Water Resources Management Approaches and Technologies

Experiences from HELVETAS Swiss Intercooperation in Nepal

Kathmandu and Zurich

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This paper discusses water resources management approaches and technologies based on experience of HELVETAS Swiss Intercooperation in Nepal. It is our hope that this publication will serve as an effective medium for sharing our long experience and learning on water resources management in the country.

We would like to thank all those who have contributed to this publication. The fact sheets of this document were developed with the contribution of Lukas Egloff, NADEL intern, and Helvetas staff Madan Raj Bhatta, Rubika Shrestha, Mohan Bhatta, Bhagat Bista, Susan Shakya and Niraj Acharya. We offer special thanks to Lukas Egloff and Madan Raj Bhatta, the main authors of the document.

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HELVETAS Swiss Intercooperation is a Swiss association devoted to development and cooperation. It works towards the elimination of the causes of marginalisation and promotes solidarity with the poor in the south and the east. Its mission is to actively contribute to the improvement of the living conditions of the economically and socially disadvantaged people in Asia, Africa, and Latin America. Currently, it runs programmes of co-operation in more than 30 countries, including Nepal.

By means of these publications, HELVETAS Swiss Intercooperation aims to contribute towards the generation of knowledge and the process of learning through sharing on development and co-operation.

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Acronyms

3R	Recharge, Retention and Reuse
IWRM	Integrated Water Resources Management
LILI	Local Infrastructure for Livelihood Improvement
SRWSP	Self-Reliant Drinking Water Support Programme
VDC	Village Development Committee
WARM-P	Water Resources Management Programme
WASH	Water Sanitation and Hygiene
WOCAT	World Overview of Conservation Approaches and Technologies
WUMP	Water Use Master Plan

Content

Introduction

Managing water resources is one of the most pressing challenges of our time; it is fundamental to how we feed people in coming decades, assure their health, eliminate poverty and reverse ecosystem degradation. A major constraint for people living in different parts of Nepal is the lack of access to safe and sufficient water for human consumption, sanitation, hygiene and agricultural use. Strong seasonal variation in supply, lack of adequate infrastructure and improper management prevent water from being accessible to everyone at all times.

Recent years have seen major efforts to increase water supply coverage across the country. The National Management Information Project Report 2014 appraises the coverage of basic water supply in the country at about 84%. In comparison with earlier numbers (e.g. 77% water supply coverage in 2006), this macro-level figure seems promising and encouraging. However, a huge gap between coverage and functionality persists; the functional coverage complying with human rights criteria is much lower, especially in rural areas. Settlements with water scarcity frequently coincide with poor and/or marginalised groups. Irrigated land is often owned by richer households in the valley floor while poorer settlements on mountain ridges typically have to cover significant distances on a daily basis to access the closest water source. Water related health risks are further exacerbated by often-inadequate water quality and climate change, the impact of which is already visible in many areas with springs drying up prematurely and devastating floods occurring more frequently.

Most recently, the disastrous earthquakes on 25th April and 12th May 2015 caused unprecedented damage to the existing water infrastructure in a substantial part of the country, thus putting an additional burden on the sector. The need for investment in reconstruction and rehabilitation of this infrastructure made the national goal of providing access to safe drinking water and sanitation to all people by 2017 much more challenging. Indeed, it was not quite reached.

On the other hand, there is legitimate hope that the Water, Sanitation and Hygiene (WASH) sector in the country will recover and progress over the mid- to long-term. The year 2015 saw the promulgation of the new constitution of Nepal, which enshrines access to drinking water and sanitation as a fundamental human right. Moreover, Nepal ratified the Sustainable Development Goals, which include a goal dedicated to ensuring the availability and sustainable management of water and sanitation for all. Specifically, an integrated approach to water resources management at the community level is endorsed. This renewed commitment and heightened priority through the constitutional provision and the Sustainable Development Goals are expected to have many positive implications on the overall development of the WASH sector in the country.

HELVETAS Swiss Intercooperation (hereafter Helvetas) has been active in the rural water and sanitation sector in Nepal since 1976. Starting with a strong focus on drinking water supply and sanitation in its early years, Helvetas' engagement has evolved into a water programme, which strongly promotes the participatory planning and management of all available water resources and includes sanitation, hygiene, irrigation, conservation and governance activities. It breaks down the sometimes academic and abstract notion of integrated water resources management to the local level by the preparation of comprehensive and tangible Water Use Master Plans (WUMPs). This publication gives an overview on the programme's evolution and presents the approaches and technologies applied today.

