Fieldwork paper

WaterAid Nepal's experiences in community-based water resource management

This paper documents WAN and its partners work on community-based approaches to water resource management, and attempts to distill important lessons from their experience to inform continued refinement of WAN's institutional approach to CWRM and inform sector learning.

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WaterAid's mission is to overcome poverty by enabling the world's poorest people to gain access to safe water, sanitation and hygiene education.

1. Introduction

Falling groundwater tables, surface and groundwater pollution, and growing and competing demands on limited water resources have emerged as significant challenges to the effective provision of water and sanitation facilities in Nepal. Combined with the broad-scale impacts of urbanization and climate change, poor communities have become increasingly vulnerable to water scarcity, water-borne disease, and social exclusion from access to water. Many of these challenges result from the historic precedence of a sub-sector approach to water management in Nepal that does not address the interconnectedness of different users and managers of water at the community level. While WaterAid Nepal (WAN) has focused its approach on the sustainable use of water within the WATSAN sector, it is now realized that a more holistic approach to water resource management is required to ensure the sustainability of water sources and the resource base from which they originate. WAN has therefore placed increased emphasis on Community-based Water Resource Management (CWRM) while designing water supply and sanitation programmes.

WaterAid/ Marco Betti

2 Background section

2.1 Background on WaterAid's Involvement in CWRM

In response to increasing concerns over the sustainability of global water resources and the associated impacts on the poor, WaterAid adopted Integrated Water Resource Management (IWRM) as key component of its International Strategy for 2005-10. WaterAid's adoption of the IWRM approach is consistent with the changing international dialogue on water resources, in which sub-sector approaches are loosing traction in favor of holistic, integrated approaches. The Global Water Partnership's definition of IWRM provides the conceptual framework for this initiative: *"IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems."*

WaterAid refined its strategic stance on IWRM at an international workshop and consultation held in Abuja, Ethiopia in 2005. The workshop and resultant IWRM policy paper highlighted the need for its country programmes to develop programmatic interventions that address the environmental, technological and social factors that characterize contemporary water resource management issues in a coordinated manner, across relevant sectors. These programmatic activities would be the basis for developing implementation models and advocacy aimed at scaling up integrated approaches to water management at the national level. The meeting in Abuja also provided clarity on the conceptual distinction between IWRM and CWRM, a community-based variant that starts at the micro level and looks upwards, which is more closely aligned with WaterAid's commitment to working directly with poor communities. With the understanding that water systems work more effectively and are more sustainable when local communities are involved in their planning and management, WaterAid has advocated the community-based approach.

2.2 WaterAid Nepal's Rationale for Engagement with CWRM

In Nepal, the water and sanitation sector as a whole has begun to recognize the importance of integrated approaches for responding to contemporary water resources management challenges. Emphasis has been placed on the sustainability of water sources and the environment that sustains them, increasing risk of water pollution resulting from poor wastewater management, and concerns over water quality. These challenges have manifested most notably within poor, marginalized communities in urban and rural areas, where access to water and sanitation is often compounded by social exclusion, conflict, and gender inequities.

Despite attempts by WAN to manage ground and surface water in a sustainable manner, a failure to manage water resources at a level that integrates all users and mangers of water has resulted in a gradual degradation of the resource base. Addressing the failure of sub-sector management requires 1) improved use and management of water within the WATSAN sector, 2) increased collaboration among relevant stakeholders in Nepal to ensure progress towards shared objectives, and 3) policy advocacy at the national level. The first point is the impetus for WANs engagement of CWRM, while the second and third points are seen as being achievable through institutional linkages and concerted advocacy.

In July 2007, WaterAid Nepal, its local partners, and other representatives from the WATSAN sector came together in Godavari to share their collective experiences in CWRM, to build capacity in various CWRM tools and techniques, and to encourage synergy of their respective policies and approaches to CWRM. The workshop resulted in a valuable collection of experiences, lessons, and insights on CWRM and its potential in Nepal. The workshop also allowed WAN and its partners to initiate dialogue with organizations from outside the WATSAN sector that share a common concern for the sustainable management of water resources. Participants agreed that an important next step was to compile and document the experiences of WAN its partners so that the lessons and insights gained at the workshop can be used to inform the continued development of WAN's approach to CWRM.

2.3 Objectives of the CWRM Documentation

As such, this paper builds directly on the Godavari workshop and the CWRM experiences shared by the participants. It is a summary of what has been accomplished to date in Nepal, with a focus on the tools and techniques of CWRM. This paper has three central objectives:

- First, this paper outlines WAN's preliminary approach to CWRM. The fact that this is a preliminary approach is important, and this paper should be seen as part of an ongoing learning process.
- Secondly, it is a catalogue of CWRM technologies, tools and techniques that have been used to date by WAN and its local partners. These experiences are substantiated through case studies.
- Third, this paper attempts to identify important lessons, information gaps, challenges, and opportunities for CWRM in Nepal. These are used to develop recommendations for the continued development of WAN's approach to CWRM.

This document will be of interest to WAN and its local partners, WaterAid's country programmes in South Asia and beyond, and to other organizations working on community-based resource management.

3
CWRM in WAN's context

3.1 WaterAid Nepal's Guidelines on CWRM

To guide WAN and its partners approach to CWRM the following minimum requirements have been established for designing their water, sanitation, and hygiene projects in Nepal. They reflect a response to the three central challenges faced by rural and urban communities in Nepal: source sustainability, pollution risk, and water quality.

- *Source Sustainability* - All project proposals include an assessment of the sustainability of the water resource and either a description of the actions to be taken to safeguard or enhance that sustainability or reasons why no actions are required.
- *Pollution Risk Reduction* - Water quality policies are enacted in the country programme and that all sanitation project proposals include an assessment of the risk of pollution of drinking water sources and actions to prevent the same, if necessary.
- *Water Quality Data Management* - WaterAid and its partners will maintain relevant data on water quality and hydro-geology of utilized water resources, and make access to this information available to others.

To meet these requirements, WAN has adopted a four component approach that involves technical development, capacity building, institutional linkages and policy advocacy. This approach is described at greater length below.

3.2 WAN's Approach to CWRM: Where We Are and Where We Want to Go

The idea of community-based "integrated" water resources management is still largely conceptual, and very few applied examples from South Asia currently exist. Determining the parameters of ones engagement is very challenging, and must be responsive to the local environmental, social and political context, as well as the capacity of the implementing institutions and their partners. At this early stage, an emphasis on learning is critical. In response, WAN has initially focused its approach to CWRM on the development and diffusion of appropriate technologies for water optimization and waste water management at the household and community level, combined with appropriate management of water quality data. Limiting its CWRM activities to the WATSAN sector, WAN has been implementing these technologies in a largely ad hoc manner, without an up to date guiding policy. WAN seeks to transition towards a systematic model for community assessment that is driven by the three CWRM operating guidelines. This assessment process would expose risks and opportunities for community-based water resource management and determine which techniques and tools will be employed in the given context. Examples of such an assessment model do exist in Nepal's rural and urban context - Helvetas' Water Resource Management Programme (WARM-P) programme, and Center for Integrated Urban Development's (CIUD) Water and Environmental Sanitation Improvement (WESI). WAN believes that both models provide significant learning and can be developed to influence WAN's approach to CWRM, these are further discussed in Section 6.

It is also anticipated that new institutional linkages combined with capacity building activities will allow WAN to gradually expand its community-based approach to encompass watershed-level and livelihoods-based activities that more appropriately address the aspects of integration that are advocated through CWRM. The Multiple Use Water Systems (MUS) implemented through International Development Enterprise's SIMI project are an excellent example of a livelihoods-based approach that may compliment WAN's approach to CWRM, as are a range of biogas technologies that currently emerging. Outside of the WATSAN sector, these linkages may also include mangers and users of agricultural water and hydropower facilities. As this approach is scaled up, WAN will work through the NGO Forum, FEDWASUN (Federation of Water and Sanitation Users in Nepal) and other national level advocacy platforms to influence national policy.

