

- In 21 study areas, innovative multiple-use water services were piloted and documented. In nine study areas, there were de facto multiple-use systems that were designed for a single use. In one case this was by the irrigation sub-sector and in all other cases by the domestic sub-sector. Service levels for water uses at and around homesteads varied across the multiple-use systems and domestic-plus systems.

- In all study areas, the focus was on homesteads and surrounding areas. Moreover, most case studies (20 out of 30) also examined how communal systems for homestead-scale water service delivery were interlinked at higher levels with other domestic or irrigation systems and with community-scale water resource management in general. These case studies highlight 'community-scale MUS'.

- Six water service provider groups were included:
  - Water users themselves for self-supply, sometimes supported by small-scale private water entrepreneurs,
  - NGOs,
  - Domestic sub-sector,
  - Productive sub-sector,
  - Local government,
  - Knowledge centres, which can be seen as indirect public service providers.

  All six main water service provider groups were represented, although not all groups were necessarily present in each of the study areas. One group took the lead in the CPWF-MUS case studies and learning alliances.

- All three main categories of water technologies and their related institutions were included in the sample: privately managed homestead-based technologies, such as homestead ponds and other water harvesting techniques and wells; communally managed single access points (wells and boreholes and village reservoirs); and communally managed systems with distribution networks which conveyed surface water or groundwater either to standpipes, the homestead, or distant irrigated fields.

This diversity in water service provider groups drove the CPWF-MUS country activities and initiated the learning alliances, and as a result, the foci of case studies and learning alliances also differed. These different starting points greatly influenced the learning alliance composition and steps taken, the type of obstacles faced and also the strategies developed to overcome these obstacles. In Colombia and India, the main focus was on government domestic sub-sector plans and programmes; in Nepal, Ethiopia and Zimbabwe work evolved around NGO innovations; in Bolivia, Thailand and partly in South Africa, it focused on cases where household and communities themselves invest and manage their own systems. Scaling up was mainly at the intermediate level in Bolivia, Colombia, and India, and both at intermediate and national level in Nepal, Thailand and South Africa. (Butterworth et al., 2009). Taken together, this gave important new insights into the strengths and weaknesses of different water service providers in contributing to an overall enabling supportive environment for implementing MUS at scale, as further discussed in Chapter 4.

The next section illustrates the strong diversity in poverty levels and socioeconomic context, ranging from Ethiopia (lowest GDP) and South Africa (highest GDP), and in the physical and hydrological context, ranging from 300 mm/yr average rainfall in Maharashtra, India to up to 2,200 mm/yr in Nepal. These variables further accounted for variation in water services levels.

6 The table on the following pages uses the full names of the geographical areas. In the remainder of this book, we will refer to the shortened versions of these, which are in bold.

Table 2.1. (pages 44 and 45) Overview of the study areas[6], predominant service providers studied, technologies and foci of the learning process. Countries are sorted in an ascending order according to GDP (see Table 2.2).

Country and estimated number of households studied	**Study area**	**Predominant service providers studied**	
Ethiopia 2,687	A. One Peasant Association of 11 communities in **Dire Dawa** Administrative Council B. One sub-catchment in **Tigray region** C. 40 technology adopters in **Tigray region** D. Two communities in one Peasant Association in **Ginchi** *woreda* (district), Oromiya Region E. Three villages in two *woredas* in **East Hararghe,** Oromiya Region F. 57 adopters of ponds in Oromiya and SNNP Regions. G. Irrigation farmers in **Bure** district, West Gojam, Amhara Region	A, B, & E. NGO-initiated community-scale MUS, in coordination with local government C. Government-initiated individual homestead-scale MUS. D. Government communal domestic water services and self-supply. F. NGO-initiated individual homestead-scale MUS G. Traditional farmer-managed irrigation systems	
Nepal 62	Three communities in three districts in the **Middle Hills** in the southern Himalaya	NGO-initiated MUS in strong collaboration with local government and line agencies	
Zimbabwe 140	Three Rural Districts of **Marondera, Murehwa** and Uzumba Maramba Pfungwe (**UMP**)	NGO- (various) initiated individual homestead and communal technological innovation for multiple uses	
Bolivia 1,300	Five peri-urban communities and one multi-purpose dam in **Cochabamba valley**	A. Communal homestead-scale and community-scale self-supply for multiple uses, supported by local private supplier and local government B. NGO irrigation services C. Multi-purpose dam	
India 362	Two communities in **Nasik** District in the state of Maharashtra	State government communal domestic water services, with NGO introducing homestead-scale productive uses	
Colombia 3,000	Six communities and sub-catchments in the **Quindío** and **Valle del Cauca** Departments	Local and provincial government domestic services programme (PAAR) with *de facto* multiple uses	
Thailand 120	120 technology adopters in the Provinces Buriram, Mahasarakam, Nakhon Ratchasima and Yasothon of **N.E. Thailand** and regional farmer network	Homestead-based self supply for multiple uses promoted by regional farmer wisdom network	
South Africa 60	A. Eleven communities in one ward in **Bushbuckridge** Municipality. B. Technology adopters	A. Local government services, with NGO assisting in planning for multiple uses B. Homestead-based self supply for multiple uses promoted by grassroots movement	
Total households 7,831	Total study areas 30		

Predominant types of technologies studied	Focus of the learning process
A and E. Groundwater-fed piped distribution systems, with scattered standpipes B and E. Surface-water fed system designed for irrigation, cattle, domestic uses and water treatment C and F. Farm ponds D. Home water treatment G. Irrigation systems from river and springs	A, B, and E. Documentation of community-scale MUS by NGOs A. Scaling up by a learning alliance at district level C. Documentation of government-initiated individual homestead MUS D. Water quality studies F. Documentation of NGO-initiated individual homestead MUS G. Assessment of willingness to pay for multiple uses of irrigation systems
Surface water fed piped distribution systems with domestic standpipes, irrigation outlets and household storage for multiple uses	Piloting MUS through an NGO programme, and outscaling and scaling up with local and national government agencies and NGOs through a learning alliance
Homestead shallow wells with improved lifting devices Communal boreholes with handpumps	Documentation of innovations under past and ongoing NGO programmes. Sharing lessons learnt through national learning alliance
A. Both groundwater and surface water-fed piped distribution systems with household and field connections, tankers B. Open canal irrigation systems C. Dam	Documentation of community initiatives for accessing water for multiple-uses in peri-urban areas, and learning alliance to strengthen support by local private sector and local government
Groundwater-fed piped distribution system with standpipes and household connections	Piloting MUS within the government rural water supply programme through direct contacts with communities for including homestead-scale productive uses
Surface-water fed piped distribution systems with household connections	Learning about *de facto* multiple-use systems, with a view towards inclusion of MUS concepts and lessons learnt into the work of PAAR and other local organisations
Rooftop rainwater harvesting for domestic water and new run-off farm ponds for various productive uses	Outscaling and scaling up homestead ponds and other technologies through the learning alliance with the ‘Farmer Wisdom Network’ focused on self-sufficiency and integrated farming. Engagement with and support from national policy makers
A. Both surface and groundwater-fed piped distribution systems with scattered public standpipes. B. Rooftop rainwater harvesting and new run-off farm ponds for multiple uses	Introducing MUS into the integrated development planning process of the Local Municipality and scaling up at national level.

2.1.2 Poverty, institutional and hydrological context

Case study countries include some of the least developed countries with low GDP and HDI indicators (Ethiopia, Nepal and Zimbabwe, Table 2.2). There are also middle-income countries, Colombia, South Africa, and Thailand. Of these, Colombia and South Africa have high levels of inequality[7] and all have important pockets of poverty. Our study areas were in poor areas, so communities and most individuals in our case studies are also poorer than the national average shown in Table 2.2. Poverty does not only reflect on the economic status and livelihood patterns of individuals and communities but also on the institutional capacity to provide infrastructure, water and finance related services. In middle-income countries, a relatively strong government makes considerable investments in water development and management. Services are increasingly formalised as water uses and management are increasingly brought within the ambit of the state, parastatal bodies and, exceptionally, commercial companies. NGOs and donors are the main agencies that promote development in the poorest countries. Individual households or communities informally initiate and finance the development of their own water services where governments and NGOs are ineffective or absent.

The availability and access to water infrastructure is also related to the degree of poverty (and vice versa). As shown in Table 2.3, rural water supply coverage in Ethiopia is very low and where services exist these are often very basic. This situation is also common in India, South Africa and Zimbabwe. Although coverage figures in Bolivia, Colombia and Nepal are low, the water service levels are much higher. Public communal infrastructure for water in rural N.E. Thailand is present in some areas and related to small-scale irrigation.

The importance of farm and off-farm income differed across the case studies. Each community includes households which only have food and/or cash income from agricultural activities on their homesteads and fields, and other households that receive significant off-farm income, sometimes in the form of remittances (services, trade, construction work, farm labour, and pensions). Off-farm income usually requires much less water than income from farming. The fraction of households in a community that generates off-farm income depends on employment opportunities which are generally larger near urban areas.

7 Inequality as measured by the Gini coefficient for income. A low figure represents a more equal society; a high figure represents greater inequalities.

Table 2.2. Wealth indicators of the CPWF-MUS countries (Sources: Wikipedia 2006, World Bank 2006)

Country[8]	National GDP (purchasing power parity, in US$ per capita per yr)	National Gini-coefficient
Ethiopia	1,192	30.0
Nepal	1,596	47.2
Zimbabwe	2,011	50.1
Bolivia	2,984	60.1
India	3,827	32.5
Colombia	7,967	58.6
Thailand	9,331	42.0
South Africa	11,960	57.8

The physical and hydrological context of our case studies ranges from semi-arid areas (Ethiopia, parts of Zimbabwe, Bolivia, India and South Africa) to sub-humid and humid areas (Nepal, Colombia, Thailand). The study area of Maharashtra, India, is physically water scarce in the sense that available groundwater resources have been developed. The study area in South Africa approaches physical water scarcity. Moreover, in all study areas there is 'economic scarcity': cases where at least some water resources are available to meet demand, but where infrastructure is lacking to access and convey this water, especially for the poor (Table 2.3).

Table 2.3. Water resources and water scarcity in countries and study areas

Country	Precipitation in case study area (mm.yr^{-1})	National rural water supply coverage (%) (WHO/UNICEF, 2006)	Water scarcity situation in study area
Ethiopia	420-1,680	11	Economic scarcity
Nepal	1,800-2,200	89	Economic scarcity
Zimbabwe	600-1,000	72	Economic scarcity
Bolivia	400-700	68	Economic scarcity
Maharashtra, India	300-500	83	Physical scarcity Economic scarcity
Colombia	1,100-1,200	71	Economic scarcity
Thailand	1100	100	Economic scarcity
S. Africa	500	73	Close to physical scarcity Economic scarcity

8 Whenever countries are mentioned in the text or in Tables in following chapters, we use the sequence in which we find them in Table 2.2: from low to high GDP.

2.2 Ethiopia: struggling with basic water supply delivery in conditions of extreme poverty

2.2.1 Country and general features

The Federal Democratic Republic of Ethiopia is a large landlocked country situated in the Horn of Africa with an area of 1.1 million km² and 75 million inhabitants (Figure 2.1). It consists of a massive highland complex of mountains and dissected plateaus divided by the Great Rift Valley and surrounded by lowlands, steppes, or semi-desert. The great diversity of terrain has led to wide variations in climate, soils, natural vegetation, and settlement patterns. On the basis of elevation and geographic location, we can distinguish three climatic zones: the cool zone above 2,400 m where temperatures range from near freezing to 16°C; the temperate zone at elevations of 1,500 to 2,400 m with temperatures from 16°C to 30°C; and the hot zone below 1,500 m with both tropical and arid conditions and daytime temperatures ranging from 27°C to 50°C.

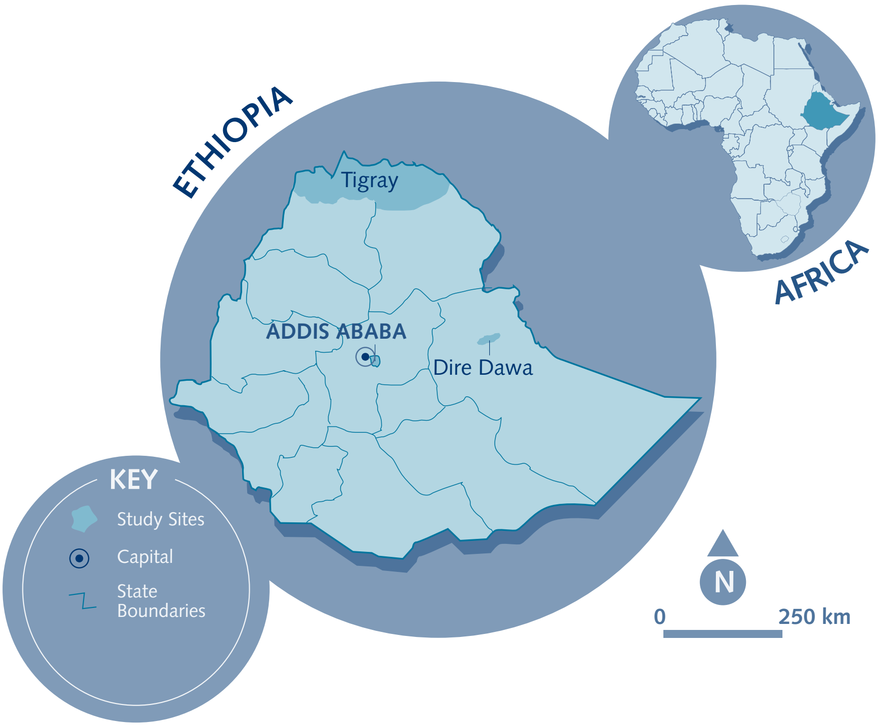


Figure 2.1. Map of Ethiopia and location of study sites

Ethiopia is one of the poorest countries in the world with a per capita GDP of US$ 1,192 yr. However, wealth and poverty are relatively evenly distributed as the Gini coefficient is 30.0 (Table 2.2). Ethiopia is a donor dependent country with US$ 1.8 billion out of US$ 9.7 billion GDP coming from Official Development Assistance

(ODA). In 2001, Ethiopia qualified for debt relief from the Highly Indebted Poor Countries initiative.

Ethiopia's economy is based on agriculture that accounts for half of GDP, 60% of exports, and 80% of employment. The agricultural sector suffers from frequent drought and poor cultivation practices. Coffee is critical to the Ethiopian economy with exports worth US$ 350 million in 2006, but low prices induced many farmers to switch from coffee to produce qat to supplement their income. The war with Eritrea in 1998-2000 and recurrent drought have damaged the economy, in particular coffee production. Most people are poor and face food insecurity for a large part of the year.

2.2.2 Water resources and water development

The rainy season is from mid-June to mid-September (longer in the southern highlands) preceded by intermittent showers from February or March; the remainder of the year is generally dry. Annual average precipitation ranges from less than 100 mm to more than 2,000 mm (Aquastat, 2008) and is largely related to altitude. Water resources are as variable as rainfall, with major lakes and rivers coexisting with large dry areas with a deep groundwater table.

Ethiopia covers 12 river basins with an annual run-off volume of 122 billion m^3 of water and an estimated 2.6 billion m^3 of ground water potential. This amounts to 1,707 m^3 of water per person per year, a relatively large volume. However, due to lack of water storage capacity and large spatial and temporal variations in rainfall, most farmers are not able to access this water to produce more than one crop per year. Frequent dry spells and droughts exacerbate the incidence of crop failure and hence food insecurity and poverty. In view of the above, there are a range of initiatives to develop water resources, both through large-scale and small-scale irrigation. The latter have the potential to enable supplementary irrigation for millions of people. The area equipped for irrigation is nearly 290.000 hectares, which is only 11% of the area that could be irrigated economically (Aquastat, 2008). Domestic water is supplied to only 22% for the country as a whole and 11% in rural areas.

2.2.3 Water governance

Ethiopia is a federal state that has decentralised power to 11 Regions. The formal government structure runs from federal to regional government, to Zones (in some areas), administrative councils (for some cities), districts (*woreda*) – the lowest level at which formal government operates – and to *kebele*s or peasant associations (collections of villages), which have elected councils, but no civil servants.

The formal planning system is in a state of change, with a commitment to decentralised and integrated planning and with a bottom up flow starting at the *kebele*. In practice however, most planning remains sectoral. In the water sector (particularly rural water supply) severe limitations in finance and human capacity imply that the role of government is often limited to overseeing the activities of NGOs and other implementation agencies.

A large number of NGOs and donor projects work in a more or less coordinated fashion, and typically make agreements to operate exclusively within a given *woreda* (or group of *woredas*). In theory all work is coordinated through regional bureaux but in practice that is limited to informing them who does what and where. While there is some private sector involvement, for example in well-drilling, it is limited and weak. Spare-part chains are also notoriously weak, unsurprising given the distances, lack of roads and other infrastructure, and hence high costs of travel to distribution centres.

2.2.4 Project experiences

The aim of the MUS project in Ethiopia was to understand how people are using different water systems for multiple purposes. The INGO Catholic Relief Services (CRS) had already started supporting community-scale MUS projects, implemented by its partners, but no research on MUS had been done in Ethiopia prior to the CPWF-MUS project.

The work at the community level was carried out in five areas: in Dire Dawa Administrative Council and some nearby villages in Eastern Harerghe, Oromo Region; in Tigray Region in the Adidaero and Wukro watersheds and in the western Oromo Region near the town of Ginchi. In addition, several water harvesting sites in Oromiya and Southern Nations, Nationalities and People's Region (SNNPR) and irrigated areas in Amhara Region were studied. Several studies were done in the Lege Dini Peasant Association, in Dire Dawa Administrative Council. Lege Dini is a mountainous semi-arid area (rainfall 420-650 $mm.yr^{-1}$) and groundwater is the predominant source of water. The farming system is agro-pastoralist in nature and comprises field cropping and livestock rearing. Our project worked mainly with a local NGO, Harereghe Catholic Services (HCS), supported by CRS. The case study focused on the impacts of the MUS approach practised by HCS to provide rural water services in an integrated way, using multiple sources (where available) for multiple uses. Local government was involved through their day-to-day relationship with HCS, and by involvement in a learning alliance established by IWMI and HCS.

The Tigray Region has similar physical characteristics and precipitation levels to Lege Dini. Livestock is an important part of people's livelihoods, complemented by cultivation. Here the work also focused on the documentation of experiences of CRS partners in the watershed of Adidaero (Figure 2.2), complemented by student research on farm ponds implemented by the Bureau of Agriculture in the Wukro watershed. However, there was no learning alliance.

Yubdo Legebato Peasant Association in Dendi *woreda* in western Oromia near the town Ginchi is in a slightly more humid highland climate with a rainfall of 800-1200 mm/yr. Our additional studies were focused on water quality and potential for home water treatment.

An MSc thesis was also carried out on the willingness of irrigators to pay for multiple uses of water in Amhara Region.

In Ethiopia, MUS activities at national level started through a research project on water, sanitation and multiple uses, led by the Overseas Development Institute (ODI) and hosted (since 2008) by HCS: the Research Inspired Policy and Practice Learning in Ethiopia and the Nile region, known as RiPPLE (http://www.rippleethiopia.org). IRC and IWMI were also partners in this project.

Figure 2.2. Laundry basin (top) and storage of filtered water with handpump (bottom) as part of a multiple-use system in Adidaero in Ethiopia (photos: Michiko Ebato)

Table 2.4. Case studies in Ethiopia: Community-scale MUS innovation by a poverty-focused NGO

Study area	Description of system
11 villages in **Lege Dini** Peasant Association (PA) in Dire-Dawa Administrative Council	Various systems in the area: • Groundwater piped distribution system with few public standpipes (the *Ajo* system) • Protected springs with piped distribution system with few public standpipes (*Kora* system) • Unprotected hand-dug wells, ponds and river • Boreholes with non-functional handpumps
5 sub-villages in **Adidaero watershed** in Tigray Regional State	Various systems in the area: • Shallow wells with handpumps • Canal irrigation system • Multipurpose system: diversion dam with water treatment for consumption and canal irrigation system
Individual farmers with **pond systems** in Hintalo Wajerate, Atsbi Wonberta and Kilte Awlaelo *woredas* in Tigray Regional State	Household water harvesting ponds
Water quality in **Yubdo Legebatu** in Ginchi *woreda* (district)	Various water sources (river, wells, spring, standposts) and home water treatment (slow sand filtration pot)
Villages in **Eastern Harerghe**	Springs for irrigation Springs for domestic purposes, with add-ons: showers, laundry, basins, cattle troughs
Water harvesting ponds in Oromiya and SNNPR	Water harvesting ponds for irrigation and other uses
Irrigators in Amhara Region	Traditional surface irrigation system (earth canals, simple diversion structures)

2.3 Nepal: hybrid systems for domestic use and small-scale irrigation

2.3.1 Country and general features

Nepal is a landlocked country of 141,000 km^2, located in the Himalaya range between China and India (Figure 2.3). There are three distinct regions: (i) the high mountains region, (ii) the middle hills, and (iii) the *Terai*, the flat fertile area in the south of the country bordering India. The MUS project was carried out in the middle hills.

Number of users	Focus of the study	Reference
1,600-4,000 inhabitants; wide range due to a large floating nomadic population	Combination of studies addressing all aspects of multiple uses	Ayalew, 2006; Ayalew et al. 2008; Jeths, 2006; Scheelbeek, 2005; Simachew, 2005; Van Hoeve and Van Koppen, 2005
2,100 inhabitants	Gender, poverty and institutional issues	Ebato and Van Koppen, 2006; Yehdego, 2006; Ebato et al., 2008
Around 60,000 people spread over three *woredas*. 60 households were studied in this work.	Analysis of pond systems and their potential for multiple uses.	Lemma Hagos, 2005
5,614 people in 796 households, of which 40 tested the filtration pot	Water quality	Cousins, 2007; Guchi, 2007; Million, 2008
210 households with access to water points for domestic uses; 92 households with access to springs for irrigation	Livelihoods	Ebato et al. 2008
57 households included in the survey	Water productivity.	Tulu, 2006; Tulu et al. 2008
260 households included in the survey	Willingness to pay	Bane, 2005

Nepal has a population of around 27 million inhabitants. It has an agriculture-based economy: 76% of the population depends on agriculture and they produce 39% of the country's GDP. However, much agriculture is rain-fed production for subsistence. Remittances from Nepalis abroad are an increasingly important source of income for many households.

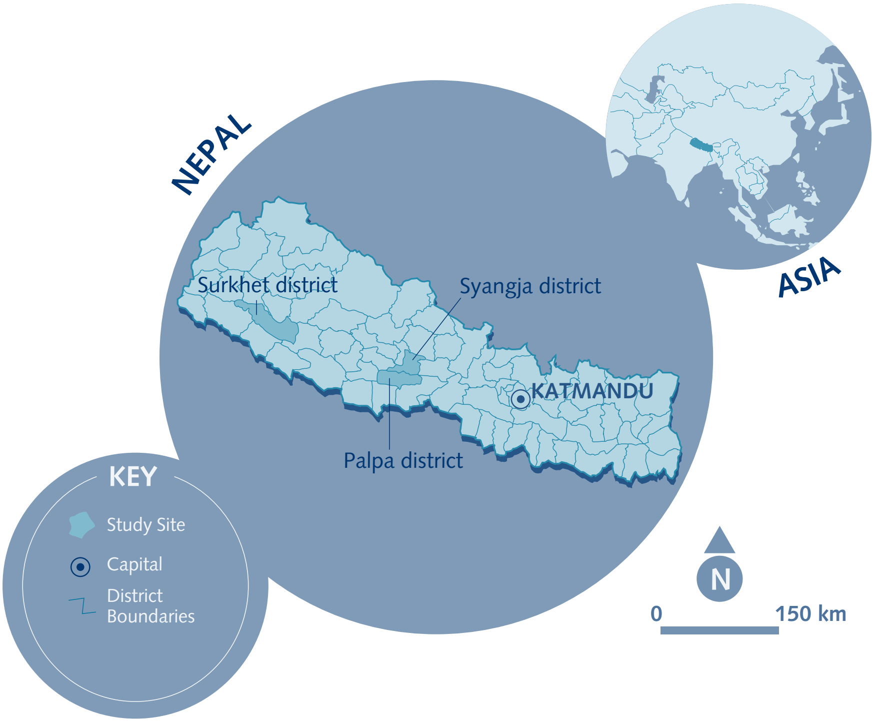


Figure 2.3. Map of Nepal and location of study sites

Nepal is among the least developed countries with a per capita GDP of US$ 1,596. Poverty is equally spread across much of Nepal, particularly in the large rural areas (Gini coefficient of 47.2). The average farmer cultivates only 0.8 hectares (Central Bureau of Statistics, 2002) but in the middle hills farm size is much smaller. Access to markets is difficult: only 30% of the rural population has access to all-weather roads. This also hampers delivery of social services.

During the time of this action research, the country suffered from a political conflict between the King and the abolished parliament. This was compounded by a Maoist insurgency that had been active in rural areas of the country since the 1990s. This affected many rural communities, but also impacted on the wider economy, the position of state institutions and the activities undertaken by NGOs and international donors.

2.3.2 Water resources and water development

Rainfall in Nepal varies greatly with altitude and latitude. The southern slopes of the Himalayas, including the middle hills, receive ample rain (around 2,000 mm/yr). This water comes in the few months of the monsoon, and drains rapidly because of the mountainous conditions. Climate change is more pronounced at higher elevations than at lower ones. Nepal is already experiencing this phenomenon with positive and negative impacts. The snowline is moving up, making new land available for cropping, but rainfall is becoming more intense and variable so that, together with melting permafrost and glaciers, risks of damage to water supply systems by landslides and glacier lake outbursts are increasing.

The geographic conditions, including the deep incisions of the rivers, make it difficult to develop water resources. Only a few rivers have seen the development of dams to increase storage capacity (now 0.1 km^3). Yet, hydroelectricity accounts for more than 96% of total electricity generation. Most water resources development takes place at a small scale by numerous irrigation schemes that harness mountain streams. These are built and managed by smallholders themselves. The total irrigated area in Nepal is 1.1 million ha, of which 75% are farmer-managed systems with a long history.

Irrigation is seen as a key strategy to reduce rural poverty. According to the latest Nepal Living Standards Survey (Central Bureau of Statistics, 2005), the risk of poverty is more pronounced among farm households that do not have access to irrigation. Irrigation was also identified as the key driver for agricultural development in the 1995 Nepal Perspective Plan. Investments in irrigation are therefore important and have increased.

The water supply coverage rate is 89% in rural areas (WHO/UNICEF, 2006), which is relatively high. However, only 8% have household connections and many people get water from communal taps and spend time on water collection.

2.3.3 Water governance

The major government departments in relation to multiple-use water services are the Ministry of Water Resources, the Ministry of Local Development, and the Ministry of Agriculture and Cooperatives. The Department of Irrigation (DoI) falls within the Ministry of Water Resources while the Department of Local Infrastructure Development and Agricultural Roads (DoLIDAR) falls under the Ministry of Local Development. The Department of Water Supply and Sewerage (DWSS) is in the Ministry of Physical Planning and Works. The Department of Agriculture falls under the Ministry of Agriculture and Cooperatives.

The DWSS is supported by various donor agencies to provide for construction of water delivery systems for urban areas and some rural villages in the hills. However, they only work with communities of populations greater than 1,000. DWSS has not been involved with the small size communities that have worked on MUS to date. The DWSS operates in conjunction with the Rural Water Supply and Sanitation Fund Development Board (called the "Fund Board"), which was created in 1996 to promote sustainable and cost effective demand-led rural water supply and sanitation services. The Fund Board is able to work with smaller communities and operates predominantly through NGOs and CBOs at the local level to emphasise community ownership. While the Fund Board is largely focused on domestic water, there has been recent interest in micro-irrigation and MUS. The DoI is responsible for providing support for the construction of new irrigation systems and for upgrading farmer-built irrigation systems nationally and through their district level offices.

At district level, the main body is the District Development Committee (DDC), which receives technical support from the District Technical Office (DTO) and is overseen by DoLIDAR at the national level. DoLIDAR is meant to coordinate directly with other line agencies such as the DoI and the Fund Board. DoLIDAR is also responsible for working with DDCs to construct small-scale domestic water supply systems as part of their rural development work.

The DDCs oversee all the Village Development Committees (VDCs), the lowest administrative level. The formal governing body of a VDC has traditionally been a 13-person Village Development Council headed by a chairman, vice chair, and secretary. However, with the recent political changes in Nepal, the true VDC leader is the Secretary, who is appointed by the Ministry of Local Development.

Several governmental organisations assist farmers with agricultural services. These include:

- District Agriculture Development Office (DADO)
- District Livestock Services Office (DLSO)
- Agriculture Service Centre (ASC)
- Livestock Service Centre (LSC)

DADO and DLSO are district departments of the Ministry of Agriculture and Co-operative with offices in each district headquarters. ASC and LSC are like extension agencies each servicing around 4-5 VDCs. They are responsible for disseminating information to farmers through demonstrations and other knowledge-sharing exercises.

Both statutory and customary water rights guide ownership of water resources in Nepal. Customary rights revolve around land ownership next to a stream or river. However, the Water Resources Act of 1992 established government control of all water sources. Priority was given to domestic use, with irrigation taking secondary status and all other uses following. Non-formal associations have long existed for almost all farmer-managed irrigation systems, and the Act gave these Water User Associations (WUA) legal status for the first time. The Act also established District Water Resources Committees (housed within the DDC) as licensing bodies, and although WUAs are allowed to own a "project", the DDC retains ownership of the source. To complicate matters, the WUA is only allowed to register source use for one purpose. Furthermore, a farmer production group can register use of the source with the DDC, but will not be considered a formal WUA. Most of the Water User Committees (WUCs) established through CPWF-MUS used this method of registration, and thus are not considered formal WUAs although they have a right to use the resource. In most projects, the WUC had to negotiate with prior rights holders for use of some or all of the source. The agreement sometimes required the community to provide labour or materials to the previous source holder(s) and/or promise to use only a specified quantity of water per season.

2.3.4 Project experiences

Against this backdrop, the NGO International Development Enterprise (IDE) implemented a USAID funded development programme (the Smallholder Irrigation and Market Initiative, SIMI) in partnership with Winrock International, assimilating the MUS concept of developing water supply systems for both domestic and productive uses, especially at and near homesteads. The SIMI project became the vehicle for supporting villagers in the design and construction of multiple-use gravity-fed schemes. These schemes piped spring water to village collection tanks and distributed the water to taps for domestic use and irrigation of land near the homestead (Figure 2.4). Three of these experiences have been analysed in detail (Mikhail and Yoder, 2008): in Chhatiwan (Palpa district), Senapuk (Syangja district), and Krishnapur (Sukhet district). These represent water-rich, water-moderate, and water-poor areas, respectively.

Figure 2.4. Taps and drip kits for multiple uses in Nepal (photos: Monique Mikhail and Robert Yoder)

In the middle hill areas the most prevalent land type is called *bari*, or sloping (sometimes terraced) land. *Bari* is largely used for rain-fed crops due to lack of access to canal irrigation. However, it does hold potential for micro-irrigation provided it is applied without danger of erosion. The SIMI project combined multiple-use water services with micro irrigation application on *bari* land. Multiple training sessions, including cultivation techniques, were conducted to assist farmers in growing high-value vegetable crops for consumption and sale in local markets. WUCs were established in the villages to lead the communities through the multiple-use system construction process, creating rules for distribution, and taking responsibility for operation and maintenance. Marketing committees were also created to link production groups within a district. These committees provided marketing information, and assisted households in collection and sale of their produce.

The WUCs were also responsible for obtaining water rights prior to system construction, and searching for matching funds from partner organisations (both NGOs and government organisations). Partners then became involved in the project implementation process, creating the basis for the learning alliance at the district level. These potential new partners and WUC representatives met together at district level learning alliance workshops to discuss MUS work and conceptualise potential approaches for scaling up. Similar meetings were held at the national level with governmental and NGO partners to share the MUS concept, obtain support for future projects, and discuss scaling up possibilities (Mikhail and Yoder, 2008).

Table 2.5. Case studies in Nepal: NGO-driven technological innovation for MUS

Study area	Description of system	Number of users	Focus of the study	Reference
Community of **Chhatiwan** in Chirtungdhara Village Development Committee of Palpa district	• Surface water piped distribution system with hybrid standpipes (for both domestic use and irrigation) and irrigation outlets • Drip and sprinkle irrigation for field application	40 inhabitants spread over ten households	Hybrid system with single tank – one line distribution system for different uses in relatively water-rich area	Mikhail and Yoder, 2008
Village of **Senapuk** in Syangja district	• Surface water piped distribution system with domestic standpipes (shared by a few households) and irrigation outlets (shared by field neighbours) • Drip and sprinkle irrigation for field application	235 inhabitants spread over 36 households	Hybrid system with double tank two line distribution system for multiple uses in mildly water-scarce area	Mikhail and Yoder, 2008
Community of **Khrishnapur** in **Karre Khola** Village Development Committee in Surkhet district	• Open irrigation canal supplies water to community storage and is distributed to outlets, each shared by two households. • Later supplemented by surface water piped to the same community storage. • Households built individual storage containers to store water from community storage tank for all-but-drinking use • Drip and sprinkle irrigation for field application	200 households in the village, of which 16 households served by the system (one branch of the three-branch farmer-managed irrigation canal system)	Multiple use in water scarce community	Mikhail and Yoder, 2008

2.4 Zimbabwe: technological innovation

2.4.1 Country and general features

The Republic of Zimbabwe is a landlocked country in southern Africa with a population of 13 million people in an area of 391,000 km^2, (Figure 2.5). Four major geographical regions are distinguished on the basis of elevation: (i) the hot lowveld <600 m above mean sea level in the valleys of the Limpopo and Zambezi rivers; (ii) the middleveld (600-1.200 m); (iii) the temperate highveld (1,200-2,000 m); and (iv) the mountainous Eastern Highlands (2,000-2,400 m).

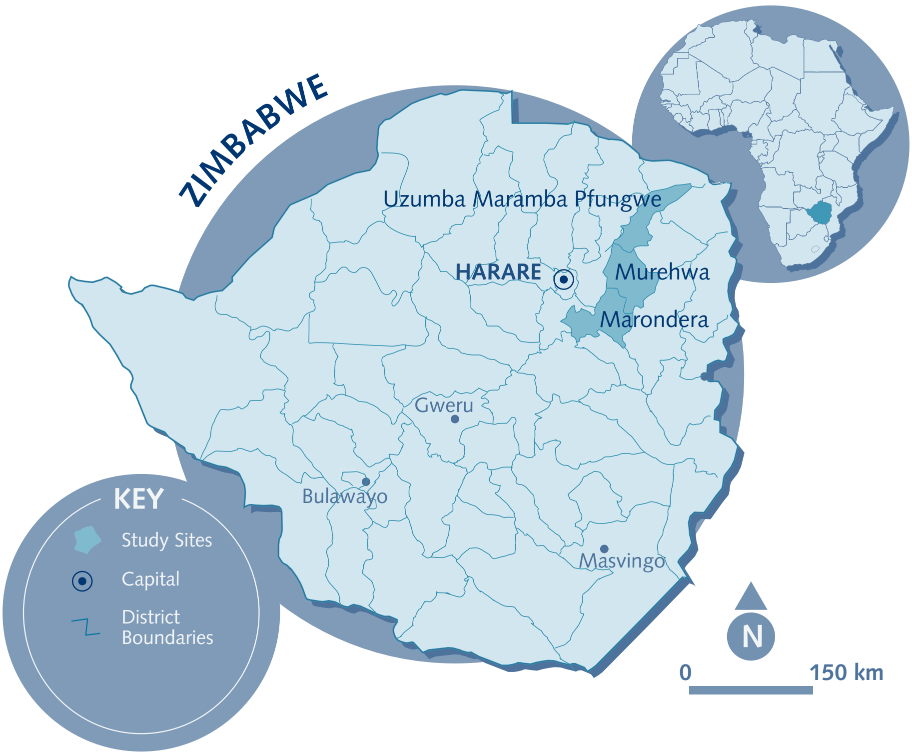


Figure 2.5. Map of Zimbabwe and location of study sites

Climatic conditions in Zimbabwe are largely subtropical with a single rainy season from November to April, a cool winter season from April to August and a hot and dry period from September to mid-November. Average rainfall is 657 mm/yr but it ranges from over 1,000 mm/yr in the Eastern Highlands to 300-450 mm/yr in the lowveld in the south.

Mineral exports, agriculture, and tourism used to be the main foreign currency earners of Zimbabwe. Yet, agriculture is the cornerstone of the Zimbabwean economy and about 60% of the economically active population depend on it for food, employment and income. Women play an important role in agriculture and 70% of small-scale farmers are women. With the shrinking of the formal cash economy, many people have returned to self-sufficiency.

During the research, Zimbabwe faced a wide variety of difficult economic problems after it abandoned earlier efforts aimed at developing a market-oriented economy. Current problems (2008/2009) include a shortage of foreign exchange, soaring hyperinflation, and supply shortages. The main sectors of the economy have largely come to a standstill. In reaction to this situation, many donors have abandoned support to Zimbabwe and turned away from development-oriented programmes towards humanitarian assistance. The crisis has also reduced the capacity of the Government to invest in development.

The economic crisis is compounded by the HIV/AIDS pandemic. The prevalence rate of HIV/AIDS in adults was 20% (2006) and there are many child-headed households. Life expectancy is 36 years, one of the lowest in the world.

2.4.2 Water resources and water development

Zimbabwe is blessed by abundant water resources, albeit unevenly distributed. Total internal renewable water resources have been estimated at 12.26 km^3 yr^{-1}, of which up to 11.26 km^3 is in surface water and 1- 6 km^3 in groundwater (Aquastat, 2008).

From the 1980s, Zimbabwe embarked on a well-acclaimed Integrated Rural Water Supply and Sanitation Programme (IRWSSP), which helped to make great strides in coverage rates of domestic water supply. Coverage currently stands at 72% in rural areas, down from even higher levels in 2000. Rural water supply had typically a health focus, providing only for basic needs and not for multiple uses. Since the start of the economic crisis, the IRWSSP has practically come to standstill.

Zimbabwe used to have a smallholder irrigation programme, promoted by the Department of Agricultural Engineering and Technical Services (AGRITEX). Its approach was to provide irrigation schemes to groups of smallholder farmers (Robinson et al., 2003). However, this programme has also stalled over recent years, due to the economic crisis.

2.4.3 Water governance

Zimbabwe intends to decentralise responsibility for water resources management to the catchment level through the establishment of (sub)catchment councils (CCs).

The IRWSSP was characterised by a well-defined institutional framework, mechanisms and structures. At national level, it was coordinated by the National Action Committee (NAC), a coordination body between the different relevant Ministries, and its executive secretary the National Coordination Unit (NCU). The NCU supported the implementation of the programme, through planning, monitoring and financing. At district level, the programme was implemented by the District Water and Sanitation Sub Committee (DWSSC) which brings together the Rural District Councils, representatives of line Ministries and NGOs. This served for planning and coordination at decentralised level, using a number of tools, procedures and mechanisms. However, the DWSSCs are now inactive in most places.

Over recent years, NGOs, UN bodies and donor programmes have become relatively more important, as the government programme ceased to function. Some NGOs started working outside the formal frameworks of the IRWSSP, innovating in various aspects, such as technology, and aiming to respond to the economic crisis and the new needs brought forward by the HIV/AIDS pandemic. Innovation included attention to low costs technologies, including the rope and washer pump and the family well, and paying greater attention to the impact on livelihoods. NGOs involved in this kind of work include Mvuramanzi Trust, PumpAid, World Vision and Plan Zimbabwe.

NGOs at times acted on their own initiatives but over the last four years efforts have been made to bring the sector together, especially at national level. The Water and Environmental Sanitation Working Group (WES-WG), chaired by UNICEF, was established in 2003, bringing together the main NGOs, UN bodies, donors and government agencies, initially to coordinate humanitarian assistance. Over the years, it has added a strong learning component to its agenda. It has also tried to exchange experiences about approaches to provide water for livelihoods.

2.4.4 Project experiences

The CPWF-MUS project worked mainly at national level, bringing together experiences and technological innovations from NGOs and projects throughout the country. Lessons were shared through WES-WG which acted as a national-level learning alliance.

A survey and case study work was done in villages of the three districts of Marondera, Murehwa and Uzumba Maramba Pfungwe (UMP) in Mashonaland East. This area represents the geographical environments in which the most common and innovative technologies are applied. The area is relatively well-endowed with shallow-to-deep groundwater resources and also has some surface water. The average mean rainfall in the district ranges between 700 and 1,000 mm/yr. The drier parts of the districts (especially UMP) resemble other dry parts of Zimbabwe, in that groundwater is relatively deep and needs to be extracted through boreholes. Marondera has shallow groundwater and family wells are common (Figure 2.6).

Table 2.6. Case studies in Zimbabwe: NGO-driven technological innovation for MUS

Study area	Description of system	Number of users	Focus of study	Reference
A survey across 140 households from 33 villages in the districts of **Marondera, Murehwa** and Uzumba Maramba Pfungwe (**UMP**)	• Individual protected shallow wells with windlass and buckets • Individual protected shallow wells with rope and washer pumps • Boreholes with handpumps (known as bush pumps) • Farm ponds • Rooftop rainwater harvesting and storage tanks	140 households interviewed. Total population of the three districts is 370,000	Survey on multiple use at household level Analysis of past experiences with technologies	Guzha et al., 2007; Katsi, 2006; Katsi et al., 2006

Figure 2.6. Different technologies to access and distribute water in Zimbabwe (photos: Stef Smits)

Engagement with intermediate level stakeholders proved extremely difficult, as there were no major programmes running in the districts. Attempts to engage district level in other parts of the country ran into the same problem.

2.5 Bolivia: community initiatives for water supply in a peri-urban area

2.5.1 Country and general features

Bolivia is a large country (1.1 million km^2) in the heart of South America (Figure 2.7) and home to 9.1 million inhabitants. The country can be divided into three main geographical regions: the *altiplano*, a vast and sparsely populated highland more than 4,000 m above sea level, the fertile inter-Andean valleys with a temperate climate, and the lowlands which are in the tropical rainforest area of the Amazon basin and in the dry scrublands of the Gran Chaco.