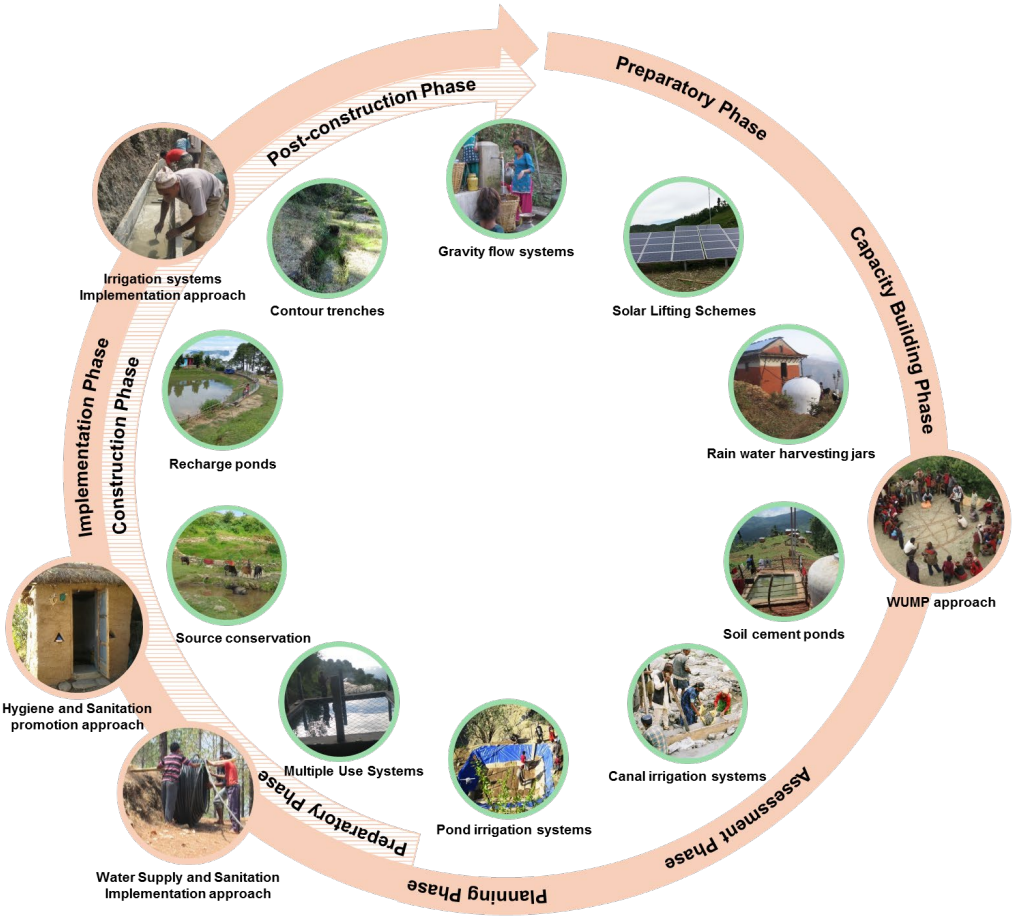
Intent and Structure of this Publication

This publication gives an overview on the water resources management approaches and technologies applied in the work of Helvetas in Nepal. Helvetas' approach to planning of water sources, its implementation approach to water and sanitation projects as well as the applied technologies are all documented in separate World Overview of Conservation Approaches and

Technologies (WOCAT)[1] factsheets. The factsheets aim to be self-explanatory and accessible to the reader largely independent of each other. At the same time, all these "tools" belong to an aligned system. We believe that effective water resources management can and should amount to more than the sum of the individual parts. If approached with a big picture mind-set, the potential for mutual benefits in water projects becomes more visible. In this spirit of integrated water resources management, we opted for what we hope is a cohesive compilation of the individual factsheets. In addition, we felt it important to elaborate on aspects which did not fit within the scope of the WOCAT factsheets, such as: reflecting more in-depth on the historical background and evolution of programmes, discussing current challenges, and providing more information on recent pilot undertakings.

The following figure gives an overview on the water resources management practices covered in this publication. In total, 4 approaches (orange shaded circles) and 10 technologies (green shaded circles) are documented.