3.3 Applications of CWRM: Rural Versus Urban, Hill versus Tarai

Depending on their location, communities in Nepal face a different set of challenges in the management of water resources. As such, approaches to CWRM must address different social and environmental contexts. In rural hill areas, distance to safe and reliable water sources is a major constraint. Many communities relay on spring-fed gravity flow water systems that are susceptible to technical and environmental failure due to watershed level processes such as deforestation, erosion, and seasonal changes in rainfall. In this context, approaches to CWRM must effectively assess the threats to source sustainability, develop source protection measures, and deploy technologies, such as rainwater and fog water harvesting systems, that supplement groundwater sources and optimize other available sources to meet the community's needs in a sustainable manner.


WaterAid/ Oliver Jones

High ground water in the Tarai

The situation in the Tarai is much different. Both rural and urban communities there rely primarily on ground water made available through tube wells. High water tables, water logging, the challenge of managing wastewater and flooding all contribute to a high risk of water source contamination. Furthermore, space, as a result of complicated land rights and ownership, are a constraining factor in ensuring the appropriate spatial arrangement of latrines and water points. These constraints place communities at risk of serious health problems. In the Tarai, approaches to CWRM must mitigate the risk of anthropogenic ground water pollution while monitoring and improving water quality at the point of use. Rethinking the spatial arrangement of water points and latrines, or employing sealed tank latrines can reduce contamination risks, while simple point of use (PoU) water treatment technologies can remove persistent chemical contaminants, such as arsenic. Additionally, high levels of groundwater extraction for agriculture and industry have resulted in falling water tables. These water intensive activities also contribute to pollution through heavy use of fertilizers and release of industrial wastes and effluents.

In many parts of Nepal, urbanization results in increased pressure on water resources. This is especially true when urban growth is poorly managed. In Nepal the rates of urbanization are among the highest in South Asia. In dense urban centers water scarcity is a persistent problem resulting from over-extraction, and leakage from poorly maintained piped systems. The poor management of wastewater threatens the quality of this already limited resource. In this setting, water optimization, re-use, and treatment technologies are part of the approach to CWRM, as are techniques such as ground water recharge. Where space is increasingly limited, constructed wetlands function to keep dangerous wastewater out of ground and surface water sources.

Given the rate of urbanization in Nepal and its complex challenges, much of WAN's work on CWRM to date has focused largely on the urban context. The matrix in Annex 1 provides an overview of the challenges and CWRM options under various scenarios.


WaterAid/ Anita Pradhan

Waiting to fetch water in Bansighat squatter community in Kathmandu

4 An overview of CWRM technologies, tools and techniques

The following section provides an overview of the different CWRM tools and techniques that are being used by WAN and its partners. While some of these techniques are new, many have been used by WAN and its partners for many years. Also included are tools drawn from other organizations that WAN is evaluating for inclusion in its working approach to CWRM. This collection can be described as the "toolbox" that WAN and its partners can draw from when implementing the CWRM approach in a given project context. Approaches are presented categorically, based on the three guidelines that frame WAN's approach.

Source sustainability	Pollution risk reduction	Water Quality
▪ Assessments of Environmental Change ▪ Appropriate Infrastructure to Conserve and Sustain Water ▪ Multiple Use Water Systems ▪ Rainwater Harvesting ▪ Fog water Harvesting ▪ Ground Water Recharge	▪ Wastewater Management ▪ ECOSAN ▪ Constructed Wetlands ▪ Other Emerging Wastewater Treatment Technologies	▪ PoU Water Treatment ▪ Water Quality Testing and National Standards

4.1 Source Sustainability

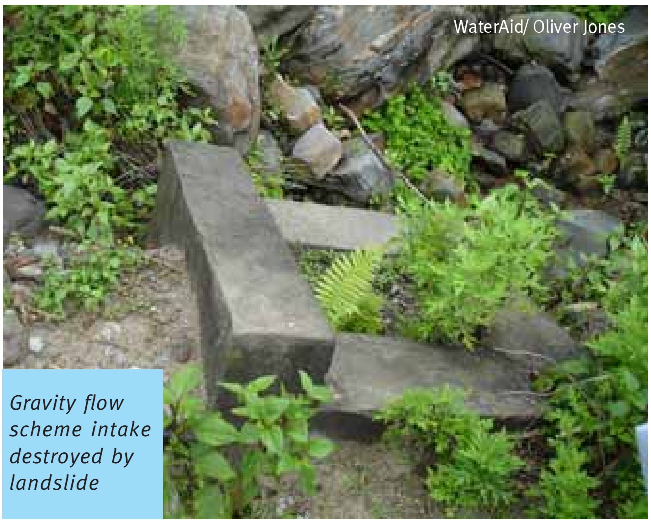
Ensuring source sustainability is an important component of WAN's approach to CWRM. Water systems have a limited design life, and technical failure may occur without the viability of the source itself being compromised. A more serious, and less understood threat to sustainability, is how broader processes occurring within the watershed impact upon the source itself, independent of technical failure. While the former can be addressed through design and improved monitoring, the latter requires engagement of broad-scale issues of change in the environment, the climate, and land use. Given the vulnerability of sources to natural and technical failure, protection and diversification are essential.

4.1.1 Assessments of Environmental Change and Variation

How do we protect the sources themselves, in addition to the system designed to provide water from that source? This requires an examination of how environmental change and variation impacts upon the sustainability (flow and quality) of a water source. Poorly understood hydrology, fragile geology, erosion, pollution, and deforestation all challenge source sustainability at the watershed level. Furthermore, climate change threatens to amplify the impact of all of these micro level problems, and may required local adaptation to changed conditions. These issues are not constrained to the WATSAN sector, and addressing them will require not only research, but collaboration among relevant institutions and the stakeholders. WAN anticipates that through research, improved monitoring and new institutional linkages it will be able to more effectively ensure source sustainability.

4.1.2 Appropriate Infrastructure to Conserve and Sustain Water

Beyond broader issues of environmental change, likely threats to the sustainability of a source are localized environmental calamities such as landslides and flashfloods, which may unearth an intake or topple a tap stand. Locals tampering with the drainage, as well as crabs,