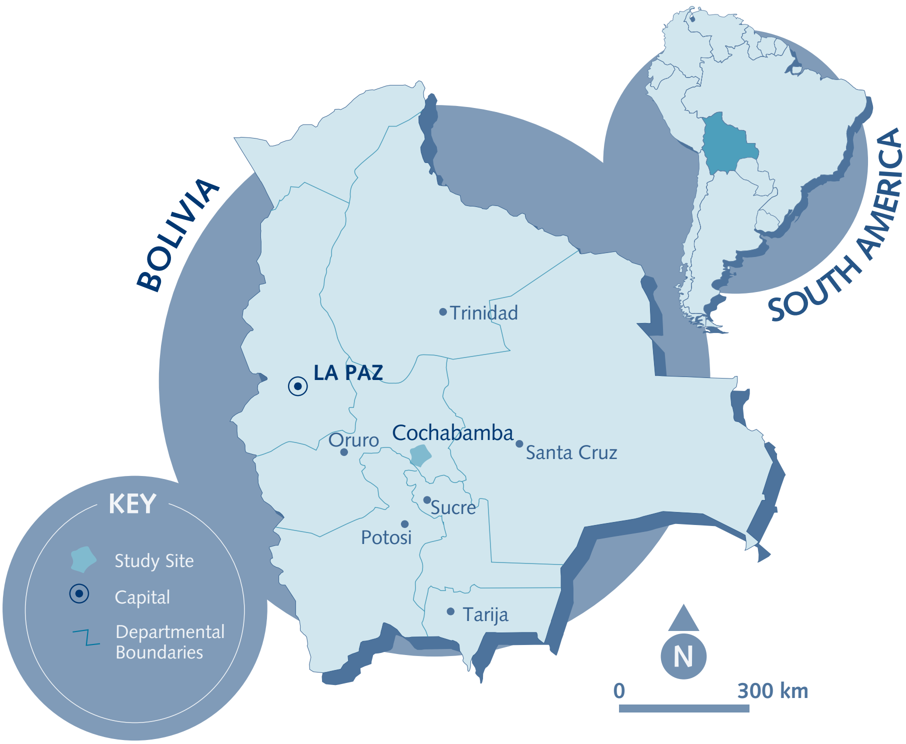


Figure 2.7. Location of Cochabamba in Bolivia

Bolivia is one of the poorest countries in the continent. There is a high degree of economic inequality (Gini coefficient 60.1) that partly follows the geographical dividing lines. The lowlands are home to most of the natural resources, most notably gas, and are the basis of large-scale agro-businesses. The inter-Andean valleys are home to subsistence and small-scale family agriculture and attract a massive influx of migrants from the *altiplano* with its fragile environment. The degree of urbanisation is more than 63%, as demonstrated in the case studies that deal with the rapidly growing (peri)-urban area of Cochabamba.

Politically, the country has been unstable – several Presidents were ousted over the period of the research. At the root of the instability are the different economies and huge levels of inequality. People in the lowland areas demand autonomy, the benefits of natural resources, and a capitalist-based society, while the peasant and working classes, especially in the Andes, demand a socialist approach with re-distribution of benefits from natural resources and transfers of incomes. Power has shifted between different political groups and geographical areas. Issues of decentralisation and autonomy, as well as access to natural resources and basic services are hot political topics.

2.5.2 Water resources and water development

Bolivia has one of the highest average per capita water availability in the world, although this figure is skewed by the high rainfall in the Amazon basin. The *altiplano* and valleys are much drier with rainfall of 500-700 mm/yr and a long dry winter season.

In the *altiplano*, surface water is the traditional source of water, mainly for irrigation of crops. In areas such as the Cochabamba valley, there are many traditional farmer-managed irrigation schemes. Complex systems of water rights and of rotation between and within systems have been developed over time. Over recent decades, under increasing population pressure, other sources of water have been developed. Medium sized dams and reservoirs have been created, often for multiple purposes (irrigation and municipal water). An example is the Laka Laka reservoir near Tarata (Bustamante et al., 2004a, b). Groundwater is being rapidly developed by private individuals who drill boreholes in the inter-Andean valleys. Comprehensive data on trends in groundwater are lacking, but there are already local indications in the Cochabamba valley that the groundwater level is falling. Around big cities, re-use of wastewater is rapidly increasing, but often without proper treatment.

Water supply coverage is 85% for the country as a whole, but only 68% in rural areas (WHO/UNICEF, 2006). Municipal utilities are struggling to provide services to the rapidly growing peri-urban population.

2.5.3 Water governance

Water resources management and access to water resources and water services have long been subject to debate and conflict. Confusion about the national legal framework is at its basis: the water law, which dates from 1906, has been partially revoked but initiatives to develop a new water law have not been concluded. Most legislation and regulations are still sector-based.

Several issues are hotly contested including water rights. In the valleys, farmers have irrigated their crops for many years, sometimes even with pre-Colombian systems, and managed water resources successfully. Traditional water law decides allocations between different uses. A new national law that allows water use by others may create tensions with these traditional legal systems.

Municipalities are responsible for assuring water and sanitation services, and some major cities opted for private providers. This proved a contentious issue as documented by the 'water war' in Cochabamba in 2000 and a scandal around the utility in La Paz. Law 2066 regulates water supply and sanitation services, but no regulations have been developed to make this law operational. Currently, there are debates about revoking the law altogether and developing a new one. In smaller towns, municipalities struggle to provide water services due to limited capacity.

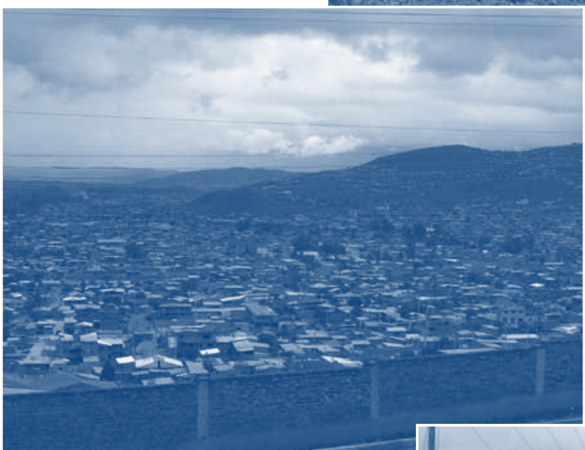
There is a strong tradition of community management and initiatives, especially in the irrigation sector and rural water supply. Where the state has failed to provide services, communities have often developed water services on their own initiative. Rural community organisations, and especially their associations, are relatively strong and independent. Indeed, associations of irrigators are major political powers. The current government is paying more attention to supporting the development and rehabilitation of smallholder irrigation schemes.

2.5.4 Project experiences

The study area is formed by the two valleys of Cochabamba (Valle Alto and Valle Central). These valleys contain the city of Cochabamba and a patchwork of satellite towns, rural towns, villages and agricultural land (Figure 2.8). Some 900,000 people live in this area, spread over seven municipalities.

The annual population growth over the last ten years was 2.5% for the Municipality of Cochabamba itself but 4.5-11% for the surrounding municipalities (Lavrilleux and Compère, 2006). With such high population growth rates, the authorities struggle to provide services. The utility companies, which traditionally served only the main towns, now cover only 50% of the population. There is insufficient infrastructure capacity to meet increasing demand, high tariffs, and above all a lack of capacity (technical and financial) to provide services to the rapidly expanding peri-urban population.

Figure 2.8. The Cochabamba valley is turning into a patchwork of rural, peri-urban and urban settlements (photos: Stef Smits (a,c and d) Gustavo Heredia (b))



For a long time attempts have been made to overcome these problems. One highly contested approach to solve the water crisis is through a mega-project, Misicuni, in which large quantities of water are to be channelled through tunnels into the valley, accompanied by privatisation of the water supply system. This Misicuni proposal led to the 'water war'. With all financial, political and technical uncertainties around Misicuni that ensued, utilities remain even further away from meeting their service provision targets.

In this situation, communities and individuals are taking the initiative by establishing independent community-based service providers to fill a crucial gap in provision for peri-urban settlements. A survey in the Valle Central showed that there are now between 500-600 community-managed water supply systems, many of them very small and covering fewer than 150 families (Lavrilleux and Compere, 2006). In these schemes, 40% of the capital investment costs are covered by the users.

In peri-urban areas, there is a mix of rural and urban livelihoods. Patches of rural farmland are being encroached on by the city; people who newly settle in an urban neighbourhood retain some of their rural livelihoods and keep cattle or small gardens. In addition, older field scale irrigation systems criss-cross the area. Small-scale productive uses such as cattle raising and gardening are very common, but these are not always considered when planning services, especially in the more urban areas. Yet, in the peri-urban setting, producers are close to markets and also have easy access to such things as spare parts and consultancy support.

CPWF-MUS research revolved around getting a better understanding of water use patterns in relation to these dynamic livelihoods in peri-urban areas, and about ways in which community organisations, private infrastructure enterprises and utilities respond. This was done through a number of case studies, as summarised in Table 2.7. This was complemented by an institutional analysis (Quiroz et al., 2007a).

At the intermediate level, the learning alliance revolved around the question of how to support the community-managed systems through a Resource Centre (Heredia, 2007). Although it is recognised that community-managed systems play a crucial role and are often more effective, more efficient and cheaper than utilities, to be sustainable they need support in:
(i) Legal issues – 42% of community organisations are not legally established and do not have documented legal ownership of their infrastructure,
(ii) Operation and maintenance issues, including water quality, and
(iii) Financial administration.
Many of these issues of community management are related to possibilities to stimulate multiple uses of water.

Table 2.7. Case studies in Bolivia: communities' self-supply supported by local private enterprise and municipality

Study area	Technology	
Caico alto	• Groundwater-fed communal distribution system with household connections • Open canal irrigation scheme • Some household wells	
Challacaba, community in District 9 of Cochabamba	• Groundwater-fed communal distribution system with household connections (metered) • Open canal irrigation system	
Chaupisuyo; rural community in the Municipality of Sipe Sipe	Three overlapping schemes: • Open canal irrigation scheme • Communal distribution system with connections at field level for irrigation. One branch has household connections for domestic use. • Surface-fed communal distribution system with household connections	
District 9 of the Municipality of **Cochabamba**	• Tanker providing water door-to-door • Distribution systems with household connections • Open canals for irrigation	
Users of the Laka Laka dam in the town centre of the Municipality of **Tarata**	• Open canals for field scale irrigation and irrigation of gardens in towns, coming from multi-purpose dam • Groundwater fed distribution system	
Four peri-urban neighbourhoods in the municipality of **Tiquipaya**	Overlapping systems • Groundwater-fed distribution systems with household connections • Open canals for field irrigation • Household dug wells and boreholes	
Seven communities in the rural area of the Municipality of **Vinto**	• Communal distribution system with shared intake and two branches • Open canals for irrigation • Distribution system with household connections	

2.6 Maharashtra, India: Introducing multiple-use water services into the government rural domestic water supply programme

2.6.1 State and general features

The CPWF-MUS work was carried out in the State of Maharashtra, the third largest state in India, with a population in this single state larger than any of the other seven countries in the project.

The area of Maharashtra is 307,713 km^2 and the population is around 96 million. It is located in the western part of India and has the mega-city of Mumbai as its capital (Figure 2.9). Geographically, Maharashtra can be divided into three regions. From west to east, these are (i) the Konkan coastal plains, 50-80 km wide with Mumbai; (ii) the Western Ghats, a hilly range parallel to the coast at an average elevation of 1,200 m and (iii) the flat Deccan Plateau, traversed by several rivers that are used for large-scale irrigation.

	Number of users	Study focus	Reference
	45 households, 225 inhabitants	Design process of multiple use system	Heredia and Valenzuela, 2008
	60 households	Sustainability of community-managed multiple-use system	Heredia, 2005; Coignac et al., 2005
	88 households, approximately 440 inhabitants	Irrigation-plus and multiple sources for multiple uses	Valenzuela and Heredia, 2007
	46,000 people in District 9	Survey of water use and systems among 44 households	
	4,000 persons in the urban centre of Tarata	Conflicts around multiple use at different levels (catchment; in town)	Bustamante el al., 2004a, b; Flierman et al., 2003
	666 households	Survey of water use and systems among 64 households	Durán et al., 2004; Hillion, 2003
	4,700 people	Process of negotiation, decision-making and design of a multiple-use system	Quiroz et al., 2007b

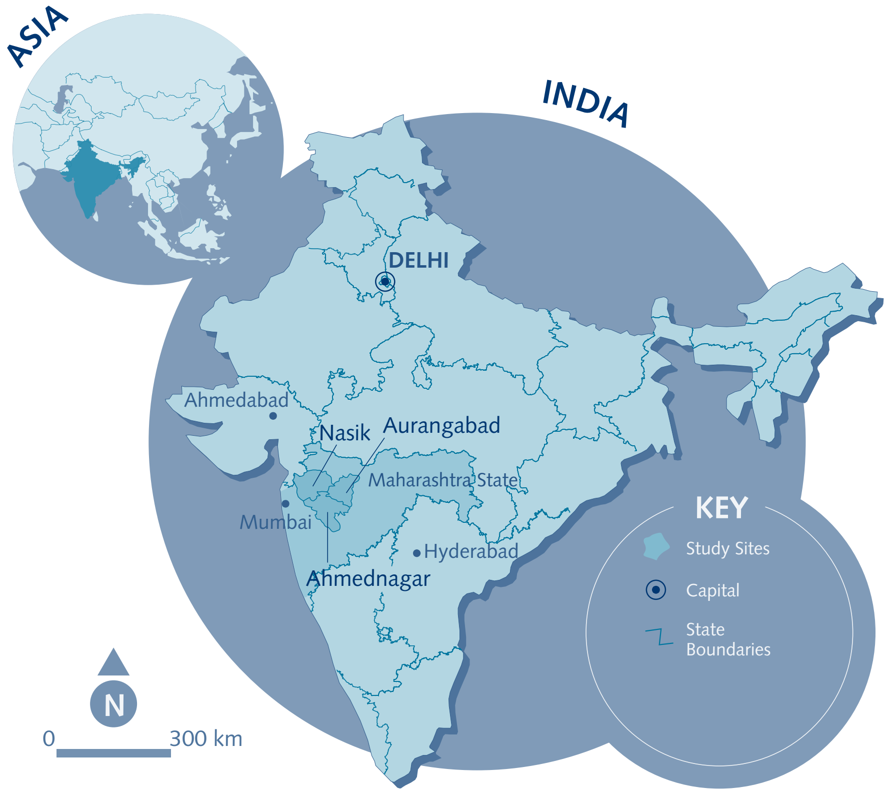


Figure 2.9. The State of Maharashtra in India and location of study sites

Economically, Maharashtra consists of two halves. The western part of the State is heavily influenced by Mumbai, as a major industrial and commercial city. Maharashtra is one of India's most urbanised states, with 42% of the population living in urban areas. By contrast, the Ghats and Deccan plateau provide a very rural context and, in total, 64% of the State's population depends on agriculture and related activities. Part of the agriculture is commercial sugarcane cultivation; part is subsistence agriculture.

While Mumbai is one of India's most important economic hubs, poverty is still widespread in the State. In rural areas it is partly associated with the fact that the rain-fed agricultural areas are drought-prone.

In the case study site of Kikwari there was a distinct difference in poverty level between the relatively well-off inhabitants in the core of the town, and the much poorer tribal people at the village fringe, where 38% of people live below the Indian poverty line. In the case study site of Samundi, 95% are tribal and 73% of the households were classified as being below the Indian poverty line.

2.6.2 Water resources and water development

Rainfall in Maharashtra ranges from 2,000 mm/yr along the coast to 300-500 mm/yr in the Ghats and on the Deccan plateau. Rainfall is monsoonal and varies considerably between and within years. Most of the rain falls in the monsoon period, but sometimes the monsoon starts late, or rains are insufficient. The short-term government response is food and fodder relief. The long-term response has been large dam and canal construction. In terms of water supply, most are high-cost schemes that are built by contractors and handed over to the local government. According to the most recent survey (1999), 78% of all habitations with a population of at least 100 people, had full coverage (Government of Maharashtra, 2006).

Maharashtra's water resources are heavily developed. During the colonial period in India, dams and canal systems were built for the production of export crops including sugarcane, indigo, cotton, and wheat (Maharashtra is the largest sugarcane producer in India). There are 2.5 million hectares of irrigated land where groundwater is the prime source of water. Colonial administrators created infrastructure to protect against drought and famine, but this was largely used for sugarcane production.

Maharashtra's groundwater resources are severely constrained and depleting, suffering from swings between heavy monsoon rain and drought. This is exacerbated by unregulated groundwater abstraction for irrigation and industry and poor management of domestic water systems.

2.6.3 Water governance

The state government of Maharashtra has historically been responsible for implementing both irrigation and drinking water systems. Three state government organisations have been set up to build rural drinking water systems. The first, Rural Water Supply and Sanitation (RWSS), works primarily through the *Zilla Parishad* (District Council) to supply small water systems to individual villages (*gram panchayats*, local government bodies at the village level comprised of elected members from the village and the Village Development Officer). The second organisation, called the *Maharashtra Jeevan Pradhikaran,* was created through the Maharashtra Water Supply and Sewerage Board Act of 1976. It builds larger water supply systems and can work independently of the *Zilla Parishad*. The third and most recent is the Jalswarajya/Aple Pani Project with staff from the RWSS. The Jalswarajya project is funded by the World Bank and the Aple/Pani project by German KfW, but their approach is the same. It is intended to institutionalise the decentralisation of the RWSS delivery to rural local governments and communities (Mikhail and Yoder, 2008).

NGOs have not played a significant role in design or implementation of domestic water supply until recent state projects. Jalswarajya/Aple Pani, however, relies heavily on NGOs, particularly at the local and district level, to assist communities with their projects and other income generating activities. Conversely, NGOs have been involved in watershed work for the past few decades, focusing on water budgeting, water source strengthening, and conservation education.

2.6.4 Project experiences

Given the importance of state government in providing water supply services and the limited role of NGOs in actual service delivery, the NGO International Development Enterprises (IDE), who managed the MUS project in India, chose to collaborate with the Jalswarajya/Aple Pani Project, which introduced community-led, demand-driven water supply services. This represented a shift in the state's approach to domestic water schemes and a way to decentralise project management. In that sense, we expected that it would provide an interesting case to introduce MUS as part of a larger government domestic water scheme. The substantial project resources and the government/NGO mechanism provided a good opportunity to test implementation of MUS projects.

We piloted this approach in three districts: Nasik, Aurangabad and Ahmednagar. IDE advised the communities to incorporate MUS into their planning as a part of the Jalswarajya/Aple Pani Project. When first approached, the state level management of Jalswarajya/Aple Pani supported the concept of MUS, but due to the community-led focus of the project, encouraged IDE to approach communities independently for inclusion. Because it had few staff in the state, IDE formed a learning alliance of NGOs working on Jalswarajya/Aple Pani within each district to increase the number of communities reached. Through these partnerships, the NGOs shared information and reached a wider number of communities with the MUS concept. Thus, IDE and local partners worked with communities to encourage the productive use of the current additional water available from the extra water allocated for population growth. The forms of productive use were primarily livestock and drip irrigation of kitchen gardens. Some communities, however, chose to promote the MUS concept in further ways. For Kikwari, this included capture and filtration of wastewater for irrigating a community garden, use of system water for land rented from the community by a women's self help group, and use of the water for a goat farm managed by the tribal community members. In Samundi, some households irrigate fruit and nut trees in addition to their kitchen gardens.

Unfortunately, state officials did not fully sanction multiple-use water services because they had previously established a menu of technology options and a set quantity of water that could be delivered to the community through the project (40 lpcd). Although the community was meant to lead their own project, the guidelines established by Jalswarajya/Aple Pani left little room for flexibility. However, despite these significant constraints, motivated communities were able to make remarkable progress. Two communities in Nasik district (Table 2.8) were approached to provide a test case for MUS. In Kikwari, an existing system was expanded and embedded within a broader set of water resources management activities. Samundi, suffering much worse domestic water conditions, developed a new system for multiple uses. In both cases, the CPWF-MUS project assisted the communities to assess their needs for productive uses, and to develop practical ways of including these into the planning and design (Figure 2.10). The resulting documents describe these planning and design processes and their outcomes. In the other districts, most of the CPWF-MUS work consisted of interaction with the learning alliance members. The partners then worked independently with communities to incorporate productive use into their systems.

Figure 2.10. Searching water for crops, cattle and human consumption in Maharashtra
(photos: Sudarshan Suryawanshi (a and c), Monique Mikhail (b))

Lessons learnt are now being fed back to Jalswarajya/Aple Pani, but the rigid parameters provide little opportunity to institutionalise the approach within the Project. However, due to the shift in state domestic water provision toward community-led demand-driven projects, there is room for growth of the MUS concept, particularly if project leaders are approached at the project's inception.

Table 2.8. Case studies in Maharashtra: Integrating MUS into the domestic sub-sector

Study area	Description of system	Number of users	Focus of study	Reference
Kikwari in Nasik district	• Groundwater piped distribution system with household connections • Communal wells with handpumps • Rooftop rainwater harvesting • Drip irrigation for field and kitchen garden application • Wastewater collection and filtration for community garden • Water for the tribal goat farm provided from the previous drinking water system	1,764 inhabitants in 242 households	Pilot implementation of MUS	Mikhail and Yoder, 2008
Samundi in Nasik district	• Groundwater piped distribution system with household connections • Drip irrigation for field and kitchen garden application	759 inhabitants in 120 households	Pilot implementation of MUS	Mikhail and Yoder, 2008

2.7 Colombia: Learning from communities to influence rural water supply programmes

2.7.1 Country and general features

Colombia is home to a population of 44.1 million inhabitants. Its territory covers 1.1 million km^2 and its geography is strongly influenced by the Andes (Figure 2.11). Its main regions are (i) the tropical Pacific areas mainly consisting of inaccessible jungle and with a rainfall of up to 10,000 mm.yr^{-1}; (ii) the Andean range, with climates ranging from hot in the valleys of the Cauca and Magdalena rivers to temperate in some of the plateaux and around Bogotá, to very cold at its highest peaks; (iii) the Eastern lowlands which drain to the Amazon and Orinoco basins and are inaccessible and sparsely populated; (iv) the hot Caribbean coast.

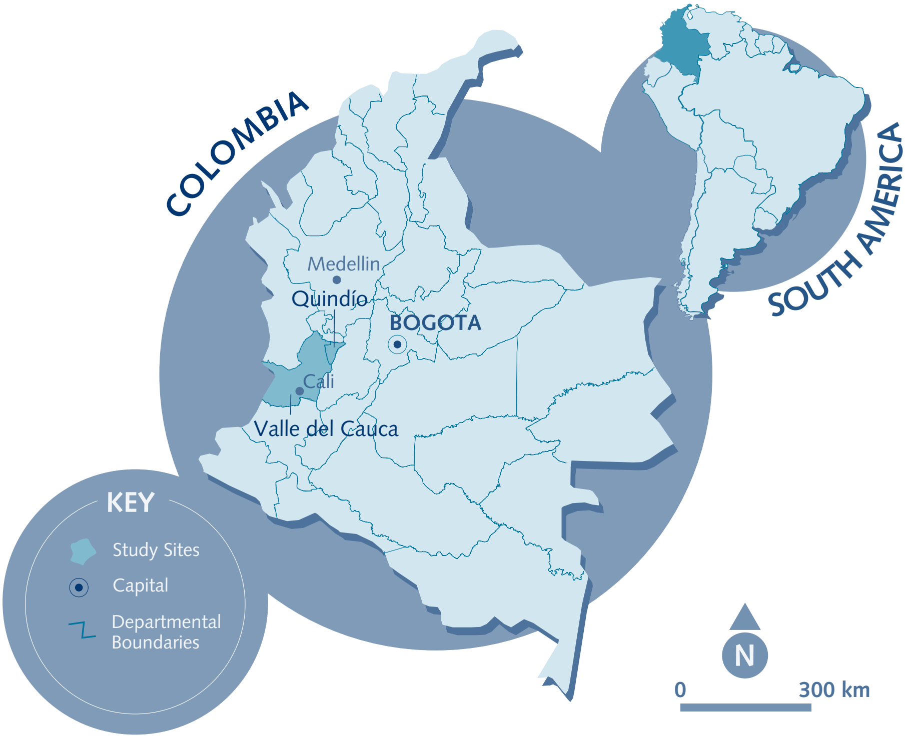


Figure 2.11. Map of Colombia and location of study sites

The population is mainly located in the valleys and high plateaux of the Andes as well as in cities near the Caribbean coast. Colombia is highly urbanised with mega-cities of Bogotá, Cali and Medellin. Although the countryside is very fertile and could support many rural livelihoods, the presence of armed groups (guerrilla, paramilitary forces, narco-traffickers) and war have made many people flee to the towns and cities. There are an estimated two million internally displaced persons.

Colombia is a middle-income country with a relatively diversified economy. Its main sources of income include commodities such as oil, coal and precious stones, and also various tropical products such as coffee, bananas and sugarcane. Its agriculture is a mix of plantation agriculture (e.g. bananas, sugarcane) and smallholder farms where food and cash crops are grown. The climatic diversity results in a high level of geographical specialisation. Smallholder farms occupy the slopes and highlands of the Andes while plantation agriculture is predominant in the river valleys and coastal lowlands. A growing sector in rural areas is domestic tourism, especially around the main cities, as city dwellers buy or rent holiday houses in villages and some relocate and commute to the towns.

The distribution of wealth is very unequal: the Gini coefficient is 58.6 and 24% of the population lives in extreme poverty (UN, 2005). The rural areas often present a patchwork of livelihoods, and poverty levels. Well-off city dwellers may live in villages alongside poor peasant farmers. Many villagers may have off-farm jobs in neighbouring towns or villages. Rapidly growing peri-urban areas, where urban livelihoods predominate, encroach on rural areas.

Official Development Assistance (ODA) represents only 0.5% of the GDP. International agencies and donors do not represent major players in development in the country.

2.7.2 Water resources and water development

Most of Colombia, including our study area, has a bimodal rainfall pattern, with the twin peaks of rainfall in the Bogotá area in April and October. The two dry periods last three months but are not completely dry: there may be heavy rains during the dry season, and short dry spells during the wet season. Total rainfall is largely determined by the mountain ranges. The relatively constant rainfall and its location near to the equator give Colombia an extremely high average per capita water resource of more than 50,000 m^3 per year. Yet, stress on the resources is growing in the most densely populated areas. A national water resources study indicated that the number of municipalities experiencing absolute water scarcity is still small, but their number is rising and they are mainly located in the valley of the Cauca river and the highlands north of Bogotá (IDEAM, 2000). As water has always been abundant, the management of the resource has not received high priority in the past. This has changed over the last few years. The environmental authorities have started issuing licenses or permits to users, and levying pollution charges. Law 373 (Congreso de la República de Colombia, 1997) attempts to increase water use efficiency in the domestic and other water using sectors.

Water resources are available in many small mountain streams that ultimately drain to the Cauca and Magdalena rivers, as well as into the Amazon basin. Groundwater resources make up around 20-25% of total available water resources, and these are mainly developed by private farmers and private water suppliers along the coast.

Of the 750,000 hectares of irrigated land, 62% is developed by farmers and communities and 38% by the public sector (Vermillion and Garcés-Restrepo, 1998). Public sector schemes are typically large schemes with many smallholder farms. They are located in the valley bottoms of the Cauca and Magdalena rivers. In the 1990s, most of these schemes were transferred to the farmers (Vermillion and Garcés-Restrepo, 1998). The large-scale farms in the valley bottoms of the rivers use surface water and groundwater for crops like sugarcane. The mountain slopes and highlands are home to a large number of small-scale, community-managed intakes from mountain streams with piped or open canal distribution systems. There is still much scope for expanding the area under irrigation, especially by small-scale irrigation schemes (Vermillion and Garcés-Restrepo, 1998). Community initiatives could play an important role but they need technical and financial support.

Average domestic water supply coverage is 93%, but falls to 71% in rural areas (WHO/UNICEF, 2006). Some argue that coverage with safe water in rural areas is much lower (Visscher, 2006). Most systems are surface water-fed piped systems.

However, water treatment is either absent or non-functional. Only an estimated 7% of rural water supply systems receive adequate treatment (Visscher, 2006).

Apart from some isolated rural settlements, sanitation mostly comes in the form of water-borne sanitation, either with septic tanks, or direct outfalls into the rivers. Wastewater treatment is poor. Pollution with domestic wastewater is a growing concern in peri-urban areas. Attempts to reduce it are underway through levying pollution charges, developing wastewater facilities and reuse of wastewater in agriculture.

Over the last few years, the government has put great efforts into revitalising rural areas in an attempt to bring peace and development. Water supply is a key priority in some areas, including the Valle del Cauca, where most of our case study sites are located.

2.7.3 Water governance

Colombia's water governance can be characterised by a high degree of decentralisation, both for water resources and water services. Water resources management is delegated to the Corporación Autónoma Regional (CARs), or environmental authorities. They arrange for water use permits and pollution charges.

The water supply and sanitation services sector has extensive legal and institutional frameworks, provided for in Law 142 (Congreso de la República de Colombia, 1994) that clearly defines the role of the different actors. Ultimate responsibility for water and sanitation services provision lies with the municipalities. They have the so-called authority function and are directly responsible for capital investments as well as long-term support to communities.

They also need to define the modality of actual provision, which can be carried out by different entities, including a municipal-owned utility, a private enterprise or community-based service providers. In rural areas, the last of these is by and large the default option (90% of the service providers in rural areas are community-based), as there is a long history of community management. Law 142 also formally recognises community management as a service provision option. Community-based service providers have to comply with certain standards, including establishing itself as legal entity under the chamber of commerce and registering with the Superintendent for Public Services Provision. Of the approximately 11,000 water service providers in rural areas, only 17% are registered at the Chamber of Commerce, and even a smaller percentage at the Superintendent (MAVDT, 2004).

As in Bolivia, support for community management is crucially needed, as many service providers are struggling in some aspects of their role. Less than 20% of the operators have received some form of technical or administrative training (MAVDT, 2004). The long-term support role officially lies with municipalities, but many do not have the capacity or resources to take up this role effectively. In response, there have been various initiatives by communities. A well-documented example has been the establishment of AQUACOL (Association of Community-based Water Supply and Sanitation Service Providers of Colombia) (García Vargas, 2004). This association brings together many of the community-based service providers from South-west Colombia, who try to strengthen each other's capacity, and also provide a collective voice in discussions with the State.

National level actors mainly have a role in regulation. The sector seems over-regulated with technical norms and standards, tariff calculations standards, etc. These are applied as a blanket approach to rural and urban areas alike and to community-based services providers and private enterprises. However, they display an urban bias and do not adequately reflect the reality of rural community-managed services. For example, tariff structure calculations are supposed to be based on all kinds of socioeconomic data, and budgets, whereas most communities just apply simple flat rate structures or volumetric payments.

The tension between the very detailed legal and institutional frameworks and the largely informal community-managed services result in "legal shopping" by communities and government officials alike: they refer to and use the formal laws when they suit, but ignore them if not. For example, government officials accuse communities of not complying with legal standards for service provision, but ignore their own official responsibilities to support communities. Likewise, community-based service providers will purposely not register with the Superintendent, because of the hassles involved, but refer to legal dispositions when conflicts within the community arise.

2.7.4 Project experiences

The project was carried out in the Departments of the Valle del Cauca and Quindío in South-west Colombia (Figure 2.11), home respectively to 4 million and 500,000 inhabitants. These two departments are important in Colombia's economy, as much of the country's agriculture and agro-industrial processing and trade take place here, especially around the city of Cali. They are relatively well-resourced and accessible in terms of transport and other services. The mountain slopes are home to numerous small towns and rural settlements, with small-scale agriculture predominant. The valley of the Cauca river is mainly taken up by large-scale sugarcane agriculture. Although mainly rural, the entire area is influenced by the presence of the city of Cali. Markets are close and infrastructure, including transportation, is good. In some villages, the phenomenon of rural tourism and ownership of weekend and holiday homes by city dwellers is important.

The overall scope of the CPWF-MUS project in Colombia was to learn with communities and officials about de facto productive water uses of 'domestic' systems and participatory approaches in rural water supply programmes (Figure 2.12). We built our work on previous case studies and student theses. The main vehicle for research was the learning alliance, which brought together a range of stakeholders (Cinara, 2006g). The main stakeholder is a government rural water supply programme, Programa de Abastecimiento de Agua Rural (PAAR) that aims to transform rural water supply coverage in the Department of the Valle del Cauca. It is driven to a large extent by efforts to improve the quality of life in rural areas and has strong government-backing. The programme brings together financial resources and technical capacity from the main actors at different hierarchical levels. It is run by the Corporación Autónoma Regional del Valle del Cauca (CVC, the environmental authority), the government of the Department of the Valle del Cauca (AQUAVALLE, a utility that provides water in small and intermediate towns of the Department), and all Municipalities of the Department. The actual implementation is undertaken by the Comité de Cafeteros (coffee growers association). The comité has developed water supply schemes in many rural areas, often with a view towards facilitating the processing of coffee beans that requires much water. The programme represents thus the major water development initiatives in the region. The CPWF-MUS project worked with PAAR to learn about local multiple uses of water and to see how the programme could take those into account. By selecting this range of communities as study sites, we hoped to learn from community experiences and improve their performance. The learning alliance also included AQUACOL, as well as universities knowledge and institutes such as CIAT.

Figure 2.12. The Learning Alliance in action in the field and in the meeting rooms (photos: Grupo GIRH – Cinara)

In order to learn about the ways in which multiple uses could be included in rural water supply programmes, learning alliance members themselves selected a number of communities for research on different aspects of multiple uses, considering the diversity of demographic settings and spatial scales. The project included studies ranging from an analysis of water use at farm/homestead level at selected farms in the Quindío Department, to multiple use of water in the sub-catchments of the Quindío river and the El Chocho. But most case studies focused at community/system level. Some addressed all issues related to multiple uses (such as water use, technology, financing, community management, etc.), others only addressed a particular issue. Details are given in Table 2.9.

Table 2.9. Case studies in Colombia: integrating MUS in the domestic sub-sector

Study area	Technology	Number of users	Focus	Reference
Cajamarca and San Isidro in the Municipality of Roldanillo	Two surface water piped distribution systems with household connections; one originally meant for irrigation, the other for domestic supply for Cajamarca	700 inhabitants	Community case study of irrigation-plus	Cinara, 2006b
6 communities in the **El Chocho** micro-catchment of the Municipality of Cali	Six independent surface water piped distribution systems with household connections	16,000 inhabitants, spread over six communities	Multiple use within a sub-catchment perspective	Burbano and Lasso (2004); Duarte and Jordan, 2004; Muñoz and Narváez, 2004; López, 2005; Sánchez et al., 2003; Cinara, 2006c
Small town **Costa Rica** in the Municipality of Ginebra	Surface water piped distribution system with household connection.	5,000 inhabitants in 820 households	De facto multiple use system	Cinara, 2007b
La Palma-Tres Puertas, water supply system for seven communities in the Municipality of Restrepo	Surface water piped distribution system with household connections	1,827 inhabitants in 404 households	De facto multiple use system	Cinara, 2006a
Quindío river catchment	Individual households accessing open water sources, through intake and pipes to the homestead	478,000 inhabitants in the entire catchment	Planning at catchment level Water use at household level	Jiménez, 2007; Arías, 2006
Los Sainos, micro-catchment in the Municipality of El Dovio	Surface water piped distribution system with household connections Rooftop rainwater harvesting tank	290 inhabitants	Water use at household level	Roa, 2005

The research at the community level was complemented by studies on institutional issues at community, intermediate and national level, such as a general review of the institutional framework for multiple uses (Cinara, 2006f), the PAAR project cycle (Cinara, 2006e), and planning mechanisms at catchment level (Arías, 2006).

There are large wealth differences within Colombian communities. In our case studies, a majority of families were poor in relative and absolute terms (income equivalent to US$ 1 per person per day, the threshold often used to define absolute poverty) while a small number of people were quite rich.

2.8 Thailand: Self-sufficiency through multiple uses of multiple sources in integrated farming

2.8.1 Country and general features

Thailand is a lower middle-income industrial developing nation, heavily dependent on exports. Thailand has a total area of 513,000 km^2 and about 66 million people. It is divided by rivers and drainage patterns into four parts: North, North-east, Central and South (Figure 2.13). The upland plateau of Khorat is drained North-east by the river Mun and East by smaller rivers that flow into the Mekong river. The South-west monsoon exerts much influence on the climate. Thailand has three seasons: a hot and dry season (in average temperature 34 ^{o}C and 75% relative humidity), a rainy season (29 ^{o}C, 87%) and a cool dry season (32 ^{o}C, 20%). The North-east is slightly cooler and drier than other parts of the country. This climate leads to a relatively high use of water. Roughly 20% of the country is covered by mountains and hills. In 2005, arable land accounted for 27% of the total area of which 7% was planted to permanent crops. Deforestation has occurred throughout the country. In the North-east deforestation has been severe and loss of nutrients and erosion has degraded the soil (Ruaysoongnern, 2001). Mismanagement of irrigation has lead to intrusion of saline water into the groundwater in the North-east.

The North-east has the largest population (21 million). Of the total, 22% is below 15 years of age, 70% is aged 15–64, and 8% is 65+. Thailand's population has a low growth rate of 0.68% with a total fertility rate of around 1.6 children per woman (Library of Congress, 2008), i.e. below replacement rate. Education is compulsory up to the age of 16 and the literacy rate is high. As a result of an active campaign, the HIV/AIDS prevalence is relatively low at 1.8%.

Thailand's developing free-enterprise economy had, at the time of the project, recovered from the financial crisis of 1997. Between 2002 and 2005 the number of poor people declined by 2 million and poverty stood at 10% of the population. Annual per capita GDP was US$ 9,300 (at purchasing power parity, see Table 2.2). Agriculture forestry and fishing contributed less than 10% to GDP but employed 39% of the workforce. Although the distribution of income is relatively equitable, there are more poor people in the North-east than in the other three regions. The rapid economic growth has brought a widespread shift towards urban lifestyles and has brought much social disruption in rural areas, as members leave the family to find employment in cities. There are still large differences in income, employment, wellbeing between cities and rural areas, but the latter are catching up fast.

North-east Thailand is a semi-arid region in the Mekong river basin. The annual rainfall of 1,100 mm/yr is concentrated over 4-5 months, but with an erratic distribution that often causes floods and droughts in the same year. Our research was carried out in this region.

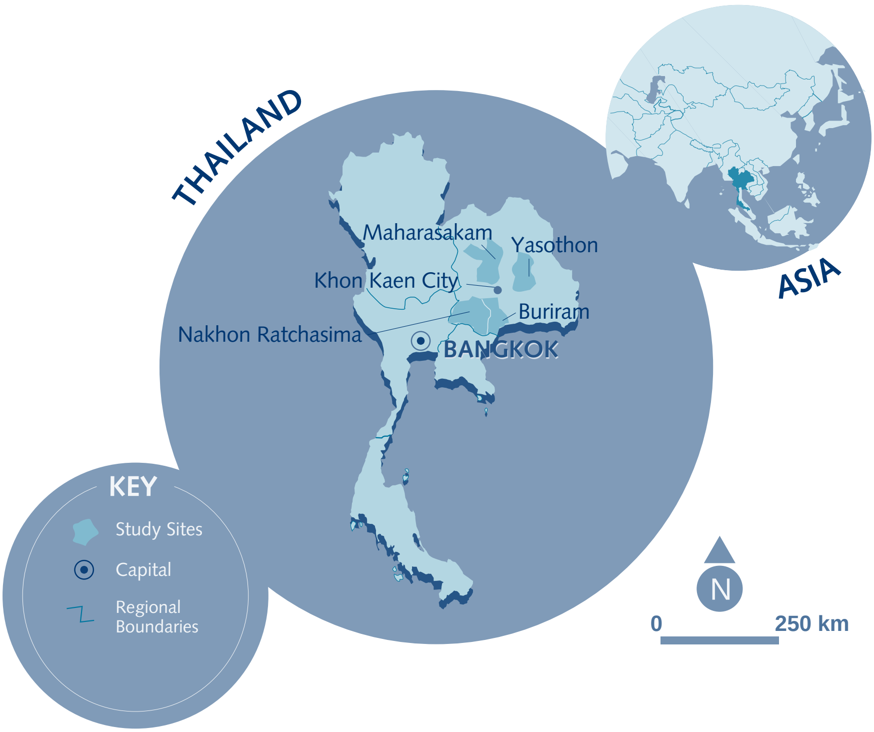


Figure 2.13. The five regions of Thailand and the location of study sites
(Source: Tipraqsa et al, 2007)

The economic crisis in Asia in 1997 had a big negative impact on the Thai economy and underlined the need for more sustainable practices that became part of the latest National Development Plan (NDP). As a result, agricultural water resource rehabilitation is now redirected for sustainable development. Furthermore, the direction of the 8th NDP points towards use of participatory approaches as also prescribed in Thailand's new Peoples Constitution, adopted in 1997. Hunger had been widespread in North-east Thailand, but is now largely eliminated. Many farmers report satisfaction with the self-sufficiency lifestyle and food situation, even with a low cash income.

2.8.2 Water resources and water development

In North-east Thailand, economic development in the 1960s and 1970s was mainly by expansion of direct exploitation and extraction of natural resources, in particular of soil fertility. People relied on ponds for drinking water and on natural water bodies for other domestic and agricultural purposes. Later (1980s) this was intensified through modernisation and industrial processing. Farming included large scale harvesting of land and water resources and lacked any concept of recycling. Even in the following phase (1990s) when value adding technologies were introduced, farming still caused the depletion of natural resources. The 7th NDP (1992-1996) and the 8th NDP (1997-2001) further promoted agricultural exports. Despite the evolution in farming practices, the extractive, unsustainable use of natural resources remained a basic feature of agriculture. Inevitably, land and water resource degradation became widespread (Anukulampai et al., 1983; Noble et al., 2000; Bridges et al., 2001).