Overview of Water Resources Management Practices



The WUMP approach serves as an umbrella for all the other factsheets. It covers the participatory identification, planning, prioritisation and implementation of all technologies in any given project area. The two implementation approaches - the first is concerned with water supply and sanitation systems in general, the second with irrigation systems in particular - describe the last WUMP phase (implementation phase) in more detail. That is, they summarise the steps of detailed design, realisation, general operation and maintenance as well as monitoring. Awareness-raising activities on sanitation and hygiene, which parallel the implementation of any drinking water scheme, are documented in a separate factsheet.

[1] www.wocat.net

The WOCAT model of pairing approaches with technologies echoes one of the key concepts of the water resources management programme of Helvetas: applying clearly defined participatory and community-led approaches to select and implement water technologies, in what one might call a blending of “software” and “hardware” support.

This publication is divided into three sections. First, a summary of Helvetas history in the water and sanitation sector in Nepal is presented. In the second part, the approach factsheets are introduced. The third part contains the implemented technologies.

The presented approaches and technologies have undergone and will undergo modifications, adjusting for instance to changes in the political landscape, user needs or the environment. As such, the documented approaches and technologies reflect a snapshot in time; the way they were being applied by Helvetas in the years 2014 to 2017. We hope that they enrich the toolbox of other water and development practitioners and scholars and prove useful for their work and studies.

PART 1: Helvetas Involvement in the Water and Sanitation Sector in Nepal

Helvetas has been active in the rural water and sanitation sector in Nepal since 1976. Helvetas' drinking water and sanitation programme in Nepal evolved through three distinct phases, where experiences and learning of previous phases guided modifications to the programme approach in subsequent years. As much as the current modus operandi of the programme accounts for the present political and socio-economic context, it also originates from the programme's history, which - in many ways - mirrors past and current challenges and developments of the Nepalese water sector as a whole.

Community Water Supply and Sanitation Programme (1976 – 1994)

In 1976, Helvetas was one of the first agencies in the sector to introduce technical assistance to the Community Water Supply and Sanitation Programme (CWSSP) in the Western Development Region of the country. The Swiss Government financed programme adopted several innovative aspects in the drinking water sector. Among them was the emphasis on technical capacity building to improve operation and maintenance of the water schemes. Training programmes were developed to capacitate technicians, engineers, village maintenance workers and user groups with managerial and technical skills. Further key features included sanitation and health education and the promotion of women's involvement. Helvetas was one of the first agencies that introduced sanitation activities in Nepal during the mid-1970s. The programme worked in close collaboration with governmental line agencies, was geared to water supply schemes of larger scale and applied a rather "top-down" approach. By 1994, around 340 drinking water and sanitation projects in 16 districts had been completed, benefiting about half a million people.

Self-Reliant Drinking Water Support Programme (1994 – 2000)

After a re-organisation of the governmental ministries and a major political transformation in Nepal, which allowed civil society to become active in development activities, Helvetas decided to develop a new approach on its own, which led to the birth of the Self-Reliant Drinking Water Support Programme (SRWSP) in 1994. Reflecting contemporary movements of the global development agenda of that time, the programme embraced a more participatory and community-led approach. To foster a strong sense of ownership, it focused on smaller-scale, user-managed water and sanitation schemes, with special emphasis on the involvement of women and the poorest segments of society. These changes corresponded to the adoption of a new programme outlook, under which the construction of drinking water and sanitary facilities aimed at empowering communities on their way to self-reliance and development. The shift in the programme approach was trailed by a geographical move at the end of the 1990s, when Helvetas moved its water programme to the Far and Mid-Western Regions. Under this programme, 109 schemes were constructed benefiting about 34,000 people from 1994 to 2000.

Water Resources Management Programme (since 2000)

The new participatory, community-driven approach to project planning and implementation proved successful in many ways. The promising results prompted Helvetas to document the step-wise approach in 2000 to share the learning and promote the methodology among other development actors[2]. While there were encouraging signs, major challenges also remained, which were documented in Helvetas Best Practice publications. They are reproduced below in largely unabridged form.