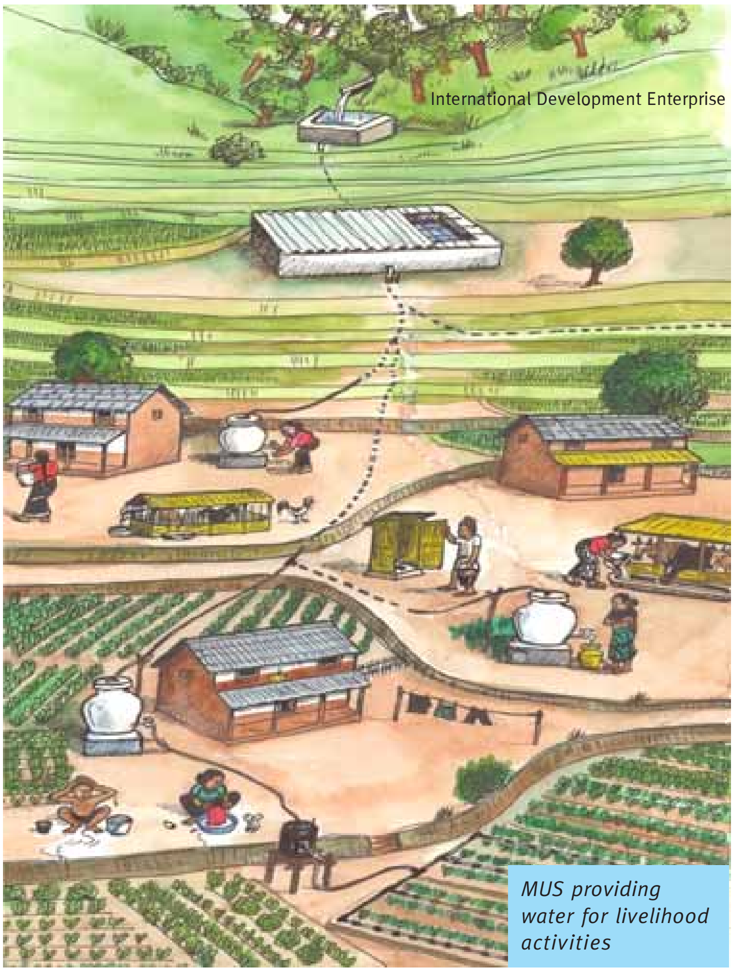


Gravity flow scheme intake destroyed by landslide

rodents and other animals getting into the tanks, reflect the importance of proper design, maintenance and community caretaker training in achieving sustainability. Structural options exist including **erosion control barriers, construction of drainage channels, plantation surrounding the sources, and pipeline protection.** Conservation measures include wastewater treatment and re-use, and use of alternative sources, such as **rain and fog water,** as discussed below. Choice of approach will be driven by the local environmental context and composition of water users in the community.

4.1.3 Multiple Use Water Systems (MUS)

Multiple Use Water Systems have been developed and advocated by International Development Enterprises Nepal as part of their USAID funded Smallholder Irrigation Market Initiative (SIMI). The system is designed to meet both drinking water and irrigation water demands in small hill communities. Based on a gravity flow system, water is collected first into two or three thousand liter "Thai Jars," a design favored for its structural integrity. This water is distributed for drinking through a series of community taps. Any water that exceeds the storage capacity of the Thai Jar overflows into an open tank that supplies another set of taps that are generally coupled to the same water point as the drinking taps. Combined with drip irrigation and other water conserving irrigation techniques, communities are able to grow a variety of valuable fruits and vegetables that can be sold for a small profit. The SIMI programme has also made the important step of linking new suppliers with local markets. The MUS system is an important livelihoods-based option for hill communities seeking to both access drinking water and improve the productivity and value of their small



MUS providing water for livelihood activities

landholdings. While WAN has not yet implemented this approach, due to their experience of implementing gravity flow schemes and relatively small adaptations required to develop a MUS systems, they are in discussion with IDE about the potential for integrating MUS into their approach to CWRM.

4.1.4 Rainwater Harvesting

Proper management of rainfall is a central component of the WAN's approach to CWRM, as two thirds of surface water enters into the cycle of rainfall, evaporation, and runoff. Additionally, if structures are well maintained rainwater is generally of very high quality. Rainwater harvesting has applications in both rural and urban settings.

In rural hill areas, WAN's partner NEWAH has been promoting rainwater harvesting as a useful technique to supplement other sources, when scarcity results from insufficient or distant surface water supplies. At the household level, NEWAH has constructed rooftop systems that collect into 2,000 liter Thai Jars for domestic use. NEWAH has also implemented rainwater harvesting in schools, collecting the water in larger, ferro-cement tanks up to 20,000 liters in size. Runoff can destabilize steep hillsides, so rainwater harvesting ponds and check dams can be used to reduce the likelihood of landslides.

In urban areas rainwater harvesting can be used for drinking water or as a valuable means of recharging groundwater and improving water quality of the well and aquifer through dilution. WAN's partners UEMS, Lumanti and CIUD have all implemented rainwater harvesting schemes. Due to abundance of pavement and concrete in urban areas, runoff is typically much higher, and infiltration slower, so rainwater harvesting reduces the amount of rainwater going into sewers, drains and may reduce flooding and clogging of water channels and uptakes. In urban areas, the suitability and cleanliness of rooftops is a major constraint on the feasibility of rainwater collection as it impact on both quantity and quality of water harvested.

4.1.5 Fog water Harvesting

In many parts of Nepal, communities have settled high on ridgelines, above any suitable water sources. Technologies for lifting water are prohibitively expensive and difficult to maintain, therefore where rainfall and other surface water sources do not meet the local demand, fog water harvesting is a viable option in some parts of the Eastern Region. Fog collection technology, which is capable of collecting up to 5,000 liters of fresh water in 24 hours, allows WAN to further diversify it water provision methods and expand its approach to CWRM into numerous impoverished rural communities. To date, WAN's partner NEWAH has implemented pilot projects in Dhankutta, Illam, Terathum and Taplejung, and has feasibility studies ongoing in the Eastern Region to broaden their understanding of the potential range of this technology. These initiatives have been effective in meeting the domestic water demands of local communities, and creating a surplus of water for productive uses in the community. If WAN can source low-cost, locally produced alternatives to imported mesh that is used in the fog collectors, there is potential for this technology to be replicated in other areas where the climate and topology are suitable.

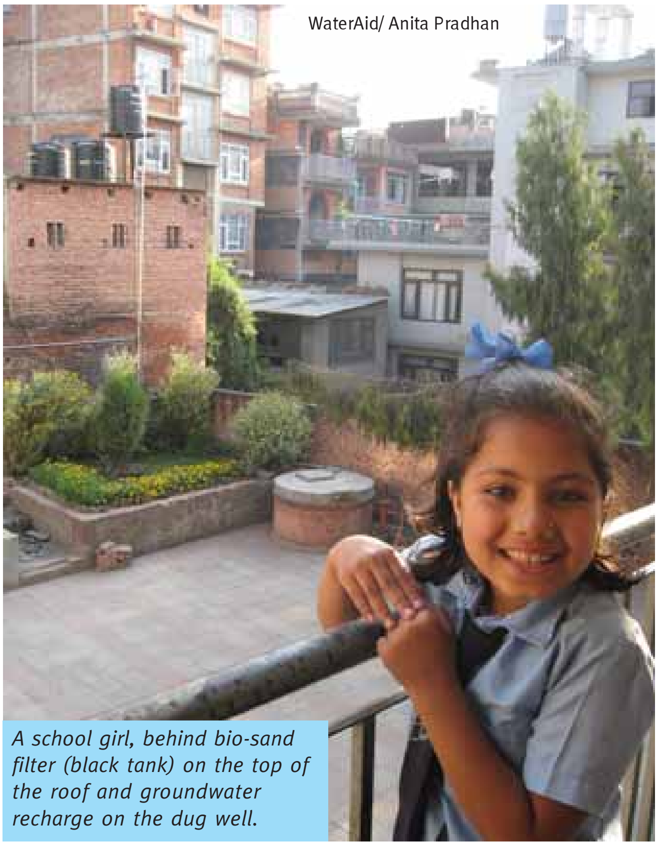

NEWAH

Harvesting water from the fog

Lalit Kalyan School

The Lalit Kalyan School is located in Lolha, Ward No. 8 of the Lalitpur Metropolitan City. Established in 1990 by a local social organization, Lalit Vikas Kendra, the school provides primary-level education to poor and orphaned children. Like many schools in Nepal's urban centers though, Lalit Kalyan faced difficulties in providing clean water to its 270 students and 14 staff. When the government serviced tap went dry 2 years ago, the school began to bring in water from a local tanker service, which cost NRs. 1,600 (US$ 25) a month. In addition to the burdensome cost of the tanker, the water was not sufficient for toilet flushing and proper hygiene practices. The lack of sanitation facilities kept many girls at home, while others complained of chronic stomach ailments associated with pathogens in the water. In 2006, WaterAid Nepal's urban partner Urban Environmental Management Society (UEMS) assisted the school in constructing a brand new 32 ft deep dug well at their premises. To ensure that the well provides a sufficient amount of water even during Kathmandu's dry season, when ground water levels drop, UEMS fitted the well with a system that uses rainwater collected on the school's roof to recharge the well. The rainwater recharge system, by diluting the water stored in the well, has also been effective in reducing the turbidity and strong iron smell that sometimes accompanies Kathmandu's ground water. The children of Lalit Kalyan are particularly happy about that.