The decline in the quality of farm land and water resources in the North-east caused a decline in productivity and in farm income and led to an increase in poverty. It forced farmers to look more critically at water resource management and to try out multiple uses of water. It also forced farmers to find off-farm employment, predominantly in the larger cities. This emigration has created social problems, associated with increased consumerism, increased reliance on off-farm incomes and a dependence on loans.

In the past, the government supported local communities with small-scale irrigation systems and farm ponds. However, these assets were hardly used due to the high cost and the use of inappropriate technologies. In 2000, the Thai government approved a programme to provide revolving funds to villages for development initiatives (MOAC, 2001), and in 2004 approved a programme to create 450,000 farm ponds throughout the country, towards which it provided 2,160 million Baht (€ 43 million) in the period 2005-2007.

As early as 1987, His Majesty King Bhumibol Adulyadej presented his New Theory as a holistic approach to stimulate new thinking about water resource rehabilitation, integrated farming and community development (Ministry of Education, 1999). The influence of the King as mentor of the Thai people is hard to overestimate, particularly since the economic crises of the 1990s when his concept of the Sufficiency Economy was incorporated into the National Economic and Social Development Plan of 2002. The concept mixes economic ideas of sustainable development, equitable growth, and protectionism with moral sentiments of responsibility, moderation, and self-restraint. His New Theory aims at self-reliance in terms of food security for households and communities and has been promoted in many ways and researched in several agro-ecologies (KhaoHinSon, 1999). Figure 2.14 shows the concept graphically: diversification of production and resources, recycling, farm ponds, conservation of natural resources. Development of an integrated farming system has also assisted in improving the fertility status farms on light textured soils (Tipraqsa et al., 2007) that dominate the North East.

Figure 2.14. An image of a Thai farm according to the New Theory of his Majesty the King of Thailand (Source: Bridges et al., 2001)

Taken all together, the economic crisis created countrywide and positive awareness about the urgent need for rehabilitation of water resources for agricultural sustainability and autonomy (Kudwongkeo, 1999).

2.8.3 Water governance

In the 1970s and 1980s when the government's approach was still strongly top-down, the Thai NGO Population and Community Development Association (PDA) brought an alternative development programme to the North-east (D'Agnes, 2000; PDA, 2005). Its emphasis was (and is) on empowerment of individuals and communities with skills, tools and institutions, using water, sanitation, agriculture and industrial employment in innovative ways, with the NGO in the role of initiator and facilitator. PDA's original objective was family planning and it considers health to be essential for that to take place. It introduced and promoted large scale use of jars to store rainwater collected from roofs in order to achieve 'first health then wealth'. This programme to promote roofwater harvesting and storage of water for domestic purposes has been very instrumental in improving rural health. Later, PDA organised in many villages in North-east Thailand community piped water systems for domestic use and for garden irrigation, and as part of this established village water management committees. This process of working with communities and the private sector from the bottom-up and of learning with them about the most pressing problems and opportunities resembles in many ways 'learning alliances' well before the term was coined. PDA carries out the project Sky Irrigation (*pra pa loi fah*) that aims at water development and income generation, usually through the year round production of vegetables. Its approach remains an important stimulator for rural development.

In the 1980s and 1990s, there was something of a backlash against the migration to cities and its impact on the cohesion of families and on debt. Dissatisfied with city life, some farmers returned to their rural homes to take back control over their lives. With some external support from NGOs these farmers undertook a self-assessment of their situation: analysing their problems, assessing the lessons they had learnt and identifying potential alternatives and solutions to these problems. They identified as key problems (i) degradation of community values and (ii) unsustainable systems of agricultural production and use of water. Many farmers own their land and the water on it. They identified opportunities for multiple uses of water (domestic and productive) from multiple sources (rain, roof run-off, other run-off onto farm, groundwater) as a key to development that would be under their own control. Using household labour and limited financial resources, farmers started to develop integrated farming systems around farm ponds. Water was used to produce vegetables for the household and for the market, and for supplementary irrigation of the rain-fed rice crop. Stored water was used to irrigate trees, to create fish farms and to provide drinking water for cattle, pigs, ducks and chickens. The manure from livestock was used to fertilise crops. Income generated from these diverse activities has been used in the development of further water storage structures with support from government or research teams. Other farmers, suffering under the same needs and constraints, followed suite and the movement snowballed into a Farmer Wisdom Network, particularly after some of the nation's leading figures provided moral support.

Farmer groups and networks in the North-east have dramatically expanded from fewer than 100 leading farmers 15 years ago to a few thousand farmer leaders, each with an active group. The leaders interact at national forums and with politicians. By 2005 approximately 100,000 households had joined the movement and the target is one million households by 2013. These networks have transformed water use patterns and national policies have been introduced to support them. Their activities include local research to identify indigenous water resource rehabilitation and resource management technologies, participatory technology development, biodiversity promotion, C-sequestration (carbon fixing), community forests management, and agroforestry. Through participatory technology development and transfer between farmer networks, integrated farming systems and methods of integrated pest management were developed by farmer groups using their indigenous knowledge. Integrated farming means trying to be self-sufficient through recycling resources and reusing the by-products of activities with plants and animals. Multi-functional water use is a key element of integration, so that integrated farming and multiple uses of water are two sides of the same coin. Farmer networks were also able to connect producers to markets. Farmer networks and government officials together are now creating Learning Centres for economic self-sufficiency to promote integrated farming.

A recent development in North-east Thailand is the provision of piped water from a large and deep bore-well, managed by local authorities as a district level government service. Users in the community pay a moderate fee for the connection and/or for water they use.

2.8.4 Project experiences

At community level, the CPWF-MUS project engaged the farmer networks. At national level, the networks have direct contacts with national government with respect to developing guidelines for rural development. Farmers' networks facilitate both farmer-to-farmer learning and interaction with national level and as such, they operate as an intermediate level organisation, between national and community level. CPWF-MUS provided scientific support in the negotiation process.

We investigated four groups of 20-40 farm households in four provinces of the North East: Buriram, Mahasarakam, Nakhon Ratchasima and Yasothon (Figure 2.13). Each group is a member of the large farmer's network. Individual farm households had already adopted integrated farming and as such were not representative of the average Thai farmer. A survey of five nearby farms who had not yet adopted integrated farming served as our control. The group in Mahasarakam acted as a single community in managing water in their watershed (e.g. by facilitating water trading within the group). Each household consisted of a couple, often with small children. The groups were formed by farmers to create eco-friendly farms for which water is a key natural resource. On their farms, they do this by integrated farming, as described above.

The groups evolved independently in areas with somewhat different resources. Within each group, there are some farms with a very low production and no sales and one or two farms with a relatively high monetary income. For the survey (in 2006) we asked each farm about characteristics of water and land sources, water use, income and wellbeing. We analysed the answers by group and for all the farms collectively. Tipraqsa et al. (2007) compared farms in North-east Thailand that adopted 'integrated farming' with conventional ones from the perspectives of productivity, biodiversity and social acceptability. The integrated farms were similar in size and productivity to those in our survey. Integrated farming included the introduction of farm ponds. The authors conclude that productivity of the land for food and produce for sale increased, as did the social acceptability of the system and its biodiversity.

Table 2.10. Case studies in Thailand: user-initiated innovation

Study area	Description of system	Number of users	Focus of study	References
Four farmer groups from provinces Buriram, Mahasarakam, Nakhon Ratchasima and Yasothon. **Regional farmer networks** and partners in learning alliance. Water management is predominantly household based.	Homestead farms use rainwater (roof harvesting, run-off into ponds) and public water when available (piped, canals) for all domestic purposes and integrated farming that includes vegetables, fish, rice and various other small livestock. Communities share information and provide small loans. Network partners share information; create learning centres to share integrated farming practices.	4 x 30 homesteads in our survey; over 100,000 households (2005) in the network.	Understanding the functioning of MUS in practice. Participation in the learning alliance by farmers and government agents.	Ruaysoongnern and Penning de Vries, 2005; Penning de Vries and Ruaysoongnern, 2009.

2.9 South Africa: Great policies and weak local implementation capacity

2.9.1 Country and general features

South Africa is the southern-most country on the African continent with an area of 1.2 million km^2 and a population of 47 million. A large part of the territory is taken up by the central highland (called the highveld), with a temperate climate, which slopes into the *karoo* and Kalahari semi-deserts to the West, and into the hot tropical lowveld in the East. The South-western tip around Cape Town enjoys a Mediterranean climate, while the coastal areas of KwaZulu Natal in the South East have a sub-tropical climate.

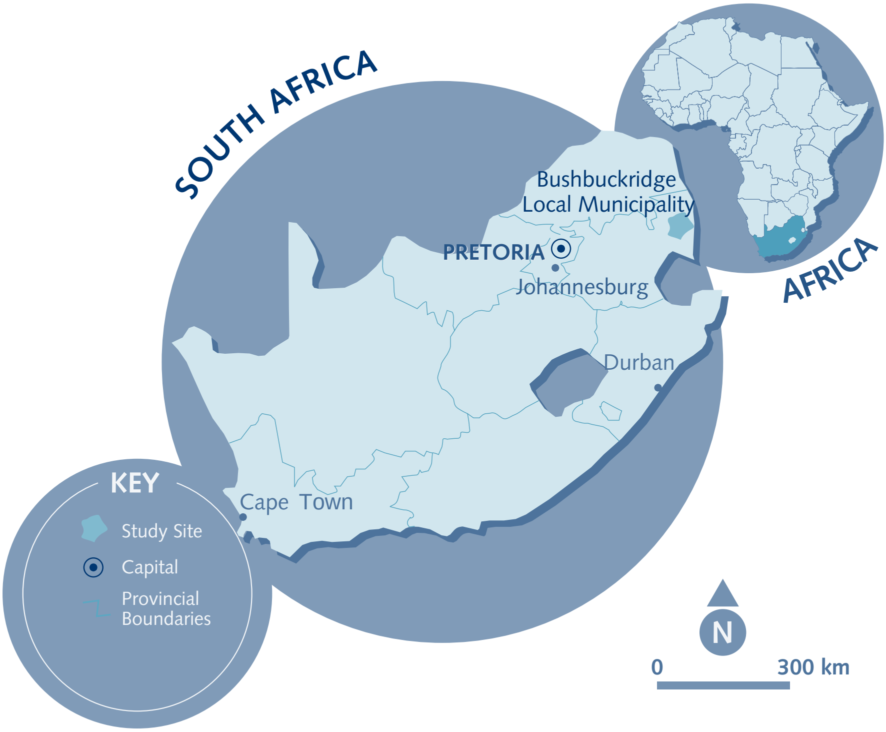


Figure 2.15. Map of South Africa, with Lesotho and Swaziland

Many demographic and economic aspects of South Africa can be traced back to the apartheid era, and the subsequent response after the 1994 democratic elections. It is a middle-income country (Table 2.2) with an important emerging market and is the economic powerhouse of the region. It has significant mineral resources (including gold and platinum), important industry, commercial agriculture and associated service sectors, like financing and transport, with modern infrastructure. Wealth is not equally spread amongst its population, as reflected in a high Gini coefficient of 57.8. Although there is an emerging black middle class, the majority of the black population still lives in poverty with lack of economic empowerment. An estimated 20% of the adult population lives with HIV/AIDS and the pandemic is a major constraint in development. Poverty alleviation, through basic services delivery and economic empowerment, is among the key strategies of government to redress this situation. For this, the government has relatively high budgets available when compared to neighbouring countries. These budgets are often spent at local level even though skills to implement policies efficiently are not always well developed there.

2.9.2 Water resources and development

The climate of the country is pre-dominantly temperate due to its mainly sub-tropical location and high elevation of the central plateau. Average rainfall is 495 mm/yr, ranging from less than 100 mm/yr in the western deserts to about 1,200 mm/yr in the eastern part of the country. Only 35% of the country has a precipitation of 500 mm/yr or more. The range of climates brings a very large biodiversity.

Per capita renewable water resources are 2,100 m^3/yr. Surface water sources are nearly fully developed and utilised, through small to large dams. Groundwater development has traditionally received less attention but is amply developed in valley and (dry) riverbeds.

In 2006, approximately 73% of rural and 92% of urban households had access to an improved domestic water source (WHO/UNICEF, 2006). Water-based sanitation is estimated at 46% and 70% for rural and urban populations. The development of water supply services is high on the political agenda, with national targets that are more ambitious than the Millennium Development Goals.

Irrigation is well developed by commercial farmers, and irrigated agriculture plays an important part in the rural economy, even though agriculture only accounts for 4% of GDP. Informal smaller-scale irrigation has traditionally been discouraged. Withdrawal of state subsidies for larger smallholder irrigation schemes after 1994 led to the (partial) collapse of these schemes. Currently, the government is trying to revitalise smallholder agriculture, including irrigation.

2.9.3 Water governance

Since the advent of democracy in 1994, South Africa is widely seen as having been a world leader in terms of policy and legislation. The constitution has been characterised as being on the 'leading edge', supporting a strongly decentralised state, with a strong focus on basic service delivery and poverty eradication. However, the huge structural imbalances left by apartheid between the industrialised cities and the impoverished rest of the country mean that the push to decentralisation has run into problems of implementation. Local government in South Africa was only established in 2000 and local government bodies are still developing their capacity. This results in a certain degree of confusion, high reliance on consultants, and often a low quality of decision-making and transparency. This is also the case in the water sector.

Water resources management in South Africa is laid out in the National Water Act (NWA) of 1998. Key elements include (i) decentralisation of implementation of water resources management to Water User Associations and Catchment Management Agencies (CMAs), which bring together representatives from the main sectors using water; and (ii) a system of water resources allocation which gives priority to basic human needs and to environmental water needs. Other water uses are allocated through a permit system, which entails a blanket permit for very small uses and allows specified quantities through general authorisations. By 2007, four CMAs had been established. As with other aspects of its policy and legislation, the arrangements for water management are ahead of South Africa's capacity to implement them. Moreover, there are risks that powerful elites capture these decentralised structures to the disadvantage of small-scale water users.

Water supply and sanitation services are regulated by the Water Services Act of 1997 and specified in the Strategic Framework for Water Services (DWAF, 2003). These delegate the Water Services Authority function to municipalities, which have ultimate responsibility for these services and are responsible for capital investments and for strategic planning. The actual service delivery, as specified in a Water Services Provider's (WSP) function, may be delegated to a utility, a private enterprise, or to community-based service providers, although communities rarely fulfil this function, even in rural areas, partly due to the complicated procedures for assigning the WSP function (Dlamini, 2007). Usually, local government provides services directly or appoints a utility. The role of community structures such as water committees is reduced to that of liaison between the community and local government.

At the same time, local government struggles to fulfil its WSP role, despite having relatively large budgets for investment in community programmes. The focus is on capital investment while the operation and sustainability of service delivery does not receive sufficient attention.

The role that water services for productive uses can play in poverty alleviation has been recognised since 2003, when the Strategic Framework for Water Services acknowledged the need to provide water services with a livelihoods focus by 'climbing the water ladder'. Efforts are underway to turn this policy into strategies for implementation.

Another attempt to link water services provision with broader development and poverty alleviation is through the Integrated Development Plan (IDP), one of the main planning instruments for local government. The use of IDPs is complemented by a drive towards cooperative governance, close integration and coordination between and within levels of government. In theory, this opens up space for integrated poverty alleviation approaches, including MUS. However, in this case too, capacity at local government to carry out policies to turn ideals into action is limited, and the quality of implementation remains poor.

2.9.4 Project experiences

The CPWF-MUS project in South Africa focused on the problems outlined above and on how to improve water services at a local level. It engaged with national stakeholders on the policy framework for multiple use, and specifically on how it can be implemented at local government level (Cousins and Smits, 2005 and 2006).

At community level, CPWF-MUS devoted most attention to Bushbuckridge, a former "homeland" as a designated area under the apartheid regime where people of an assumed specific ethnicity were supposed to have their own homeland. In practice, people were moved to such places by force from different parts of the country, and left to start up new livelihoods in new communities. Under apartheid, water services were developed in a haphazard and ad hoc way, if at all. Many overlapping and poorly functioning systems can be found, resulting in a relatively low coverage of services.

Bushbuckridge can be considered typical for many areas in South Africa. Although rural, it has a relatively high population density. The majority of the population lives in semi-rural villages with livelihoods characterised as peri-urban: with reliance on remittances and government grants, off-farm jobs in the formal and informal economies, mixed with small-scale agriculture and livestock rearing. There are a few smallholder irrigation schemes.

At this level, the NGO Association for Water and Rural Development (AWARD) worked with the Bushbuckridge Local Municipality and other decentralised agencies, such as the Provincial Department of Agriculture, to undertake a process of participatory planning for multiple-use services with communities, in a selected ward in the Municipality, originally Ward 16 – renumbered in 2008 as Ward 33. Specifically, it developed a participatory planning approach, dubbed SWELL (Securing Water to Enhance Local Livelihoods), which would align with the existing municipal planning procedures (the IDP), and develop capacity at decentralised and community level to engage in such processes (Figure 2.16). This work built on earlier activities by AWARD which also centred around strengthening local capacity to implement national policies. These include the WHiRL (Water, Households in Rural Livelihoods) project, in which the foundation of the SWELL methodology was developed along with a framework for looking at water in the broader context of human and environmental needs - see www.nri.org/whirl).

Figure 2.16. Joint planning to improve water services for domestic and animal needs in Bushbuckridge local municipality (photos: AWARD)

A second focus was on the Water for Food Movement. This grassroots movement, most active in South Africa and Lesotho, was inspired by MaTshepo Khumbane and aims at household food security among the poorest of the poor. Traditional values and indigenous knowledge are being revived and renewed to test and disseminate a range of technologies for improved land and water management around homesteads. Mobilising people to reflect on their experiences and people's empowerment for self-sufficiency are vital in the scaling up strategy. This homestead-based MUS model has found support at policy levels in the Department of Water Affairs and Forestry (DWAF), the Department of Agriculture, other government arms, NGOs and church organisations. Government has allocated subsidies for a roll-out programme for rainwater harvesting and run-off tanks across South Africa, for which a special implementation structure has been created.

Table 2.11. Case studies in South Africa: Integrating MUS into local government planning and user-initiated innovation (AWARD, 2007)

Study area	Description of system	Number of users	Focus of study	References
11 communities (Seville A, B and C, Thorndale, Hlalakahle, Gottenburgh, Delani, Hluvukani, Lephong, Dixie and Utah) of **Ward 16** of the **Bushbuckridge** Local Municipality	• Various groundwater piped distribution systems with few public standpipes • Multi-village surface water piped distribution system with few public standpipes • Village cattle dams • Household rainwater harvesting tanks • Private boreholes	30,000 inhabitants from 4,069 households. 158 households were surveyed	Assessment of current situation as input for Municipal Integrated Development Planning process	Pérez de Mendi-guren, 2004; Maluleke et al., 2005a, 2005b; Cousins et al., 2007a, 2007b.
Technology adopters in South Africa and Lesotho	Rainwater harvesting, run-off ponds, soil moisture retention, integrated farming and food processing	Estimated 150 adopters	Water for Food Movement social mobilisation and scaling up	De Lange and Penning de Vries, 2003

In Bushbuckridge the villagers defined their own indicators for wealth groups. Dependency on cash income and especially its reliability proved to be the most important indicators of wealth. A small fraction of the community was classified as rich and the majority as poor or very poor.

3 Models for homestead- and community-scale MUS

3.1 Introduction

In Chapter 1 we described the MUS conceptual framework, which will also structure the following analysis of the findings from the CPWF-MUS case studies. This chapter discusses results of how to implement MUS on the ground in communities and identifies generic MUS models at homestead- and community-scale. The framework indicates that in order to achieve successful implementation of MUS in communities, five principles need to be in place:

(i) people's multi-faceted livelihoods are the starting point,

(ii) appropriate technologies are used,

(iii) financing of multiple-use services is feasible,

(iv) for communal systems, organisational structures are in place to manage the system and fair rules, regulations to manage multiple uses are well defined and applied, and

(v) all this takes place within integrated water development and management at community-scale.

We analyse the case studies according to these principles in Sections 3.2 to 3.6. Further, we test the validity of the multiple-use water ladder discussed in Section 1.3, which links the first principle of livelihood benefits through water use and the four other principles which together determine water access. We also examine the evidence found in the light of our expectation that homestead-scale MUS is the most effective way of using water to contribute to the dimensions of wellbeing as stipulated in usual poverty definitions or the Millennium Development Goals.

3.2 Livelihoods-based services: Climbing the multiple-use water ladder

3.2.1 Livelihood benefits from homestead-scale MUS

When water use is promoted for more than one single use, a wider range of livelihood benefits can be expected. This was confirmed in the CPWF-MUS case studies. In addition to the domestic use of water, a range of productive water uses were found. These included:

- Water for growing plants: vegetables, staple foods like rice or maize, herbs, fruit trees, wood for fuel, fruit and trees for shade;
- Water for watering dairy cattle, camels, pigs, goats, poultry, ducks, frogs and for fish farming;

- Water for enterprises: coffee beans processing, butchery, beer brewing, ice-making, meals for small restaurant; brickmaking, pottery, mat making, and small enterprises of hair salons, laundry, car washing, etc.

Each use was an important factor in giving specific livelihood benefits. In this chapter we discuss the benefits that flowed from domestic uses and productive uses of water for food security and income, the relative importance of this income within the total household budget, and the various ways in which higher incomes were used to improve wellbeing. Water use also improves health, but can have some negative impacts in increasing the amount of labour household members undertake. This livelihood benefit analysis is largely qualitative with some rough quantified income estimates. There are also some indications whether and how MUS reaches the poor and women. These findings allow MUS to be evaluated in the light of the MDGs. In assessing livelihood benefits, no systematic differentiation was made according to service level.

Domestic water uses

Homestead-scale MUS meets domestic water needs. The importance of this hardly warrants further explanation. However, for comparison in water productivity assessments, one CPWF-MUS case study tried to express the value of domestic water uses in monetary terms. Tulu (2006) estimated water productivity in 57 water harvesting projects in Oromia and SNNP Regions of Ethiopia. He defined domestic use of water as the amount of water used for drinking, cooking, bathing, washing clothes and utensils, food processing, brewing, house construction and production of handicrafts, and he attributed economic values to these activities. He arrived at a productivity of domestic water of US$ 22 per cubic metre of water, much higher than the water productivities he estimated for crop and livestock production of US$ 0.8 and US$ 4.2 per cubic metre respectively.

Food and income

Among the array of benefits from productive water uses, the case studies found that increased household food security, income generation, and empowerment of women were the most common. Productive activities increased **household food security,** although the proportion of the households in the case study communities that grow (part of) their food or breed animals is quite variable.

Gardens in the study area in South Africa are mainly used to grow vegetables and legumes which otherwise would not be bought in such quantities, while raising small animals provides milk, eggs, and meat. In Thailand, food at homesteads provides an average of 30-50% of the food consumed in a household and includes fish and the staple food, paddy. The homestead is also a source of spices and herbs that are key ingredients of meals, befitting the concept of household self-sufficiency. In Chhatiwan and Senapuk, Nepal, villagers with irrigated homestead cultivation consume more food overall especially vegetables (interviewees estimated that their daily vegetable intake increased 4.5 fold). In Krishnapur, Nepal, the poorest households produce much of what they need for their own consumption; using water to increase vegetable production allows them to eat more vegetables than before.

Home-grown plant and animal products help household food security in two ways: they allow an increase in the daily energy and protein intake, and they allow the family to reduce expenditure on buying food.

The choice of productive activity for **income generation** depends on the local market, tradition, individual initiative, and a perceived need for an income (communities aiming at self-sufficiency, such as in North-east Thailand, may not give priority to a monetary income). However, the most profitable water-based activities, in terms of income per unit of water, are uncommon because there are often only few opportunities for such businesses in a community and they may require more capital and knowledge to start up.

Accompanying measures by agencies can significantly enhance incomes where markets, fertilizer, capital, etc., are a major constraint for developing productive uses of water. In Nepal, IDE/Winrock paid attention to access to markets, which is often complicated due to the topography and poor condition of roads, by creating marketing committees and collection centres. Some communities managed to market their produce better than others – in Senapuk labour scarcity and off-farm income allowed for the development of a village market. Thus, in the Nepal case study areas, farm families increased the annual income from vegetables by an average of US$ 225 in Chhatiwan and by US$ 199 in Senapuk.

In Thailand, it was found that integrated farming systems at homesteads, where multi-functional water use is a key element of the 'integration', outperform other farming systems in all four dimensions of a multifunctional agriculture: food security, environmental functions, economic functions, and social functions (Tipraqsa et al., 2007). This finding confirms that intensive integrated homestead cultivation, coupled with recycling water and nutrients, performs well in both economic and ecological terms.

The value of produce sold from the Thai farms varies from nil to US$ 1,000 per year with some farms, particularly those selling fish or rice, exceeding this value significantly. These case-study households derive between 10% and 90% of their cash income from homestead cultivation. However, the need for cash in the case of the many Thai farmers who practise self-sufficiency is low, and many households have off-farm income as well. This means that while water for productive purposes provides some households with a significant share of their income, for others it represents only a fraction of total family income. In a gross average, Thai integrated farmers save annually 20 kBaht (US$ 570) or some 15% of their income by growing food for self-consumption. When food is sold, it usually brings only a small amount of cash but about 10% of the farms obtain significant income from fish or from rice.

Figure 3.1 highlights the results of a study in four communities in the Municipality of Tiquipaya in peri-urban Cochabamba, Bolivia (Durán et al., 2004) where water-based activities, such as gardening and raising small livestock, are only the third and fourth most important sources of income of livelihoods in the community.

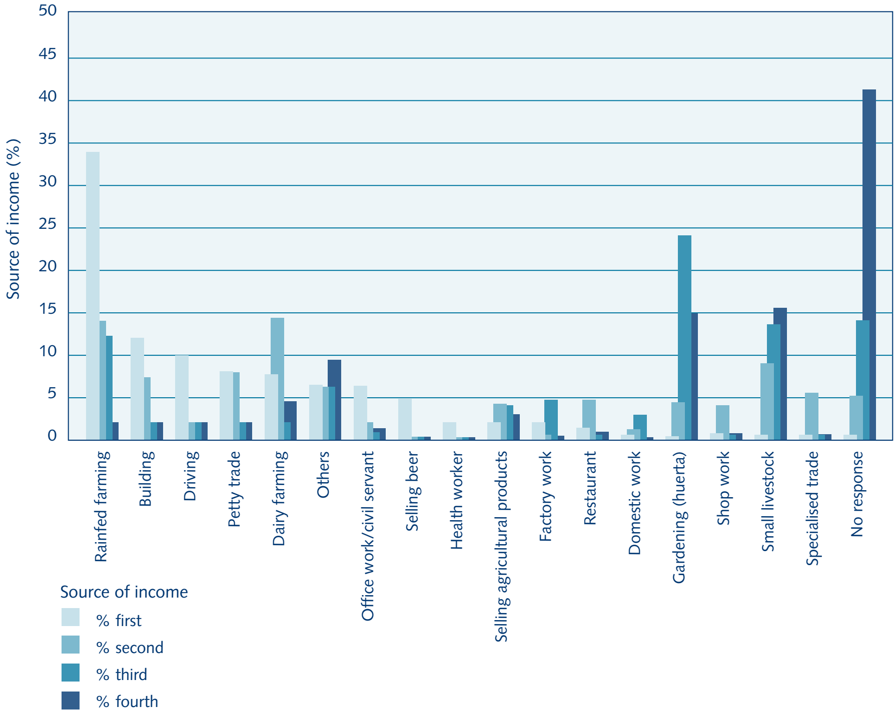


Figure 3.1. The relative importance of different livelihood activities for family income in Tiquipaya, Bolivia (Source: Durán et al., 2004)

Figure 3.2 shows that in the case study area in South Africa (where water supply is limited and unreliable), homestead gardening comes after formal employment, field-scale agriculture (rain-fed or irrigated) and even after grants as a source of income. (Cousins et al., 2007a).

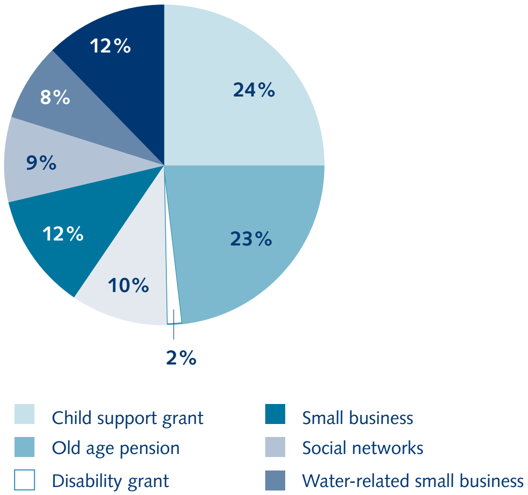


Figure 3.2. Sources of household income in Bushbuckridge, South Africa (Source: Cousins et al., 2007a)

One of the various indirect impacts of higher food security and income that were reported is debt repayment. Thai integrated farmers paid off light and moderate debts, acquired before they went into integrated farming, in 2-5 years. Those with heavier debts can cope by using more home-grown products and so reducing spending. Increased household income also avoids the need for future loans and the very high interest rates they attract. Households and communities also became more resilient. Homestead activities can be taken up easily and there is sufficient variety of activities for a flexible choice to be made according to the changing environment. Such resilience is especially important to mitigate economic and climatic adversities.

Heterogeneity: poverty, gender, and livelihood strategies
The figures above are averages across communities. For poor families homestead activities can still be the main cash earning activity. In Nepal, IDE/Winrock 'levelled the playing field' by providing the same volume of water to all households for domestic use and irrigation, with the greatest relative benefit to the poorest families, who achieved a relatively larger increase in their income, up to 50%. Some of the poorest families commented that prior to the project they frequently had to take large loans from their wealthier neighbours. Due to the income they receive from selling vegetables, they now need much smaller loans. This change makes them more independent and less indebted to the wealthy in the community. However, in other case studies, the wealthier benefited relatively more. In Kikwari, India, the productive use of water has not reduced the stratification of the community. The tribal groups did indeed benefit from water for productive uses and from improved access to domestic water, but the better-off part of the community did so too. In this case, increased access to water for productive uses benefited everyone, but those with more land or capital were able to benefit more. This implies that targeting remains critical to reach the poor and to contribute effectively to achieving the MDGs.

For the MDGs related to **gender**, the importance of homestead-scale MUS was clear: income generated through homestead-scale multiple water uses tends to be income for women, because water-related activities near the homestead are generally managed and carried out by women. In Colombia, for example, the rearing of poultry, and pigs and backyard gardening typically are the woman's responsibility while field-scale agriculture and larger livestock are the responsibility of men (Cinara, 2007a). In Lege Dini, Ethiopia, it is mainly the women who are responsible for milking livestock, which often provides one of the few sources of cash income. With improved water services, the animals yielded more milk, providing women with a higher income with less effort (Van Hoeve, 2004). In North-east Thailand growing vegetables and fish on the homesteads is carried out by men and women together. Most is used for family consumption, but women also sell some produce and can use the income as they see fit.

Empowerment of women through homestead-scale MUS can go further. In Kikwari, India, for example, women's groups have developed greater confidence and willingness to take up new projects and activities. In Ajo village in Lege Dini, Ethiopia, the increased milk production and the fact that women spent less time collecting water led to the development of a women's milk group (Van Hoeve, 2004). Intra-household relations may change as well. In Senapuk, Nepal, it was reported that men have started undertaking more domestic chores now that taps are closer to home.

Livelihood strategies

Even when the water supply allows for productive uses, not everyone takes up this opportunity to the same extent. Heterogeneity in livelihood strategies plays a role. In North-east Thailand, 85% of the rural farmers sell vegetables or other produce from their farms, but many sell only small quantities. In Colombia, the case studies show (Figure 3.3) that in the peri-urban communities of Golondrinas and Montebello only about 50% of the families use water for production, while 80-100% of families in rural villages do so.

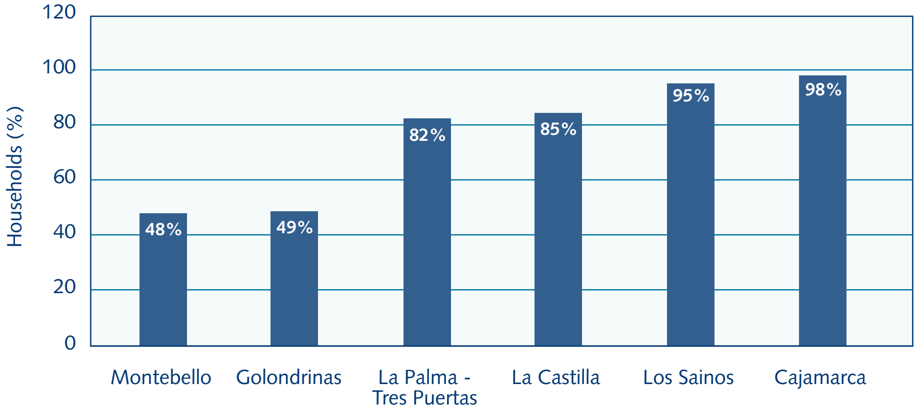


Figure 3.3. Percentage of population engaged in productive use of water from domestic systems in six population centres in Colombia

According to our survey in Zimbabwe, 20-40% of the respondents were engaged in some form of productive use of water that was provided for domestic use. However, access to water is a more important factor than a general livelihood strategy for influencing uptake of water for productive uses. In Ward 16 of Bushbuckridge, South Africa, only 36% of the households used water productively in some way, citing poor and unreliable access to water, next to lack of credit, as the reason for not doing so.

Water and health

Although the CPWF-MUS case studies did not assess changes in people's health, we have argued in Chapter 1 (1.2.2) that better access to water for domestic and productive use has the potential to raise health levels especially by enhancing hygiene and income for child care, reducing women's domestic chores and by opportunities to combat HIV/AIDS, malaria and other diseases. A small quantity of water (3 lpcd) must be of high quality for drinking. The other benefits flow as higher food security, income generation and women's empowerment positively influence nutrition and health and spending on health care. Making larger quantities of water available for hygiene is more important for improved health, e.g. to reduce water-washed diseases such as skin and eye infections, than water quality per se (Van der Hoek et al., 2002b). The use of larger quantities for such purposes can be stimulated as part of MUS. In IDE/Winrock's overall programmes in Nepal, for example, latrines were constructed in some of the villages as part of MUS.

The importance of general hygienic practices and sanitation was confirmed in Lege Dini, Ethiopia. A study by Ayalew et al. (2008) in three villages in Dire Dawa found high levels of both *Cryptosporidium* and *Giardia* but no significant difference in prevalence between children with access to protected and unprotected wells respectively.

For communities themselves, the quality of the small quantities of water used for drinking appeared less important than having larger water quantities for productive uses. This may affect water treatment technology options, as will be discussed later.

A negative health issue related to the higher quantities of water of MUS was the increase in breeding sites for vectors. In Senapuk, Nepal, greater productive use of water brought an increase in *Anopheles* mosquitoes and malaria as there were more pools of standing water around the village. In North-east Thailand an increase in dengue fever was observed in the 1980s when water storage in jars was first promoted. This was also due to increased breeding habitats for mosquitoes. Since these early days it has become common to place a mosquito net over jar tops, or to keep small fish in the jar, and the disease has become much less prominent (Vinnakota and Lam, 2006). Such simple measures or better drainage can be promoted to protect health. As was reported for malaria caused by irrigation systems, the improved crop production and income allows people to spend more on malaria prevention, so that in the end less disease may result (IJumba and Lindsay, 2001). Such overall balance is also likely with productive activities around homesteads.

In sum, CPWF-MUS found no evidence to undermine the hypothesis that MUS is a highly effective way to use water to contribute to all MDGs, provided MUS is well targeted to the poor. Taking measures to avoiding breeding sites for vectors, and to improve sanitation, hygiene education and accompanying measures can add to these livelihood benefits. However, establishing a definitive link between MUS and improved health would require long-term research looking at the homestead use of water and health outcomes.

3.2.2 Linking water use and access

Labour to access water

The next question is then: what determines people's uptake of water for domestic and productive uses and corresponding benefits? As hypothesised in Section 1.3.3, access to water at and around homesteads plays a most decisive role. The link between access to water and use is well known in the domestic sub-sector and underpins its efforts to provide for higher service levels. We suggested that access to water that exceeds the 20 lpcd basic domestic amount is increasingly used for productive purposes according to a multiple-use water ladder. Our case studies confirmed the link between access to water and the use of water for productive activities, even when quantities are below the basic domestic use limit.

Physical access to water is a matter of bringing sufficient water of the right quality to the right place (at and around homesteads) at the right time (year-round for domestic uses, with generally more flexibility for productive uses). Predictability and reliability of water supply are crucial for many aspects of livelihoods. For domestic consumption and for livestock a basic volume is needed every day. For most productive purposes, the duration and frequency of water supply should be predictable. If water has to be carried, labour is the constraining factor and depends on the distance between the water sources and points of use. As is well known in the domestic sub-sector (Caincross and Cliff, 1987), we also found that an inverse relationship between distance to source and water uses when water is collected and carried home. Scheelbeek (2005) observed in Legi Dini that the longer the distance for water collection the less water a family collects and uses (Figure 3.4).

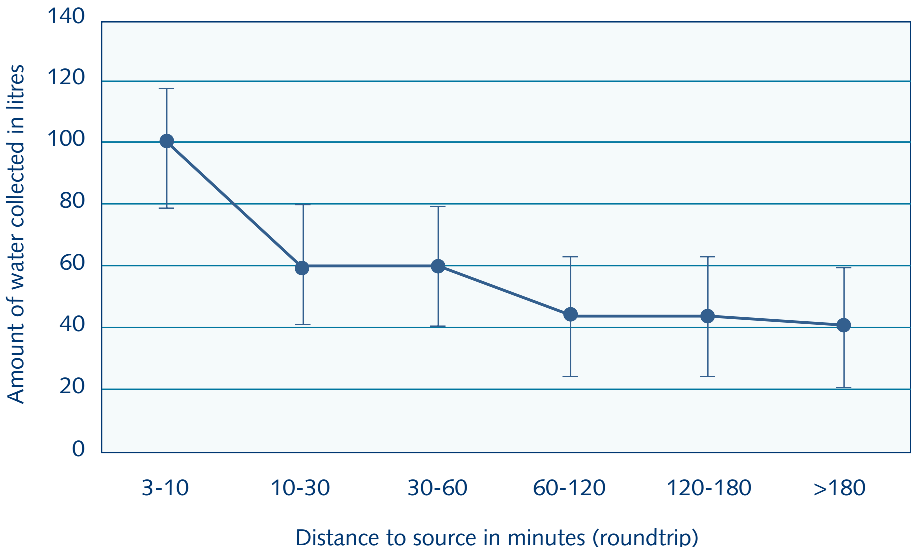


Figure 3.4. Volume of water collected by an average household as a function of distance to the source (Scheelbeek, 2005). The cut-off value at 40 litres corresponds to two jerry cans transported by a donkey; poor households without donkey collect less water. (Source: Ebato et al., 2008.)

The replacement of human labour by technology that brings water closer to the point of use strongly improves access to water, for multiple use as well as for domestic use. Observations in Zimbabwe confirm the relation between distance and volume collected and domestic and productive uses. Katsi (2006) measured household consumption for 140 respondents in three districts. Most respondents in Marondera and Murehwa consume over 70 litres per household per day whereas the majority in the UMP-district uses much less (Figure 3.5). In the UMP district 80% of respondents relied on communal single-access boreholes with handpumps ('bush' pumps), whereas up to 80% of users in the other two communities have homestead-based family wells.

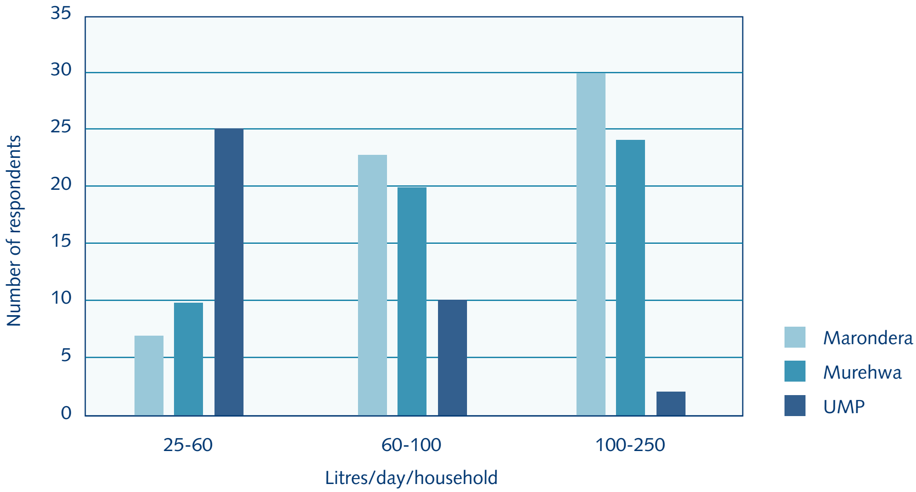


Figure 3.5. Average household consumption in three districts in Zimbabwe (Source: Katsi, 2006)

Improved access to multiple-use water near the homestead not only enables a greater use of water, but also improves livelihoods by alleviating the labour burden. In Senapuk and Chhatiwan (Nepal) 1.5-2.5 hours per working day were saved by women once water was available closer to home; time they now spend in irrigation and other activities. Their net labour time has remained the same or even has gone up, but as this is now productive time, they welcome the change. In Burak and Gorobiyo villages in Eastern Ethiopia, the time taken to collect water was reduced from 21 and 41 minutes to 11 and 18 minutes, respectively, which allowed women to fetch water whenever they needed it (Ebato et al., 2008).

The reverse is also true: the drudgery of collecting and carrying water impacts negatively on small entrepreneurs as shown in peri-urban Bhuj, India (Verhagen and Bhatt, 2006). The importance of ready access to water often becomes more evident when systems break down. When failure occurred in the Ajo system, Ethiopia, women needed much more time to fetch water and their health situation deteriorated (Jeths, 2006). In the study area in South Africa, because of unreliable water supplies, people either go to neighbouring villages themselves and spend a lot of time collecting water or hire someone to get it for them. Poor reliability reduced the uptake of productive water uses. As women and girls are disproportionately charged with fetching water, the reliability of supply affects them in particular. However, better water provision can also free (usually) boys and men from having to herd animals to distant water sources. These labour alleviation and time-saving benefits distinguish homestead-scale water use from productive water use elsewhere, and confirm that MUS are the most effective way of using water to contribute to the MDGs.