In October 2006, in response to concerns over the micro-biological and chemical water quality of the well, UEMS, with financial support from the Environmental Camps for Conservation Awareness (ECCA), installed a bio sand filter at the school. The bio sand filter, which functions on the same premise as a traditional slow sand water filter, is made of locally available materials such as sand and gravel which trap sediment and pathogens. The results of recent water quality testing have shown that levels of pH, turbidity, iron, and coliform have all been reduced. Equally impressive is that the technologies used at Lalit Kalyan have been managed almost entirely by its staff. Mr. Ramesh Shrestha, acting principle of the school, is very happy with the impact it has had on his students. He told us: The students have less stomach illnesses and diarrhea now that the dug well has been constructed. He also attributes part of this success to an education programme that stresses the importance of proper sanitation at school and at home.



A school girl, behind bio-sand filter (black tank) on the top of the roof and groundwater recharge on the dug well.

4.1.6 Ground Water Recharge

Water scarcity is an increasing problem in urban areas, where well levels are in decline, taps are subject to intermittent supplies, and accessibility of water tankers is limited and costly. These impacts are compounded by physical problems such as high evaporation rates, surface water contamination, and drainage problems due to failing infrastructure. In areas vulnerable to such problems, rainwater harvesting for groundwater recharge is an important tool of CWRM whereby excess rainwater can be used to recharge groundwater levels. It is important to view ground water recharge as a social activity, in which individual efforts at the household level contribute to the greater good of the community. Only those individuals with excess water are likely to put water back into the aquifer, highlighting the need to promote recharge as a coordinated community effort to ensure its effectiveness and reduce conflicts that may arise due to perceived inequities in individual contribution to the social good.

The importance of ground water recharge is exemplified by the fact that groundwater extraction in Kathmandu outstrips recharge by nearly 300%. With falling ground water levels, many urban communities are forced to bring in water by tanker, an expensive option. Recharge raises the water table, may improve water quality through dilution, results in a cleaner source, and puts significantly less pressure on drains by reducing urban runoff. WAN's partner organizations CIUD, UEMS and Lumanti have been implementing rainwater harvesting and groundwater recharge at the household and community level in both schools and office buildings. Recharge options are easily adapted from existing rainwater harvesting infrastructure. The objective is to hold rainwater as long as possible so that maximum infiltration may occur, and to make provisions so that the rate of infiltration is maximized. WAN's approach advocates both non-structural (advocacy, documentation and awareness) and structural methods (recharge wells including dug, bore wells, and hand pumps; percolation pits and percolation trenches). The NGO Forum has been critical in urban recharge advocacy, and WAN's engagement with Tribhuvan University has resulted in new innovations such as urban rain gardens (bowl-shaped gardens) based on a traditional design that absorb storm water run-off from surfaces such as roofs and parking lots.

Reviving Traditional Sources in Lalitpur Municipality

For many years the residents of Chocchen, a small, densely settled community in Ward No. 11 of Lalitpur Metropolitan city, survived on a piped government supply of water that was sporadic, and often of poor quality. The residents struggled to meet their daily water needs for drinking and sanitation. In 2006, with the assistance of WaterAid Nepal and the Urban Environmental Management Society (UEMS), the community constructed a new dug well. The well was combined with two five thousand liter overhead tanks that are filled each day by an integrated electric pump, after which the caretaker distributes water to over fifty households. The caretaker, a local resident, does this twice a day, ensuring that each household gets thirty minutes of equal access per day. While some residents have rooftop storage tanks, many collect the water in buckets or other vessels until it is needed.

New dug well and overhead tank

While the quality of the well water is frequently checked by UEMS, many residents still use point of use (POU) treatment such as boiling, filtration, or chlorine to ensure that the water that they consume is of high quality. To keep the community system operational, residents each contribute NRs. 50 per month, NRs.1,200 of which goes to pay the caretakers salary. They rest of the money goes into a bank account established in the communities name where it remains for eventual repair and maintenance. The community members are very happy to be self sufficient: Before the installation of our own system, we received more false promises than water. We have now broken off our links to the central piped supply, and rely totally on our own community-managed system. With the water flowing, the community has begun to think about the next steps towards making their community system even more sustainable. They are currently consulting with UEMS and relevant experts on how to integrate a rooftop rainwater collection system to their recharge their well. With the government supply facing increasing strain in meeting community needs, decentralized community-managed systems such as the one in Chochhen will take on an even greater importance.

4.2. Pollution Risk Reduction

Reducing water pollution results in increased water resources available for domestic use. The CWRM tools and approaches available are designed to promote proper sanitation and manage and treat wastewater in a manner that does not contribute to water contamination. They include improved latrines and water treatment facilities, water points and construction of aprons to avoid water contamination from infiltration, and encouraging creation of Water Safety Plans (WSP) to prevent contamination during planning, implementation and afterwards. One of the pillars of this approach, ecological sanitation, integrates a vital livelihood component that encourages water and nutrient re-use in communities that practice agriculture.

4.2.1 Wastewater Management

While great emphasis has been placed on water supply, little attention has been given to the fate of wastewater once it leaves the drain. Wastewater may end up in a local river, harming the natural ecology, or may wind up contaminating ground water that is used for drinking. These problems can compromise the environment and the availability of clean drinking water. Alternatively, wastewater may be viewed as a resource that can be treated and re-used for a myriad of non-consumptive uses. The aim of wastewater management is to mitigate water pollution risks, protect the environment, and increase agricultural yields while improving hygiene at the household and community level. Eco-sanitation latrines make operational the notion of "closing the loop," by collecting urine and feces in a sealed tank and turning it into a valuable fertilizer. One important urban wastewater management technique within the scope of CWRM is the management of grey water, an often forgotten component of water and sanitation projects. Water from baths, showers, hand basins, laundry and kitchen sinks represents a large volume of water with relatively low nutrient contents. Technologies such as constructed wetlands filter this water for re-use around the house, for example, flushing toilets, in doing so optimizing water use.

Kirtipur Housing Project

The Kirtipur Housing Project (KHP) was designed to house the 44 families evicted following the Vishnumanti Link Road (VLR) Project located in Paliphal, Ward No.6 of Kirtipur Municipality, the project is a first in urban poor housing, aimed at providing improved living conditions through adoption of eco-friendly principles rooted in CWRM. WaterAid Nepal's urban partner, Lumanti, a national NGO focused on urban shelter, was responsible for implementing the KHP with support from WAN and the Environment and Public Health Organization (ENPHO). The Kirtipur Housing Management Committee (KHMC) was established to manage and oversee the KHP project. To ensure that the project prioritized the needs of the community, their involvement was sought from planning through to implementation. Because the families rehabilitated to this settlement cannot own this type of housing through immediate investment, the houses are provided under an interest free loan from the Urban Community Support Fund (UCSF) which the community will pay back within a period of 15 years. WAN provided financial and technical support for awareness campaigns and trainings on environmental sanitation, providing knowledge on waste and wastewater management, value based water education and promotion of health and hygiene education at local household and community level. In total 44 individual units were constructed within an area of 32,856 sq ft.