Technologies to access water

Technologies largely determine the distance between the water source and the point of use and can be seen as a proxy for access to water and service levels. In the following Table 3.1 we test the multiple-use water ladder by classifying findings on average water use and related technologies across the case studies according to the service levels defined. Note that most data refer to use from the main water supply system but that people may also be taking water from other sources. Note also that the numbers refer to the water that people actually use (unless indicated otherwise) and that significant losses, up to 50%, are common during transport in pipes and open systems.

Table 3.1. Technologies, water uses and multiple-use service levels in selected case studies

Site, case and type of system	Average use lpcd	Type of use	Level
Ethiopia			
Lege Dini: Groundwater-fed piped distribution systems with scattered public taps	7-17	Livestock (3 lpcd)* Domestic uses	Basic domestic
Eastern Harerghe: Handpump	7	Domestic uses**	Basic domestic
Tigray Adidaero: Handpump	8	Domestic uses**	Basic domestic
Bure district, Amhara: Spring and river	12	Domestic uses**	Basic domestic
Tigray: Ponds	30-65	• Irrigation • Livestock • Domestic uses	Basic-intermediate MUS
Nepal			
Chhatiwan: Surface water with piped distribution system with frequent domestic and irrigation taps	220 (design supply)	• Domestic uses (45 lpcd) • Irrigation (175 lpcd)	High level MUS
Krishnapur: Surface water with piped distribution systems with frequent domestic and irrigation taps and household storage	220 (design supply)	• Domestic uses (45 lpcd) • Irrigation (175 lpcd)	High level MUS
Senapuk: Surface water with two piped distribution systems with frequent domestic and irrigation taps	137 (design supply)	• Domestic uses (45 lpcd) • Irrigation (92 lpcd)	High level MUS

Site, case and type of system	Average use lpcd	Type of use	Level
Zimbabwe			
a.) Communal borehole with handpumps ('bush pump') b.) Individual shallow wells with windlass and buckets c.) Individual shallow wells with rope and washer pumps	a.) 10-15 b.) 60-70 c.) 80-90	a.) Domestic use, few cattle or community garden c.) Domestic uses and extensive homestead gardens	a.) Basic domestic b.) Intermediate MUS c.) Intermediate MUS
Bolivia			
Challacaba: Groundwater-fed distribution network with household connections	69-86	• Domestic uses (69 lpcd) • Livestock (17 lpcd)	Intermediate MUS
Chaupisuyo: a.) Boreholes b.) Gravity-fed system with household connections	a.) 57 b.) 90		Intermediate MUS
District 9 Cochabamba: a.) Tankers filling homestead tanks b.) Piped distribution systems	a.) 30-40 b.) 80		a.) Basic MUS b.) Intermediate MUS
Tiquipaya: Piped distribution systems with household connections, dug wells	125-140	• Domestic uses (75 lpcd) • Productive uses (50-65 lpcd)	High level MUS
India			
Kikwari: Groundwater-fed piped distribution system with household connections	40 (design supply new system)		Basic MUS
Samundi: Groundwater-fed piped distribution system with household connections	40 (design supply)		Basic MUS
Colombia			
Cajamarca and San Isidro: Surface water fed piped distribution systems with household connections	Gross supply: • "Domestic": 370 • Irrigation: 4,400		High level MUS

Site, case and type of system	Average use lpcd	Type of use	Level
El Chocho: Surface water fed piped distribution systems with household connections	Net supply: • La Castilla: 201 • Golondrinas: 243 Gross supply: • Villa del Rosario: 601 • Las Palmas: 676 • Golondrinas: 317 • Campoalegre: 169 • Montebello: 109		All high level MUS
La Palma-Tres Puertas: Surface water fed piped distribution system with household connections.	• 217 (gross average supply 317, so losses are around 30%) • 72% of the users consume 150-250		High level MUS
Los Sainos: Surface water fed piped distribution systems with household connections	191	• Domestic uses (73 lpcd) • Irrigation (90 lpcd) • Livestock (28 lpcd)	High level MUS
Thailand			
Farmer groups N.E. Thailand All sources combined: a.) Farms with ponds b.) Farms without ponds	a.) > 100 b.) 80-500	a.) and b.): Domestic uses (20-60 lpcd) Productive uses: Gardens (100-300 lpcd) Irrigation rice (>500 lpcd)	a.) High level MUS. b) Intermediate MUS
South Africa			
Bushbuckridge: Surface and ground water fed piped distribution systems with scattered standpipes	30	Productive uses (4 lpcd)	Basic MUS

* Water for livestock is expressed in terms of litres per *human* capita and can therefore seem low (e.g. when there are cattle but few people).

** Water used for irrigation from the same source is not included in the average use column.

These data confirm that the multiple-use water ladder fits reality significantly better than the ladder commonly used in the domestic sub-sector. Productive uses of water even start below the basic domestic service levels. With a very low average consumption of only 12 lpcd, as in Ethiopia, part of the water is given to livestock, especially for poultry and for young and lactating animals kept at the homestead (Figure 3.6) and less water is used for hygiene, (Van Hoeve, 2004; Scheelbeek, 2005). When water quantities increase, many more productive activities are taken up.

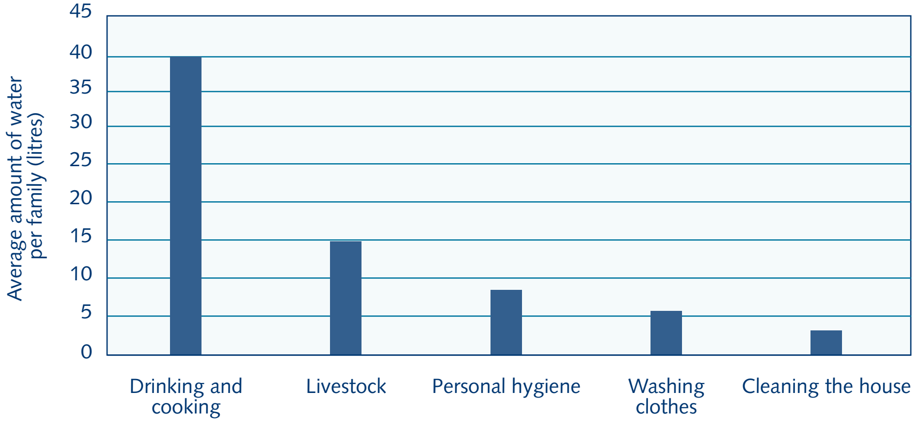


Figure 3.6. Water use for domestic purposes in Lege Dini. Average family size: 5.9 persons (Source: Scheelbeek, 2005)

Other studies have also started validating and using the multiple-use water ladder and redefined service levels accordingly (Renwick et al., 2007).

3.2.3 Conclusions: Livelihoods as driver of MUS

Multiple water uses has the potential to enhance health (through drinking, washing, bathing, hygiene), food security, animal health, cash generation, women's empowerment and alleviate domestic chores or cattle herding to water points. These direct benefits bring other benefits. Integrated farming with re-use of water and nutrients around homesteads performs well and allows intensification of production. The diversity of homestead-scale productive activities strengthens flexibility and resilience. These benefits are all envisaged in multi-dimensional definitions of wellbeing and gender equity in the Millennium Development Goals. Evidence from CPWF-MUS confirms the hypothesis that homestead-scale MUS that reaches the poor is the most effective way to use water to contribute to all the MDGs.

Livelihood benefits are augmented when steps are taken to prevent mosquitoes and other vectors breeding near homesteads, when hygiene and sanitation measures are taken, and when training is given or market linkages are strengthened.

Whenever people in the case studies have access to water at or sufficiently near to homesteads, significant proportions of them use it for domestic and productive uses, even if they have very low access levels, below basic domestic needs. There is some evidence that the proportion of people taking up productive water uses is higher in rural areas than peri-urban areas. Reliability of access is the determining factor, rather than whether services are planned for multiple uses or not.

The linkages between service levels and water use can be summarised in the multiple-use water ladder below; this is based on empirical findings from CPWF-MUS and Renwick et al., 2007. This ladder reflects reality to a much better extent than the ladder commonly used in the domestic sub-sector. One can use the multiple-use water ladder for the same policy aims as the domestic sub-sector one is used, i.e. to set targets for service levels. Doing so implies that policies that seek to enable significant productive water uses should try to achieve intermediate or high-level MUS, by providing 50-100 lpcd or more. This implies at least doubling or tripling service levels from those determined for basic domestic needs.

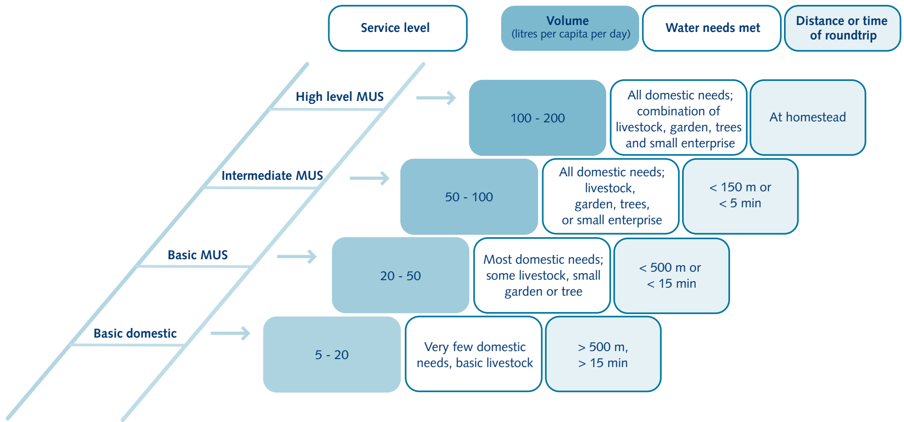


Figure 3.7. The multiple-use water ladder of service levels and water uses (Van Koppen and Hussain, 2007; Renwick et al., 2007)

3.3 Appropriate technologies

3.3.1 Introduction

As already seen in Table 3.1, different technologies have the capacity to provide different levels of water services. The case studies demonstrated a broad range of technologies in various combinations to provide water for MUS. In this section we assess the potential of these technologies to facilitate multiple use of water. We first look at homestead-based technologies, followed by communal systems with single access points, and finally communal systems with a distribution network. A specific section is dedicated to water treatment technologies, which can be applied both in individual and communal systems.

Knowledge of and expertise in the technology, production processes and marketing are requirements for successful productive activity. Part of the process of promoting multiple uses of water therefore includes training, demonstrations, and some means of connecting local communities to markets for their products. Water users need information to manage multiple water use services and to practise integrated farming ('how much water is needed and when?') and higher levels of knowledge because the systems are more complex. An important part of why the farmer networks in North-east Thailand are highly successful is that they have created Learning Centres where men and women come to learn what to do and how to do it. And although the farmer networks share their traditional knowledge, they also need new knowledge to make full use of new technologies: (power pumps, electricity, organic farming), new commodities (new rice varieties, mushrooms, frogs, etc.) and connections to new markets.

3.3.2 Individual homestead-based technologies

Homestead-based technologies have a high potential for providing intermediate levels of MUS. Homestead-based options that allow a range of multiple uses include shallow wells, boreholes, ponds that store run-off water, and roofwater harvesting as well as the lifting devices and storage facilities. Generally, there is no need to share water with others, except for emergencies and basic drinking needs. In some cases, households sell water.

Shallow wells: Shallow wells are widespread. In Zimbabwe, even though shallow wells were not developed with productive uses in mind, they were sufficiently flexible to allow for productive uses. One risk is that pollution can enter the groundwater and contaminate shallow wells (Shortt et al., 2003). Drinking water and water for cooking should either be treated or taken from a cleaner source.

Lifting devices for shallow wells: Water for household uses can be obtained with a windlass and bucket but the lifting capacity generally limits productive uses. The capacity of wells has been boosted by lifting devices such as rope pumps (Guzha et al., 2007), which not only provide more water, but also significantly reduce the time spent on lifting water and applying it to the field. Katsi (2006) reported that the time needed for watering plots fell from eight hours to less than three hours in Marondera district when water was obtained from a family well with a rope pump. WSP (2004) reports that adding cheap lifting devices to family wells in Zimbabwe allows the farmer to increase the land under cultivation and to multiply income by a factor of eight. Easier access has been at the basis of the rapid take up of the rope pump in Nicaragua, the country where it was first introduced (Alberts and Van der Zee, 2004).

Homestead options are often better maintained as this is not a shared task for a shared asset, but an individual responsibility for an asset prized by the household. In a survey of all rural water supply systems in Zimbabwe it was found that household options, such as family wells, are much more sustainable than communal boreholes or deep wells with handpumps. Of the 26,745 boreholes and deep wells in rural areas 11,506 (43%) were non-functional (UNICEF/NAC, 2006). Of 112,785 family wells, only 15,844 (14%) were non-functional. The fact that family wells allow for greater productive use than the communal handpumps is one explanation. Family wells are closer to the homestead so people can make more use of them, they are easier and cheaper to maintain, and there is often a greater sense of ownership by the users than in community managed systems, and fewer problems with the shared management of a community property.

Another lifting device used for shallow groundwater is the treadle pump, which can lift water 3-5 m from wells or surface water (Kay and Brabben, 2000). Since farmers with a larger income usually buy powered pumps, treadle pump are said to 'self-select' poor households (Penning de Vries and Bossio, 2006; Adeoti et al., 2007). However, treadle pumps are normally used for productive, not domestic uses.

Figure 3.8. A treadle pump from the NGO IDE in a wetland near Lusaka, Zambia (photo: Frits Penning de Vries)

Another technology used at individual homesteads (or fields) is rainwater harvesting. A distinction is made between 1) in-field rainwater harvesting with storage in ponds; 2) rainwater harvesting with storage in fields and 3) rooftop water harvesting.

Harvesting of rainwater or run-off and its storage in ponds: Run-off from largely impervious surfaces is collected and stored in ponds, from where it can be extracted using simple lifting devices. (Run-off is sometimes known as "run-on" when it comes from neighbouring land.) Water can be used for productive activities as well as some domestic ones, although using such water for drinking is often not possible without treatment (filtering or boiling). In the areas where CPWF worked, construction of farm ponds of 50-500 m^3 was promoted at a national scale in Ethiopia (Awulachew et al., 2005) and in Thailand (Ruaysoongnern and Penning de Vries, 2005). Water in such farm ponds is sufficient to irrigate a garden or vegetable plot for several months but not adequate to irrigate large fields.

Figure 3.9. A farm pond in Tigray, Ethiopia (left), and one in N.E. Thailand (right) (photos: Eline Boelee and Frits Penning de Vries)

The siting of ponds is crucial. In Tigray, homestead ponds were sometimes located too far from the homestead to be of use for homestead production. In addition, for many ponds the run-off was insufficient or water loss through seepage was too rapid. As a result, a large number of the ponds did not fill but nearly all the ponds that did fill are in use (Table 3.2). Where they were successful, respondents were able to develop or expand home gardens and provide irrigation water during dry spells in the rainy season and even to extend the growing season into the dry season. Some farmers used the water for their staple cereal crop (Lemma Hagos, 2005). The ponds can also be used for fish farming.

Table 3.2. Performance of homestead ponds in three woredas in Tigray (Lemma Hagos, 2005, after BoANR, 2003)

Woreda	Ponds	Ponds filled	Ponds used
Hintalo Wajerate	2,450	1,029	1,003
Kilte Awlaelo	1,945	564	564
Atsbi Womberta	2,109	350	350
Total	6,504	1,943	1,917

Ponds often lose water through downwards and sideways leakage and through evaporation and generally have only little water left when the next rainy season starts. Farmers can take steps to minimise the loss of water by adding sediments to form a clay seal on the bottom and to make the water more turbulent. Evaporation can be reduced with windbreaks and by creating shade. In North-east Thailand, many ponds and water channels developed in the 1980s did not hold or carry water sufficiently long to be useful, but this has improved with the ponds created more recently.

Harvesting of rainwater and run-off and storage in soil: This is known as 'green water' and is a traditional technique in many countries, related to water management at homesteads and extensively documented (WOCAT, 2008). Individuals from many countries have developed rainwater harvesting on their farms and developed a profitable enterprise (Witoshynsky, 2000; Mati and Penning de Vries, 2005; Kahinda et al., 2007), however it is labour demanding and the volume harvested annually is not fully predictable. Figure 3.10 presents the layout of a garden where infiltration is maximised by prevention of leakage, storage of water in tanks and roofwater harvesting to increase the yield. This model homestead farm of the Water for Food Movement in South Africa provides vegetables and maize for household food security. It can therefore be considered a relevant complementary source of water in MUS.

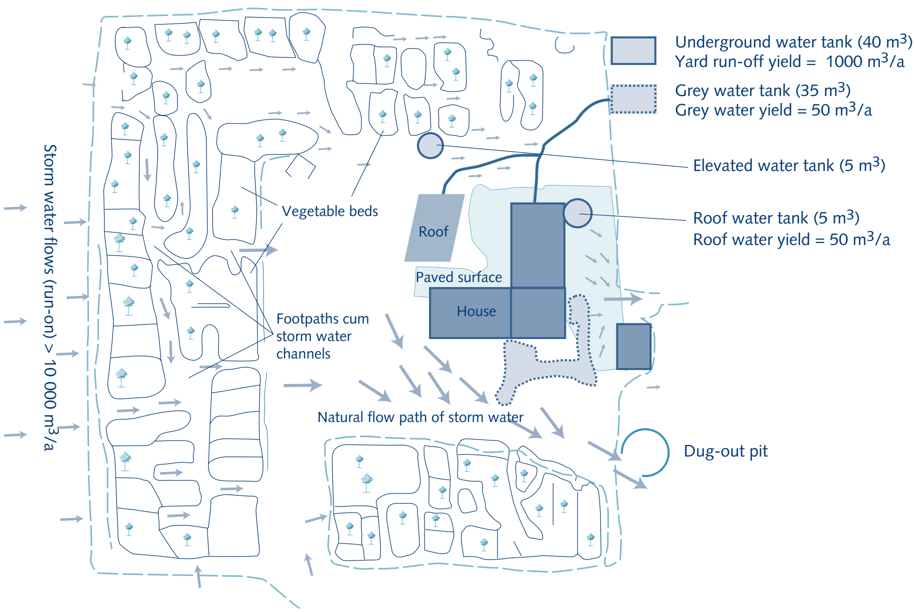


Figure 3.10. The layout of the farm of Mma Tshepo Khumbane, Cullinan, South Africa shows how run-off water flows and infiltrates in her garden (Source: De Lange and Penning de Vries, 2003)

Roof rainwater harvesting: Rainwater harvesting refers to the capturing of water from roofs, and storage, e.g. in one or more jars with a typical capacity of 1 m^3 or more, as seen in Thailand, or in large cellars underground, as seen in Ethiopia, Latin America and Morocco. The quality of the water is often good and sometimes preferred for drinking over all other sources, including for example in the study areas in Thailand.

The amount available for use depends largely on the storage capacity of the tanks. Often, the capacity of the storage vessels is such that it allows families to bridge the dry season for domestic water needs but is not adequate for watering gardens throughout the dry season. This is often the case, for example, in Zimbabwe (Guzha et al., 2007). Roofwater can thus be a valuable part of the domestic water supply but mostly cannot support productive uses on its own. As a component of multiple-use systems, it can be one source of high quality water.

Field application technologies: In some cases, in India, Zimbabwe, and Nepal, field application technologies, such as drip kits or sprinklers, were used. These are often promoted with a view towards making water use more efficient, managing small amounts of water, and reducing labour time. However, these met with differing degrees of success. In Zimbabwe, drip kits were only used when water was scarce but abandoned when water was plentiful as they require more labour. The same was found in Nepal, where farmers found using a garden hose easier in villages without an urgent need to save water, but this changed in the dry season, when water got more scarce. In Thailand, farmers experimented with their own design of sprinklers made from local materials and prefer these over drip kits that were considered too vulnerable to clogging and damage. In Lege Dini, Ethiopia, too farmers developed their brand of drip irrigation, by punching small holes in oil tins, and putting these next to papaya trees. These tins were filled with household wastewater that had been used for bathing or washing utensils (Scheelbeek, 2005).

Re-use of water was practised in a number of countries, as a way to save water and nutrients. Farmers in North-east Thailand recognise that recycling water and nutrients is important. Grey water goes to vegetables and sometimes to fruit trees. In Kikwari, India, the community capture their wastewater, filter it and use it on a communal agricultural plot. This practice is an important complementary technology in multiple-use services. A particular form of wastewater use from kitchens is reported from Kenya. A 25 L or 50 L standard bag is filled with soil and irrigated from the top; vegetables are planted in 15-25 small holes made in the sides (Figure 3.11). This is an interesting approach when space (also in cities) is scarce. In other countries, some vegetables are grown like flower plants in hanging pots near the house and given household waste water. Despite these interesting examples, very few households were practising reuse of grey water. The practice was notably missing where people have piped systems, despite more grey water usually being generated.

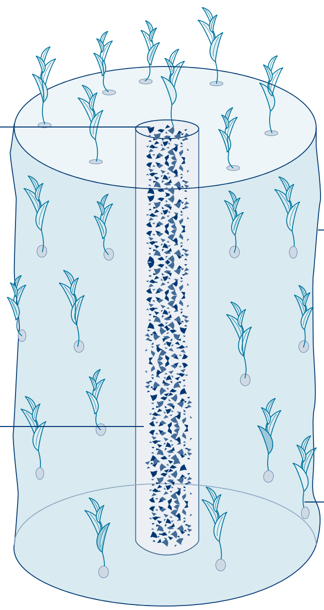


Figure 3.11. A bag with soil and a central drainage column serves as a micro-garden for vegetables. It can be drip-irrigated with kitchen waste water. (Source: Mati and Penning de Vries, 2005)

3.3.3 Communal systems with single access points

Three types of communal MUS water systems are distinguished: (i) systems with a single access point, (ii) systems with a distribution network to standpipes, and (iii) communal systems with a distribution network to homesteads or fields. This distinction is made as the distance between the access point and the point of use has an important influence on the amount of water people can use. This section will look into systems with single access points, i.e. systems where water is accessed at the same place as the source, such as for example a borehole or well with a communal handpump or village ponds.

Boreholes or wells: Groundwater extraction from boreholes or wells provides access to deep groundwater, which tends to be a more stable source than shallow groundwater as it is less affected by seasonal variations. However, care must be taken that the extraction rate is below the natural replenishment rate. Communal wells and boreholes have limited potential for productive use of water at homesteads when the distance between the source and the homesteads is large and users need to carry water over long distances.

Handpumps or motorised pumps:

In addition to the limitation of distance and sharing of communal boreholes and wells, there may be limitations due to the lifting device. While it is well known that water can be drawn from depths of more than 50 m with handpumps by human or animal power, this takes a lot of effort. Even at shallower depths, the amount of water people extract with handpumps tends to be limited and this in turn tends to limit water for domestic use and animal watering. Such a situation was found in Samundi, India, before the project intervention, when the discharge from the community handpump was so low that it took two round trips of 2-3 hours to get enough water to satisfy just the household domestic needs.

To supply water at intermediate or high-level MUS from a borehole requires a motorised pump. In many cases, the capacity of the borehole plus pump is more than adequate for a homestead, so that opportunities for sharing and community use exist. In such cases, the discharge is often higher than what can be used immediately, and water storage facilities or a distribution system are needed. That would take the technology to another level (to be discussed in the next section). An example was found in Challacaba, Bolivia, where a simple well and handpump system was upgraded with a motorised pump and a piped distribution system. However, motorised pumps may be beyond the capacity of users, and maintenance may be problematic as was found in Lege Dini, Ethiopia (Scheelbeek, 2005, and Jeths, 2006). Investments are relatively high and groundwater is not always sufficient.

'Add-ons' to single access points, such as cattle troughs and washing slabs and cattle entry-points facilitate access for multiple uses. Washing slabs next to water points in Lege Dini, Ethiopia, were appreciated by the women. Water can also be used productively in communal gardens near the access point. Add-ons need to be well targeted. In Zimbabwe, cattle troughs used to be provided at each bush pump, irrespective of whether users had cattle or not. As this was not the case in all villages, many troughs were not used or well maintained. This underlines the need to take into account diversity in livelihoods and water use. In Asgherkiss, Morocco, the users of a small reservoir designed and constructed special smaller troughs for sheep and goats and larger ones for cattle.

Small village reservoirs: These constitute a second single access point technology, often constructed at the level of one or more communities. Large cascading tank irrigation systems have been part of the water infrastructure for domestic and productive uses for centuries (Ranganathan and Palanisami, 2004). In countries as varied as Brazil, Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, India, Kenya, Mauretania, Nigeria, Morocco, Sri Lanka, Tunisia, Yemen and Zimbabwe, small dams have been constructed for many decades and are still being built, serving the needs of livestock, farmers and household water users, and recharging groundwater. While these small reservoirs may originally have been planned for one purpose, such as livestock watering in Zimbabwe and northern Burkina Faso or irrigation in Brazil, most are community-managed facilities used for many purposes, including fisheries, brickmaking and drinking (CPWF-SRP, 2008). In CPWF-MUS we didn't study these in detail, but more information can be found in CPWF-SRP (2008).

3.3.4 Communal systems with distribution networks

Communal systems with standpipes: Standpipes generally bring water closer to users than single access points, as standpipes are shared by a number of neighbours. Actual use depends to a large extent on distance between watering point and site of use. In Lege Dini, Ethiopia, there are only very few standpipes and users still spend a lot of time queuing and walking to fetch water. In Ward 16 of Bushbuckridge, functioning taps are widely spread. Such systems cannot provide enough water for more than basic MUS and act similarly to single access point systems. Systems with many standpipes, with a small average distance between the tap and homestead, are more amenable for productive use at the homestead. Distance was taken into consideration as an important design criterion in the hybrid systems in Nepal: points for irrigation and domestic use were placed at convenient locations in relation to fields and homesteads, allowing for high-level MUS.

Figure 3.12. Two off-takes at a standpipe in Nepal (photo: Bimala Colavito)

Communal systems with distribution networks to homesteads: Such communal systems hold most promise for multiple uses of water. In these systems, generally, water moves through pipes into the homesteads or to yards where it becomes available for use. All household connections in our CPWF-MUS allowed intermediate- or high-level MUS, except in Maharashtra, where design norms were fixed at basic MUS levels. Piped gravity systems with household connections fed by sufficient water resources from mountain streams, as in Colombia, easily provided over 100 lpcd at very limited cost.

However, in communal systems with household connections, equitable sharing of water becomes a concern, and may be jeopardised for various reasons. Poor design of the network, particularly in mountainous regions with large height differences, can lead to inefficient distribution and use of water, as in La Castilla in the El Chocho catchment, (Sánchez et al., 2003). In Lege Dini one of the reservoirs was not high enough to provide pressure to reach all standpipes in one village, so that local people had to walk to another village (Jeths, 2006). In study areas in Nepal pressure regulators were installed to ensure that households received equal shares of water despite large variations in elevation.

In flat areas, an elevated storage tank is often used to maintain pressure in a piped system. An interesting technological innovation in Bolivia is the hydro-pneumatic tower as in Challacaba and Chaupisuyo. This creates a constant head of water of up to 45 m in a piped system, reducing the need to build overhead tanks for storage and pressure (Plastiforte, 2007). The hydro-pneumatic tower uses sensors and interconnected electrical pumps and costs are a fraction of those of conventional overhead tanks.

A second risk for equitable water distribution lies in the fact that with increased access to water, differentiated demand may develop. While domestic water uses are universal, variation in use is much larger for productive water uses, particularly at the higher end of the spectrum. This is related to the nature of water-dependent activities (e.g. cultivation), compared with those that require less water (e.g. hair salons). Water use is also proportionate to the size of the enterprise, varying for example with the extent of land being irrigated. Larger water users may deprive other users. This can be counteracted through management rules (see Section 3.5.3) or through technical measures, which we discuss here. Equitable allocation can also be hardwired into the design. In Nepal, IDE/Winrock applied the equal-portion rule that was commonly used in domestic systems even for the productive portion of the supply. All households received the same quantity of water, bringing the greatest benefit to the poorest households.

In Kikwari, India, the system was a mix of household connections and public standposts. Those with household connections consumed a lot of water that caused pressure to drop for other users and led to conflicts. After upgrading the system, all households got direct connections with limited diameters. Those with larger household connections from the earlier system were forced to restrict the diameter of their pipes to cap water use.

Another technical aspect relevant for communal systems for multiple uses is the need to prioritise domestic uses before larger-scale productive uses are allowed. In Senapuk, Nepal, the priority for domestic water uses over irrigation was hardwired in the technical design. Its hybrid system captures water from a spring that has only a limited discharge. It was decided to meet domestic demands first and allow only surplus water to be used for irrigation. In this system, water flows first into a distribution tank which feeds into a domestic distribution pipeline (Figure 3.13). The surplus water flows into another distribution tank and into a piped distribution system for irrigation. The high visibility of different water uses from this two-tank two-distribution line system makes compliance easier. In designs with one tank and one distribution system, productive uses are forbidden once the storage falls to a certain minimum level and water is only delivered intermittently.

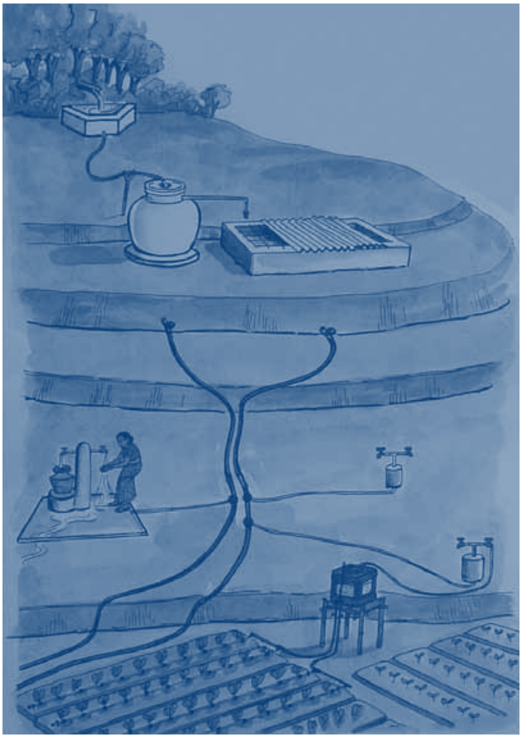


Figure 3.13. Drawing showing how the priority for domestic uses is handwired into a multiple-use system in Senapuk (Source: Mikhail et al., 2008)

Open canal systems: Another type of distribution system is the (large) open canal systems used for irrigation in arid and semi-arid countries like Pakistan and Morocco. These often provide the only source of water for all uses in their areas and the water is used for productive and domestic purposes, including drinking (Boelee et al., 2007). Washing steps, cattle entry points and bridges facilitate access at various points in the community. This practice has been widely studied, but we didn't include any such case studies in the CPWF-MUS project.

Homestead storage devices in distribution networks: Homestead storage devices are often used in combination with rainwater storage, gravity-fed streams or piped water and include: barrels, buckets, jars and tanks. These can go with any of the technologies mentioned. In Chhatiwan, Nepal, for example, 200 L drums were used. Together with standpipes close to homesteads, the women saved up to 2.5 hours per day in water collection. In Krishnapur, Nepal, an important step in upgrading the water situation consisted of improving on-farm storage capacity through Thai-type jars of 1–1.5 m^3 (Figure 3.14) On-farm storage allows each household to fine-tune timing of irrigation. In Morocco, rainwater storage tanks were adapted to store irrigation water when large-scale irrigation systems were built, bringing more water closer to villages and households for livestock and domestic purposes (Laamrani et al., 2000; Boelee and Laamrani, 2004).

Figure 3.14. Modified Thai jars for on-farm storage of piped water in Krishnapur, Nepal Such jars are used for roofwater harvesting in North-east Thailand (photo: Ryan Yoder)

A large storage capacity, however, may also bring drawbacks when filled from a communal system as it may allow hoarding, to the disadvantage of others. In Utah village, South Africa, when users filled rainwater harvesting tanks with water from the main domestic system, this left other villages without any water. In La Palma-Tres Puertas, Colombia, individual households started building household storage tanks to deal with the infrequent supply. The total number of these became so large and some were so big (one doubles up as the base for a bar-discotheque) (Figure 3.15) that when water came, it would only fill the tanks of those who had built their own household storage.

Figure 3.15. An excessively large household storage tank with a bar-discotheque on top in La Palma-Tres Puertas (Source: CPWF-MUS project)

The importance of storage becomes clear, when it is not available. In district 9 of Cochabamba, lack of barrels to fill with tanker water is one of the main factors for the limited engagement with productive activities by users who rely on tanker systems. Not having storage capacity in South Africa was found to increase people's vulnerability (Maluleke, 2007).

3.3.5 Water treatment technologies

Another group of technologies is related to the treatment of water, mainly to achieve drinking water quality for at least 3 lpcd in multiple-use systems. Obtaining such quality is a concern in surface water systems and in open unprotected groundwater wells. The case studies highlighted the following (combinations of) technological options that operate at different scales.

Protecting the spring or source: Building a protection box or screen around the spring with a hygienic outlet is possible when there is a clearly defined spring and was done in all Nepal cases and at various springs in Eastern Ethiopia (Scheelbeek 2005, Ebato 2008). Proper protection may reduce the need to treat relatively clean surface water sources.

Central treatment of water: Central treatment is the approach followed in most urban areas where water of drinking quality is delivered to all houses. This is also the most common approach in rural communities that rely on surface water systems, such as those in Colombia. However, treatment plants at the beginning of a piped system limit easy access to larger quantities of water and may limit multiple use. As people prefer larger quantities over higher-quality water, they may construct new pipes to bypass the plant. In La Castilla (Colombia), the municipality's Health Secretary wanted to build a treatment plant and to forbid the use of water for irrigation. The community rejected the entire plan (Sánchez et al., 2003).

Users trust that water is potable and drink it without boiling. However, not all treatment systems work well. In addition, re-contamination may occur after treatment, and the handling of water in the household may be unhygienic. In Lege Dini, Ethiopia, water from a clean source (e.g. a borehole in Ajo or a protected spring in Kora) became as contaminated in the containers used to carry it as water from surface water sources (Scheelbeek, 2005). Chlorination of community systems is often promoted, even in groundwater-fed systems, such as in Kikwari, India. However, chlorinated water has low acceptability to users. Moreover, as in various communities in Colombia, users don't want to spend money on chlorinating all their water, when only a fraction is for drinking or cooking.

Partial central treatment with separate distribution systems: It is possible to treat part of the water centrally and distribute treated and untreated water through separate distribution systems. We encountered several examples in our case studies. One community in Colombia, with a predominant indigenous population, was more interested in getting water for irrigation than high-quality domestic water. However, the drinking water project didn't want users to use this expensively treated water for such things as irrigation. In the end, as a compromise, a shared intake from the surface water source was developed with two distribution systems, one for treated drinking water and one for untreated irrigation water to the fields. Obviously, such a system is relatively expensive. In Adidaero, Ethiopia, a comparable low cost system was constructed. Water from the diversion dam is split after some hundred metres into a surface irrigation canal and an underground horizontal filtration gallery (Figure 3.16). The filtered water enters a storage facility with a handpump.

Figure 3.16. Filtration gallery for drinking water (right) in the multi-purpose system in Adidaero, Ethiopia: the underground canal from the diversion dam splits into an irrigation canal (left) and the filtration gallery (photo: Eline Boelee)

Household-level treatment: Home treatment can improve water quality for drinking, cooking and hygiene at the point of use, where it is most needed (Clasen and Cairncross, 2004). Moreover, even water in domestic systems, e.g. from deep boreholes, may get polluted during collection, transport and storage, leading to deterioration of water quality (Jensen et al., 2002; Scheelbeek, 2005; Guchi 2007; Million, 2008), so home water treatment is crucial for health and hygiene (Mintz et al., 1995; Clasen and Bastable, 2003). Going up the water service ladder, home water treatment can be extended from low quantities for drinking to include water required for cooking and hygiene (especially handwashing). The advantage of household-level treatment is that expensive central treatment of a large amount of water is not necessary, but only local treatment of the small fraction that is actually drunk. This opens the door to a wide variety of multiple-use water services from a range of water sources. Once home water treatment has become standard practice, water quality at the source becomes less important.

In Yubdo Legebatu, Ethiopia, a huge improvement in drinking water quality was achieved by storing water from springs and rivers at the household in 40 L jars of baked clay with a sand filter and gravel inside (Figure 3.17). The jars provided water treatment, kept the water cool and prevented recontamination through the addition of a user-friendly plastic hose. Repeated water quality analysis showed that the water from these pots had 93-99.7% fewer coliform bacteria and 81.9-99.4% less turbidity than open water sources that were polluted by human and animal faecal matter (Guchi, 2007). They cost about US$ 5 and give cool and clean water in an easy way (Boelee et al., 2008).

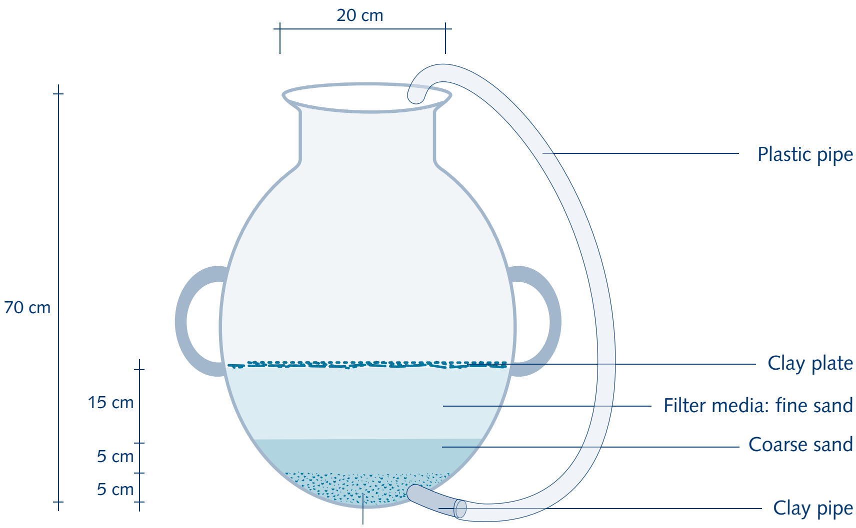


Figure 3.17. Schematic drawing of water storage jar (50 litres) with sand filter and plastic pipe as designed by Abiye Astatke for Yubdo Legebatu, Ethiopia (Source: Guchi, 2007)

However, there are risks related to household-level treatment. Effectiveness depends on continued correct use of the treatment, which in turn is a function of well-functioning supply chains (in the case of chemical water treatment) as well as awareness and practices at household level.

The communities of Cajamarca and San Isidro in Colombia provide an interesting comparison between poorly functioning central treatment and effective household treatment. Cajamarca receives water from a piped system with a treatment plant. However, the plant functions very poorly. San Isidro only has a piped irrigation system and people use that for domestic purposes as well. As users are aware that water is not treated, most users boil water for drinking. In areas without sufficient fuel, boiling is not an option.

3.3.6 Conclusions: Appropriate technologies

We have seen how different technology types provide different levels of access and allow for a higher or lesser degree of multiple uses of water. The table below summarises these findings, indicating for each technology type the potential in providing access for multiple uses.

Table 3.3. Technologies and their potential for MUS

Group	Technology	Potential for multiple use	Incremental changes in technology
Household-based options	Wells	Individual (shallow) wells at the homestead provide a reasonable quantity, although reliability may be reduced due to fluctuations of groundwater levels.	Installing additional lifting capacity to facilitate multiple use
	Rooftop rainwater harvesting	As stand-alone source, it may not have sufficient storage capacity, particularly in semi-arid areas, for all uses year-round. It can be used as complementary source to other year-round supply systems.	Increasing household storage capacity for as far as possible
	Household ponds, and other in-field rainwater harvesting measures	Potential for increasing availability for productive uses. Water quality is usually not suitable for domestic consumption, and needs to be complemented by another good quality source.	Including point-of-use treatment technologies
Communal single access point systems	Communal wells or boreholes with handpumps	Limited potential for multiple uses at the homestead, as quantities are often limited and average distance is large.	Including communal productive uses by add-ons such as a communal cattle trough, or developing a communal garden next to the water point Increasing household storage capacity
	Village ponds	Multiple productive purposes around the pond. Sometimes also domestic uses, though water quality and distance between pond and point of use may be limited.	Including point-of-use treatment technologies
Communal distribution networks	Piped systems	Potential for multiple use depends on system capacity and average distance between point of use and water points. Household connections provide plenty of scope for multiple use at homestead. If standpipes are few and far between, multiple use is limited by distance and quantity. Water quality may be a concern in case of surface water sources.	Reducing average distance between point of use and water points Increasing household storage capacity Increasing overall capacity (in L/s) of different infrastructure components Various treatment options at different levels in the system
	Gravity-fed open canal systems	High potential, as quantity is often not a limiting factor. Continuity and quality may limit domestic uses.	Various treatment options, especially point-of-use treatment Increasing household storage capacity

The technologies reviewed here provide planners and designers with a series of options to choose from when developing systems for multiple use in different contexts.

The findings show that multiple use does not require any new technologies, but new combinations of existing technology can together, provide more water near to homesteads. The findings show that there is no single best technology for multiple water uses because all technologies have advantages and disadvantages in the local physical and socioeconomic context. Yet, some generic points can be made. First of all, homestead based options show reasonable potential in providing an intermediate level of multiple-use services, as these don't require any sharing of water, and the distances between source and point of use are short. Various incremental changes can be made to such technologies, such as better use of lifting devices. Some homestead options, particularly rainwater harvesting, provide a complementary (high-quality) source of water. Single access point technologies show least potential for multiple use of water at the homestead, as distances and extraction capacity are often limited. However, with such options, communal multiple use, e.g. community gardens, may be possible. Whether communal systems enable greater productive use or not depends on water volumes and distance to end use. Hence, systems where water is delivered to the homestead have a higher potential than systems with only scattered standpipes.