WaterAid/ Kabir Rajbhandari

Recharge pit of Kirtipur Housing Project

Given the strain on resources and services available for urban water and sanitation, KHP integrates the concepts of recycling (water and waste water, solid waste and soil), regeneration, recovery of wasteland and encroached areas, recharging of the ground water table, and rejuvenation of rivers and water bodies. Rainwater harvesting techniques have been used throughout KHP to ensure alternate water supply facilities for the community. In addition to domestic use, the rainwater is also being used to recharge groundwater through the use of recharge pits. These help address the issue of water depletion caused by water extraction from the two community dug wells. In addition, KHP incorporates solid and liquid waste recycling, recovery and reusing mechanisms. Liquid waste is recycled and reused once it is treated through a decentralized wastewater reed bed treatment plant. The treated wastewater is used for washing, cleaning, gardening and also for irrigating adjacent farm land. To ensure residents of the KHP are conscious of the surrounding environment, training was provided on collecting and managing solid waste, including composting techniques and demonstrations on recycling and reusing waste. As an outcome kitchen waste composting is now taking place and the fertilizer which is produced is sold generating a profit for the community. Residents were also made aware of water optimization concepts and the issue of water quality. Awareness of this was gained through water education and demonstration of water treatment techniques. Point of Use (POU) treatment mechanisms such as Solar Disinfection (SODIS), PIYUSH (chlorine liquid) and bio sand filters are now common practice for treating rainwater, groundwater and piped water.

The KHP project has not only provided shelter to displaced families in Kathmandu but it has opened up avenues towards sustainable alternative solutions for managing urban water resources through effective community-based programmes. The project also demonstrates how dynamic and innovative approaches can result when organizations with different but complimentary specializations work together.

4.2.2 ECOSAN

ECOSAN has rural, peri-urban and limited urban applications in areas where both ground and surface water sources are at risk of pollution due to high water tables and small land holdings that constrain the spatial arrangement of water points and latrines. ECOSAN functions by diverting the flow of urine and feces, and storing them separately in sealed tanks under conditions that promote aerobic digestion and creation of organic fertilizer that can be used on farm or in kitchen gardens. This has a three-fold value within the scope of CWRM. First, it reduces the potential for human waste to contaminate the drinking supply, and second, eliminates the problem of people using

WaterAid/ Marco Betti

Taking manure out from ECOSAN toilet

precious drinking water to flush their toilets. Thirdly, by closing the loop, it utilizes the urine and faeces as a high nutrient organic fertilizer in the agriculture thereby reducing the reliance on chemical fertilizers which have become a prime culprit in ground water pollution. ECOSAN toilets, which have become an important component in projects implemented by ENPHO, Lumanti and CIUD, have been particularly effective in the peri-urban settlements within the Kathmandu Valley that are still mostly agricultural, and acceptance of human faeces use is high.

4.2.3 Constructed Wetlands

Constructed wetlands are a biological wastewater treatment facility designed to mimic processes found in natural ecosystems where wetland plants and their associated micro-organisms remove pollutants from wastewater. This technology was introduced as an option for decentralized wastewater treatment in Nepal in 1997 by ENPHO, one of WAN's implementing partners. The benefits of a decentralized sanitation system are that they are easier to plan and implement, the investments are typically less, capacity expansion can closely track local demand, and different strategies can be swiftly deployed in different contexts.

ENPHO, with the assistance of WAN, has constructed 13 such treatment systems, ranging from single household units with a capacity of 0.5m^3 per day to institutional plants treating 50m^3 per day. Most of the constructed wetlands that have been developed for managing wastewater are based on Reed Bed Treatment Systems (RBTS). The major challenge at present faced by this technology is to promote and upscale the use of this technology across the country. ENPHO, with support from WAN, UN-HABITAT and ADB, piloted this technology in the Sunga community of Madhypur Thimi Municipality for the first time in Nepal. It is hoped that the demonstration of this project will encourage its replication and wider application once other sectoral actors, institutions and individuals can see the benefits. The process of replication of this technology has already been initiated by Urban Environment Improvement Programme (UEIP) of Department of Urban Development and Building Construction (DUDBC) under Ministry of Physical Planning and Works (MPPW) of Government of Nepal (GoN). The government has made mandatory for all the 8 towns, where UEIP is being implemented, to replicate the model of constructed wetland for treating wastewater piloted in Sunga Community for Madhyapur Thimi Municipality.

Wastewater Treatment in Thimi Municipality

The community of Sunga in Madhyapur Thimi Municipality has constructed a community based Reed Bed Treatment (RBT) facility for managing wastewater. Madhyapur is located in the Kathmandu Valley and has a population of around 48,000 and covers 11.11km^2. Although the community has a network of sewer lines, the absence of treatment facilities has resulted in municipal wastewater being discharged directly into nearby water bodies, polluting rivers and streams along the periphery of the community where most of the agriculture land is situated. The RBT facility was developed to promote simple but effective community-based urban wastewater management, to improve sanitation and hygiene, to improve water quality, to provide alternate non-drinking water facilities (such as flushing school toilets), and to create livelihood opportunities for the local poor (such as for the caretaker of the system). Active participation of the community in the inception, planning and implementation of this project has been central to its success. A Community Users Committee, comprised of 17 members representing local leaders, CBOs, the community, municipality and local schools was set up to manage the project. The community played an active role in identifying the land for the plant and the committee is now responsible for its continued operation and maintenance. ENPHO provided technical training to the users committee members and caretaker of the plant.

Reed Bed Wastewater Treatment Plant

The RBT in Sunga has the capacity to treat 50m^3 of waste water per day from 200 households. While some of the treated wastewater is discharged back into local streams, a proportion of it is being used for gardening and cleaning surroundings, and there is talk of diverting a certain proportion of the treated water to surrounding farmland for irrigation. The treated effluent is considered to have high organic nutrients and therefore enhances crop yield. Bali Premi Secondary School, adjacent to the plant, has also agreed to use a proportion of treated wastewater effluent, for the purpose of toilet flushing and cleaning the surroundings of the school during the dry season. Sludge, which is a heavy mass of waste dissolved in the wastewater, is collected in the settling tank and baffle reactor. The sludge is removed at a defined frequency and transported to the sludge drying bed, where it is piled up and dried. The dried sludge can be used both as a fertilizer and as fuel. There are also valuable uses for the reeds once they have reached maturity - some are trimmed down to a fixed height and re growth is started again while others are used for fencing around the treatment plant. If there is any surplus, it is planned to be used as a source of biomass energy for burning. The Sunga Treatment Plant is the first community based wastewater treatment facility in Nepal. It is hoped that the project will encourage replication, once other sectors and individuals can see its benefits.

For further information on this see WAN's document on Wastewater Treatment Plants

4.2.4. Other Emerging Wastewater Treatment Technologies

In addition to the aforementioned technologies, WAN is also working alongside its partners in the development of an anaerobic digester that can be linked to a community-managed biogas plant, allowing communities to convert sludge into a valuable resource that can be used for cooking in the household. This provides an important linkage between wastewater management, CWRM, and livelihoods. WAN is also assisting in the development of a septic tank that incorporates bio-filter plant. This would have space saving benefits over the constructed wetland option, and would further encourage re-use of black-water and grey-water for non-consumptive purposes. This is still in a pilot phase.

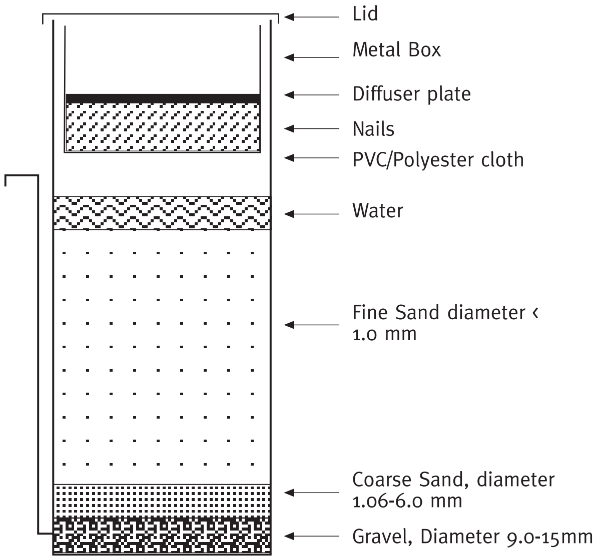
4.3 Water Quality: Treatment, Testing, Monitoring And Data Management

Chemical and biological contamination is a persistent threat to water quality and public health in Nepal resulting in diarrhea, waterborne disease and skin disease, especially among women and children. Those institutions and organisations have a responsibility to ensure that mechanisms are established to guarantee that the water people are drinking is safe. Aside from mitigative and technical measures, this involves a commitment to monitoring of water quality and proper management of that information.