Water allocation in communal systems with distribution networks for multiple uses has to find a way to accommodate the greater diversity that comes with productive use. The technical aspects of this include the initial allocation design (which is most equitable and pro-poor when all users receive equal amounts), technical capping of large users, and priority of water for domestic use. There may also be financial and institutional measures to deal with diversified demand. Inequities may be caused by pressure differences in sloping areas and by poor design.

Water treatment options have also been reviewed in order to assess their potential to deliver drinking water quality in MUS systems. Point-of-use treatment options show a high potential as they treat water at the point where it matters and only treat the limited quantities required for drinking water. However, success depends on the knowledge and practices of the end users.

3.4 Financing MUS

3.4.1 Introduction

The financing arrangements for water are a major factor that affects access. A positive cost-benefit ratio is needed to make it worthwhile investing in access to water for multiple uses. If the financial costs to the user are too high, access may be limited. An unequal contribution to the costs of the service may result in unequal access. In this section, we therefore look into the financial implications of providing multiple-use services. In this we look into two key aspects: 1) cost-benefit relationship of multiple-use services, and 2) financing mechanisms.

3.4.2 Cost-benefit analysis

Analysing the cost-benefit implications of multiple-use services means looking into i) incremental costs (both for capital and operational expenditure), and (ii) the additional income generated. It is important to look at the incremental costs, to ascertain that multiple-use services do indeed provide an additional benefit over and above the known benefits of domestic use. However, seemingly straightforward data are generally difficult to obtain and in our case studies we obtained few reliable data. This was compounded by the fact that in many systems, gradual expansions to higher service levels were made without clear records of the incremental costs involved in each step.

For the financial net benefit, our case studies indicate that, as an order of magnitude, annual net income per household increases US$ 100–500 or, expressed per volume of water, US$ 0.7-2 m^{-3}. A broader study was undertaken (Renwick et al., 2007) which looked at incremental costs and benefits, including the CPWF-MUS cases as well as a broader data-set. Caution should be taken with these figures, as only few reliable data sets on this exist. The results presented below come from that study, unless indicated otherwise. Table 3.4 shows the capital invested to move up the ladder and the estimated return in extra income a year. It shows how many months it would take to pay off the investment costs from the increased income (net of recurrent costs).

Table 3.4. Costs and benefits of multiple-use services (Renwick et al., 2007)

	Capital investment costs (hardware plus software (US$ /capita)	Annual income net of recurrent costs (US$ /capita)	Repayment period (months)
		New systems	
Basic MUS	98 – 116	8 – 9	147–155
Intermediate level MUS	**56 – 105**	**42 – 51**	**13 – 30**
High-level MUS	140	21	80
		Upgrading existing systems	
From basic domestic to basic MUS	25	22	12
From basic domestic to intermediate level MUS	32 – 84	46 – 58	7 – 22
From basic MUS to intermediate MUS	56	26	25

As can be expected, moving up the ladder requires higher investments. But, the table shows that capital investment costs for multiple-use services range widely, depending on the level of MUS that is aimed for. These are mostly modest, but adopting a completely new technology may involve major financial costs.

Renwick et al. (2007) estimated that the return from small enterprises is in the range of US$ 20-150 per capita per year. Looking at the returns according to water used, rather than time taken to repay an investment, Renwick et al. (2007) also estimated that income generated by using the water is on average US$ 100-300 higher than the cost, or US$ 1.5-3 per cubic metre of water used. They also show that gardening augments income by up to US$ 2 per cubic metre of water used, while small livestock augments income by, up to US$ 1 per cubic metre. This productivity per unit of water compares well with a productivity for irrigated rice of about US$ 0.2 per cubic metre (Cai and Rosegrant, 2007). A similar positive difference of homestead vs. field productivity was found by Molle and Renwick (2005) in their field study in Sri Lanka.

These benefits imply that income often exceeds operational cost and that investments (in hardware and software) can often be repaid over a period of about 6-36 months. Judging from experiences in North-east Thailand with repayment of the loan for the village piped water supply system, this is a fair estimate. Micro-credit from the farmer network group is also typically repaid within 6-12 months.

In conclusion, it can be said that the incremental costs of providing multiple-use services are cost-effective, as the period of return on investment is relatively small (Renwick et al., 2007). This is particularly the case for investments that take steps towards the intermediate level on the MUS ladder (see Table 3.5).

3.4.3 Financing mechanisms

The previous section demonstrated a positive indication of incremental costs and benefits from MUS systems. In this section, we look at how the case-study communities set about covering these capital and operational costs.

Capital costs

Table 3.5 provides an overview of the contributions by different players to investment costs in multiple-use services.

Table 3.5. Contributions by different players to investment costs in multiple-use services

Site	Contributions to capital investment costs
Ethiopia	
Adidaero	International NGO (Catholic Relief Services) – 100%
Pond systems in Tigray	Various foreign donors through the Tigray Bureau of Agriculture – 100%
Nepal	
Chhatiwan	Community 32% (includes drip kits), NGOs 63%, local government: 5%
Krishnapur	Community 40%, NGO 60%
Senapuk	NGO 43%, community 57%

Site	Contributions to capital investment costs
Bolivia	
Challacaba	Community 100%; plus community labour
Chaupisuyo	Done in various steps with 20-40% community contributions in first steps and 100% community contribution in final step
Vinto	Belgian Technical Cooperation 79%, Community 16%, and Municipality of Vinto 6%
India	
Samundi	Non-tribal households contributed 10%, tribal households contributed 5%, Government contributed the remainder.
Kikwari	Non-tribal households contributed 10%, tribal households contributed 5%, Government contributed the remainder.
Colombia	
Cajamarca and San Isidro	Domestic system: Departmental government 100% Irrigation system: National government agency 80%, community 20%
Thailand	
	End users 100% by reimbursing loan from the NGO, PDA
S. Africa	
	Local government through its Municipal Infrastructure Grant fully covered capital investment and operating costs

The table shows that in most cases a significant share of capital costs is assumed by external agents (NGOs, governments, or a "project") with an in-kind contribution from the community. The contribution from the community to capital costs differs widely, from nothing (e.g. in Bushbuckridge, South Africa and the Ethiopian case studies) via a small contribution (study areas in Maharashtra and in Nepal) and a large fraction (Thailand) to a full coverage by the community (e.g., Challacaba, Bolivia). Communities see their own contributions as a way of becoming owners of the system. Newcomers may have to pay relatively high costs to join. For example, new members in Chaupisuyo, Bolivia, pay US$ 70 per family for domestic uses and US$ 1,600 for irrigation, which is higher than the original connection fee for the original members. Where users are making most of the investment costs themselves they may need special financing arrangements. Many farmer groups in Thailand ask members to pay small monthly contributions to a group fund from which members can borrow money for short periods to upgrade their farms with respect to multiple uses of water and other key investments. This informal micro-credit system has enabled farmers to adopt multiple uses of water rapidly and has been at the basis of the rapid growth of the farmer networks. The NGO PDA implemented piped water systems in more than 100 villages (average 150 households) in North-east Thailand, provided loans to pre-finance them, and gave training in financial management for households and communities (Bepler, 2002). In Bolivia, microfinance played a role in providing capital for communities to invest in their systems. Despite these experiences with communities investing in their own services, the most common approach is that the bulk of investment comes from outside agencies. This can be expected to remain predominant, as the initial cost of infrastructure development remain high compared to users' capacity to pay, particularly in the poorest countries. At most, users can be expected to pay a slightly increased contribution when systems are upgraded to an intermediate level of MUS.

Operation and maintenance costs

The recovery of (part of) the operation and maintenance (OpEx) costs takes place through tariffs. In these case studies we found five approaches to charging for water:

(i) A flat tariff per unit of water used,
(ii) Tariffs that are differentiated according to some criteria,
(iii) A fixed rate per month,
(iv) Rates set by other criteria, or
(v) Water provided for free.

Table 3.6 provides an overview of the types of tariff systems established in some of these study areas, as well as some guide to how sustainable these systems are.

Table 3.6. Tariff systems and their functioning

Site	Tariff system	Financial sustainability of service
Challacaba (**Bolivia**)	Volumetric system	Tariffs cover operational costs, as well as savings for expansion
Chaupisuyo (**Bolivia**)	Volumetric system, with different rates for domestic and irrigation users	Tariff is much higher than needed for operational costs
Cajamarca / San Isidro (**Colombia**)	Volumetric system, with different rates for large and small farmers	Tariffs cover operational costs
Various communities of El Chocho (**Colombia**)	Flat rate, with one case of cross-subsidy between poor and better-off	Tariffs cover operational costs, but actual income is too low, due to high default rate
La Palma – Tres Puertas (**Colombia**)	Flat rate for basic consumption, and volumetric above that	Due to high default rate, actual income is too little to cover all required costs
Lege Dini (**Ethiopia**)	Volumetric system (per jerry can)	Actual income insufficient for major repairs
Samundi (**India**)	Flat rate	Tariff covers operational costs
Chhatiwan (**Nepal**)	No tariff system. A revolving loan is set up, and the interest is used to cover operation and maintenance costs	Too early to tell

Site	Tariff system	Financial sustainability of service
Senapuk (**Nepal**)	Flat rate and additional contribution of labour	Too early to tell
Ward 16 of Bushbuckridge (**South Africa**)	Water is provided free to users as part of Free Basic Water policy. Municipality assumes the costs	No data on implications of financial sustainability for the Municipality

From this table, a number of observations can be made on cost sharing mechanisms for operational expenditure. In systems which have motorised pumping, tariffs for water relate to the amounts used, such as in the cases from Lege Dini (Ethiopia), Bolivia, and in North-east Thailand. These systems are metered or the water is paid per container. Another modality is differential tariffs according to some criteria, for instance on the households' wealth status, as in El Chocho. Gravity-fed systems, such as most of the Colombian systems and the three Nepali systems, have flat rate tariffs for households. The flip side of flat rate tariffs is that people are not encouraged to be efficient with water, as can be seen by the poor efficiency records in the Colombian cases. In La Palma – Tres Puertas volumetric payment was introduced to encourage more efficient use and to reduce the need to develop additional sources. Such measures were accompanied by improving the distribution of water, reducing leakages in pipes etc. However, volumetric payment brings additional management challenges. South Africa provides an interesting case in point. People are provided with 25 lpcd under the Free Basic Water policy. The state through the local governments, is supposed to cover operational expenses, such as expenditure on diesel and electricity, the salaries of operators and plumbing activities. Consumption exceeding the free basic rate is supposed to be paid for by the users. However, this appears to be difficult to manage. For instance, in Ward 16 of Bushbuckridge, most systems are not metered so it cannot be established when users have used their free allocation and are supposed to pay. Even if meters were in place, there is no organisation in place for billing and collection. It is generally assumed that those who only have standpipes don't use more than the basic allocation. The study in Ward 16 shows that this is indeed correct. Only yard tap users would have to be metered and billed but this produces relatively large overhead cost when there are only three or four households in a village with yard taps. Volumetric payment becomes a relevant option when there is a differentiated demand within a community and when the costs of operation increase with volumes used. This is a tariff option that should particularly be studied in multiple-use systems fed by groundwater, where demands may differentiate. But it needs to be accompanied by a management capacity.

Another consideration is how the tariffs are set. In Colombia and Bolivia, the tariff is mostly defined by the users in general meetings. They set a tariff they feel comfortable with, in line with their willingness and capacity to pay. However, it may not relate to actual expenditure on running the systems. In Chaupisuyo, Bolivia, the costs of producing the water are low at US$ 0.025 m^3, but the tariff does not reflect that. The original irrigators from the borehole provide domestic water en bloc to the domestic tank at a slightly higher tariff (US$ 0.05 m^3) than to irrigators (US$ 0.03 m^3). Internally, domestic users pay a tariff of US$ 0.17 m^3. This tariff wasn't based on the actual cost of water but on tariffs in neighbouring communities.

When expenditure is higher than the income, infrastructure cannot be maintained in good condition and reduced services lead to even more defaulters (users who don't pay their water bill on time) and lower income. A gradual return to full operation is difficult and a boost in payment for maintenance from an outside source (government, NGO) is often needed. Hence, the fact that tariffs are set randomly puts many systems at risk, as Table 3.7 suggests.

In some cases, income from tariffs exceeds expenditure, as in Chaupisuyo. The excess income can be used to account for defaulters, or saved for future replacement or rehabilitation costs. In practice, however, it is rare for communities to save for future replacement costs. Consensus is growing that it is not realistic to expect this kind of saving. Despite having a 30% default rate, expenditure on the operation and maintenance of the system is less than the revenues in La Palma – Tres Puertas, Colombia. However, the water services are sub-optimal because the community does not employ an additional operator and the system is not run and maintained properly.

It is important to look at **willingness to pay for water**. One of the key assumptions of the MUS approach is that communities and households are willing and able to pay for 'additional water' if the latter can be used for productive purposes. In that way, multiple-use services would be sustainable financially. Obviously, people who are willing to pay for extra water consider that it is worth it.

There is ample indirect evidence that many households will pay once they are given the chance to use a predictable water supply that meets their needs. There were many examples in our case studies. In a village study in the Blue Nile Basin in Ethiopia, people were willing to pay US$ 3.72 per household per year to be allowed to use irrigation water for domestic uses, US$ 4.34 to use it for home gardens and US$ 5.64 if the water quality improved (Bane, 2005). Rapid growth of the farmer network in North-east Thailand, where households pay most of the cost of upgrading their farms to integrated farming suggests that the returns on investment are significant even if only considered in monetary terms. This willingness to pay suggests that benefits of multiple uses of water often exceed the cost.

For communal systems, one of clearest cases of a high willingness and ability to pay for water from piped systems is in Challacaba, Bolivia. Here, water users gain a significant benefit out of using water for dairy farming and reinvest profits into the systems. But we should be careful in extrapolating from this observation. In Lege Dini, Ethiopia, for example, users of the borehole-fed scheme often did not have money to buy diesel for the pump, or lacked the physical means to go to the regional capital to buy the diesel. The technology in this case was probably too advanced and an unreliable water supply system was the result.

Another indicator of willingness to pay is the default rate, i.e. the percentage of users who don't pay their water bill on time. A detailed study was made in Colombia of default rates on payments for water (Table 3.8). This is related to other factors such as the gross supply (as an indicator for consumption), continuity (as an indicator for reliability/frequency), the tariffs (as an indicator of cost) and the percentage of users engaged in productive activities. The table does not give a clear picture of why some households do not pay, but unreliability of supply is among the prime reasons. It does not show whether those who use water for productive purposes default less or more often than others. In other studies it has been suggested that willingness to pay relates to sustainability of the service in a chicken-and-egg relationship (Schouten and Moriarty, 2003). If the service is reliable and sustainable, people are willing to pay, but when performance goes down and service becomes irregular, people are less inclined to pay, so that income for the water services provider diminishes, which in turn reduces the capacity to maintain and operate the service and leads to worsening performance in a downward spiral. Systems with strong water user associations and with differential tariffs that depend on the economic capacity of the users have low default rates.

Table 3.7. Default rates of payments for water in Colombia (Cinara, 2006d)

Water supply system	Default rate (%)	Continuity of supply (hours per day)	Gross supply (litres per capita per day)	Tariff (US$ per household per month)	Users engaged in productive uses (%)
Campoalegre	50	6	169	3.6	No data
La Palma-Tres Puertas	30	8	317	1.2	82
Montebello	30	1	109	3.2	48
Golondrinas	25	4	317	2.8	49
Costa Rica	20	18	270	no data	46
Cajamarca (domestic)	7	24	370	2.4	98
Cajamarca (irrigation)	7	24	4,400	2.0 – 3.0	98
Las Palmas	5	24	676	1.8 – 9.3	No data

Allowing or facilitating multiple uses by providing more water does not necessarily always translate into higher willingness to pay, or reduced default rates. However, the opposite strategy leads to problems: not allowing or forbidding multiple uses often does lead to problems of sustainability, such as in Tarata (Bustamante et al., 2004a, b), La Castilla (Sánchez et al., 2003), and others (Moriarty et al., 2004). Lack of proper rules for use of water leads to conflicts in the community and reduces willingness to pay.

3.4.4 Conclusions: Financing MUS

This section has shown that providing higher access levels to water to facilitate MUS comes at incremental costs, particularly for investments. These incremental costs are mostly modest, but may be large when large steps in access levels are made. However, these costs can be justified by the benefits. A review of data at global level showed positive cost-benefit ratios for incremental investments in MUS.

These positive cost-benefit relations do not automatically translate into investments by the beneficiaries themselves in multiple-use services. Public investments may be required, particularly for the initial hardware costs. On the other hand, experiences from Bolivia and Thailand show that users can contribute to incremental costs. Operation and maintenance costs are often met by the users themselves. A range of mechanisms has been developed to regulate the water use for multiple purposes, including volumetric tariffs or cross-subsidies for the poorer groups, but many communities are struggling to adopt such mechanisms fully, in particular with respect to water supply to the poorest. It is not clearly shown that provision of water for multiple use leads to an increased willingness to pay for operation and maintenance costs. However, willingness to pay often depends on the reliability of systems and reliable systems often facilitate multiple use.

3.5 Institutions for communal systems

3.5.1 Overview

This section analyses the institutions that manage the water supply systems in the case studies and how that affects access to and use of water for individual users and for the community. An overview of the organisational models that we encountered in the case studies is presented in Table 3.8.

Table 3.8. Organisational forms of management of multiple-use water supply systems

Site	Type of organisation responsible for management of the system
Ethiopia	
Adidaero watershed	Water committee
Lege Dini	Water committee, established under the village water committee
Pond systems in Tigray	Household managed
Nepal	
Chhatiwan	Water user committee (WUC)
Krishnapur	WUC
Senapuk	WUC
Zimbabwe	
Family wells	Household managed
Bush pumps	Water point committees

Site	Type of organisation responsible for management of the system
Bolivia	
Caico Alto	Organización Territorial de Base (OTB)
Challacaba	Water user association (WUA)
Chaupisuyo	Each system has its own entity: • Agrarian syndicate for La Mita • Water supply committee, for the infiltration gallery system • Irrigators association for borehole • Water supply committee for domestic pipe
Tarata	• Agriculture and livestock association • Municipal-owned utility
Tiquipaya	• Large number of community-based associations
Vinto	• Irrigation association • Water supply users' association
India	
Kikwari	Village Water and Sanitation Committee (VWSC)
Samundi	VWSC
Colombia	
Cajamarca and San Isidro	Irrigators' association is responsible for the management of the irrigation and the domestic system.
Costa Rica	WUA
La Palma-Tres Puertas	WUA
Thailand	
Farmer network	Household managed
Village piped water system	Village water management committees, with initial NGO support
South Africa	
Ward 16	Local municipality

The Table shows three basic organisational models for management of water services:

- Household management without much community involvement;
- Management by an external agency, such as a water supply utility or the local government;
- Community management; as in the majority of the cases. Water user associations usually have an executive committee for the actual management.

With regard to the first model of household management, these are characterised by systems that have little or no connection between homesteads with respect to water, so collective or community-level management is superfluous. We saw this model in North-east Thailand, as well as in Zimbabwe. In this model, there are no specific institutions to manage water at communal level. Yet, the knowledge and skills required to do household-level management efficiently are easily underestimated.

There were two CPWF-MUS cases with an external management model: in parts of peri-urban Cochabamba, Bolivia and Ward 16 of Bushbuckridge, South Africa. The utility of Cochabamba (SEMAPA) is only slowly extending its network to the peri-urban areas, and at the same time providing some service through tankers. In general, this service is poor and expensive, especially as compared to performance indicators of community-managed service providers. However, there is a tendency to link the various existing stand-alone community-managed services to the main municipal network. This is supposedly done for reasons of economy of scale, but there are many doubts about this.

In Bushbuckridge, the local municipality is the officially appointed Water Services Provider (WSP). However, this responsibility has only recently been transferred from the Department of Water Affairs and Forestry (DWAF), and during the time of our research there was still confusion about roles. To complicate things further, community organisations have a role in liaising between the community and the municipality and often have a broader mandate than water alone. The general state of confusion over roles and responsibilities has resulted in poor performance in service provision and very poor community participation. For the most vulnerable groups, participation in any discussions around water development has become even more complicated. In externally managed systems, it is more difficult to develop locally specific rules. In the case of Ward 16 of Bushbuckridge, South Africa, DWAF is struggling to turn local rules into specific guidelines for local government. It is difficult to make effective guidelines for a wide range of situations and cases. Decentralised community-managed systems have much more flexibility in this respect than externally managed systems. However, it must also be noted that the exclusion of groups within the community, often the poorest and most vulnerable, may be an issue that demands external assistance.

It appears from these two examples that management of water supply from outside the community has significant drawbacks. Yet, further work on MUS under a utility supply model would be needed to draw firm conclusions.

The third management form, community-managed systems, is the most common model in the CPWF-MUS study areas and discussed in the next section. We look first at some key characteristics regarding the organisational arrangements which are common in any community-management model. Then we analyse the various more specific rules for multiple use.

3.5.2 Community-managed systems: Organisational structure

We found two modalities for the organisational structure in the study areas. These modalities appeared to be strongly, but not exclusively, related to the infrastructure and its dominant uses.

- *A single water committee* is responsible for the entire system(s). A single water committee responsible for all uses is the common form in domestic systems which consist of one piece of infrastructure, as in Challacaba, most of the systems in Colombia, India and Nepal, and in the PDA-villages in Thailand. Exceptionally, a single water committee can also manage two different systems. This is the case in Cajamarca and San Isidro, Colombia, where the communities have a domestic water supply system and a piped irrigation scheme. Originally, both systems were run by separate user associations and their corresponding *juntas* (boards). They judged that the domestic system was not managed efficiently, while the irrigation system was. In 1995, the community asked the users' association of the irrigation system to take care also of the management of the domestic system, and they have been doing that ever since.

- *Separate committees are responsible for different branches with different uses*. Such a model is found when there are separate branches or distinct infrastructure components for different uses. This is the case in Chaupisuyo, Bolivia, where there is a separate committee for the irrigation distribution system and one for the domestic branch. In Vinto, with a shared intake but separate distribution systems, there are also separate committees. However, Senapuk, Nepal, with a similar lay-out, at much smaller scale, has one integrated committee.

Water committees may function more or less autonomously, depending upon their embeddedness in more general community bodies that also assume responsibility for water supply. Examples include Indian cases where the VWSC falls under the *gram panchaya*t. This arrangement has the advantage that when a water sub-committee is not legalised, it is still able to mobilise external resources and to get government support. Also, conflicts that cannot be resolved by the committee itself can be taken one level up. The disadvantage is that users may be confused on roles and responsibilities of different community bodies. Lege Dini, Ethiopia, provides an example: it has three different committees: the general Village Development Committee (VDC), the Water Development Committee (WDC), responsible during the construction phase of the project, and the Water (Sub) Committee (WC), responsible for operation and maintenance (Jeths, 2006).

A common condition for support to water committees is that they register as a legal body and they are often required to open a bank account. That is why the three user committees in Nepal study areas registered with the district government. In Lege Dini, Ethiopia, the legal establishment was also a precondition for obtaining support from outsiders and for opening a bank account. However, most self-initiated water user associations in Bolivia, Colombia and Thailand do not have a formal legal personality. Many of the committees do not want to register as a legal entity out of fear that they will then be fined and taxed by the authorities, e.g. for environmental permits. They see registration more as a burden than as a potential way to improve their management. Moreover, formalised institutions do not necessarily manage better. For example, the water user committee in Cajamarca and San Isidro is one of the best performing committees we found in Colombia even though it is not registered as a community service provider with the regulatory authorities and does not have a concession from the environmental authority to extract water.

Of crucial importance is how the water user committee is accountable to users and whether it responds in an equitable and effective way to their needs. Issues such as representativeness, communication with users, and leadership are key factors in this. In La Palma – Tres Puertas, Colombia, for example, there is a poor relationship between users and the *junta* (board or committee): despite being a small community, only a few users know their representatives on the board of the users association and hardly anyone attends community meetings. In other communities, such as Challacaba, Bolivia, there are strong and representative boards. Another representation issue can be the participation of women and men in the executive committee and in general assemblies. In some cases a target for female participation is set, such as in Lege Dini, Ethiopia, where it is a precondition by the implementing NGO to have female members on all committees. This is well-accepted in this society where women are seen as reliable treasurers (Jeths, 2006). In Nepal, there is a minimum target for female participation, set at one third of the committee for multiple water use systems.

A main task of the committee and its members is to define and enforce the rules for system management. In community-managed systems such as the ones in Colombia, Bolivia and Nepal, a range of rules and mechanisms is being developed to match local needs. In new or upgraded water supply systems, these rules often develop at the same rate as people get used to the new systems, as for example in Lege Dini and other areas in Eastern Ethiopia (Jeths, 2006; Ebato et al., 2008). There the users adapted rules on how much to use and on tariff systems when they started to understand their system better and saw the linkages between household characteristics, consumption patterns and costs of diesel. The villages in North-east Thailand, where piped water systems were introduced by PDA, developed rules for water use and for payment of operational expenses and capital cost in a participatory manner. NGOs like PDA and IDE/Winrock emphasise from the beginning that a condition of their support is that management will become a matter for the village only.

The following section describes the substance of the rules.

3.5.3 Rules on multiple uses of water in community-managed systems

In terms of *formal and informal rules* around multiple uses of water, we can distinguish the following types: (i) rules for equitable allocation, (ii) rules regarding priority for domestic uses and animal watering, (iii) rules regarding who is allowed to use water, and (iv) rules regarding efficient use of water.

Equitable allocation: The rule for water allocation in the three Nepal study areas, which was hardwired in the design, was that everybody should get the same access to the new services for multiple uses, irrespective of land size or other variables. This benefited the poor.

Priority for domestic uses and animal watering: It is widely accepted, implicitly or explicitly, that when a relatively limited amount of water has to be shared in a communal system, a basic amount for domestic use and animal watering should be guaranteed for everyone. This is important when service levels are as low as 'basic domestic' whether this is due to general poverty and low service levels, high costs of pumping water, dry season scarcity, drought or erratic supply. In such cases, limitations on non-domestic uses are set through simple rules that may be formalised in the statutes or by-laws of the community water user association and service providers.

In Ward 16 of Bushbuckridge, South Africa, the 2-3 bucket rule applies: an unwritten rule that people are not allowed to take more than two or three buckets from a standpipe, corresponding roughly to the 25 litres in the South African basic free water right. The same rule was applied in Samundi, India, before project intervention, when the community relied on a handpump. It is also common for neighbours to help each other to access water: those with yard taps may share with neighbours when the standpipes are not functioning. In Lege Dini, Ethiopia, water for hygiene (washing) has a lower priority than livestock watering. There are no formal restrictions on water use but the caretaker knows the size of each household and only allows users to fetch just enough for basic domestic needs, and he distributes the surplus for small ruminants and irrigation. In the Kora spring system in Lege Dini, cattle and goats can drink from cattle troughs and only surplus water is allowed for irrigation. In the Ajo system in Lege Dini, irrigation is allowed if the users buy the diesel themselves in town. In this way not only the costs of the diesel but also the effort to collect it are transferred to the user and the community as a whole reduces its risks (Jeths, 2006).

In Senapuk, in order to address dry season scarcity, the priority of domestic water over productive water was hardwired into the supply system (Section 3.3.4) and a time-based rotation system was established for sharing water for productive uses in line with what is common in conventional 'domestic' systems. Timed access was adjusted per season depending on water availability in the system.

In Challacaba, Bolivia, watering cattle and backyard gardening from the piped supply system are allowed but field-scale irrigation is not, as the capacity of the borehole is not sufficient. No definitions are given on what constitutes a backyard garden, so informal rules apply. This is also a common practice elsewhere in the Cochabamba Valley, where most community-managed systems to supply water are for human consumption and cattle only.

In the above-mentioned cases, rules are generally put in practice, but change as soon as more water becomes available. In Las Palmas (El Chocho catchment, Colombia) irrigation is only allowed during the night when domestic demand is lower. People who irrigate outside those hours are fined. In La Palma-Tres Puertas water supply is for domestic use only according to the rules of the users' association, but most people also use it for a lot of other purposes, and this is not seen as a problem. But in Campoalegre in the El Chocho catchment, productive use is prohibited and the association tries to fine people who are caught in such use. But judging by the high percentage (49%) of people still doing this they struggle to enforce the rules.

Rules on who is allowed to use water. Water use is allowed for everyone who is a "user", i.e. a member of the users association. In many systems, becoming a member is through investing in the system in cash or in kind and hence becoming a co-owner of the system, as described in our case in Challacaba, Chaupisuyo, all Nepal cases and Cajamarca-San Isidro. At the time of construction, potential water users can be excluded if they are not able or willing to invest in water supplies. However, none of the cases mention that, although in Senapuk it was mentioned that those who did not comply with their construction duties would have to pay a fine. There may also be concern about future users. For example in Challacaba and Chaupisuyo, the connection fee for newcomers to the area is much higher than for the original members. This may exclude newcomers from accessing the water.

Rules to avoid wasting water. In piped systems, conveyance losses are common. As a result, there is often a significant discrepancy between the volume of water that households should get and what they actual receive. In piped systems in Colombia, losses are of the same order of magnitude as what is needed for productive activities. Where there are unlined channels, 50% of the water may seep into the earth. In Senapuk, Nepal, people used to leave taps running 'as it was surface water anyway'. In the newly developed system, the amount available for irrigation in that village depends on the amount left over after domestic purposes as priority for the former is hardwired in the system. This has led people to better conserve water.

3.5.4 Conclusions on institutions for communal systems

Three models for the management of multiple-use water systems were found (i) household management in cases where there is no exchange of water between one homestead and others because of distance or abundance, (ii) management by an agency outside the community; and (iii) community management where a water user (sub)committee looks after the concerns of water users and the systems. The last of these was most common in CPWF-MUS.

The organisational forms and issues of community-management of multiple-use systems are quite similar to single-use systems. Rules are more specific for multiple uses. In some cases, the rule was that everybody should get equal access to the new services for both domestic and small-scale productive uses. This was hardwired into the design and generally also put in practice. Generally, rules guarantee a basic supply for domestic uses and animal watering to all, which is important when competition for water is high. Obviously, there is no need to apply such rules when sufficient water is available.

3.6 Water resources and community-scale MUS

3.6.1 Introduction

The final principle of the MUS conceptual framework concerns the wider context of water resources in which water for homestead-scale MUS functions. The management of water resources should be done in such a way that access to this water is sustainable. This principle goes beyond the internal management of a single communal system, and refers to all natural water resources at the higher relevant scales of water development and management above the sites of end users. The CPWF-MUS case studies show the importance of various aspects of water management at this scale. One regards the concurrent use of multiple water resources in an area for use at homesteads as well as at other sites, including fields and along surface water. This is also the scale at which irrigation, fisheries and other productive water uses link with homestead-based water uses. These are discussed in 3.6.2. Next there are many untapped opportunities for an integrated approach to water development for multiple uses at multiple sites, which we define as 'community-scale MUS'. Some examples that were found in CPWF-MUS cases are discussed in 3.6.3. Third, sharing water and other resources is a community-scale issue, as analysed in 3.6.4. Some overall conclusions are drawn in 3.6.5.

3.6.2 Multiple sources for multiple uses at homestead level

People use water from multiple sources for multiple purposes at homestead scale. Combining water from different sources augments the total water supply and allows households to employ water of different qualities for different purposes (Scheelbeek, 2005). The extent to which multiple sources are used differs from case to case. At one end of the spectrum, we see families in Thailand that use up to nine different sources of water. In many other places, most people use water from one single source, through a piped system, as in Colombia, or a household well, as in Zimbabwe. Complementary use of rainwater or other sources was an exception in these cases.

The survey in North-east Thailand showed how farms draw from at least nine different sources and many farms use at least six of them simultaneously. These are:

i) Rainwater harvested from roofs and stored in several large jars, (3.5-5 m^3 per farm);
ii) Bottled water, (expensive), from shops;
iii) Piped water supplies (at 70% of farms);
iv) The shallow well from which water is drawn in buckets, previously the main source of water for irrigation and still in use on 30% of the farms;
v) Deep wells (boreholes of 10-30 m), common where electricity is available for pumps;
vi) About 85% of the farms surveyed have ponds that hold water used for productive purposes with fish farming in adjacent but separate tanks; (this is a much higher fraction than outside the selected groups);
vii) About 25% of the farms use water from nearby streams or canals – whether this is feasible on an individual farm depends on the local situation and proximity of such water sources;
viii) About 25% of farms make explicit use of run-off water from nearby fields or roads, in particular for paddy rice – again feasibility depends on local topography;
ix) Rain, of course, provides the 'green water' for all cropped areas.

Figure 3.18 shows the layout of an integrated farm with multiple productive uses.

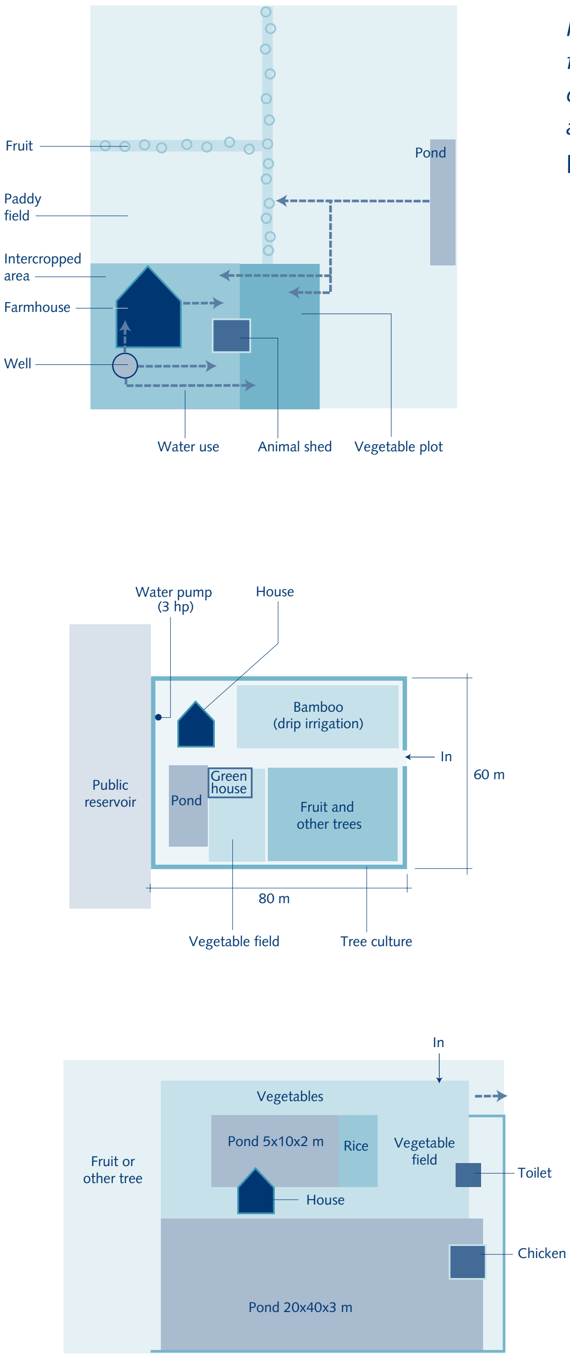


Figure 3.18. Layout of integrated farms where water is used for domestic and various productive activities (Source: CPWF-MUS project)

The survey also showed how particular sources of water can be reserved for specific uses, in particular for drinking and cooking. For drinking water households use mainly rooftop water stored in jars where it retains a high quality. This water, however, is not sufficient for washing, laundry and cleaning. In several cases, piped water has become available, but its quality is usually seen as inferior to roofwater. Other water sources are used for irrigation and watering livestock or keeping the fish tank adequately filled. The situation in summarised in Table 3.9.

Table 3.9. Sources and use of water in Thailand

Source/Use	Domestic use	Productive use	Comment
Bottled water	Drinking	None	Uncommon
Rainwater	Drinking, cooking	Rainy season crops	Stored in jars
Piped water	Drinking, cooking, washing	Irrigation of small garden, if plenty	Not available to all households
Shallow wells	Drinking after treatment	Irrigation of garden, poultry	
Groundwater from borehole	None	Irrigation of large garden; fruit trees, livestock	Saline groundwater in many areas
Run-off water stored in pond	Only if no other water available, as in the past	Irrigation of garden and, if ample, rice paddy & fish production	On integrated farms for the dry season
Public canal or stream	None	Irrigation of rice paddy	Not available to all farms

In other case studies, it was not possible to see such a clear relationship between a source and a particular use. In Bushbuckridge, South Africa, some differentiation was found between the ways in which sources are used for different productive activities, but the preference was for the communal tap (Figure 3.19). In Colombia, piped systems were the main source of water for all types of use. In both countries, agencies only promoted piped supplies and per capita costs of alternative complementary infrastructure were often higher.

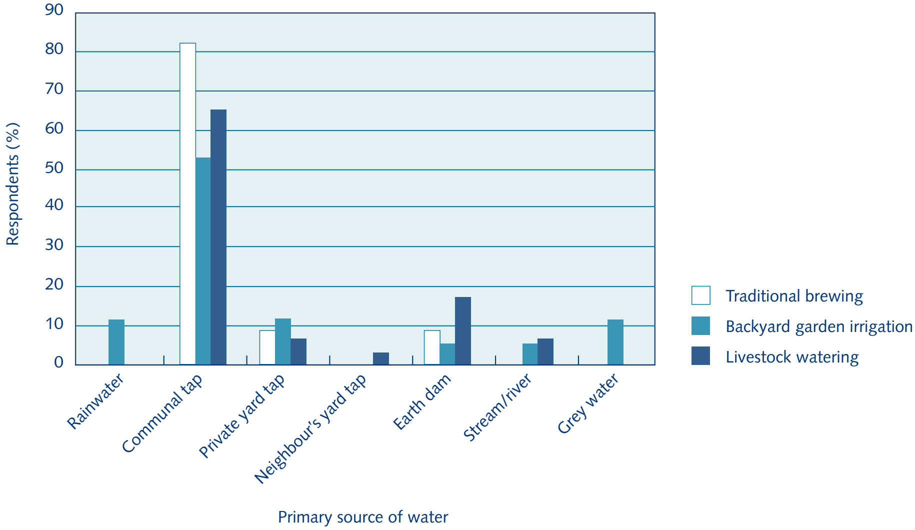


*Figure 3.19. Different sources of water for different productive uses in Ward 16 of Bushbuckridge (*Source: MUS project)

Promoting and using various water sources can enhance total water quantities, stimulate water re-use, and allow households to apply different quality levels for different needs. Above all, it can increase resilience of water availability, in the event that one of the other sources fails. However, it also may increase total capital investment costs, as compared to developing one single source with a higher capacity. Mobilising multiple sources for multiple uses thus requires capital investment costs to be optimised and matched with the need to develop these various sources.

3.6.3 Community-scale planning to develop multiple sources for multiple uses

At community level too, multiple sources can be planned and developed for multiple uses. This is relevant where two or more communal infrastructures are being used to meet multiple water needs at different sites, beyond the homestead but within the community. Some CPWF-MUS case studies highlighted significant advantages for planning and designing communal infrastructure under such a holistic approach. The advantages of community-scale MUS over single-use approaches are manifold. It is therefore cost-effective to share bulky infrastructure like intakes, storage and conveyance for multiple uses, where appropriate. It also allows costs to be saved by building on existing infrastructure, which can then be regarded as sunk costs. Water that is freed up at one site can be channelled and used at another site. Combining multiple sources enhances resilience.

The approach by IDE/Winrock in Krishnapur and Senapuk, Nepal, is a clear example of cost-saving, following a MUS approach. New infrastructure was grafted onto existing irrigation systems. These earlier investments became sunk costs for the new project. In Krishnapur the community's network of streams and infrastructure was seen as a whole. Lining of an irrigation canal saved water that was then channelled to homesteads for multiple uses there. In Kikwari, India, IDE integrated new infrastructure as incremental improvements to existing resources. In this community, several wells were developed, some of which feed into the drinking water system while others are used in part to irrigate community plots.

Community-scale MUS allows use of different water resources, as underlined in the literature on multiple uses of irrigation systems. In irrigated areas, seepage from fields and unlined canals recharges groundwater aquifers, and thus enables indirect multiple use of irrigation water, including domestic uses from wells (Shortt et al., 2003; Meijer et al. 2006; Rajasooriyar et al., 2008).

Another advantage of community-scale MUS is that source mobilisation and storage costs can be shared between different types of use. In the Adidaero sub-basin in Ethiopia, a single dam delivered water to a cattle trough, a laundry slab, an irrigation system, and, via a sand filtration gallery, to a standpost for domestic uses. This integrated water system with shared storage was cost-efficient; while water sharing between the multiple end uses was transparent and avoided conflicts. On the other hand, lack of integration was seen to create inefficiencies. Various case studies in CPWF-MUS documented inefficiencies resulting from single-use perspectives. In one and the same area in Cajamarca in Colombia, for example, the government had constructed two small piped 'domestic' systems and one large piped 'irrigation' system, all tapping from the same stream. Infrastructure costs would have been significantly reduced if there had been one system for multiple uses, or if they had at least shared some components such as the water intake.

On the other hand, the development of various partly overlapping or parallel systems is often a product of the gradual expansion and growth of the community, and its capacity to mobilise more water sources. The community at Chaupisuyo, Bolivia, supported by local private designers, gradually expanded water uses by developing four overlapping systems to accommodate domestic needs, field irrigation and small-scale productive uses for different parts of the village, largely in response to the growth of the community (Figure 3.20) (Valenzuela and Heredia, 2007):

- An open irrigation canal (*Mita)* to which some users have customary water rights for irrigation. It runs dry during the dry winter.
- A drinking water system, fed by an infiltration gallery, that serves the upper part of the community.
- A borehole and piped distribution system for irrigation, that serves the area above the Mita canal, as well as complementing it in the area below the canal.
- A piped distribution system for drinking water for the lower part of the community, interconnecting with the piped irrigation system.