4.3.1 PoU Water Treatment

Point of Use (PoU) options are used to treat water at the source of consumption, thus making them an important component in any approach to CWRM, particularly with respect to water quality objectives. Even when water is of high quality at the point of collection, or source, it can become contaminated prior to consumption through human contact or transportation and storage in an unclean vessel. Much of the contamination occurs in the household. WAN and ENPHO have developed and advocated a variety of PoU treatment options for rural and urban households to ensure that the quality of the water is safe at the time of consumption. PoU options developed and advocated by ENPHO include **bio-sand filtration, chlorination, boiling, and SODIS.** These options are increasingly gaining traction within the sector, and have been adopted by numerous organizations working in WATSAN.

Bio-sand filters, produced on a small scale by ENPHO, are effective in removing arsenic, iron,



Bio Sand Filter

turbidity, and microbial contamination from drinking water. Their simple, multipurpose design that incorporates several strata of filtration materials makes them suitable in Nepal. For household use they have not yet gained popularity - prohibitive cost and high maintenance make them less appealing compared to other options. However, several of WANs partners, including CIUD and Lumanti have developed large scale bio-sand filters (500 liters) that can be incorporated into rainwater harvesting and dug well supply systems. Another low cost option for treating drinking water at the point of use is chlorination. Both Water Guard and Piyush are widely available chlorine solutions can be used to treat water at the household level, though bad taste has limited their widespread use. The most common and accessible PoU option for poor households is boiling. Though costs are incurred through the use of gas or firewood, this option is highly effective at removing contaminants from drinking water, though it does not remove arsenic. A final option for PoU water treatment is SODIS, which is a non-commercial method of solar disinfection. This method prescribes placing clear plastic water bottles in direct sun for a period of 6-8 hours during which Ultra Violet radiation functions to kill contaminants. While suitable in urban areas, a shortage of PET bottles in rural areas limits the viability of this option in remote areas. Please refer to Annex 2 for a matrix overview of PoU options.

Apart from the above mentioned POU Treatment technologies, WAN is undertaking a research supporting ENPHO to have new technology called Water Pasteurizing through Improved Cook Stoves (WAPIC) with a view to combat with both water borne diseases as well as acute respiratory infection caused by indoor air pollution.

4.3.2. Water Quality Testing and National Standards

Drinking water quality is a major public health concern in both rural and urban areas. Therefore monitoring water quality is an important aspect of CWRM. Conventional means available to WAN and its partners for monitoring physical, chemical and biological parameters require manpower and well equipped laboratories, of which there are only a few located in urban centers in Nepal. These labs are expensive and inaccessible to most, especially if samples must be delivered from rural areas. Further, imported field testing kits are expensive and up until recently, were difficult to use and prone to error. WAN is currently working in conjunction with local partner ENPHO to have their locally manufactured field testing kit validated and accredited, so as to build the capacity of its partners to more accurately monitor and manage water quality in rural and urban areas alike. International accreditation of ENPHO's testing kit will also benefit other agencies in Nepal and throughout South Asia.

In a step towards ensuring water quality, WaterAid Nepal developed its Water Quality protocol as a guide to deliver safe water, which is followed in all of it programmes implemented by it partners. WAN's protocol is in line with the country's National Drinking Water Quality Standards (NDWQS) established by the government of Nepal during 2006.

The proposed implementation schedule of NDWQS states that Municipalities will have completed a Water Quality Improvement Plan within one year and will have to be brought up to standard within five years. Still, bringing community water supplies up to these standards presents many challenges. Most profound is the disparity between the standards issued by GoN and other agencies - for instance the proposed GoN standard for arsenic is 50mpb while the World Health Organization (WHO) and WAN standard has a range of 10 - 50 mpb. These disparities cause lots of confusion in implementation, and coming to a mutually agreed upon standard within the WATSAN sector will be the focus of much future advocacy work. WAN, through its partner ENPHO, will be piloting research-based advocacy programmes based on CWRM principles in six Municipalities to start with and will gradually expand to other Municipalities geared towards implementing NDWQS by developing water quality improvement plans in conjunction with Water Safety Plans (WSPs) to deliver quality water to urban consumers. Part of the process will involve a community managed water quality testing programme (with results relayed back to ENPHO), followed by technical intervention based on the results of the testing.

Women using SODIS technique at Ram Hiti Squatter Community

WaterAid/ Anita Pradhan

5 Research activities

WaterAid Nepal's programmatic work on CWRM is combined with research activities geared towards between understanding the environmental and technical aspects of CWRM. Research is used by WAN and its partners to drive technological innovation and strengthen its advocacy on core issues.

5.1 Ground Water Recharge Studies

Rainwater harvesting and groundwater recharge have been advocated in the urban context, but aside from case studies, there has been little empirical research conducted that demonstrates the relationship between recharge, groundwater levels and water quality. Such research would prove to be a valuable advocacy tool in urban areas where many residents do not wish to invest in recharge because they are unaware of the benefits.

In this context, during 2008 a research study is being carried out by NGO Forum, with the support of WAN and UN-HABITAT, as well as engaging the expertise of the Central Department of Geology at Tribhuvan University. The research on recharge of ground water (shallow aquifer) by harvesting rainwater aims to examine the suitability of four different recharge methods in the Kathmandu Valley: recharge through **dug wells, recharge through soak pits,** recharge through **soak pits with bore wells,** and **recharge from surface using infilltrometers.** This study will investigate infiltration rates at different locations in the valley, analyze rainwater quality at different locations, analyze impact of rainwater recharge on groundwater quality and study the impact on groundwater level in the locality of recharge. It is anticipated that the results of this study will assist in better planning recharge activities in different localities in the valley, and will provide a strong basis for CWRM advocacy.

In connection with this research, WAN's urban partner UEMS is currently conducting a three year programme on recharge of ground water (shallow aquifer) by harvesting rainwater. Through piloting the recommendations of the research study (mentioned above) this programme aims to demonstrate the link between recharge, ground water levels and water quality within Lalitpur Municipality.

5.2. Source Sustainability Study[1]

The Long Term Sustainability Study[2] completed by NEWAH in 2003 found that many water projects in the hills had suffered from technical failure and slipped into a state of disuse. This study brought to fore the need for improved monitoring of completed projects to ensure their sustainability. While technical failures are an anticipated result of projects with a limited life span, WAN's approach to CWRM looks beyond technical failure to understand how

[1] Systematic Issues of Drinking Water Systems, NEWAH and Nepal Water Conservation Foundation, 2007
[2] Long Term Sustainability Study, NEWAH, 2003

broader environmental processes occurring at the watershed level can impact upon the sustainability of the source itself, independent of technical flaws. This study, prepared by NEWAH, examines 15 failed gravity-flow systems to determine if failure was related to source depletion or system failure. The findings indicate that many of the projects failed due to natural, technological and social factors, rather than broad scale environmental change. The study team recommends both strategic and project level measures to ensure that risks to source sustainability are addressed at the time of project inception and monitored after completion.

5.3. Ground Water Contamination Study[3]

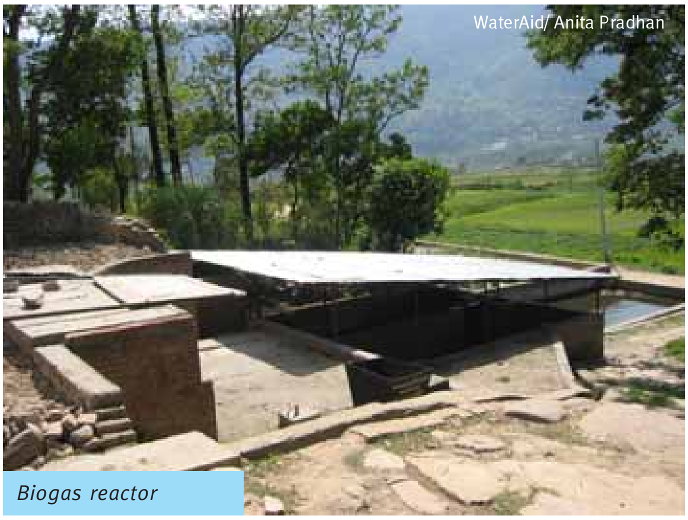
Initiated by Nepal Water for Health (NEWAH), this study examines chemical and biological groundwater contamination in tube wells in two districts of the Tarai. The study area includes 60 tube wells each in four Village Development Committees (VDC.) The focus is on 1) how tube well depth influences the degree of contamination from chemical (ammonia, iron, arsenic) and biological (fecal coliform) contamination, and 2) the relationship between tube well contamination and proximity to toilets and other factors that may influence water quality. The findings indicate that strong causal relationships do not exist, but that contamination is likely linked to more complex and localized factors of soil composition, hydrology and transport. This highlights the need for site specific assessment of factors that contribute to contamination, and the creation of preventative physical and social structures at the project site. Further action research is planned in this area during 2008.

5.4. Arsenic Study

WAN is currently funding a piece of research on arsenic contamination of groundwater in Nawalparasi District. This study aims to understand if heterogeneity in arsenic is attributable to localized hydrologic differences that control the hydro-chemical environment and arsenic mobility. To accomplish this, the study will quantify boundary fluxes (including precipitation, recharge, and evapotranspiration), quantify internal groundwater flow, test and analyze chemical changes, and develop a local, predictive model for flow flux that correlates to arsenic concentration. WAN is hopeful that this study will contribute to sectoral knowledge on arsenic and arsenic mitigation, and assist in developing new parameters for Tarai tubewell programmes. This work will be ongoing through June, 2008, in conjunction with the University of Texas at Dallas and NEWAH.

5.5. Action Research on Biogas Reactor and Septic Tank with Up-flow Bio-filter

WAN and its partners are also conducting action research on innovative waste management



Biogas reactor

[3] Physical, Chemical and Microbiological analysis of drinking water in Morang and Siraha Districts, NEWAH 7 SEAM-N-NMA Environmental Laboratory, 2008

approaches that can be integrated into a CWRM approach. Lumanti is working with the community at the Belchok Bus park in Narayangad, Chitwan, to develop a 40m^3 biogas reactor that will turn organic waste into a valuable fuel and fertilizer through controlled anaerobic digestion. The space and cost effective design reduces sludge discharge, effluent streams, and greenhouse gas emissions.

WAN and Lumanti are also working with 31 households in Narayan Tole of Kathmandu to develop a septic tank with an up flow bio-filter for treating the community's waste water. This technology is highly efficient in areas where available space is limited. Unlike Reed Beds, which require 1m^2/person, the septic tank with upflow bio-filter can be constructed in a densely settled urban area. Household effluent from the septic tank is treated by the up flow bio-filter. It is a submerged filter with stone media of 6m to 120m deep. Septic tank effluent is introduced to it from the bottom, and the microbial growth is retained on stone media making possible higher loading rates and efficient digestion. Because the design in fairly low maintenance, it can be managed by the community.


WaterAid/ Anita Pradhan

Cooking food from the biogas


WaterAid/ Anita Pradhan

Septic tank with up-flow Bio-filter

6 Ways forward

6.1. Structured Assessment and Implementation

The previous section highlights many of the concepts, tools and techniques that WAN and the organization we partner with have available to them when implementing their approach to CWRM in a project setting. This collection should be viewed as a CWRM "toolbox" from which WAN and its partners can choose appropriate components based on the context. WAN now seeks to move away from ad hoc application of these technologies and concepts towards a more systematic method for assessment and implementation. This will require several important steps, among them a clear definition of what community means in community-based water resource management. Does community refer to the familiar community, the larger administrative community (e.g. VDC or Municipality), or a broader physical community such as a watershed? Examples from the Nepal context do exist that may guide WAN's approach. Determining the definition of community that is appropriate for community-based water resource management must be based on several factors and will vary between different context, specifically urban and rural.

6.1.1 Water and Environmental Improvement Plans

In the urban context, WAN has already worked with other organisations to developed Water and Environmental Sanitation Improvement (WESI) Plans within six programme areas[4]. WESI plans attempt to address local water and sanitation (including neighbourhood environmental sanitation) needs in a comprehensive way by preparing an inventory of water resources in a specfic area. The plans also identify the demand and possible risk, such as pollution and poor water management, placed on those resources, enabling a plan to be developed for the sustainable use of the resources available. In addition, based on the demands and needs of the community sanitation improvements and hygiene promotion within the areas are included within the plan. Based on CWRM principles, WESI plans aim to ensure sustainable use of resources and infrastructure, community participation and local ownership in water and sanitation issues. Collaboration with local political bodies and empowering local users are the socio-political approach of this plan. In social term, the plan helps the judicious and equitable distribution of water and delivers sanitation services on need based demand. Moreover, it also considers the management and ownership of the system.

6.1.2. Water User Management Plans

In the rural context, following the model developed under the Water Resource Management Programme (WARM-P) currently being implemented in the rural areas of the

[4] The six municipalities are Bharatpur, Chapagaun, Kirtipur, Tigni, Gamcha and Lubhu.

Western Development Regions of Nepal by Helvetas and the Finish Government supported Rural Village Water Resource Management Project, WaterAid Nepal is focusing its efforts on developing a CWRM implementation model to be initiated at the Village Development Committee (VDC) level. The WARM-P proceeds via a multi-step process that begins with community appraisal and the formation of a VDC WARM committee. The committee guides a series of community assessments that feed directly into the creation of a Water Users Master Plan (WUMP) at the VDC level. The WUMP approach captures information of the available water resources within the VDC, the current and future demand on the resource, and water related projects based on local social and technological capacity and needs. WARM-P looks at four broad area of water use – water supply and sanitation, irrigation and drainage, environment and ecology, and other, which include electricity generation and water for cottage industry.

WAN and NEWAH have identified six VDCs[5] in hill areas of the Western, Central and Eastern Development Regions which it plans to facilitate the development of WUMPs in the coming years. The first phase of this will focus in two VDCs in the Districts of Gorkha and Udaypur, and will broadly follow the approach adopted in the Helvetas WARM-P. Based on an assessment of its suitability as a model for supporting the implementation of a CWRM approach, WAN and its partners will modify the model and support the development of WUMPs in the four remaining VDCs in two phases using a revised approach. After the second phase of implementation, WAN and its partners will also modify the approach to make it applicable to the Tarai context and facilitate the development of WUMPs in two Tarai VDCs[6]. Both the WESI and WUMP approaches are closely aligned with WAN's desire to create an implementation model that is assessment driven.