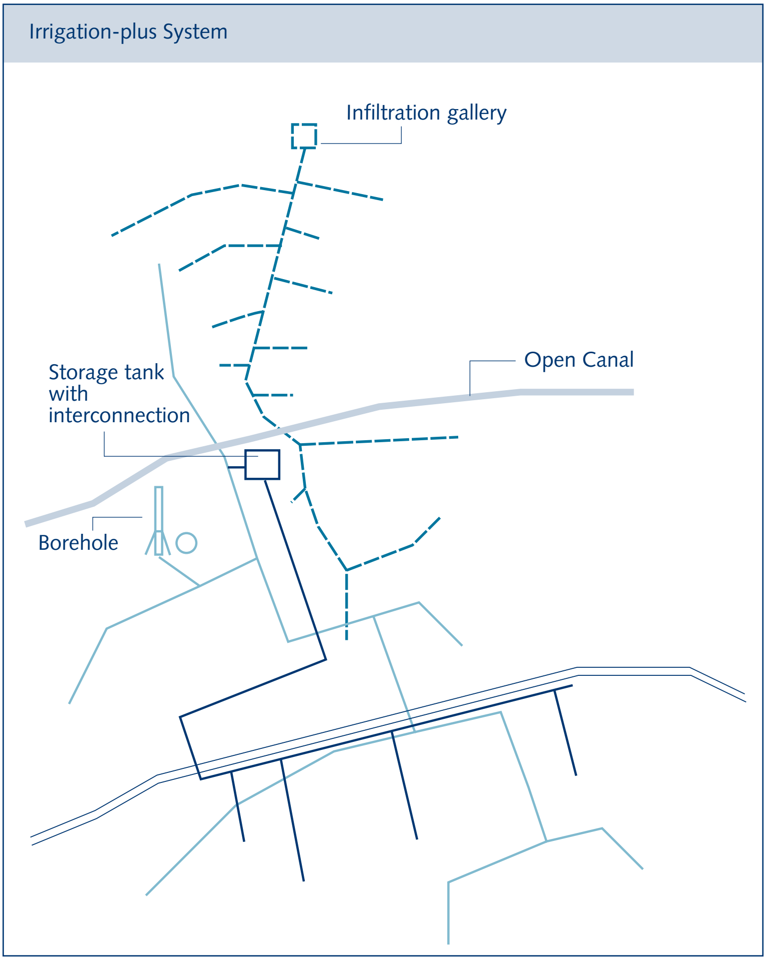


Figure 3.20. Map of the overlapping schemes in Chaupisuyo, Bolivia (Source: CPWF-MUS project)

However, such community-scale water infrastructure development requires clear operational and management guidance, otherwise it may result in unmanageable systems. For example, the infrastructure of Ward 16 in Bushbuckridge, South Africa (Table 3.10), can best be described as a spaghetti-like lay-out of interconnected systems, as an inheritance of the fragmented and ad hoc approach to water supply during the apartheid era and of interventions afterwards (Smits et al., 2004). The result is a mix of systems that are technically poorly designed and very difficult to operate, and with a large percentage of the infrastructure out of action. Interviews with users revealed that low reliability and difficulty in accessing water created a barrier to starting productive uses for many of them.

Table 3.10. Performance of water supply systems in 11 villages in Ward 16, Bushbuckridge, South Africa (Source: Cousins et al., 2007a)

Village name	Water supply system performance
Seville C	Groundwater-fed system, supplying three villages (Seville A, Seville C and Thorndale). Only Seville C, first in line, gets regular water. Only one of the two diesel engines is working. The other has a problem with the electronics, but for ten months, nobody has come to repair it.
Seville A	Doesn't get the water it should from Seville C, but the local borehole is working reasonably.
Thorndale	Of the 15 standpipes, three function normally, four are broken, eight work when the reservoir is full.
Seville B	An independent reticulation system fed by five boreholes. Out of the 16 standpipes, five are not functioning.
Hlalakahle	Stand-alone reticulation system, fed by two boreholes, only one of which is functioning. Out of the 17 standpipes, only three are working. Few of the 39 yard taps are functioning.
Gottenburgh	There are three interconnected reservoirs filled by different supply lines. The interconnected reservoirs do not receive any water, as the pumps cannot provide sufficient head to fill them.
Delani	Regular breakdowns occur. The engines are automatic, but the operator must intervene due to the inter-connection between the three engines. Few of the 28 standpipes provide water.
Hluvukani	Hluvukani reservoir is supposed to be filled by the bulk line, but since it is towards the end of the line, it doesn't regularly receive water. It relies on another reticulation line with its own boreholes, which functions reasonably.
Lephong	Of two boreholes, one provides most water, the other one is supplementary. There is a borehole at the community garden, but it has not been equipped with an engine. Of the seven communal taps five are functioning.
Dixie	Of 12 taps only five provide water.
Utah	Of the four boreholes feeding the local reticulation system, one has not been equipped with a pump, one is broken, and one (solar powered) is not working as the solar panels were stolen.

This pattern of partial failure suggests that when developing community-scale MUS, one needs to avoid just adding layers of infrastructure, but instead build upon what is there and fill the gaps.

Communities and (sometimes) outside agencies often develop water resources for homestead-scale uses as well as for community-level use. The irrigation-plus approaches discussed in Chapter 1 typically operate at these community scales, where they stimulate access to water for domestic and other non-irrigation uses, animal watering and bathing, or ensure the connectivity and storage of the bulk infrastructure that are required for fisheries and enable in-field crop-fish systems. Other surface water development also takes place at the scale of one or more communities or sub-basins. Examples are direct access to village reservoirs for multiple uses, fisheries in open streams or storage, livestock watering by herding cattle to open streams or specific groundwater points, or car washing in streams.

The common denominator across these experiences at community-scale can be conceptualised as 'community-scale MUS'. As indicated in Chapter 1, this approach considers all uses and sites of uses within communities' spatial lay-out and applies participatory planning approaches. Unlike irrigation-plus approaches, domestic and productive water uses at homesteads are fully integrated components of the options in community-scale MUS. If the choice were given to communities for water development at any site, it is likely that homestead-scale MUS would emerge as a priority for community members, certainly for women. Water needs at other places would be considered simultaneously. The Resources Infrastructure Demand and Access (RIDA) framework (Figure 3.21) allows for such genuine participatory diagnosis which leaves prioritisation to community members instead of imposing choices according to the sector in which the professionals work (Moriarty et al., 2007).

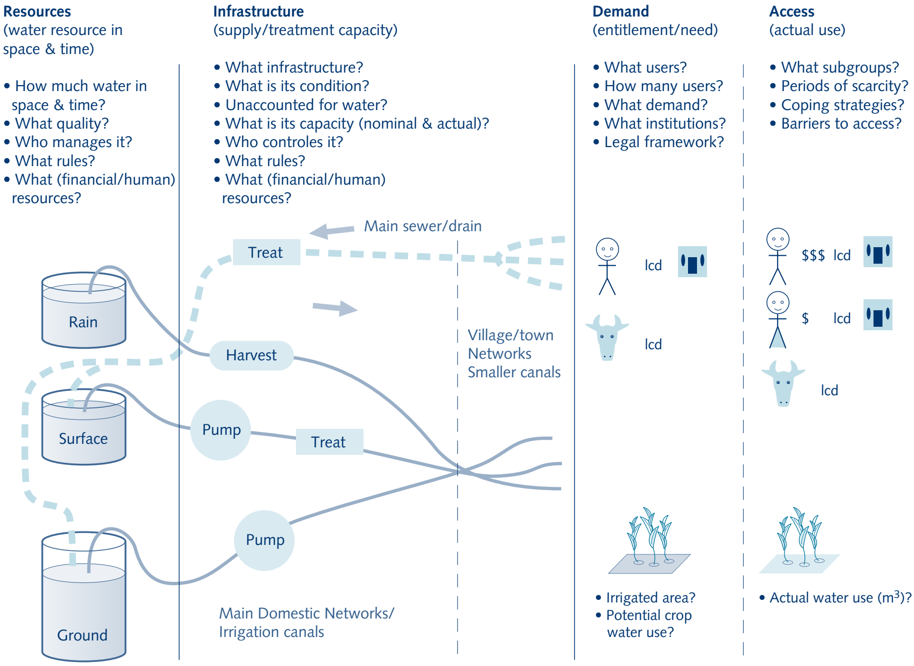


Figure 3.21. An illustration of a RIDA assessment preparation with relevant questions for each part of the assessment (Source: Moriarty et al., 2007)

Such use of multiple sources through multiple overlapping infrastructure is a daily reality for many communities who have gradually expanded and built on existing infrastructure. They tap into existing wisdom to deal with complexity, building on their knowledge and their existing management arrangements to ensure effectiveness and efficiency when developing new layers of infrastructure.

Community-scale MUS also requires transparency in resource allocation.

3.6.4 Community-scale sharing of water

A question sometimes arises of whether there will be sufficient water resources for MUS and whether serving everybody, including the relatively better-off, with better services can lead to further marginalisation of the poor. These questions were answered at community-scale in various CPWF-MUS case studies, and showed that this fear is unfounded. There are indeed important issues of equitable allocation of resources, but this rather relates to the equitable allocation of public resources for water development. Water resource allocation is a lesser issue.

The experiences of IDE in Maharashtra, the most water-stressed site in CPWF-MUS, where aquifers are seriously overdrawn, illustrate how improving access to water is primarily a matter of how decisions about access to water supply infrastructure are made. As in many areas in low-income countries, the marginalised groups in Kikwari live in specific areas, such as on the fringes of communities. Their water access was almost nil and only slightly better if their hamlets reached basic MUS levels, still not allowing for many productive uses. The wealthier village elite allocated most of the new public resources to further improve water services in their own neighbourhood, which were already much better than for the poor. In the second community, Samundi, the entire community was poor and it was selected to be supported for that reason. There, the poor were reached. In sum, the better-off usually already have access to intermediate-level, if not high-level, MUS services. The poor are most in need of good water services well above basic domestic uses. Whether the poor are reached or not depends upon targeting policies and intra-community negotiations on the allocation of public resources for water development, even when water resources are scarce. Such allocation issues are at the core of genuine participatory community-scale MUS.

When competition for water resources is growing, the key water allocation issue that emerges is the large inequity in water use between water users because of the relatively very large quantities needed for larger-scale productive uses, in particular agriculture. Irrigation specialists tend to see quantities needed for rural domestic uses as negligible, so doubling or tripling those quantities for MUS is hardly a water quantity concern either. This also appeared to be the case in Maharashtra. There is much work by NGOs, followed by government agencies, on water budgeting with communities so they can see where their resources come from, how much they have, how much they use for specific applications, etc. This integrated approach highlighted how the many sugarcane farmers, in particular those with the larger fields, were using most water. Around a third of all farmers in Kikwari decided to change crops from sugarcane to vegetables because they require less water. More water was also made available through a range of other measures through a state-wide Soil and Water Conservation Programme and local actions to recharge groundwater: practising reuse of waste water, and other conservation measures, reducing conveyance losses, increasing efficiency of water use, and development of alternative sources (including rainwater harvesting at homestead or community scale).

Calculations to assess the potential impact of 100% coverage of MUS gave similar answers in another stressed basin, the Olifants basin in South Africa. Even if providing MUS were to be a zero-sum game in terms of water resources available for human use, it would hardly affect the few large-scale users. Here, 0.5% of the water using population uses 95% of the water resources. Even moving everyone's small-scale rural water use from 116 lpcd to 277 lpcd, (more than doubling water quantities), would only require the few large-scale users to reduce their water use by a mere 6% of the total they use (Cullis and Van Koppen, 2007). In another stressed catchment in South Africa, the Sand river catchment, in which the Bushbuckridge area is located, water resources also appeared sufficient to cover water extractions of up to 60-80 lpcd (Smits et al., 2004). So the introduction of multiple-use services in rural areas will not have significant impacts on water resources available in a particular area or any higher aggregate level.

For example, if 150 people live on one square kilometre of land, as is plausible in most case studies, they will typically collectively consume 1,400 m^3 of 'domestic' water annually and 5,600 m^3 for other multiple uses. Even a low rainfall of only 400 mm per year brings as much as 400,000 m^3 per km^2 of which run-off into rivers is typically 10% or 40,000 m^3, while another significant part can be drawn from groundwater which is replenished by rain.

However, it is important to realise that introducing MUS or any other water development is hardly ever a zero-sum game. In most poor areas, certainly in sub-Saharan Africa, there is a scarcity of services rather than scarcity of water resources. Low economic development and low capacity states leave abundant water resources underdeveloped. In Sub-Saharan Africa, only 3.5% of available water resources have been developed and water scarcity is in reality economic water scarcity. The development of water storage and other infrastructure makes *more* water available for human use. The issue is not that a limited pie has to be shared, but that the pie of water resources available for any use can be increased. The issue is how the benefits of the new opportunities are shared.

Nevertheless, prior claims to water have to be considered. A holistic approach helps to find win-win arrangements. In Senapuk, Nepal, water was needed from a stream which was already claimed by a neighbouring farmer. After negotiation it was agreed that the intake for Senapuk would be constructed in such a way that sufficient water would be left in the stream for the farmer's livestock needs throughout the year, and for irrigation of paddy during the wet season. The new users committed themselves to provide the farmer with cement. In Vinto, Bolivia, the irrigation system was upgraded and a new domestic system was developed sharing the same intake and storage tank. A detailed assessment had to be made of pre-existing water rights down to the level of each individual farmer. These formed the basis for the expansion of the system. Neighbouring communities were also consulted.

Where water rights are not duly considered, conflict may break out, as shown in the case of Tarata in Bolivia. The town is fed by a multi-purpose reservoir, called Laka

Laka. Sedimentation of the reservoir happened more rapidly than expected. This first impacted on the intended domestic use, as it increased treatment costs. When this 'domestic' water was given to urban farmers for their urban gardens, irrigators who also used the dam protested that the urban farmers did not have a right to the water, and conflict broke out.

Water sharing issues also emerge when competition for water is growing, and becomes most manifest during the dry season or dry spells. The most constructive process is similar to what was observed in Maharashtra where water scarcity was much more advanced: awareness raising through dialogue, further quantification of the problem, and exploring solutions compatible with MUS. The El Chocho catchment, Colombia, is such an area where there is competition for water. Here, a dozen or so communal and individual water systems capture the El Chocho stream, many for multiple uses. As these are all gravity-fed, water comes at low costs and consumption is high. Over time, upstream water developments have reduced downstream water availability. This is compounded by a deterioration in water quality due to upstream activities like pig rearing and coffee processing, and due to increases in sewage during weekends when many urban people visit weekend houses or come to the area for recreational activities. Growing complaints led first to the quantification of the problem. A CPWF-MUS case study in El Chocho assisted in generating more insight in the number of users and their uses together with the Corporación Autónoma Regional del Valle del Cauca (CVC), the environmental authority in charge of issuing 'water use concessions'. Each individual user or community water supply system needs to apply for such a concession however small the amounts extracted. Table 3.11 lists the allocated amounts. Further, an assessment was made of the flow in the stream (Figure 3.22). For the main water supply system some actual intakes were also measured. This process gave a rough initial overview of users, allocated uses, one-off stream flows and a few examples of actual intakes. Solutions were explored through dialogue between the communities (Cinara, 2007). Emphasis was given to reducing system losses and leakages. Alternative water sources were also explored, in particular by stimulating rainwater harvesting which also provides a safe drinking water source.

Figure 3.22. A multiplicity of pipes makes it difficult to monitor water intakes in the stream of the El Chocho catchment (photo: Grupo GIRH - Cinara)

Table 3.11. Water use concessions in the El Chocho catchment (Cinara, 2006c)

Concession #	Metered stream flow prior to intake (litres/ second)	Allocated flow (litres/ second)	Actual intake (litres/ second)*	Name of concessionaire	Type of use
1	0.40	0.05		El Vergel hamlet	Domestic and garden use
2	0.35	0.05		El Vergel hamlet	Domestic, cattle and poultry farms
3	1.00	0.21		The JAC of La Paz	Domestic use for rural water supply systems in the upper part of the catchment
4	3.00	3.00		The JAC of Golondrinas	Domestic
5	0.20	0.10		Individual	Irrigation
6	0.10	0.05		Individual	Irrigation
7	3.00	0.02		Individual	Domestic use
8	3.00	0.05		Individual	Domestic use and irrigation
9	6.00	0.26		The JAC of La Castilla	Domestic use
10	9.00	0.10		Individual	Irrigation
11	8.90	0.02		Individual	Domestic use
12	8.88	0.02		Individual	Domestic use
13	12.50	10.40	11	The JAC of Montebello	Domestic use
14	2.10	2.10	5.25	The JAC of Campoalegre	Domestic use
15	0.40	0.20		Individual	Domestic, irrigation, cattle
16	4.00	0.24		Individual	Domestic and irrigation
17	5.00	1.04	4.5	The JAC of Las Palmas	Domestic use
18	3.80	0.10		Individual	Irrigation
19	4.00	1.05		Individual	Domestic and mining
19-1	0.05	0.05		Individual	Domestic and irrigation
20	7.00	3.50		The JAC of Las Palmas	Irrigation and cattle
21	12.00	1.00		El Chocho hamlet	Settling dust of road
22	11.00	1.00		El Chocho hamlet	Irrigation of lawns

* This column shows a few measurements of actual intakes at larger sites. They suggest that actual intakes are higher than allocated intakes.

In sum, considering all water sources and uses in an integrated manner at community-scale reinforces homestead-scale MUS. First, it shows that climbing the water ladder to intermediate and high-level MUS requires only a small fraction of total water resources at community or basin scale, even when promoting full coverage MUS. In stressed basins, inequities in water use are substantial and even if promoting full coverage MUS were a zero-sum game, re-allocation of some water by the few large-scale irrigators or other large-scale users in order to ensure some water for all seems legitimate. Within communities, the poor benefit most from such a reallocation of water resources, and they gain even more when public resources are made available to gain access to infrastructure. Second, an integrated community-scale approach to sharing water resources enables negotiations between newcomers and existing users because all possible sources and uses are considered. Third, when competition among existing users increases, this approach gives a transparent overview of water users, uses and sources, allows the greatest inefficiencies to be pinpointed and mitigated and shows which alternative sources can be developed.

3.6.5 Conclusions: Sustainable water resources and community-scale MUS

The last of our principles for community-level MUS was that community-scale MUS requires multiple water sources to be managed transparently and well and in an integrated way for source protection and for service delivery.

In some cases, multiple water sources are mobilised at homestead level to achieve the access levels required for multiple-use. However, this is not universal. In cases where single sources can already provide those access levels, such as the piped systems in Colombia, only few users use multiple sources. However, there were other examples in the CPWF-MUS cases where several open water bodies and infrastructure systems have been developed and used for multiple uses at community scale. These have either been developed by communities over time, or developed by outside agencies, building on existing infrastructure. Mobilisation of multiple sources not only increases access, but also can be a back-up source in case the main one fails. In some cases, this also allows users to use water of different quality for different needs.

Community-scale MUS not only strengthen homestead-scale MUS but also strengthens other water uses elsewhere within the community away from the homestead. Irrigation-plus approaches can be transformed into community-scale MUS if planners include the homestead as one of the potential sites for multiple water uses when planning new systems or rehabilitation. Many other water uses also find a home at this scale: livestock watering in grazing areas, fisheries and aquaculture, agricultural water management on scattered distant plots, orchards, water businesses, etc. All these water uses (and users) benefit from eight advantages that we found in the case studies for community-scale MUS:

i) Multiple interlinked water sources, water reuses, and conjunctive surface and groundwater uses are considered holistically at the lowest level of site management and planning. This enhances water efficiency and resilience to cope with climatic variability.

ii) It saves costs and renders management more transparent when bulk infrastructure (in particular storage, but also intakes and conveyance systems) are designed for multiple uses from the outset.

iii) A holistic assessment of existing water- and landscapes allows earlier investments in infrastructure to be integrated as sunk costs into improved systems, and builds on existing arrangements to manage multiple water sources for multiple uses. Avoiding yet another layer of infrastructure through isolated time-bound projects is critical for sustainable management.

iv) New services usually imply that the total pie of water resources available for all is increased, but the issue of how support and benefits will be divided remains. In community-scale MUS, inclusive participatory approaches should ensure that the allocation of external support and resulting benefits is transparent and demand-driven, and that the support and benefits effectively reach the target group especially the poor.

v) In the event that a new water use implies that others have to give up some existing uses (a very rare situation), an integrated approach gives a realistic insight into the quantities at stake so a well-informed decision on water resource allocation can be made. Quantities of water for intermediate and high-level homestead-scale MUS, even with 100% coverage, are still relatively small compared to few large-scale users, especially irrigators. New MUS can ensure that the poor obtain access to vital services to improve their livelihoods as a greater priority than allowing a few large users to continue using disproportionate quantities.

An integrated approach to community-scale MUS also facilitates negotiations when

vi) Water resources are sufficient to allow win-win solutions, as existing claims to water are recognised as part of the assessment of water- and landscapes.

vii) As demand for water grows, community-scale MUS offers a holistic approach to explore alternative sources.

viii) Community-scale MUS allows water quality to be safeguarded for drinking and for other high-quality uses. Cleaner but perhaps smaller sources can be used for drinking water and other high quality needs. Technological options can be applied at the most appropriate level. Point-of-use treatment at the lowest (often household) level is particularly promising for MUS as it permits water to be provided from more sources at the lowest cost.

These benefits from community-scale MUS add up to a powerful case in support of this approach. However, they have hardly been tapped in the water sector.

3.7 Conclusions on MUS models

This chapter has discussed how to realise the five conditions that we assumed were indispensable to implement MUS on the ground. This allowed us to identify two types of MUS models: homestead-scale MUS and community-scale MUS. In this final section, we summarise some of the main findings about these models and how to implement the principles to make them a reality.

3.7.1 Models for homestead-scale MUS

- Our case studies confirm that water indeed is used at and around the homestead for multiple purposes and brings substantial benefits to people's livelihoods. Homestead-scale MUS is therefore a way of achieving a more integrated set of poverty impacts than conventional water services, provided services are well targeted. This is of particular relevance for the most vulnerable groups, specifically the poor, women, children, and the sick.

- The multiple-use water ladder reflects the linkages between a given level of access to water and the uses and livelihoods that can be derived. The multiple-use water ladder sets 20 lpcd at and around homesteads as sufficient for basic domestic use, 20-50 for basic MUS, 50-100 for intermediate MUS and more than 100 for high-level MUS. Empirical findings show that the multiple-use ladder gives a more realistic representation of this relationship than previous versions of the ladder. Even below basic domestic service levels, poor people prioritise water for small-scale productive activities over personal hygiene.

- The ladder shows that to facilitate substantial water-dependent productive activities some 50-100 lpcd need to be available within a short round-trip of the homestead, and of these, at least 3 lpcd should be safe for drinking. This is at least one step above commonly considered service levels in sub-Saharan Africa and South Asia.

- Required levels of access can be provided by (combinations of) known technologies. Homestead options, such as family wells, and piped systems with household connections have high potential for facilitating homestead-scale MUS.

- Higher levels of access come at a higher investment cost, even if still modest in many cases. These incremental costs can easily be justified by the benefits that can be obtained through improved access to water, with a rapid return on investment.

- Even though incremental investments can be earned back within a relatively short time frame, this does not automatically mean that communities take these opportunities. The basic infrastructural costs often require public investments, to which communities can contribute in an incremental way. There does not seem to be any evidence that users are more willing to pay for the additional operation and maintenance costs of multiple-use services per se. However, reliability of service has an important bearing on willingness to pay, and a higher reliability in turn can facilitate multiple use. Unreliable services neither promote MUS nor promote willingness to pay.

- Multiple-use services require slight changes in management arrangements. Findings show a range of ways in which communities can deal with these.

- Water use is only one factor in creating livelihood benefits (although often the critical one in areas with low levels of water infrastructure development). Benefits can be considerably enhanced by accompanying measures such as hygiene education and sanitation, provision of inputs such as seeds and fertilizers, training, and the development of accessible markets.

We conclude that the higher service levels needed for MUS can be provided through various combinations of technology, most of which are already commonly known. The provision comes at additional cost, and may have additional management implications. The case studies have shown that none of these additional measures are unachievable and that the challenges are largely off-set by increased benefits.

3.7.2 Models for community-scale MUS

The CPWF-MUS case studies highlighted a second untapped opportunity for better service delivery when sectoral boundaries are overcome: community-scale MUS. This is relevant wherever water for homestead-scale MUS, or for water uses at other sites, is abstracted from two or more sources of water within one or more communities or sub-basins. In community-scale MUS, these are developed and managed from an integrated perspective, taking into account all water users and uses, and all water sources and sites of use. The case studies suggest the following:

- Water services can be guided by people's priorities for water use at preferred sites through a participatory planning process, rather than by sectoral mandates. Homestead-scale MUS is likely to be the priority, in particular for women, the land-poor, and people with long-term illness or disability.

- Different water sources can be used simultaneously, and each source can be used for the most appropriate purpose.

- Existing infrastructure can become a useful 'sunk cost' in incremental improvements, rather than being abandoned.

- When different sub-sectors collaborate for multiple-use services, cost-efficiency and transparency can be improved especially through synergies in intakes, storage and conveyance design, construction and management.

- Community-scale MUS allows the social capital of communities' existing management arrangements and rules for prioritisation to be recognised and harnessed.

- Where there is strong competition for water, the respective water uses by respective users can be quantified and compared. All current evidence suggests that doubling or tripling the quantities conventionally used in the domestic sub-sector has a relatively small impact on total water resources needed. This highlights the policy question as to whether some water should be allocated to everybody for basic domestic and productive livelihood needs, or whether a few large-scale users should continue disproportionate use of water for livelihoods that are well above the poverty line. In case of growing competition, holistic solutions can be found such as avoiding leakages or development of alternative sources for any water use.

- Community-scale MUS allows water quality issues for drinking water to be addressed at the appropriate level.

- Last but not least, community-scale MUS is appropriate for all water sectors. Indeed, irrigation-plus, livestock watering, and fisheries can all be transformed into community-scale MUS, ensuring that its many advantages are fully tapped. This brings about horizontal integration between different water sub-sectors and reduces the gap between the multiple-use logic and practice in communities and the single-sector approaches still found amongst the higher-level water resource planners and managers.

The findings show an array of technological, managerial and financial measures through which homestead and community-scale models of MUS can be implemented. The implications are different for different specific models, but they all require service providers to change the way in which services are provided. In each country, the implications for service delivery in their own circumstances were taken forward in discussions on services provision with the learning alliances. Lessons from the efforts by the learning alliances to establish a supportive environment for MUS services provision at scale are discussed in the next chapter.

4 Creating a supportive environment for scaling up MUS at intermediate, national, and global levels

4.1 Introduction

Chapter 3 identified models of homestead- and community-scale MUS, which was the first objective of CPWF-MUS. The second objective was to create a supportive environment for scaling up these two models. Ultimately, such an environment should provide all water users in rural and peri-urban settings with the sustainable multiple-use water services that they need. This chapter reports on the methodology, findings, outcomes and impacts of this second step.

The creation of a constellation of stakeholder groups that efficiently collaborate to provide a well-defined, easily accessible, reliable and sustainable package of services for participatory planning and coordinated support to meet everybody's needs is a tall order, and will happen gradually. The current situation is one of many parallel operating agencies, even in the same area, who hardly know of each other and know even less about the history of each other's water 'projects'. Each agency reports upwards within often narrow mandates for a single water use and has its own planning cycles and support conditions that come with the financing streams. This organisational structuring is the main reason why the many opportunities of homestead-scale and community-scale MUS have been missed.

The methodology of CPWF-MUS for changing this reality and scaling up MUS innovation was 'learning-by-doing' through learning alliances. The project partners in all countries forged learning alliances with relevant service providers including water users themselves, private sector, NGOs, domestic sub-sector, productive sub-sector, local government and knowledge centres. MUS champions were invited and participated but so too did 'gatekeepers' who were not necessarily in favour of MUS, but critical for going to scale.

The obvious first step of all learning alliances was to raise awareness about the MUS models on the ground among learning alliance members and others. Joint field visits appeared particularly convincing. Analysis and documentation of the cases, and simply giving a name to existing realities as a global research endeavour, contributed to the legitimacy of people's multiple uses from multiple sources and raised interest in their untapped potential for better service delivery. Having three or more successful cases within each country, rather than one anecdotal case, allowed some degree of generalisation and conceptualising MUS as a replicable 'model'[9].

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9 The different entry points in each country also led to somewhat different interpretations of what 'MUS' is. For example, in Colombia where *de facto* multiple uses of 'domestic' systems were studied, the term 'servicos' is avoided because this refers to formal taxable commercial activities. Given the informal character of small-scale water uses, the learning alliance refers to 'Systemas' and 'Usos Múltiples del Agua' as translation of

This awareness raising laid the foundation for the factual scaling up of the innovation through new policies and practices. Joint strategic analyses of the required institutional changes underpinned the next steps in the learning alliances. Experiences gained, in their turn, informed the analysis.

As mentioned in Section 1.4, scaling up MUS at intermediate, national and global levels was structured according to principles identified at intermediate level (participatory planning, coordinated long-term support, and strategic planning for scaling up) in order to organise the demand and respond to it. At national level, there should be enabling policies and laws and decentralised coordinated support. Such a supportive environment was expected to support homestead-scale MUS for all and, where relevant, community-scale MUS that considers the water- and landscapes of communities or sub-basins in a holistic way.

Across the eight countries, there was a wide variation in learning alliance composition, activities and outcomes. (see Table 4.1 for an overview of the 150 main learning alliance members). The most important reason for this variation was that CPWF-MUS partners and key members of the alliances belonged to different water service provider groups and the water service provider groups that were driving the learning alliances strongly influenced their further composition and dynamics. Water users, NGOs, the domestic sub-sector, the productive sub-sector, local government, and knowledge centres, each has its own starting point for moving towards homestead-scale and community-scale MUS. Accordingly, each has unique strengths and weaknesses in scaling up MUS. Indeed, an important finding was that all water service provider groups, except knowledge centres, could realise significant institutional innovation towards MUS independently, even strengthening their livelihood mandates. Knowledge centres required implementing agencies to realise change on the ground. Another finding was that some types of collaboration by a specific service provider group with other groups through the learning alliances were especially fruitful in creating a sum that was more than the addition of the components. In other words, the generalities that emerged from the very diverse learning alliances in CPWF-MUS were mostly related to the water service provider group.

The three intermediate-level and two national-level principles played a role in each of these constellations, but this was overshadowed by the importance of the different starting points and the unique strengths and weaknesses of the different service provider groups and their collaborations[10]. Hence, this chapter analyses learning alliance experiences from two perspectives: first, how did the various service provider groups scale up MUS on their own and, second, which collaborations created strong synergy towards an overall supportive environment for MUS? It should be borne in mind that

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'MUS'. In Thailand, where homestead cultivation for economic self-sufficiency was the entry point, multiple sources are obvious. In Nepal and India, affordable technologies for efficient productive water use were the entry point.

10 If time had allowed, CPWF-MUS would have translated these new insights into better principles of the learning wheel, in particular with regard to 'coordination'.

the learning alliances in these eight countries were all new collaborations and had been functioning for only two to three years. Financial resources were limited and spread thinly. Nevertheless, 'learning-by-doing' provided new insights on both questions and already led to some changes in the policies and practices of service providers. (For a detailed description of the learning alliance events in each country, see Butterworth et al., 2009.)

- **Users:** Section 4.2 analyses the various strategies of water users in scaling up water supply for multiple uses at homestead- and community-scale, as underpinned by the innovations of the Farmer Wisdom Network Thailand (with Khon Kaen University); Water for Food Movement South Africa (with IWMI); and communities and local provider Agua Tuya in Bolivia (with IRC).

- **NGOs:** Section 4.3 discusses generic insights derived from the efforts for scaling up MUS by innovators IDE in Nepal; various NGOs in Zimbabwe (with IRC); and CRS and partners in Ethiopia (with IWMI).

- **Domestic sub-sector:** Learning alliances with the domestic water supply programmes of PAAR (with Cinara) in Colombia and Jalswarajya/Aple Pani (with IDE) in Maharashtra highlighted generic strategies for scaling up MUS through the domestic sub-sector, as described in Section 4.4.

- **Productive sub-sectors:** In all countries, some learning alliance members belonged to the irrigation, livestock, or fisheries sub-sectors and highlight how scaling up of MUS through the productive sub-sectors took place. These generic lessons are summarised in Section 4.5.

- **Local government:** Integrating MUS in local government was the focus of the NGO AWARD in the learning alliance in South Africa. In Bolivia, Colombia, Ethiopia, Nepal, and Zimbabwe, local government was a key partner in the CPWF-MUS learning alliances, as discussed in Section 4.6.

- **Knowledge centres**: The role of CPWF-MUS knowledge centres in innovating steps to scale up MUS at intermediate and national level are discussed in Section 4.7. Section 4.8 concludes by describing CPWF-MUS activities for scaling up of MUS at global level.

Table 4.1. Main members of the learning alliances (lead institution in bold)

Area and focus of the learning alliance	User organisations, CBOs and local private service providers	NGOs	Government	Knowledge centres
Ethiopia **Dire Dawa** *woreda* (district) Case studies of NGO innovations in Dire Dawa district-level learning alliance	• Water users • Multi-purpose Service Cooperative of Legedini Peasant Association • Village committees • Independent consultants	• Harereghe Catholic Secretariat, supported by Catholic Relief Services	Dire Dawa Administrative Rural Council overseeing: • District Rural Development Bureau • Water, Mines and Energy office • Office of Agriculture • Office of Health	• **IWMI** • Haramaya University • Wageningen University • Overseas Development Institute
Nepal* **Middle Hills** MUS Innovation by an NGO programme, linking with government bodies and NGOs through district and national learning alliances	• National Federation of Water Irrigation Water User Associations Nepal (NFIWUAN) • Federation of Water and Sanitation Users Nepal (FEDWASUN) • Community water users committees	• **IDE Nepal and Winrock International** • SAPPROS • CEAPRED • WaterAid • NEWAH • others	District officers and national staff of Ministries, also member National SIMI Advisory board of: • Agriculture • Finance • Women, Children and Social Welfare • Local Development • Agro-Enterprise Centre • Rural Water Supply and Sanitation Fund Development Board • Department of Agriculture with District Agriculture Development Office • Department of Irrigation with the Non-Conventional Irrigation Technology project (NITP) • Ministry of Local Development with Department of Local Infrastructure and Agricultural Roads	• Kathmandu University • National Agricultural Research Council

Area and focus of the learning alliance	User organisations, CBOs and local private service providers	NGOs	Government	Knowledge centres
Zimbabwe Case studies on earlier MUS innovations in the Rural District Councils of **Marondera, Murehwa** and **Uzumba Maramba Pfungwe** (**UMP**) National learning alliance to consolidate MUS innovations		• **Institute of Water and Sanitation Development (IWSD)** • **Mvuramanzi Trust** • UNICEF, host of National Water and Environmental Sanitation Working Group (WES-WG) • Pump Aid • World Vision • Action Contre la Faim • Christian Care •	• Rural District Councils • Department of Irrigation • Inter-ministerial National Action Committee for Water and Sanitation (NAC)	• University of Zimbabwe • IRC
Bolivia **Cochabamba Valley** Awareness raising through case studies and scaling up MUS in Cochabamba Valley through a local private service provider	• User organisations from a number of communities • **Programa Agua Tuya** (provider of equipment and technical advice to communities) • Plastiforte (provider of piped and other construction material to communities)	• SNV • CIPCA • ANESAPA (capacity building network)	• Various Municipalities • PROMIC-BTC (a government catchment management programme) • SEMAPA (utility company) • CODESAB (water and sanitation board of Cochabamba, with municipalities, water cooperatives and major NGOs)	• Centro Agua (research centre at the Universidad Mayor de San Simón, Cochabamba) • CASA (research centre for water supply and quality) • IRC
Maharashtra* The districts of **Nasik**, **Ahmednagar** and **Aurangabad** Adoption of MUS by the government rural water supply programme, working closely with NGOs	• Village Water and Sanitation Committees • Women's Empowerment Committees • Social Audit Committees • Community members	• **IDE** • NGOs BSS, Adhar and Navnirman in Nasik District • NGOs SEVA, GARD, NISS, and WOTR in Ahmednagar District • Dilasa in Aurangabad District	• Jalswarajya/Aple Pani water supply programme • Tehsil Agriculture Government Officer in Nasik • Agriculture Technology Management Agency in Aurangabad	• Institute of Social Studies in Ahmednagar

Area and focus of the learning alliance	**User organisations, CBOs and local private service providers**	**NGOs**	**Government**	**Knowledge centres**
Colombia Learning alliance in **Valle del Cauca Department** and learning alliance in **Quindío** Department Awareness raising through case studies and adoption of MUS by PAAR (regional 'domestic' water supply programme) and other local organisations	• Representative of coffee growers • AQUACOL Association of 33 community organisations providing water and sanitation services • Mondomo Users Association • Montebello Users Association • RUT Restrepo-Union Trujillo Irrigation Users Association • ATUNCELA Irrigation Users Association • Golondrinas Users Association • Bellavista Users Association	• Plan International	• PAAR Rural Water Supply Programme for Valle del Cauca (pooling of public departmental and municipal resources and private resources managed by the private Coffee Association) • Departmental Secretary of Infrastructure Valle del Cauca • Departmental Secretary of Agriculture Valle del Cauca • Municipality of Buga • CVC Environmental Authority of Valle del Cauca Department • Contraloná General de la Republica (National Control Institution) • UMATA Unit for Agriculture Technical Assistance • Departmental Secretary of Planning Quindío • Departmental Secretary of Tourism Quindío • EPA Empresos Publicas de Armenia (public service provider in Armenia, Quindío) • CRQ Environmental Authority of Quindio Department. • CRC Environmental Authority of Cauca Department	• Universidad del Valle (**Cinara** and EIDENAR, the school of natural resources) • Universidad del Quindío • Universidad Javeriana (Group of water management) • CIAT International Centre for Tropical Agriculture - CEIAR Group (Watershed and community) • Universidad Nacional de Colombia – Sede Palmira (regional centre of the national university) • IRC

Area and focus of the learning alliance	User organisations, CBOs and local private service providers	NGOs	Government	Knowledge centres
N.E. Thailand Bottom up 'Farmer Wisdom Network' focuses on self-sufficiency and integrated farming. Network engages with national law-makers	• Local Wisdom Networks • Organic rice network • Other Farmer networks/groups	• Alternative agricultural network	• 30 Tambon (= district) administration organisations • 4 Changwat (= provincial) administration organisations • National Ministry of Agriculture with three regional offices of Land Development Department; and with two regional offices of Royal Department of Irrigation • National Ministry of Science and Technology with three regional offices of the Department of Water Resources	• Khon Kaen University
South Africa **Bushbuckridge** Local Municipality District learning alliance for integrating MUS in Integrated Development Plan in one ward with 11 villages, linked to national learning alliance	• Water users • Village water committees • Water for Food Movement • Consultants	• **AWARD** • World Vision • Mvula Trust	• Department of Agriculture with provincial office and district agricultural extension officers • Department of Water Affairs and Forestry with regional office and local operators • Department of Local Government and South African Local Government Association • Department of Health	• IWMI • Water Research Commission • University of Pretoria

* For an exhaustive list of learning alliance members in Maharashtra and Nepal, see Mikhail and Yoder (2008).

4.2 User-driven scaling up

4.2.1 Water users' mobilisation of integrated intermediate-level support

For water users, multiple uses from multiple sources are obvious and the main condition for improving access to water for multiple uses is appropriate private and public support at intermediate level. Water users in the learning alliances of CPWF-MUS adopted various strategies to mobilise such direct support for multiple uses. The 'illegal' use of single-use designed systems for multiple uses, which drove the global move towards MUS, also prevailed among members of the CPWF-MUS learning alliances. In Colombia in particular, widespread *de facto* multiple uses of 'domestic systems' were the basis for scaling up strategies through the domestic sub-sector (see 4.4).

In Zimbabwe, water users were the silent drivers of scaling up MUS by adopting, or not, new individual homestead-based technologies disseminated through NGOs, often paying full costs for e.g., rope-and-washer pumps (see 4.3).

Water users also demand private communal multiple-use systems wherever such private support is available. Private providers tend to be more client-oriented and offer such support. This was illustrated in the learning alliance in peri-urban Cochabamba, Bolivia. With the very rapid urbanisation, water demand in the peri-urban fringe areas of Cochabamba is rocketing and the utility cannot keep up with service delivery. Communities, who often already have a long tradition of communal systems, fill the void by investing in their own water supply systems in an incremental manner. They contract private suppliers and designers themselves, but many communities also struggle to get the designs right, to select the right technologies and to establish adequate tariff structures. For these purposes, they are seeking independent technical assistance, and in CPWF-MUS this was sourced from AguaTuya, a private sector enterprise, providing both equipment and technical advice to communities. However, the learning alliance around AguaTuya found that a greater level and greater variety of support was needed to scale up MUS, and their work extended into the creation of a Resource Centre for information exchange and for advice to water users. It also fostered linkages with the municipalities, so that they could directly support communities. Thus, the Bolivian case shows that water users have a role in scaling up through their own investments in water for multiple uses. Yet, it also shows that without long-term support by outside agencies, they cannot run services sustainably and cannot achieve larger scale services.

A last strategy at the interface of water users and service providers that emerged from the CPWF-MUS learning alliances was long-term 'service shopping'. This refers to communities' efforts over time to pick and pull together support components from whatever is on offer from projects of local government, NGOs and government programmes. In the learning alliance in Nepal, after centuries of water self-supply, communities had already identified options to improve their access to water. IDE/Winrock built upon these plans. Bringing together various pieces of support even became IDE/Winrock's strategy to mobilise a total budget for a new integrated system.

Over time communities built a network of relationships with service providers, in which those with local government were the most durable as NGOs might leave the area.

In Maharashtra's two CPWF-MUS case studies, the communities also tried to bring together pieces of support from different outside agencies to fit local conditions and needs. In these gradual processes, communities proactively built relationships of trust and reputation with external agencies, which become leverages for the next interactions. However, this search for collaboration was not necessarily equitable. In Samundi, a well-organised vocal group of poor women got the support, but in Kikwari, the respected village leader negotiated benefits for the wealthier hamlet, but less for the poorest people living at the edge of the village. Other CPWF-MUS experiences confirm how the most vocal, often men, find their way to public support, but the poor do not.