However, WAN recognizes that using administrative boundaries does have its limitations that must be addressed. In some circumstances, VDC or Municipality boundaries may cross through several watersheds, resulting in communities being linked through sharing water resources despite falling in different administrative areas. Additionally, in rural and peri-urban areas informal water management institutions exist across boundaries between communities and user groups. Isolating these communities and groups based on administrative boundaries may result in the breakdown of such institutions if their role is not assessed and their continued existence cultivated. The point is that while administrative boundaries provide an excellent framework for implementing WAN's approach to CWRM, the implementation process must include an assessment of how existing physical and social relationships that cross administrative boundaries can be reconciled to the broader objectives of the programme.

6.1.3 Capacity Building and Cooperation

WAN will focus on supporting the organisations we partner with to build their capacity to develop comprehensive water resource management plans, whether that is WESI Plans or WUMPs. WAN recognizes that another important step in making CWRM operational is identifying which other stakeholders need to be engaged, and how to engage them in a way that is constructive and meaningful. WAN believes that these CWRM planning tools will help such engagement and guide service providers at the local and community level, as well as facilitating cross-

[5] The VDCs the have been provisional identified for WARM-P activities are located in the districts of Udaypur, Gorkha, Baglung, Sindhuli and Dhading.
[6] No VDC have been selected yet but it is envisage they will be from two of the following districts: Siraha, Mahottari, Dhanusa or Bardiya.

sector linkages in collaboration with the local community, local bodies and concerned sector stakeholders. The successful demonstration of these water resource plans will help WAN and the organisations we partner with to influence the sector for replication and to have cross linkage with the sectors other than water and sanitation sector.

In operationalising its approach to CWRM, WAN must decide the following: Which stakeholders within the community to engage? With whom does WAN make institutional linkages? What is the nature of that relationship? Clearly, improved community water resource management will require increased collaboration amongst the various managers and users of water in a community, however defined. This includes local government, user groups, and NGOs working on water, irrigation, and hydropower. Thinking along these lines, stakeholders should be categorized broadly as either those that are managing water, or those that are using water. Managers of water may include hydropower plants, drinking water facilities, and managers of irrigation for agriculture. The users include the numerous smaller institutions and individuals that are directly engaged in the consumptive or productive use of that water. It would be very difficult for WAN to engage all of the implicated stakeholders in a given community, and given WAN's capacity and experience in the WATSAN sector, it makes sense for WAN to focus its resources on users of drinking water while establishing institutional linkages with the institutions and organizations that are functioning as managers of water from other sectors (primarily agriculture and hydropower). These managers can then engage their own respective end users through existing formal and informal networks. WAN and its partners, through these institutional linkages with other managers of water, may function as an institutional umbrella under which all CWRM activities are coordinated and implemented.

6.2 Advocating Community Water Resource Management:

Lastly, advocacy will play an important role in WAN's community-based water resource management activities. Policy advocacy will be critical in:

1) ensuring that others in the sector are aware of the available tools and techniques for CWRM;
2) that other organizations are able to replicate successful approaches to CWRM; and
3) so that national-level decision makers are aware of water resource management issues and the community based approaches that are available to address them.

Advocacy activities at the local level based on issues identified by communities themselves will ensure that the poor are able to contribute to the debate over how to sustainably manage community water resources. They should be viewed as an invaluable resource in project design and implementation because of their knowledge of the local context. To accomplish this, WAN's existing advocacy partners the NGO Forum for Urban Water and Sanitation Reform and FEDWASUN can play an important role in advocating both a variety of local institutions for better community management of water. In addition, WAN can work in conjunction with existing advocacy platforms on issues such as water quality, and in particular arsenic, to mobilize action among actors within the sector, and among decision makers at the national and sub-national level.

7 Conclusion

Moving CWRM in Nepal from concept to reality requires the kind of systematic, assessment based approach described in this documentation. The fact that such a diverse range of viable technologies and techniques already exists is important, and ongoing research will surely lead to the development of new techniques and an improved understanding of the environmental factors that must be considered in an CWRM approach. New and existing linkages with academia and independent research centers will help facilitate this. WAN must ensure that capacity building mechanisms are in place so that staff and partners are able to learn and apply the emerging tools and techniques in their programmatic work. The toolbox is stocked with a range of widely applicable tools and approaches for community-based water resource management. What is required moving forward is a systematic model to assess the risks and opportunities, and to guide design, implementation and monitoring. The CWRM principles developed by WAN and adopted by its partners are the true lynch pin for this effort, as they are gradually being integrated into WAN's programmes to various degrees and to date proving to be highly effective. Scaling this approach up in a national level has the potential to greatly increase the equity and sustainability of access to water and sanitation within Nepal.

Annexes

Annex One: Rural vs. Urban, Hill vs. Tarai Matrix

	Challenges and Constraints to WATSAN Provision	CWRM Measures taken by WAN and Partners
Urban	▪ Issues of water quantity and quality ▪ Social stratification in tight urban settlements complicates access ▪ Aging infrastructure makes expanding central supply difficult ▪ Lack of wastewater treatment facilities ▪ Pollution, contamination and malfunctioning of traditional water sources ▪ Falling ground water levels	▪ Constructed wetlands, anaerobic digesters, and bio-filters with septic tanks for wastewater treatment and reuse ▪ Water demand management and traditional source conservation ▪ Rainwater harvesting and ground water recharge ▪ Promotion of Ecosan toilets in peri-urban areas that are largely agricultural ▪ PoU water treatment at household level
Rural Hill	▪ Availability of water from distant, irregular sources ▪ Water quality ▪ Environmental calamities impact source sustainability ▪ Need for rehabilitation of old systems ▪ Lack of local-level capacity	▪ Source sustainability measures ▪ Rainwater and fog water harvesting at community level ▪ Livelihoods integration through innovative approaches, such as drip irrigation ▪ Development of institutional arrangements to monitor and rehabilitate systems as needed ▪ PoU treatment at household level
Rural Tarai	▪ Ground water contamination and arsenic in tube wells ▪ Water quality issues ▪ Sanitation gap – lowest in country compared to water availability ▪ High water tables and likely contamination from latrines or other sources of pollution ▪ Lack of capacity	▪ Establishment of clear guidelines on the spatial arrangement of water and facilitation facilities ▪ Development of institutional arrangements to monitor and rehabilitate systems as needed ▪ Monitoring and appropriate mitigation of water quality ▪ Promotion of Ecosan toilets ▪ PoU water treatment at household level

Annex Two: Comparing PoU options

Option	Price and Distribution	Key Attributes	Potential Market	Challenges and Issues
Chlorination		Convenient, inexpensive and has continuous action.	Both urban and rural areas.	Bad taste has slowed the uptake of these products.
Waterguard	NRs 35 per for 240ml; Commercial distribution network.			
Piyush	NRs 17 for 60ml; Distribution through medical outlets and pharmacies in urban areas.			
SODIS	No cost involved; Distribution opportunities include scrap dealers and PET producers.	Cost effective and affordable.	Urban and peri-urban areas.	PET bottles are not widely available in rural areas, limiting the suitability of this technology.
Bio-sand Filter	Rs. 1,500 – 1,700 for a household filter; Distribution network limited – orders only.	Attractive and good taste (findings from survey). Effective against arsenic.	Initially urban and peri-urban areas.	Expensive, and requires lots of maintenance (cleaning the filter materials).
Boiling	Cost involves boiling materials (including gas or fuel wood).	High awareness and well accepted.	All areas (hill and mountain preferred).	Boiling is fuel wood intensive and cooking gas intensive. Does not remove arsenic.

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WaterAid

WaterAid's mission is to overcome poverty by enabling the world's poorest people to gain access to safe water, sanitation and hygiene education.

For more information, please contact:
WaterAid in Nepal
Kupondole, Lalitpur, Nepal
GPO Box: 20214, Kathmandu, Nepal
Telephone: + 977 1 5552764 / 5552765 / 5011625
Fax: + 977 1 5547420
Email: wateraid@wateraidnepal.org.np

www.wateraid.org/nepal

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