4.2.2 Water users' MUS advocacy movements

Well-organised users can play a significant role in 'outscaling' MUS among their own members (i.e. spreading the practice amongst people at the same level) and scaling up MUS to the highest policy levels. In CPWF-MUS this occurred in both the Farmer Wisdom Network in Thailand and the Water for Food Movement in Southern Africa. In these grassroots movements, water users with visionary leaders, are self-made planners and implementers of homestead-scale MUS. In both movements, leaders established their own 'model-farms' on the basis of indigenous knowledge and a life-time of experimentation and incremental improvements.

The main goal of both movements on the ground is broad outscaling through mutual service delivery. Continuous training at model farms, mobilisation and networking creates an ever expanding informal voluntary network. Both movements explicitly target small-scale users for this outscaling. The Farmer Wisdom Network in Thailand focuses on farm sizes of about 0.20 ha. The Water for Food Movement in Southern Africa explicitly targets the poorest of the poor or 'nobodies'. It emphasises how farming at and around the homestead is the most appropriate site where the poor, in particular women, can start taking control over their lives and natural environment.

Inspired by visits and workshops at the model farms new 'members' start experimenting step-by-step. Success in a small endeavour stimulates them to try a somewhat bigger challenge. The Farmer Wisdom Network further institutionalises coordinated support for learning through 'Learning Centres'. Of these, 36 were operating in 2008 and 130 more were planned for 2009. Contacts with experts are sought as needed, through Khon Kaen University or with local equipment providers, for e.g. exposure to new technologies. The Network has its own revolving fund for small loans for investments in ponds or related activities. The Water for Food Movement also organises workshops at its model farm for members from South Africa and Lesotho. Thus, water users outscale innovative homestead-scale MUS through their own body for mutual coordinated support.

Besides these continuing activities 'on the land', the second goal of both movements is to go 'to the sky' (in the words of the Thai Farmer Wisdom Network) for awareness about their model of homestead-scale MUS. Both movements explicitly target the highest-level policy makers and senior managers. Field visits to the model farms by national policy makers but also by lower-level regional, national and global senior managers, implementers, and researchers, drove the message further home. Quite a lot of senior policy makers and managers have welcomed the movements' practical solutions because they fit well with the flagship integrated policy goals of rural development. At this high level, intervention structures have not yet become compartmentalised into sectors.

In Thailand, this model of integrated farming with homestead ponds for 'economic sufficiency' has existed since 1987 with the crucial support of the King of Thailand. After the economic crisis of 1997, Thai policy makers emphasised this model with even more force. In South Africa, the post-apartheid government was open to innovation for rural development and poverty alleviation in order to redress inequities from the past. In both countries, the leaders of these grassroot movements have become respected formal and informal advisors of the highest-level government officials. A combination of political will and practical solutions raised awareness, ensured widespread legitimacy, and stimulated uptake. Both movements have become active advisors on related issues, such as new water legislation or initiatives for Knowledge Management that seek to better acknowledge local and indigenous knowledge.

The enabling policies and laws of Thailand and South Africa led to the acceptance of the homestead-scale MUS models at national level and to some support for further outscaling. However, as informal networks, their implementation capacity was relatively limited. Moreover, at the intermediate levels the problem of narrow mandates re-emerged. Support sometimes came with strings that were incompatible with the aims of the movement. For example, the Farmer Wisdom Network got support for mechanised excavators for the ponds, but that support prescribed rectangular ponds of a standard size, while variability in size and shape was required. In South Africa, the focus on genuine mobilisation and empowerment of the poorest, combined with limited implementation capacity of the small Water for Food movement, warranted a parallel implementation structure for the government's subsidised roll-out of the rainwater harvesting tank programme that was inspired by the movement.

At the intermediate levels, the Farmer Wisdom Network and the Water for Food Movement worked in a more ad-hoc way with governmental and non-governmental water service providers or watershed committees. They provided training on homestead-scale MUS or participated in forums to promote the 'multiple-uses, multiple sources' logic. While some individuals at intermediate level were very supportive, innovations like integrated farming hardly fit the single-use mandates and bureaucracies. This can turn this intermediate level into an impermeable 'clay-layer', albeit that they remain critical for long-term service delivery (Ruaysoongnern, personal communication).

4.3 NGO–driven scaling up

4.3.1 Technology NGOs

The relative independence of NGOs, their focus on livelihoods and the pragmatism of engineers contributed to original solutions to use water for livelihoods, overcoming the single-use focus that can also affect NGOs. This had inspired NGOs to become important MUS innovators even before CPWF-MUS. This was the case both among NGOs that innovate in small-scale technologies for multiple uses and for the larger poverty-focused (I)NGOs that fill the services gap left by governments without sufficient resources or implementation capacity. Both types of NGOs were also active in CPWF-MUS learning alliances.

The technology-innovator NGOs, which have the market and the public sector as main channels for scaling up, were key in the learning alliances in Zimbabwe and Nepal. The learning alliance in Zimbabwe used and boosted the momentum of individual technologies for homestead-scale MUS built up since the early 2000s in this country (Robinson et al., 2004). Various NGOs, such as PumpAid and Mvuramanzi Trust had innovated homestead-scale wells and rope-and-washer pumps to enable basic and intermediate service levels of MUS, or 'productive water uses at the household level' – as it was called in Zimbabwe. However, experiences with these technologies were not systematically shared among NGOs. The learning alliance aimed at analysing and documenting experiences with these innovations through an existing forum, the Water and Environmental Sanitation Working Group. This network, hosted by UNICEF and bringing together key stakeholders from the water sector including government, NGOs and UN bodies further endorsed MUS.

In Nepal, the NGOs IDE and Winrock International, through the Smallholder Irrigation Marketing Initiative (SIMI) project, had technological innovation as entry point, in particular the promotion of drip and sprinkler irrigation for high-value cash-crop vegetables. This was accompanied by interventions to add value to the crops, such as extension and marketing support. In the early 2000s, it appeared that about 75% of their clients used domestic water supplies for their gardens. In order to increase water availability, IDE started implementing 'hybrid' gravity-fed communal systems. The design was borrowed from the dominant technology for domestic water uses, but was designed with higher discharges. Groups of adjacent households applied for such support, through IDE or through local government.

The learning alliance driven by IDE/Winrock strategically sought to scale up MUS. A package of technology components was established so communities could choose, for example, between single or double storage tank and distribution networks, household or communal storage or both, and whether to include off-takes for hoses or taps, or spring protection. Generic step-wise participatory planning approaches were developed for scaling up within the organisation but also through partner organisations.

At intermediate level, the learning alliance strengthened IDE/Winrock's collaboration with the district local government and government line agencies and more permanent local NGOs. Training and stock-taking workshops were held to raise awareness and to develop the capacity of intermediate-level staff from IDE/Winrock and other intermediate-level agencies. Transparent selection criteria and synthesising guidelines were developed for scaling up among this broader group. 'MUS champions' among them appeared highly effective in creating this supportive environment. This not only contributed to support to communities with hybrid systems but also facilitated MUS being scaled up in many new communities. District government involvement in identifying beneficiary communities enhanced transparency in the allocation of public resources. Technical expertise was called in as needed, in particular from the District Agriculture Development Office, the District Local Infrastructure Development and Agricultural Roads or Water Supply and Sanitation Department. Communities' direct relationships with service providers were strengthened, so they can follow up in the future, e.g. for advice on technical maintenance and spare parts or to act as mediator for any conflicts.

Simultaneously with these intermediate-level activities, IDE/Winrock forged strategic partnerships at national level, raising awareness and negotiating the endorsement of district pilot projects through the SIMI Advisory Board, with representatives from all relevant national governmental, non-governmental, donor and water user organisations from the productive and domestic sub-sectors, local government, and social welfare departments. Well-attended national workshops were organised for Board members and other national stakeholders. Again, visits by national staff to functioning hybrid systems were particularly convincing. This exposure generated interest and led to national staff tolerating, if not actively endorsing, further piloting of hybrid systems. These signals from central levels encouraged district level officials to further engage in MUS pilots.

National scaling up of MUS keeps gaining momentum in Nepal. NGOs in the domestic sub-sector, like NEWAH, promote productive uses of conventional 'domestic' systems. The Asian Development Bank and Japanese International Cooperation Agency have taken up MUS linked to micro-irrigation technologies. Finland directly supports local government in implementing MUS, which include micro-scale hydropower. Perhaps most significantly, central government adjusted its policy to allow district-level agencies to receive and spend central funding for MUS. Indeed, the environment for MUS in Nepal is amongst the most supportive anywhere. This is even more remarkable because all community innovations occurred during the Maoist rebellions of the time, before the change in Nepal's political constellation in 2008. The openness of the new government for better water services is likely to lead to further scaling up of MUS.

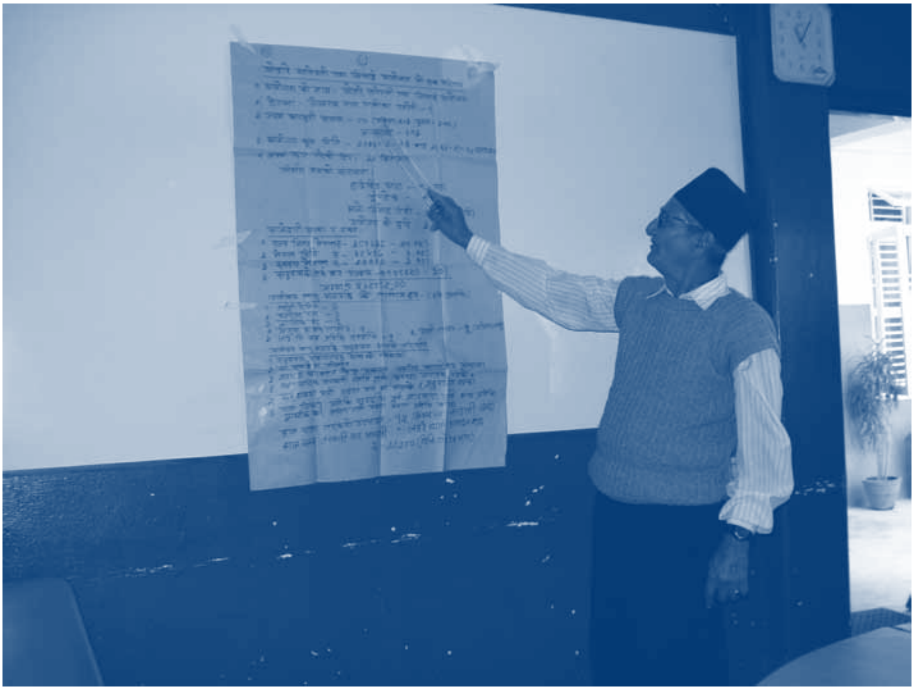

Figure 4.1. Member presenting at a learning alliance meeting in Nepal (photo: Bimala Colavito)

4.3.2 Large poverty-focused (I)NGOs

CPWF-MUS confirmed the innovative role that large (I)NGOs can play in homestead- and community-scale MUS and their strategies for scaling up, both within the own organisation and through collaboration with other stakeholders. (I)NGOs focus on poverty- and famine-relief, using water as a catalyst, and this renders them responsive to people's multiple water needs and opportunities to enhance livelihood benefits through e.g., hygiene education and extension. Thus, Catholic Relief Services (CRS) and its local partners in Ethiopia had already started piloting MUS in collaboration with IWMI in the early 2000s.

With considerable global resources, scaling up through its own CRS organisation and its global platforms is significant. Scaling up through collaboration at intermediate level has also occurred. In Ethiopia, CRS partners and other NGOs typically collaborate with rural administrative structures of Peasant Associations and Woredas (districts). Although CRS and similar (I)NGOs fill a void in service delivery that governments and water users are unable to fill because of lack of human, financial, technical and institutional resources, they also seek to integrate in local institutions. This avoids NGO interventions becoming what Schouten and Moriarty (2003) call "islands of success in an ocean of misery". The intermediate-level learning alliance in Dire Dawa area built upon these networks and undertook to raise awareness on MUS among district administrators, line agencies, technical officers and NGOs. Being close to the communities, the concept of MUS was readily accepted. Scaling up continued through a new collaboration led by ODI, with involvement of IRC and IWMI, through the RiPPLE (Research-inspired Policy and Practice Learning in Ethiopia and the Nile Region) Project (www.rippleethiopia.org). This project is hosted by the local partner of CRS in Dire Dawa.

Figure 4.2. Focus group discussion in Gorobiyo, Ethiopia (photo: Michiko Ebato)

4.4 Scaling up MUS by the domestic sub-sector

4.4.1 Domestic sub-sector agencies in the CPWF-MUS learning alliances

'The domestic sub-sector' refers to a variety of governmental and non-governmental international, national and local agencies, which work through government water, health and social welfare agencies and administrative local governments to provide services that formally explicitly encompass domestic uses and sanitation only. Collaboration with government structures, in particular local government, is usually already part of the structure of these programmes. The approach is often programmatic and much funding comes from international organisations.

There were representatives of the domestic sub-sector in the learning alliances of Bolivia, Ethiopia, and Nepal, but in Colombia, Maharashtra, and South Africa, the involvement of this sub-sector was particularly strong. In the Department of the Valle del Cauca, Colombia, a rural water supply programme PAAR, began with inputs from the regional government, local government, and other stakeholders. The objective of this programme was to improve rural water supply in the department. In this mountainous area with an annual rainfall of 1,500 mm, *de facto* multiple uses of 'domestic' systems are widespread. These domestic networks are intertwined with small-scale irrigation systems. However, this practice had so far largely gone unnoticed among sector agencies. Cinara, of the Universidad del Valle, forged a learning alliance with PAAR and others, to learn about dealing with multiple use in these *de facto* multiple-use systems at homestead- and community-scale. Awareness was created about these multiple uses through workshops, field visits, and case studies. The sites for these case studies were selected by the learning alliance members. Cinara also won an award for pilot social housing designs that included rainwater and grey-water use for small-scale productive activities. At national level, debates were initiated about national design and water quality norms.

In Maharashtra, IDE approached Jalswarajya/Aple Pani, an ongoing World Bank and German KfW funded water supply programme. This had adopted a participatory, demand-driven approach with ample involvement of local government and NGOs for capacity building for participatory planning, implementation and post-construction management. As in Nepal, IDE's entry point was the promotion of drip irrigation and other micro-technologies for water-saving small-scale production. However, in contrast to IDE's role in designing and implementing communal multiple-use systems in Nepal, in Maharashtra, Jalswarajya/Aple Pani controlled programme implementation. IDE used the learning alliance approach to create partnerships with local NGOs participating in the Jalswarajya/Aple Pani project to expand the reach.

In South Africa, the learning alliance linked the experiences of the Water for Food Movement and pilots with local government (see below) to national initiatives. The national Department of Water Affairs and Forestry (DWAF) and the Water Research Commission examined productive uses of 'domestic' systems and explored the option to increase the service level norms of Free Basic Water from 25 to 50 lpcd. The restrictive rule that directs Municipal Infrastructure Grants to focus narrowly only on domestic uses is being changed.

The following generic strategies emerged for scaling up homestead-scale MUS and community-scale MUS respectively if the domestic sub-sector is the starting point.

4.4.2 Scaling up homestead-scale MUS

The domestic sub-sector agencies in CPWF-MUS (as elsewhere) bring significant attributes required for massive scaling up of homestead-scale MUS.

i) The target group of the domestic sub-sector is typically everybody in a certain area, so including the poor.
ii) Delivery structures to realize this ambitious goal are increasingly universal and long-term, in particular by integration into local government as one of the services for decentralisation to this lowest level of government nowadays. Participatory planning is often also undertaken, e.g. by the Jalswarajya/Aple Pani programme, although participation is confined to the narrow parameters of domestic water uses only.

iii) The domestic sub-sector disposes over considerable financial resources, especially from international agencies.
iv) The sector brings engineering skills for constructing and managing water systems for small-scale uses near to homesteads, the obvious preferred site for domestic water uses.
v) They also contribute important expertise on how to turn water use into the livelihood outcome of health.
vi) The sub-sector's priority for improving domestic water uses near homesteads is echoed widely. It tallies well with at least two Millennium Development Goals: those related to gender equity and to providing basic access to safe water. This prioritisation of drinking water in particular is underscored at global level by the growing number of countries ratifying the declaration that access to water for domestic uses is a human right (UNCESCR, 2002). Communities and the learning alliances also endorsed the priority for basic domestic water uses.

The learning alliances focused on solving the main obstacle for further massive scaling up in the domestic sub-sector: the rigid norm, enshrined as mandate, that water from 'domestic' systems should only be used for drinking and other domestic purposes. This norm is anchored in low quantitative service level norms of, e.g. the sub-sector's own water ladder, and high water qualitative norms. These top-down norms shape entire investment programmes.

In all learning alliances, the starting point to change this mindset was awareness raising about the existing but hitherto ignored reality of productive uses of 'domestic' systems and the livelihood benefits this brought. The key argument was that, instead of the sub-sector's tendency to discard these uses as 'illegal' or even 'waste', the sector could immediately claim these livelihood successes as a direct result of their own investments. With a stroke of the pen and at no other cost than changing perspective, the sub-sector can change from focusing on the single water use alone to the livelihood benefits it brings.

Yet, even when this awareness raising was convincing, it was more difficult to achieve purposive planning for higher service levels for multiple uses and to contest the rigid norm that domestic systems can only be used for domestic purposes. The learning alliance in Colombia was able to negotiate such change. In their water-abundant intervention zone, PAAR service level norms were doubled and the size of intakes was increased (Cinara, 2007b).

In quite a few other situations, it was recognised that formal recognition and purposive planning of new systems for multiple uses was, in reality, an issue for the future only. Existing productive uses can be officially recognised and future uses can even be promoted because design norms are typically higher than the service level norms. Service level norms are 40 lpcd in India and the Jalswarajya/Aple Pani programme, and 25 lpcd in South Africa. In the water-abundant Departments in Colombia the norm of the water supply programme PAAR is 133 lpcd. Systems are over-designed in order to allow for future expansion, to meet demand from population growth and immigration, and to meet the criteria for targeted project life time, possible pipe breakages, leakage, efficiency of use, etc., all of them difficult to predict. Similarly, the design norms of Jalswarajya/Aple Pani programme were based on the projected population growth over the next 20 years. The programme's senior managers allowed IDE to experiment with MUS as a way to use this 'excess'. Similar arguments were heard in the learning alliances in Bolivia and Ethiopia. A study in South Africa about increasing service levels pointed out that DWAF always adhered to a standard of 60 lpcd for all bulk water infrastructure. "Many municipalities adhered to the standard, which will make the implementation of a higher level of water services standard and/or other services options much more feasible" (WRC, forthcoming)[11]. South Africa now further examines raising service levels for Free Basic Water to 50 lpcd and loosening restrictions that tie the Municipal Infrastructure Grants to domestic uses only.

One important issue in the debates to increase service levels for MUS concerned water quality, especially in the learning alliances in Colombia and South Africa. There was consensus that water used for drinking should be safe. For public piped communal systems, which are centrally treated, the circular reasoning was that expensively treated water cannot be 'wasted' for uses that do not require such high-quality water. The debate centred around the question whether *all* water delivered through 'domestic' systems, including that for flushing toilets and so on, should have this high drinking water quality, and if not, how water quality for drinking could still be safeguarded, possibly even better than now. This led to experiments with the various options that the domestic sub-sector itself is now promoting outlined in Chapter 3, including homestead-scale filtration or chemical treatment. Separately capturing and storing water for drinking and cooking through, e.g. roofwater harvesting, was widely practiced in Thailand, where tap water is typically avoided for drinking. Rainwater harvesting for drinking was also promoted by learning alliance members in Colombia and South Africa. The further adoption of decentralised water treatment for the 3–5 lpcd required for drinking would save the costs of treating water for domestic purposes that do not require such high standards and for all productive uses.

The other important issue in the debates to increase service levels for MUS concerned the priority of water for domestic uses by all, before others would start using water for productive uses. There was again consensus about the validity of such priority in all its facets. There are situations in which current promotion of productive uses would be unwise. In largely unserved areas, as in Ethiopia, or in under-designed and malfunctioning domestic systems as in South Africa, water quantities in current communal systems (but not in individual systems) are so limited that water use for

11 These quantities are also effectively taken up, as confirmed in a study by the Water Research Commission in South Africa (Main and Naidoo, 2008). This study found that households that were poor according to national definitions on average already use 62 lpcd, which is more than double the quantities formally accepted as basic human right for Free Basic Water of 25 lpcd. Half of these households use significant quantities of water for production that provide on average a quarter of household incomes.

productive purposes by upstream users is likely to deprive downstream users from water for even basic domestic water uses. Yet, even in such water-stressed situations there are opportunities for re-use of grey water.

In these and in less resource-constrained situations the debate focuses on the planning of new systems and rehabilitation. As for water quality issues, moving away from top-down norms to unpacking real-life approaches to achieving the same goals on the ground appeared fruitful. A closer look at the equity issues at stake, even in unserved areas, highlighted how new MUS could achieve the agreed priority for minimum domestic services for all even more cost-effectively, *in addition* to enabling productive uses that contribute to other Millennium Development Goals and the human right to use water to avoid starvation (UNCESCR, 2002). A better multiple-use service for the poor can be achieved within the total funds available for the millions of unserved people targeted by the domestic sub-sector.

As argued in the learning alliances (but not yet implemented), the main mechanism for better services within the available budget is better cost recovery from the income gained from productive uses. Even the poorest can at least partially cross-subsidise their domestic uses from income gained from productive uses – provided some markets are available. In low-income countries, costs are typically only designed to recover operation and maintenance costs, as the norm in both domestic and productive sub-sectors is to subsidise hardware. Capacity building is needed to help communities learn how to operate and maintain their subsidised systems from tariffs. But capacity building for such operation and maintenance is needed anyhow, and cost recovery is the key to sustainability. Thus, MUS can be an incentive for both public service providers and communities to take cost recovery seriously, on top of realising higher livelihood benefits and further contributing to achieving the MDGs among the poorest and unserved.

Another important mechanism to ensure MUS for the poorest that was noted in the learning alliances (but also not implemented to any great degree) was to take targeting more seriously. In a sense, the poor need the better services of MUS even more than the non-poor. Being poor is even more reason to be entitled to a service for all one's water needs. The problem is that public services of any kind hardly reach the poorest and that much of the funding mobilised in their name 'leaks' to the less poor. The other side of the coin is that opportunities to offer better services to the people who are able and willing to pay for such better service are hardly tapped, because subsidies only cater for mediocre services for all. Yet, differential tariffs for differential services could free up money to provide the poor with better MUS.

A third and potentially most powerful mechanism to ensure that domestic use is made a priority, is to end the way that this concern is only an issue within the domestic sub-sector. People's priority for domestic uses should be mainstreamed among all water sub-sectors and formally become the cross-cutting priority for all water professionals.

4.4.3 Scaling up community-scale MUS

In their engagement with the communal systems of the domestic sub-sector, the learning alliances in Colombia and Maharashtra 'naturally' moved up from homesteads as sites of end uses to community-scale water management issues, intertwined with productive uses. In Colombia, participatory design for MUS, reduction of water wastage through leakages in entire areas, handling upstream-downstream issues and widening up technology options all warranted an integrated view on water development and management at community-scale (Cinara, 2007c). Cinara, PAAR and other learning alliance members continue to promote these community-level innovations, among others, through funding from the government of Colombia for action research on Integrated Water Resources Management. The Water and Sanitation Program (supported by the World Bank) also commissioned a survey on MUS in Colombia in collaboration with Stanford University. Findings from these pilot studies will further inform global awareness raising on both homestead- and community-scale MUS as applications for IWRM at the lowest levels.

In Maharashtra, the learning alliance which started at homesteads soon realised the merits of moving up to the community scale. At this level, the community of Kikwari had already tried to make optimal use of available resources, e.g. by recycling grey water to irrigate a communal women's garden. Water audits, led by other NGOs, provided a holistic understanding of groundwater resources depletion and highlighted that everybody using 50-100 lpcd would put less strain on water resources than a few large-scale sugarcane farms. As realised by water service providers in this area (but not explicitly scaled up), water scarcity further underscores how allocating water, financial and other resources for any use is a community-scale issue. Yet, support agencies from the productive sub-sectors here did not always recognise, let alone prioritise domestic uses.

4.5 Scaling up MUS by the productive sub-sectors

4.5.1 Productive sub-sector agencies in the CPWF-MUS learning alliances

The productive sub-sectors concern themselves with water for agriculture, livestock, forestry, fisheries and other rural and peri-urban productive activities. For this, they focus primarily on water for fields for supposedly single uses by plants and trees, and on village streams, canals and storage reservoirs for multiple uses, in particular for irrigation, livestock watering, fisheries, milling, small-scale hydro-power, or navigation. Representatives from the governmental productive sub-sectors in the CPWF-MUS learning alliances included irrigation engineers, hydrologists, technicians and agronomists of the national ministries of agriculture, public works, or water resources management, private consultancy firms, and researchers. A few private technology dealers for such things as mechanised groundwater irrigation or other equipment, which operate largely informally, also participated.

In the learning alliances in Thailand, South Africa, and Ethiopia, the productive sub-sectors engaged in homestead pond development and small-scale irrigation. In

Nepal, the agricultural and irrigation officers were very active in the learning alliance promoting hybrid systems. There were also other contributions in the learning alliances, e.g. from the livestock sector in Colombia or fisheries in Thailand.

The attributes that the productive sub-sectors bring to enhance the supportive environment for MUS at scale are, first, financial. Although support packages from the productive sub-sectors have declined, they remain substantial, and in sub-Saharan Africa support is now reviving. Second, the productive sub-sectors provide expertise on how to render water use more productive. They can build capacity for varying issues, such as soil management, crop and seed choice, yield increase, livestock health, aquaculture, fruit tree growing, and processing and marketing of produce. Third, the productive sub-sectors bring engineering expertise to abstract, store and convey water. For this, the productive sub-sector focuses on much larger quantities of water than the domestic sub-sector, often targeting one or more communities or sub-basins.

Unlike the domestic sub-sector, with its clear service mandate to reach everybody and the poor and poorest in particular, the mandate of governmental productive sub-sectors is less explicit, and the sector commonly works primarily with those who already have some assets, such as land, or market access. Similarly, delivery structures in the productive sub-sectors are less widespread. Larger projects are area-specific and tend to run in parallel to local government, with little post-construction support. Yet, technicians are also increasingly attached to local government, as reflected by the members of the learning alliances in Nepal, Bolivia, Ethiopia, and Zimbabwe. This ensures a wider coverage in providing support on request.

MUS innovations by the productive sub-sector actors concerned both homestead-scale MUS and community-scale MUS. (CPWF-MUS did not focus on productive use at field level).

4.5.2 Scaling up homestead-scale MUS

In the learning alliance in Nepal, agricultural and irrigation officers overcame the important obstacle for the sector's recognition of homestead-scale MUS, which is that the homestead is often seen as too small-scale for significant production. Some officers became MUS champions after observing the much shorter construction periods and the quick benefits from the hybrid systems. Their engineering expertise for larger quantities of water, and in-kind support such as pipes, was instrumental in implementing and scaling up MUS to other communities in their districts. They also provided extension training and helped homestead-level users to establish better marketing linkages, enhancing their productivity and income.

A similar growing appreciation for the homestead as a site of production was found in governmental productive sub-sector support for ponds. In Thailand, the national Department of Agriculture supported the Farmer Wisdom Network. In South Africa, field-tested models for homestead-scale MUS, which included storage tanks for run-off and roofwater harvesting, were rolled-out through DWAF and the Department of Agriculture.

However, the risks of top-down government programmes with limited participation hold for homestead ponds as well. This was observed in Ethiopia where only a small proportion of the newly dug farm ponds were actually used. After some years of learning-by-doing, the programme only continued in areas where water resources were sufficient and where ponds were successful.

Yet, in these efforts to promote homestead-scale production, there was little effort to seek synergies with domestic sub-sector agencies. Domestic water uses were certainly not seen as a cross-cutting priority of all sectors, on the contrary. There was even the fear, e.g., in South Africa, that encouraging any water development for use at homesteads would be seen as 'stimulating people to drink unsafe water'. As mentioned before, this lack of collaboration even led to the unexpected use of run-off tanks as storage tanks for the 'domestic' supplies. Like the domestic sub-sector, the productive sub-sector also hesitates to claim livelihood benefits that are derived from other uses of the same water sources, even though it is well known that having more water is often more important for health than having very limited quantities of high quality water.

In sum, promoting water use for homestead-scale production is a powerful new way for the productive sub-sectors to pursue more equity within the sector's current mandate. Technically, the sector can well provide for the water quantities required, which are very small for very small-scale farming from the sub-sector's perspective. There is a major untapped opportunity to adopt domestic water uses as a cross-cutting priority. This would allow financial resources and engineering expertise to be pooled with the domestic sub-sector and would considerably enhance services for the same total costs.

4.5.3 Community-scale MUS

Whereas homesteads are the entry point for the domestic sub-sector, which then 'moves up' to the community scale, the community scale is the natural entry point for the productive sub-sectors' communal water provision, which then 'moves down' to the homestead scale and other sites of use. Unlike NGOs, representatives from the governmental productive sub-sectors in the learning alliances in CPWF-MUS did not focus on community-scale MUS as potential entry point of the productive sub-sectors. Yet, a route towards community-scale MUS, similar to that taken by NGOs, is potentially open to governments as well. In areas with communal surface water systems, this would imply that the irrigation sector's well-documented tolerance or encouragement of non-irrigation uses of its canals, storage, or seepage groundwater, could widen up to full-fledged community-scale MUS. If domestic uses at preferred sites would be mainstreamed as a priority, the homestead would be recognised as the preferred site for productive *and* domestic water uses. Water would be moved to homesteads for multiple uses instead of requiring women and girls to travel to canals to collect it. Similarly, cattle watering points would be designed at preferred sites, and other non-irrigation uses would be included at other sites.

In non-irrigated areas, community-scale MUS could equally be the starting point of government sub-sectors. Streams and storage would be planned for multiple uses with water delivery to all sites where it is used. Community-scale synergies could be exploited by combining multiple sources, re-using water; and sharing intakes, storage and conveyance infrastructure. Preferences for sites for new water development or rehabilitation would not be dictated by predetermined single-use mandates, but decided upon by community members (women and men). Expertise to render water use more productive and beneficial would remain sector-based. As productive sub-sectors move towards delivering community-scale MUS, local government would become increasingly important for sustainability and scaling up just as it is for other service providers.

4.6 Scaling up MUS by local government

4.6.1 Local government in the South African learning alliance

This book has already touched upon various roles of local government in the respective learning alliances. In the South Africa site, CPWF-MUS focused in detail on local government as driver of implementing and scaling up MUS across its area. This section first presents this case study. This is followed by a more general discussion of the other experiences in the CPWF-MUS learning alliances. Together, this shows their potentially pivotal role, but also the current lack of capacity for local government to lead the creation of a long-term supportive environment for implementing MUS at scale.

In South Africa, the NGO AWARD conducted action-research to develop a replicable methodology for integration of MUS into the planning instrument of local government: the Integrated Development Plan. This was implemented through a district-level learning alliance bringing together representatives of 11 villages of Ward 33 (previously Ward 16) in the Bushbuckridge municipality, as well as local government officials and representatives of other agencies working in this area. The MUS concept was explained and was easily understood. Participatory assessments of water resources, infrastructure, institutions, uses and livelihoods were made. On this basis, needs were identified and prioritised and then proposed for inclusion in the Integrated Development Plan. The specific requirements of the vulnerable were articulated, so that the intention of 'reaching all' did not remain an abstract claim, but actually included the poor. The Bushbuckridge municipality included the plan in its Integrated Development Plan. AWARD secured funding for continued pilot testing and outscaling, and for the technical aspects of engineering design and implementation. The district mayor committed himself to support scaling up the same methodology in his other municipalities. The involvement of high-level water officials is envisaged in these further pilots at larger scales.

Figure 4.3. Local government staff at learning alliance meeting in Bushbuckridge, South Africa (photo: Stef Smits)

These district-level experiences were shared in the national-level learning alliance. This contributed to DWAF's initiative to compile guidelines for local government that will enable municipal officials to adjudicate on MUS proposals and to provide a practical guide for implementation (DWAF, 2006). As already mentioned, the earmarks for Municipal Infrastructure Grants, which used to be confined to domestic uses only, are being widened.

On the ground, the main bottleneck was lack of time because of pressure to deliver through a plethora of parallel operating structures and initiatives. There is also confusion about institutional responsibilities for who does what on the ground. In South Africa, post-apartheid local government in former homelands are even newer institutions than elsewhere in sub-Saharan Africa, and responsibilities are still being devolved. This confusion has rendered the power of communities to hold service providers accountable even weaker – although the learning alliance was successful in contacting lower-level service providers and attracting their support. As local government receives resources from above in otherwise deprived areas, power struggles and the pursuit of personal gains in accessing the resources and job opportunities are almost unavoidable. Party politics further fuel turf wars and influence resource allocation to party members. As a learning alliance member in South Africa commented: "Development is political, and politics stops development." This experience shows that local government has the mandate to integrate service delivery and is willing to do so. However, it still lacks in capacity for genuine participatory planning and implementation, so NGOs or CBOs are still needed to assist in planning for MUS. Moreover, the many top-down defined and parallel operating programmes, which all seek to be implemented through local government, leave little room for local government to plan the development of services from the bottom up.

4.6.2 Local government in the other learning alliances

The experiences with local government in other CPWF-MUS learning alliances confirmed the potential critical role of local government in scaling up MUS but also highlighted similar challenges as in South Africa in realising this role. Local government is becoming increasingly important across the globe for decentralised service delivery for many services including water. Decentralisation better allows the integrated and localised needs of MUS to be addressed. Because of its permanent and all-encompassing role, local government is best placed to lead planning for MUS in its area of jurisdiction. Its mandate is to match the integrated needs of the entire constituency with the range of public services available. Indeed, in all learning alliances, local government officials appeared very open to the concept of MUS as they realised how it can meet their constituents' needs.

As the government arm that is closest to the people, iterative participatory planning is feasible. Participation and accountability are strengthened by democratic elections which allow constituencies to exert, in principle, some power to demand accountability, transparency and fair allocation of funds for effective service delivery. Local government has the most intimate and holistic knowledge of the communities and their needs, the history, socio-economic, cultural and physical conditions, and past and current 'projects' of government and NGOs. This includes knowledge about water resources, infrastructure, uses and users and people's multiple water needs, although this knowledge is neither systematically collected nor documented in, e.g. village water development plans or municipal databases. The generic guidelines for scaling up participatory design, as developed in Nepal (by IDE/Winrock) and Colombia (by Cinara) capacitate local government to this end. Where communities themselves are sufficiently well organised to articulate their needs and hold local government accountable, support can become highly effective.

However, politicisation is a widespread problem, especially as water projects are generally appreciated and considered one of the powerful issues that influence votes. Politics in the best sense is about prioritising and implementing initiatives that extend people's ability to improve their livelihoods, especially for those who are usually excluded. Politicisation can however, substitute favouritism and vote catching for this process. The greater the level of participatory processes and transparency at local government level, the less likely it is that priorities and plans will be distorted in this way, and the more likely it is that the political process will support the development of people-centred (and therefore multiple-use) water services.

Local government coordinates external support by fair and transparent allocation of resources among their constituencies. Even in Ethiopia, the under-resourced local government ensures that various agencies operate in different areas to avoid overlap or undue concentration of public resources in few areas only. In Nepal, local government directed IDE/Winrock to communities. In Maharashtra, local government equitably spread the information on how to apply for projects by Jalswarajya/Aple Pani.

If local government has sufficient resources, it can respond to people's multiple water needs by providing a holistic support package. Besides providing financial, technical, and institutional support for multiple-use systems, local government can also, e.g. mediate in water rights registration, as highlighted in Nepal, or in the creation of water user associations or cooperatives. It can also be called in as arbiter of last resort in local conflicts. Ideally, local government's support can be tailor-made. Budgets can be put together from various sources, as in Nepal. Also, the arrangement that attaches technicians of line agencies (irrigation, health) to provincial or district government bodies, as in Bolivia and Nepal, allows their expertise to be called in as needed. So, in principle, local government can tap the opportunities of MUS, such as integrating existing infrastructure as sunk costs, sharing intakes, storage and conveyance and efficiencies of combining multiple sources over time.

Moreover, local government's support can extend beyond the life-cycle of a particular project. When projects close and leave, local government is permanently present and the first to face the need for support when infrastructure breaks down or internal conflicts stifle water committees. When local government facilitates direct relationships between communities and public or private service providers, communities get a more active stake in the evolving sustainable network that can support MUS at scale.

However, performing these roles requires financial resources and human skills. In the CPWF-MUS cases, only better-off countries like Bolivia, Colombia, and South Africa have degree of these resources. Water users in Bolivia can receive financial and technical support from local government for communal water systems. Elsewhere, local government usually has insufficient resources and capacity to lead participatory planning processes of water projects compared for example with NGOs, which often have more time and resources for this. Also, few projects allocate resources to local government for after-care.

This general lack of resources and skills is often compounded by the inefficiencies of fragmented top-down services. Local government's strong dependency upon outside sources of funding, each with their own conditions and planning cycles, hampers effective coordinated support. Local government has to work within the frameworks, funding streams and targets of sub-sectors, under which circumstances achieving true integration remains difficult. Sectoral boundaries are often cloned at decentralised level. Even in the integrated development planning of South Africa, such plans easily become a long list of all sub-sectoral plans without integration. In districts in Colombia there are agricultural and domestic water supply units. They often have their own separate programmes, with corresponding intervention methodologies, targets, funding streams and performance indicators. Even if horizontal and vertical coordination structures are put in place, problems remain. Zimbabwe in the 1990s was an example. A District Water and Sanitation Sub-Committee (DWSSC) coordinated the inputs of line agencies and NGOs at district level, and this mechanism was reflected at national level committees of the Integrated Rural Water Supply and Sanitation Programme (IRWSSP). Yet, overall control remained in the hands of the line ministries. Thus, the Ministry of Health remained responsible for sanitation and shallow or deeper wells at homesteads. The Ministry of Water Development and the District Development Fund (an agency under the Ministry of Local Government) were responsible for communal boreholes and deep wells. The Ministry of Agriculture, Local Government and Community Development was responsible, among others tasks, for the coordination of water and sanitation projects (Robinson et al., 2004).

Making the role of local government more effective requires more resources and capacity development, but also changes in national regulations and policies and their corresponding institutional arrangements. Decentralisation of decision-making is key for coordinating support for MUS. National government remains essential in mobilising and channelling sufficient support packages for MUS from treasury, international donors and financing agencies, but decision-making needs to be decentralised. If this happens, MUS can be implemented at scale. This is shown in Nepal, which has become a global front-runner. Here, national guidelines explicitly include MUS in activities which are eligible for support and funding by local government.

4.7 Scaling up MUS by knowledge centres

The final water service provider group in CPWF-MUS learning alliances are the knowledge centres, i.e. organisations that do not provide water services directly but that develop and share knowledge on water management. In CPWF-MUS these were the Challenge Program on Water and Food, IWMI, IRC, Cinara (Colombia), Centro-Agua (Bolivia), Khon Kaen University (Thailand), Mekelle University (Ethiopia) and national partners such as the Water Research Commission in South Africa. They played various specific roles in innovating and scaling up MUS.

Knowledge centres brought expertise and resources for conceptualising MUS as a generic and globally valid thing; analysing, reporting and providing feedback to communities through case studies; structuring knowledge generation through a common framework; and comparing results for generic conclusions. Conceptualising and naming existing practices of multiple uses from multiple sources and identifying untapped potentials of service provision to that end strengthened the legitimacy of MUS across the globe, not least among those who were already working on MUS. The fact that CPWF-MUS was a global project further underscored the generic validity and, hence, legitimacy of MUS.

Knowledge centres also supported the implementing partners in CPWF-MUS. Through the jointly developed MUS conceptual framework, all CPWF-MUS partners focused on similar issues of 'how to' implement and scale up MUS. Implementing agencies have in-depth knowledge and skills to realise principles and bring about an impact on livelihoods. However, they often lack the time and sometimes also the skills to reflect, analyse, and document this knowledge. Researchers helped to draw out and make this knowledge explicit.

Knowledge centres facilitated the learning alliances and mediated among members, and also mediated vertically between communities and authorities. The documentation of learning processes is complex and time-consuming and requires analytical and writing skills that knowledge centres can bring.

Communities in the CPWF-MUS sites not only benefited from their multiple-use systems but also from the feedback they received from knowledge centres. Some communities solicited technical support from knowledge centres, such as Khon Kaen University in Thailand.

A total of 37 M.Sc. students also participated in CPWF-MUS, and MUS curriculums were developed by Centro-Agua and Cinara. By these means, new insights are transferred to the next generation of professionals.

Knowledge centres engaged in policy dialogue, networking and dissemination with intermediate, national and global level policy makers, financing agencies, implementers and academia. This dialogue was about MUS concepts, the legitimacy of MUS, the validity of field-tested generic solutions and policy recommendations for implementation. As a global project, CPWF-MUS aimed at influencing debates and practices at the highest tier of a supportive environment for MUS: the global level.

4.8 Scaling up MUS at global level

Last but not least, without calling it a 'global learning alliance', CPWF-MUS also aimed at contributing to the creation of a sustainable critical mass among global stakeholders that could change policies and practices towards MUS. Global financing agencies, donors, UN bodies, international NGOs and research institutes, and professional networks are highly influential but often reproduce sectoral boundaries in a top-down manner. The main thrust of CPWF-MUS global activities was to raise awareness and interest in MUS and its untapped potential. Perhaps the greatest impact of CPWF-MUS has been that a global vocabulary and common language is emerging to name the most common features of 'MUS', *de facto* multiple uses of single-use designed systems, domestic-plus, irrigation-plus, homestead-scale MUS and community-scale MUS.

The creation of a critical mass requires relationships beyond the time-bound CPWF-MUS project. Most partners of CPWF-MUS became members of a permanent network of professionals: the MUS Group. This network has over 300 members from both the domestic and productive sub-sectors. It has a core membership including ODI (Overseas Development Institute), IWMI, PumpAid, WEDC (Water, Engineering and Development Centre), Cinara, Plan International, Winrock International, SEI, Rain Foundation, World Fish Center, IFAD and IRC, which hosts the secretariat. The Group acts both as a think-tank and advocacy and dissemination platform. It (co)organises events at international events, organises regular meetings of its membership and provides information products such as a newsletter and website. In 2008, the MUS Group organised with the RiPPLE project an International Symposium for taking stock of achievements and challenges after five years work on MUS.

Strategic partnerships were forged by convening a session on MUS during the 4th World Water Forum in Mexico in 2006, in which local actions and emerging generic conclusions were presented. The Technical Committee of the Global Water Partnership was a co-convenor. The expert panel consisted of representatives of the Water and Sanitation Program of the World Bank (WSP), International Committee for Irrigation and Drainage, African Development Bank, Winrock International, and government officials from Colombia and South Africa. This highlighted how various agencies have committed themselves to MUS. For example, the coordinator of the Water and Sanitation Program compared the shift towards MUS in the domestic sector with the changes in the 1980s when, once and forever, sanitation became part and parcel of domestic water supply provision. The synthesis report of the World Water Forum endorsed the recommendations from this topic session by stating "In an integrated 'multiple-use water services approach' people's multiple domestic and productive water needs are taken as a starting point and the sector-barriers within the water sector are dissolved. This form of Integrated Water Resources Management, at the level of the household or the community or a number of communities, is a highly appropriate and cost-effective way to contribute to achieving the Millennium Development Goals" (Martínez and Van Hofwegen (eds), 2006).

The partnerships had become much broader by the time of the 5th World Water Forum in Istanbul in 2009. The Topic Session on MUS involved many new partners and was convened by FAO as the chair of UN Water in collaboration with the MUS Group, IFAD, the International Network of Water and Ecosystems in Paddy Fields, IWMI and CPWF-MUS.

Although it is difficult to attribute impacts, CPWF-MUS partners actively engaged in a growing number of initiatives across the water sector that together put MUS on the radars of a range of professional networks, development and financing organisations, and research institutions from the domestic and productive sub-sectors and general rural development agencies[12]. The Comprehensive Assessment of Water Management

12 Initiatives in which CPWF-MUS partners participated include a policy brief on MUS by the Global Water Partnership, opinion leader on Integrated Water Resources Management, in collaboration with CPWF-MUS and IRC (IWMI/IRC/GWP, 2007). MUS sessions were organised at the Stockholm Water Weeks of 2006 and 2007. The International Committee of Irrigation and Drainage included 'MUS' in its Poverty Task Force. IFAD highlights MUS in its gender strategy (Wahaj, 2007) and FAO, in collaboration with IFAD, promotes MUS in its report on poverty and water (Faurès and Santini, 2008). UNICEF, through Winrock International, provides support for implementing MUS at scale in India. The Water Supply and Sanitation Collaborative Council, FAO and CPWF provide financial support to the MUS Group.

in Agriculture (Molden, 2007) also refers to MUS. This multi-institute assessment of the past 50 years of water development, current challenges and solutions recommends "multiple-use systems - operated for domestic use, crop production, aquaculture, agroforestry, and livestock as one of new stimulating ideas on how to manage water resources to meet the growing needs for agricultural products, to help reduce poverty and food insecurity, and to contribute to environmental sustainability". The Challenge Program on Water and Food itself takes MUS forward as an important topic for its second phase.

Thus, in a few years, the global environment has become considerably more aware of and supportive of the potential merits of MUS. Strongly influenced by this global environment, MUS implementation is taken forward at larger scales in Colombia, Ethiopia, Nepal, South Africa, Thailand, and by UNICEF/Winrock in India.

4.9 Conclusions for creating a supportive environment for scaling up MUS

Through learning alliances in the eight CPWF-MUS countries, 150 water service provider groups piloted ways to change the supportive environment at intermediate and national level so that MUS is widely replicated and reaches everybody. Strategies varied for each water service provider group, as the starting points and related opportunities and obstacles were different. Yet, once sectoral mindsets were overcome, surprisingly little appeared as an obstacle for any service provider group to adopt community-scale MUS and homestead-scale MUS, which is a common water development priority of community members, certainly the women. For all service providers, moving to MUS better matches clients' multiple water needs and the integrated nature of water. The pathways for the various service provider groups that converge to offer MUS differ as follows.

For water users, user associations and local private providers, making multiple use of water from multiple sources is obvious. The livelihoods focus of NGOs have also stimulated NGOs to take multiple water needs as a driver for homestead-scale MUS (or field-level MUS for that matter) and for community-scale MUS according to communities' priorities in a given context.

For the domestic sub-sector, there is not much in the way of incentives either to move them towards homestead-scale or community-scale MUS. The mandate of the domestic sub-sector needs to be widened to provide for intermediate and high-scale homestead-scale MUS so that other basic livelihood improvements are included. Often, those livelihood improvements are already realised without the sub-sector appreciating its own success in this regard. Moving up to community-scale MUS is justified because various issues can be addressed more adequately at that level than by mainly focusing on the site of end use. So adopting MUS would mainly require the augmentation of service levels. Often, there is not even any need to change design norms in the short-term. The water quality standards for the 3 lpcd required for drinking should be safeguarded, without worrying about providing such high quality water for uses that do not need it. The sub-sector's health expertise remains important here. Admittedly, adopting MUS is more expensive than providing lower service levels for domestic uses only. Within a given budget (without pooling resources with the productive sub-sectors) this could reduce the number of beneficiaries. However, this can be overcome by better cost recovery through fees that can be paid from the extra income they make from their productive activities. Furthermore, those who can pay can be asked to cross-subsidise water for multiple uses for the poorest people in communities.

The productive sub-sectors can immediately adopt MUS by including the homestead as a hitherto overlooked site of production. Moreover, domestic sub-sector's priority for domestic uses can be mainstreamed in the productive sector, taking charge of delivering water for multiple uses. For the productive sector, it would open up new opportunities to target the poor, to empower women, and to assist the sick and vulnerable. The productive sub-sectors are already engaged in multiple direct uses of open water in community-scale infrastructure and storage. The sub-sectors' engineering expertise for developing and managing larger quantities of water and their expertise on how to get more produce and income out of productive water uses remain this sector's unique contribution.

All three professional water service provider groups (NGOs, the domestic sub-sector and productive sub-sectors) would greatly benefit from a better interface with communities through which support can be provided. Such improvement is especially needed to ensure accountability of service providers downwards (a key condition for sustainability of services), and for full exploitation of local knowledge. This would also provide an avenue for transparency in the allocation of public resources, pooling resources in cash, kind and technical resources from communities and other service providers, and for tapping economies of scale in service provision. Last but not least, such an interface needs to be sustainable over time so that the many post-construction issues that seriously threaten the sustainability of systems can be addressed (such as spare parts, cost-recovery enforcement and conflict resolution). In the rare 'luxury' cases where several agencies from any sector 'compete' with each other to provide services to the same beneficiaries, pooling resources for infrastructure development and management allows them to deliver better services together than the sum of the services that each agency can deliver alone.

Local government has the mandate for such role. Fulfilling that role would institutionalise participatory planning, ensuring that each community could get the coordinated long-term support it needs, and ensure that all the fragmented components of support on offer at intermediate level were brought together strategically and efficiently, with a long-term perspective, instead of the adhoc crisis management that many local government officials face today. Local government needs to be supported and empowered to fulfil such role. This requires national and global level agencies to support intermediate-level players in their overall mission to bring rural development and poverty alleviation, and avoid politicisation. Decision-making about the support that is needed and how to pull it together needs to be decentralised.

A first step for such empowerment is the removal of artificial conditions that burden local government with bureaucratic tasks and block opportunities for integrated service delivery. Notions of separate 'domestic' water and 'productive' water and technologies create such artificial and counterproductive conditions.

5 Conclusions and recommendations

5.1 Conclusions on MUS principles and issues

5.1.1 Introduction

Over the past few years, multiple-use services have gained increasing recognition as an approach to water services that can better meet people's needs in rural and peri-urban areas in low- and middle-income countries. In this book, we analysed how such services can be provided at community level, and how they can be supported and scaled up by intermediate and national level actors. The evidence for this came from action research conducted at 30 sites in eight countries. The wide range of physical, socioeconomic and institutional contexts demonstrated the diversity of MUS. In order to compare findings and derive generic conclusions, a MUS conceptual framework was developed consisting of 'principles', which are the key conditions that need to be in place in order to implement and scale up MUS.

In communities, CPWF-MUS innovated and tested two models of MUS at homestead- and community-scale. For scaling up, CPWF-MUS forged learning alliances in each country, consisting of (local) government agencies, NGOs, private service providers and research centres. Learning alliances initiated the scaling up of MUS models at intermediate and national levels in order to create a supportive environment for delivering MUS to all rural and peri-urban water users. The learning alliances identified a number of promising pathways for such institutional reform.

5.1.2 Conclusions on MUS models

The five principles that need to be in place to implement MUS on the ground included livelihoods as the driver and four other principles that together determined access to water at a specific site of use: technologies, institutions, financing and sustainable water resources. In the course of the project, it was realised that differentiating according to site of use and scale of water management considerably clarified issues at stake. Accordingly, a distinction was made between homestead-scale MUS and community-scale MUS. Homestead-scale MUS refers to water provision to homesteads and surrounding areas both from water sources at the homestead and from communal sources. All CPWF-MUS sites included homesteads as a site of multiple water uses. This evidence underpinned the model for homestead-scale MUS. Community-scale MUS, or important components, were piloted in two thirds of the cases. This takes people as the entry point for services delivery, considering in an integrated manner technologies and institutions for system management to meet the needs of all water users at multiple sites for multiple uses. So community-scale MUS includes (usually multiple) water uses at homesteads and (multiple or single use) in fields. Natural water sources and human-made systems can channel water to homesteads or fields or both and can also be used directly (for multiple uses such as fishing, laundry, livestock watering). At community-scale, interventions by all water sub-sectors at any site and for any use by the same community *de facto* come together. This includes irrigation-plus, village reservoirs, fisheries, livestock watering, navigation, milling, hydro-power, or approaches like watershed management. Instead of becoming 'add-ons' in domestic-plus and irrigation-plus approaches (e.g. communal garden, washing steps), water needs beyond the mandated single use that professionals have set become integrated parts of community-scale MUS. At community scale, water is developed and managed according to this integrated reality. Such a focus on multiple sites of multiple uses and scales of water development and management within communities' water- and landscapes appeared a more realistic guide for water services provision than the single uses which currently structure water services delivery.

5.1.3 Livelihoods

Livelihoods at homestead-scale: climbing the water ladder for more MDG per drop

CPWF-MUS confirmed that water services for multiple uses at and around homesteads are particularly important for multi-faceted livelihoods. The health, labour-alleviation and social benefits of domestic water services for women and girls in particular are well known. Animal health also improves while the time needed to herd animals is reduced. Productive activities contribute to food security and income, which in turn promote health. Productive activities may represent an important part of people's income or food production. But even where they do not, they are of importance in diversifying people's livelihood options, reducing vulnerability or providing access to cash.

CPWF-MUS showed that the extent to which people take up productive water uses primarily depends on the level of access. Comparing water uses across sites highlighted that wherever water is available reliably and sufficiently near to a homestead (less than 3-5 minutes walk), a significant proportion of water users take up productive water uses. In rural areas, where livelihoods strongly depend on water-dependent agriculture-based activities, this proportion can be 100% and is higher than in peri-urban areas, where uptake can still be significant. Even at service levels that are below the commonly defined levels to meet 'basic domestic' needs of 20 lpcd, part of the water is used and re-used for productive uses, such as livestock, fruit-tree growing, or gardening. At higher service levels, water is disproportionately used for productive purposes. CPWF-MUS case studies underline how homestead-scale MUS has a unique potential for intensifying production because it frees up the labour and recycles water and nutrients.

The fact that widespread productive uses flourish wherever water is available confirms that the water services ladder that is commonly used in the domestic sub-sector would reflect people's water uses better if productive uses were included. In the CPWF-MUS project, water uses at the foot of such a 'multiple-use water ladder' and related service levels between 20 and 50 lpcd were called 'basic MUS'; between 50-100 lpcd, 'intermediate MUS' and above 100 lpcd, 'high-level MUS'. So when water service levels provide access to 50-100 lpcd (or more), productive uses become substantial. This evidence makes the multiple-use water ladder a valid planning tool for the water sector. The livelihoods impact of water services can be considerably enhanced by allowing water users to climb the multiple-use water ladder. Out of the quantities made available, at least 3 lpcd should be safe for drinking at all steps on the ladder. As found in some case studies, communities preferred access to more water over access to a smaller quantity of high-quality water.

CPWF-MUS also confirmed the expectation that homestead-scale MUS is a particularly powerful untapped potential for multi-faceted poverty alleviation and gender equity that can reach out to all the rural and peri-urban poor. All eight MDGs stipulate key dimensions of wellbeing that are addressed directly or indirectly through homestead-scale MUS. Critically, moreover, homestead-scale MUS is the only way of using water that can categorically reach the peri-urban and rural poor, including youth-headed households. For them the homestead is often the only site to which they have access for undertaking water-dependent productive activities on their own account. Sick people often lack the ability to work elsewhere. There is a similar untapped opportunity of *a priori* inclusion for the MDGs related to gender. Homestead-scale MUS not only meets domestic water needs but tends to give women a greater say over productive activities at home than elsewhere. It can be hypothesised that homestead-scale MUS is the best way of using water for productive self-employment that intrinsically and categorically includes the poor and women. In that case, homestead-scale MUS potentially has the highest 'MDG per drop'. But this supposes that MUS successfully reaches the poor – which remains a major challenge to be addressed in community-scale MUS.

Livelihoods at community-scale
In a full-fledged 'community-scale MUS' model, the livelihoods of community members become the driver of water services. People are the entry point for service delivery that considers all water uses, sites, technologies and institutions. Water services are provided through facilitated participatory planning processes in which support agencies come to the table with a menu, from which communities can chose options that they re-assemble and extend according to their own priorities. In this model, the community in concert with service providers matches available budgets and other resources to their priority plans. Support by service providers is coordinated to respond to this demand.

One key livelihood issue for service delivery at community-scale regards the intra-community allocation of public support: whose livelihoods are to be improved? Whose preferences are followed in selecting sites of use and uses? Are there options for differential service delivery so that those who can pay, do pay? The importance of such intra-community allocation of external resources for water development for inclusion (or, in its absence, exclusion) of the poor and women cannot be overemphasised. In a genuine and inclusive participatory planning process for community-scale MUS in largely unserved communities, women, the poor and the sick may well prioritise homestead-scale MUS over field irrigation, which, inevitably only benefits part of the community. This warrants procedures in which the voices of all women and the poor are articulated and in which both men and women recognise the importance of domestic water uses.

Water is only one factor contributing to livelihoods, albeit a profoundly important one. Indeed, water is likely to be the limiting factor according to the CPWF-MUS finding that wherever water was available in and around homesteads, it was taken up by a significant proportion of the community. Nevertheless, health and sanitation education, agronomic knowledge about soil moisture retention and nutrients recycling, market linkages, veterinary services, and many other things are critical to enhance the productivity and benefits of water use. Expertise about how to turn water use into livelihood benefits is sector-based. This aspect of sector-based approaches remains equally meaningful in MUS. Sectoral divides are counterproductive for all the principles to do with the integrated resource of water. Overcoming those divisions either by expanding services provision or pooling efforts with others opens new potential for better service delivery, which can also affect overall costs.

5.1.4 Water resources

MUS requires the sustainable availability of water resources. CPWF-MUS found several advantages in an integrated perspective for water resources compared to single-use perspectives. Water is, literally, a pooled resource. CPWF-MUS confirmed how various water sources were used in an integrated manner through e.g., groundwater recharge, conjunctive groundwater-surface water uses, and considering upstream-downstream linkages.

Several CPWF-MUS cases at homestead- and community-scale, found that considering multiple sources opened the possibility of combining water resources to enhance volumes made available according to natural water variability. Specific water sources were used for specific uses, e.g. using rooftop water for drinking because of its higher quality. In this way, multiple uses allowed efficient complementarities and increased community resilience.

An integrated perspective also led to re-use of waste and nutrients and to water treatment at the most appropriate scale, in peri-urban as well as in rural areas.

A third advantage was that as competition for water resources grew, an integrated perspective of all sources and uses gave a better insight into the distribution of water uses among users. At homestead-scale, different adults may have different priorities – an issue not studied in-depth in CPWF-MUS. At community-scale, CPWF-MUS found that quantities for domestic use are usually negligible compared to what is needed to irrigate large plots. So doubling or tripling quantities to achieve intermediate or high-scale homestead MUS still requires relatively limited water resources. Such overviews can inform decision-making about equitable distribution and guide decision-making about where water savings would free up most water, for example by curtailing sugarcane irrigation or repairing leakages.

5.1.5 Technologies

Homestead-scale MUS

A range of technologies already exists to provide different levels of access (both in terms of quantity and quality) for homestead-scale MUS. None of these technologies is new. Small incremental changes or new combinations are all that is needed. For homestead-scale MUS to take place at significant level, technologies need to provide at least 50-100 lpcd. The CPWF-MUS cases showed that this can be achieved through on-site technologies like homestead wells, boreholes, rainwater and run-off harvesting and storage. Communal systems that channel water to well-sited public taps or house connections also allow this level of MUS. However, communal single-access points, such as boreholes with handpumps or village reservoirs, are usually too distant for homestead-scale MUS. These can still provide access for communal productive activities, such as a community garden or cattle trough.

CPWF-MUS analysed various technological options to safeguard the quality of at least 3 lpcd for drinking, realising that there is no need to provide high-quality water for uses that do not require such quality. Different options for treatment at different levels (point of use or central treatment or separate systems) have various advantages and disadvantages.

Community-scale MUS

From the perspective of the conventional domestic or irrigation systems, which starts from water uses at one particular site, technologies become slightly larger (e.g. for higher discharges) and slightly more complicated (e.g. washing steps). However, CPWF-MUS found that when there are overlapping communal surface systems and interlinked natural surface water bodies for multiple sites, the technical design from a MUS perspective becomes more efficient at community-scale. An integrated perspective at community-scale allowed the reality of multiple water sources, whether natural or human-made, to be fully exploited, using the most appropriate source. In planning incremental improvements that take a holistic view of the current situation, existing infrastructure can be incorporated as sunk costs, even if designed for another use. This avoids yet another isolated layer of infrastructure. Bulk infrastructure such as intakes, storage, and large conveyance systems to multiple sites were shared, which led to important economies of scale. Damage to infrastructure from unplanned use was avoided. Add-ons were not needed because they became a full part of the community-scale design. Water treatment technologies were applied at the most appropriate scale.

A unified approach

In various CPWF-MUS cases, these advantages could be exploited once it was realised that everybody dealt with the same water resources, technological solutions, and people. Water resources and water technologies were recognised to be ‘use-neutral’. The only real difference appears to be a matter of scale, where the domestic sub-sector is better used to smaller scales while the productive sub-sectors are more accustomed to larger scales. It was also realised that service providers differed in their preferred sites of use, related to their sector mandate. Neither sub-sector recognised the homestead as a potential site for productive uses. Once this site issue was overcome, sectoral differences in infrastructure development faded away.

In assessing potential advantages of MUS compared to single-use approaches in the development of technology, the question is: compared to what? Technology developments for the higher discharges required for homestead-scale MUS are somewhat more complex, although smart combinations of water sources can be exploited. This picture changes at the community-scale for communal systems, where new efficiencies open up. Here, multiple sources can be combined, economies of scale are used in sharing intakes, storage, and conveyance, and existing infrastructure is integrated as sunk costs. Integrating technology design and pooling engineering skills and equipment across sub-sectors unlocks these opportunities. The main difference in the development of technology by sub-sector is a matter of scale and where the end use takes place.

5.1.6 Institutions

Institutions cover the organisation and rules for the planning, design, construction, and operation and maintenance of communal infrastructure, and, where needed under growing competition, the sharing of water resources. For technologies that are used on-site by households, there are no management complexities, but this is different for communal systems. Problems of leadership, book-keeping, rule setting and enforcement, cost recovery, and the need for post-construction support are well known in both 'domestic' and 'irrigation' systems. In fact, the complexities are quite similar for user associations with comparable numbers of members, whether for irrigation or homestead-scale uses.

Acknowledging and promoting multiple uses by multiple users and participatory community-scale MUS may seem to add to this institutional complexity. It is true that managing a differentiated demand may be more difficult. However, CPWF-MUS case studies also found opposite trends. First, the people with multiple needs are individuals with multiple interests in one or more systems. Single-use approaches artificially split up people's interests, as they do for integrated water resources and technologies. Second, *de facto* multiple uses already exist. By making these existing practices transparent, systems become more manageable. This holds even more for various overlapping systems. As the better-off tend to use more water for multiple uses, such transparency especially benefits the poor. Third, managerial issues can be discussed up front and influence the crafting of institutions and even the choice of technology with its related managerial requirements. Communities can develop tariff systems that accommodate multiple uses, such as volumetric pricing, block tariff systems and cross-subsidies, as was found in some CPWF-MUS case studies. Fourth, in a participatory process, existing community institutions can become involved and the social capital of communities can be further developed. For communities, multiple uses from multiple sources is a daily fact-of-life. Local governance rules have developed on many managerial issues like priorities of use, dealing with prior claims to water based on investments made, etc. Well-anchored institutions are essential for sustainability and rule enforcement in water user associations.

Lastly, with growing competition for water within one system and between systems at community-level, e.g. during the dry season, a MUS perspective also allows a clear articulation of the issues at stake. After exhausting solutions for water saving, allocation of water resources becomes a matter of prioritisation in a zero-sum game. In several CPWF-MUS cases, an integrated overview revealed the phenomenon that few users consume large quantities of water, while others cannot even get enough for basic or intermediate MUS. More equitable rules can be conceived and enforced, e.g. to promote 'some for all', before 'most for a few'.

In sum, multiple uses from multiple sources is obvious for users and embedded in their institutions. Explicitly acknowledging this allows the management of communal water systems to be strengthened. When it comes to community decision-making on water sharing, clarity about all uses by all users is especially in the interests of the marginalised whose productive water uses are relatively small and whose power to negotiate a fair share is likewise small.

5.1.7 Financing

This principle has two aspects: what are the benefits and costs of MUS and how can the costs be financed?

Compared to conventional domestic services, homestead-scale MUS has the benefit that people's domestic *and* productive needs are met, including not only better health and less time spent on domestic chores, but also greater food security, and higher incomes. Investment costs are slightly higher, but the potential income gained from productive water uses, which were estimated at US$ 100-500 per year (or US$ 0.7–2 per m^3), still implies favourable benefit-cost ratios. As shown in Section 3.4.1, investments made to climb to intermediate MUS can often be repaid within 6-36 months. This calculation does not include potential efficiencies from water and nutrient re-cycling in integrated farming at homesteads and the smart use of multiple sources.

For community-scale MUS with interlinked water sources and communal systems, no specific benefit-cost calculations were made, but the potential for greater efficiencies are likely to improve the benefit-cost ratios compared to an intervention by a single sub-sector. The improvement in benefit-cost ratio would probably be even higher if the resources for infrastructure and institutional development from different sub-sectors could be put together to design better communal infrastructure and better water user institutions for considerably more benefits from multiple water uses at different sites.

In community-scale MUS, communal technology development would improve its benefit-cost ratio by:

- Combining the use and re-use of multiple sources;
- Integrating existing infrastructure as sunk costs;
- Achieving economies of scale by sharing bulk infrastructure;
- Applying water treatment technologies at the most appropriate scale; and
- Avoiding damage because of unplanned *de facto* multiple uses of single-use planned systems.

Institutional development at community-scale would provide better services for certain costs by:

- Recognising the holistic needs of the institutional players and triggering more commitment;
- Rendering *de facto* and planned multiple uses transparent from the onset, so that multiple uses can be better managed without being disturbed by 'illegal' use of single-use design;
- Incorporating the social capital of communities to manage water from multiple sources for multiple uses; and
- Systematically allowing the option of homestead-scale MUS for productive uses, especially to the poor and to women, to contribute to reaching the MDGs.

These indications exclude the costs needed for the participatory and inclusive planning processes and technology choice that are at the heart of community-scale MUS. As participatory planning procedures for community-scale MUS are still rare, the costs and cost savings are not known.

Last but not least, all these untapped potentials are known to contribute to the sustainability of systems and benefits. Hence, it is concluded that the cost-benefit ratios of homestead-scale and community-scale MUS are likely to be quite favourable compared to other investments in water for livelihoods.

With regard to the second question on how to finance homestead-scale MUS compared to conventional investments in domestic systems, it was calculated that income from productive activities can recover the system construction and operational costs. However, cost recovery was hardly ever applied in the CPWF-MUS cases. In most cases, communities at best contributed a small percentage of investment costs. There were some notable exceptions of users' self-supply in which investments in homestead-scale MUS were entirely self-financed. This aligns with communal irrigation systems, where income generation is the goal but where hardware also tends to be partially, if not fully subsidised, with users expected to take responsibility for operation and maintenance.

In nearly all CPWF-MUS case studies, users were responsible for covering operation and maintenance costs. No clear evidence was found that users actually did cover these costs any better than they did for conventional domestic systems, possibly due to the numerous problems that communities face managing their systems.

5.1.8 Recommendations to promote MUS models

In view of the merits of MUS models identified above, it is recommended that governmental and non-governmental policy makers and implementers across the water sector adopt a MUS approach, irrespective of any single-use mandates.

For homestead-scale MUS policy makers and implementers should:

- Promote homestead-scale MUS for all by ensuring that people can climb one or two more steps on the multiple-use water ladder. This implies:

  - enhancing service levels for intermediate and high-level MUS to provide at least 50-100 lpcd - doubling or tripling current service levels in largely unserved areas such as sub-Saharan Africa and South Asia;
  - ensuring that at least 3 lpcd of water is safe for drinking.
- Unlock the major potential of homestead-scale MUS to contribute directly and indirectly to all MDGs by targeting the poor.
- Adopt the multiple-use water ladder as a more realistic and better planning tool for water services at and around homesteads in rural and peri-urban areas in low- and middle-income countries.

For community-scale MUS policy makers and implementers should:
- Promote community-scale MUS in any situation of communal systems and shared water sources for multiple uses at homesteads, fields or through direct access.
- Fully acknowledge that the homestead is often the preferred site for productive water uses, in particular by the poor, women and the sick.
- Conceptualise water services according to the site of multiple water uses and the scale of water development and management.
- Remove single use(s) as the structuring principle of the water sector and better distinguish sites of (multiple or single) water uses and scales of water development and management.
- Leave the decision about whether a particular water use is of primary or secondary importance to users themselves, e.g. during the allocation of public resources for water development and during negotiations for sharing water resources where there is growing competition.
- Pool technical and institutional support, while maintaining use-specific expertise on how to render water use more beneficial for water-related health, food security, and income.

The implementation of these recommendations at scale, so that ultimately everybody can be reached, requires innovative approaches.

5.2 Conclusions and recommendations for creating a supportive environment to scale up MUS

5.2.1 Introduction

In all eight countries, CPWF-MUS tried to scale up the MUS models which were being pilot-tested or studied, at intermediate, national and global levels through newly forged learning alliances. Besides awareness raising about the MUS models, efforts were undertaken to replicate these models at scale. Such replication warrants institutional reform towards a supportive environment for service delivery for homestead- and community-scale MUS that would reach everybody, including the poor. In some cases the efforts of the learning alliances led to changes in policies and practices even within the limited time and resources of the CPWF-MUS project. In all learning alliances, new insights were generated.

5.2.2 Intermediate level

According to the MUS conceptual framework, the creation of a supportive environment at intermediate level was expected to require:

- Participatory planning approaches in which existing infrastructure and institutions are assessed and incorporated in the design; genuine water needs and priorities are articulated for any use at any site; heterogeneity is addressed to ensure inclusion of marginalised people; information is provided on technology options with institutional and financial requirements and choices are left to communities.
- Coordinated long-term support to meet people's multiple water needs and ensure sustainability of systems over time. This encompasses technical, institutional, and financial support (which can be pooled across projects and sub-sectors) and support to turn water use into livelihood benefits (which is use- and sector-specific).
- Strategic planning for scaling up so that MUS is mainstreamed across the water sector to reach, ultimately, everybody.

5.2.3 National level

At national level, there should be:

- Enabling policies and laws, which seek to use water for livelihoods and poverty alleviation, and remove those aspects of sectoral approaches that are counterproductive and that hamper meeting people's needs, while maintaining the merits of sector specialisation.
- Decentralised long-term financial, technical, and institutional support to enable intermediate-level service providers to provide locally appropriate and coordinated support.

In the supportive environment for water services, a range of water service provider groups can be active: users, NGOs, the domestic and productive sub-sectors, local government and knowledge centres. Two sets of innovation pathways were found: one set in which each water service provider group improves its own service delivery towards MUS, and one in which the different water service provider groups better collaborate for MUS. For going to scale, both pathways are needed. The following initiatives for both pathways contribute to creating an encompassing supportive environment for MUS and are recommended to be taken forward.

5.2.4 Users, user associations and local service providers

Within the water user groups, considerable initiative for self-help MUS at homestead- and community-scale was found. As manifest in *de facto* multiple uses, communities seek to meet multiple needs from multiple sources. Users have aspirations and plans for incremental improvements in water access for multiple uses. Local providers can meet those needs to some extent. Grassroots water user movements can deploy great creativity and organisational skills for innovation and scaling up homestead-scale MUS on a largely voluntary basis. However, users on their own, certainly the poor, lack finances and technical and organisational skills to improve their access to water to levels that also accommodate population growth and respond to technological and market opportunities.

In seeking collaboration, users were found to search proactively for external support and reassemble the various components on offer to fit their local integrated needs. Users are the driving force to integrate fragmented support. However, the poor and other marginalised groups risk being excluded from this self-initiated search for support and need to be explicitly targeted by service providers. Collaboration with user groups according to their needs is at the heart of MUS.

Therefore, it is recommended to:
- Strengthen user innovation and organisation for MUS in water user associations and CBOs.
- Support users in advocacy and in articulating their demands and proposed solutions in individual communities and at larger scales.
- Recognise users as the driving force for requesting and integrating support that meets their needs and capacities, while ensuring that the marginalised are also included.

5.2.5 NGOs

NGOs were innovators for MUS even before CPWF-MUS. Participatory approaches, a livelihood focus and relative independence in dealing with sector boundaries all encourage NGOs to provide the coordinated support required for MUS. NGOs and donor agencies are pioneers in holistic participatory planning processes for MUS, a field with limited expertise. International NGOs play an important role in global scaling up. The weakness of NGOs is that they are often area-specific without a mandate to reach everyone. They may also depart at some stage, leaving systems without after-care. In the end, their accountability remains upwards to their funders and their support remains tied to specific conditions and planning cycles. In very poor areas, they may dominate even governmental structures. In order to overcome these weaknesses, NGO partners in CPWF-MUS proactively collaborated with local government on a range of issues, including identification of potential beneficiary villages; transparent and equitable allocation of public resources; ensuring long-term support after project closure; mobilising technical and institutional support from government; collaboration with other local agencies; and scaling up of successful innovations like MUS at district and higher aggregate levels.

It is recommended that NGOs:
- Continue pioneering MUS and broaden their capacity, in particular on participatory planning processes, development and dissemination of appropriate technologies and management, and national and global dialogue and advocacy on successful approaches.
- Further work towards a goal of reaching the whole community, including women and the poor.
- Collaborate with local government to align with and strengthen local planning processes and ensure the long-term institutionalisation of MUS innovations with continuous support to any community and district-wide scaling up.
- Pool resources for infrastructure and management with other water agencies present in an area.
- Continue facilitating multi-stakeholder exchanges, e.g. as learning alliances.

5.2.6 Domestic sub-sector agencies

National, bilateral and international governmental institutions and programmes that focus on water provision for domestic uses and sanitation have considerable resources with the mandate to provide everyone with these services. They thus have a key strength for scaling up because of their presence, their financial and human resources for implementation, and their role in policy, norm setting and support for decentralisation. They also play a key role in providing long-term support for communities.

However, they also have serious limitations for enabling MUS, mainly in the field of norms and standards and in their specific single-use mandate. Where supply norms are defined at the basic domestic level, public investments cannot easily provide the higher required service levels. Even where service levels can meet the need for intermediate or high MUS, a rigid norm may stipulate that domestic systems can only be used for domestic uses. Another norm concerns water quality. In many countries, agencies try to ensure that all the water supplied is of potable quality. This may limit productive uses. The cases have shown that users give priority to using water for productive purposes. There are various ways in which this issue can be dealt with, balancing the need for some safe water with the possibility of using lesser-quality water for production.

At community scale, the domestic sub-sector tends to maintain its single-use mandate for communal systems. Yet, CPWF-MUS learning alliances showed that moving up to community-scale MUS was feasible and opened up new opportunities. Domestic agencies used to run stand-alone programmes, but they increasingly work through local government in a global move towards decentralising government support. This improves accountability downwards and sustainability, which supports the implementation of MUS. There is also some collaboration with NGOs, but little collaboration with the productive sub-sectors.

In order to stimulate scaling up of MUS and building a supportive environment, it is recommended that the domestic sub-sector:

- Further pursues the goal of reaching all community members, including the poor.
- Recognises and legitimises the livelihood benefits of current *de facto* multiple uses of domestic systems and provides support to these communities in managing and financing these uses.
- Plans new systems or future extensions by increasing norms and standards for service levels, balancing the need to treat at least 3 lpcd water to drinking water standards with the need for more water for production.
- Moves up to community-scale MUS for its various advantages and the fact that it addresses people's multiple water needs beyond homesteads.
- Strengthens collaboration with local government, and accesses expertise for productive uses.
- Pools resources with other agencies in the same area, for infrastructure and management, while providing expertise on how to enhance health benefits of

water use and sanitation. Conditions tied to the sub-sector's support should reward such collaboration.

5.2.7 Productive sub-sector agencies

The various productive sub-sector agencies tend to operate on-site with individual technologies or at community scale for communal technologies and water resources management. They also provide support on how to use water productively. This is the case for irrigation, soil conservation, fisheries, livestock, forestry, village reservoirs, enterprises, hydropower, navigation, and watershed management. The focus is typically on fields (and increasingly on fish-crop systems) and on open access to water (for multiple uses) rather than on homesteads. Efforts are also undertaken to reach small-scale farmers and women, in particular through appropriate technologies for small-scale food production and national food security. However, unlike the domestic sub-sector, there is no clear aspiration to reach everybody.

Collaboration with local government has been limited, but is increasing, in particular by attaching technicians to district or provincial government. However, large-scale governmental productive water-use projects tend to have their own vertical structures. There are also many sustainability problems stemming from project closure or the devolvement of management to user associations.

Adopting community-scale MUS would open up new advantages, including pooling engineering and managerial support. If people prioritise homestead-scale MUS, such choice should be respected by the productive sub-sectors as well. This would mainstream the domestic sub-sector's priority for domestic uses into the entire water sector. Therefore, it is recommended that productive sub-sector agencies:

- Adopt community-scale MUS to tap various advantages and, when communities prioritise it, include homestead-scale MUS by providing intermediate and high-level MUS to homesteads, including those of the poor.
- Establish a similar systematic collaboration with local government as the domestic sub-sector, with the benefit of accessing expertise on water and health issues.
- Pool resources for infrastructure and management with other agencies present in the same area, while providing expertise on how to make more productive use of water. Support conditions set at higher national levels should reward such collaboration.

5.2.8 Local government

The potential importance of local government in coordinating initiatives amongst various support agencies and between them and communities has already been emphasised. Local government has the mandate to plan and coordinate service provision for all citizens in its area of jurisdiction and is, in principle, accountable downwards through democratic elections. In addition, local government has a key role in providing long-term support. Local government is thus a crucial player in MUS.

Currently, their task is very complicated. Various governmental and non-governmental agencies report upwards and have to abide to conditions set from the top-down, and some bypass local government. Another problem is lack of capacity and resources, in spite of national policies for decentralisation. Furthermore, politics may dominate over service delivery. CPWF-MUS showed how NGOs can strengthen this capacity for participatory planning of MUS.

In order to strengthen local government's pivotal role in coordinating MUS, it is recommended that:
Local government's capacity and resources to plan and coordinate the delivery of MUS services should be strengthened, through:

- Facilitating iterative participatory planning processes;
- Facilitating relationships between communities and service providers and empowering them to hold service providers directly accountable;
- Coordinating service delivery from various agencies;
- Equitably allocating available resources;
- Coordinating long-term support to communities.

NGOs can support local government in such innovation.

5.2.9 Knowledge centres

Many CPWF-MUS partners belonged to knowledge centres. They played an important role in conceptualising MUS or 'giving a name' to existing practices. They facilitated learning alliances for awareness raising and scaling up at intermediate, national and global levels, documented and analysed pilots, provided feedback to communities and learning alliance partners, trained professionals on MUS and, through this book, presented generic conclusions and recommendations. On this basis, it is recommended that knowledge centres:

- Continue innovating with MUS, while maintaining expertise to enhance the benefits of water use.
- Train professionals in MUS.
- Accelerate action research through 'learning by doing' with homestead- and community-scale MUS at scale, in close collaboration with implementers.
- Facilitate learning alliances for global institutionalisation of MUS.

Knowledge and perceptions are shaped by paradigms. This book has highlighted multiple uses and multiple sources as the main paradigm for water users. It has also elaborated many aspects of MUS as a paradigm shift for most professional service providers. It has shown how a shift in perception unlocks new potential for better water services, especially in the light of the MDGs. Through CPWF-MUS and other global stakeholders, improvements as a result of this paradigm shift have started to be proven empirically. This fully justifies implementation of MUS at much larger scale for the further exploration and realisation of its untapped potential.

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About IRC

IRC facilitates the sharing, promotion and use of knowledge so that governments, professionals and organisations can better support poor men, women and children in developing countries to obtain water and sanitation services they will use and maintain. It does this by improving the information and knowledge base of the sector and by strengthening sector resource centres in the South.

As a gateway to quality information, the IRC maintains a Documentation Unit and a web site with a weekly news service, and produces publications in English, French, Spanish and Portuguese both in print and electronically. It also offers training and experience-based learning activities, advisory and evaluation services, applied research and learning projects in Asia, Africa and Latin America; and conducts advocacy activities for the sector as a whole. Topics include community management, gender and equity, institutional development, integrated water resources management, school sanitation, and hygiene promotion.

IRC staff work as facilitators in helping people make their own decisions; are equal partners with sector professionals from the South; stimulate dialogue among all parties to create trust and promote change; and create a learning environment to develop better alternatives.

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About IWMI

The International Water Management Institute (IWMI) is a non-profit, scientific organisation and one of 15 research centers supported by the Consultative Group on International Agricultural Research (CGIAR). IWMI has been instrumental in shaping the global agenda on water. The Institute focuses on the sustainable use of water and land resources in agriculture. Its goal is to generate and disseminate groundbreaking research which can benefit poor people in developing countries and improve food and livelihood security. With its headquarters in Sri Lanka, IWMI has regional offices in 12 countries across Africa and Asia.

IWMI's research identifies the larger issues related to water management and food security, while developing, testing and promoting management practices, tools and technologies to manage water and land resources in a more sustainable, and productive way. An important aspect of its work is in clarifying the link between poverty and access to water in developing countries. The Institute also ensures that health and environmental concerns related to agricultural water use are addressed. A new area of research for IWMI is the impact of climate change on water resources.

In addition to generating new knowledge, IWMI helps developing countries strengthen their own research capacity through PhD and post-doctoral fellowship programmes. IWMI works in close partnership with international and national research institutes, universities and development organisations. The Institute draws on the expertise of economists, agronomists, hydrologists, engineers, social scientists and health researchers from the North and South. IWMI's products include research reports, working papers, water policy briefings, newsletters and corporate communications material. These are freely available as global public goods.

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About CPWF

Water scarcity is one of the most pressing issues facing humanity today. Provision of sufficient water is necessary for human health and poverty reduction. The Challenge Program on Water and Food (CPWF), an initiative of the Consultative Group on International Agricultural Research (CGIAR), contributes to efforts of the international community to ensure global diversions of water to agriculture are maintained at the level of the year 2000. It is a multi-institutional research initiative that aims to increase water productivity for agriculture – that is, to change the way water is managed and used to meet international food security and poverty eradication goals – in order to leave more water for other users and the environment.

The CPWF deals with complex, diverse and dynamic agriculture-related systems, for which there are a growing number of stakeholders generating information. Its community-of-practice works in innovative ways to collate, unify, organise, extract and distill the ideas, information and knowledge to allow research users to gain insights and deduce principles, concepts and cause-and-effect relationships from its research results. To help achieve this, the CPWF focuses on building multi-disciplinary north-south and south-south partnerships, as demonstrated by its work in the MUS initiative.

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Climbing the Water Ladder

In low- and middle-income countries, people need water for drinking, personal hygiene and other domestic use. But they also use it for livestock, horticulture, irrigation, fisheries, brickmaking, and other small-scale enterprises.

Multiple-use water services (MUS) are best suited to meeting people's needs. However, most water services are designed only for domestic water or only for agriculture, and fail to reflect its real-life use.

The action research project 'Models for implementing multiple-use water supply systems for enhanced land and water productivity, rural livelihoods and gender equity' developed case studies in eight countries (Bolivia, Colombia, Ethiopia, India, Nepal, South Africa, Thailand and Zimbabwe) involving 150 institutions.

The project analysed two models: homestead-scale and community-scale MUS and developed a 'multiple-use water ladder' to show how better livelihoods flow from increased access to water.

This book shows how livelihoods act as the main driver for water services and how access to water is determined by sustainable water resources, appropriate technologies and equitable ways of managing communal systems.

Climbing the water ladder requires a small fraction of total water resources, yet has the potential to help people climb out of poverty.

Local government can be the pivot to make this happen. But, it needs support to implement its mandate to meet multiple-use demand and to become more accountable to people in communities.

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