[2] 25 Steps to Safe Water and Sanitation, Experience and Learning in International Cooperation, May 2000, HELVETAS Best Practice Publications

The Most Significant Problems Encountered by SRWSP

(i) Disputes associated with the use of water sources
The most important problems faced were disputes associated with the use of water sources. Usually these disputes take the form of competition between the communities and individuals, either over the establishment of ownership over the water resources or over the mode of water use, e.g. drinking water versus irrigation. The reluctance to share water is another source of conflict. The situation is further aggravated by the gradual deterioration of water sources in rural hills due to the continuous depletion of trees and other vegetation.

(ii) Inefficient use of existing water
Existing water is used inefficiently due to leakage from different parts of the system and non-use of waste water. More economical use of water is not only a technical matter but also a social issue. There is a need for raising awareness of water as a scarce commodity and for developing a sense of ownership in the communities.

(iii) Lack of co-ordination and planning at the local level
Due to overly bureaucratic procedures and frequent budget cuts, the local government agencies (then district and village development committees, now urban and rural municipalities) face difficulties in facilitating smooth implementation of construction and repair works. This leads to the community being tempted to by-pass official procedures, and turn directly to national and international non-government organisations for support. There have been many instances of communities forwarding an application for drinking water to different organisations, without informing the local authorities. This leads to duplication of efforts and ultimately inefficient use of available resources.

Based on the above difficulties, the programme team concluded that the inappropriate selection of water sources combined with a lack of open and democratic planning on its use, have a crippling effect on the sustainability of investments in the water sector. It further inferred that the planning, construction, maintenance and repair of water systems should be carried out in collaboration with the local authorities and the users and guided by a common, long-term vision.

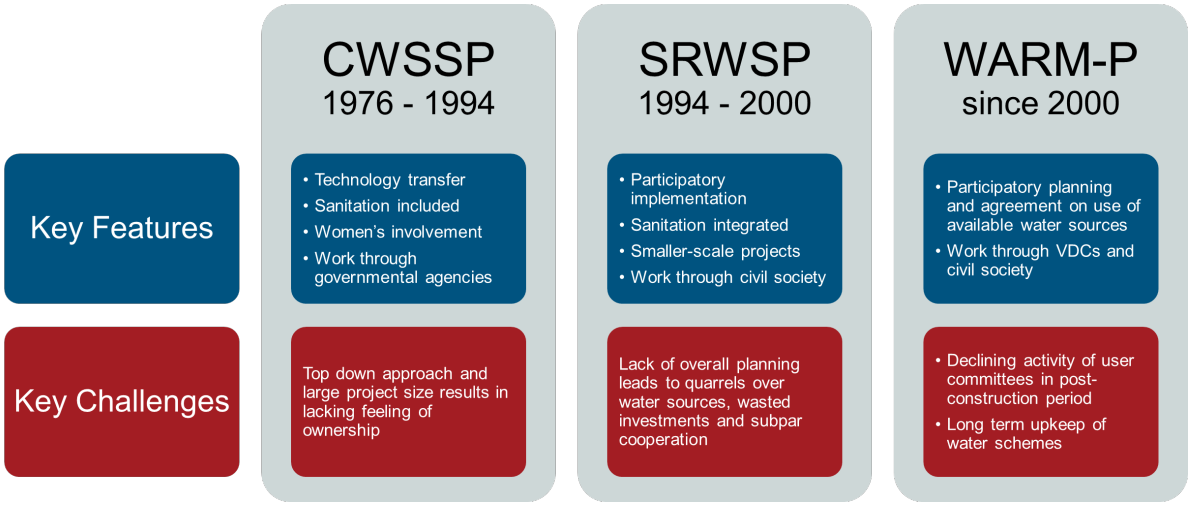
In view of these challenges, Helvetas decided to assume a more holistic vision of water sources and their use in its involvement in the Nepalese water sector. While the supply of drinking water remained the key component of the programme, its range of activities was expanded to include participatory planning of all locally available water sources. The concept of the Water Resources Management Programme (WARM-P) was developed. It builds on the idea of integrated water resources management at the local level by preparing comprehensive Water Use Master Plans (WUMP) for village development committee areas (VDC), until 2017, the lowest administrative units in the country. Key feature of the WUMP is its strong focus on “planned and agreed use” of water resources. The preparation of a WUMP serves as an entry point for interventions in the water sector and sets priorities in terms of using available water sources and the implementation of related water projects.

By the end of 2015, WARM-P had supported the construction of 421 drinking water and sanitation schemes which served about 150,000 people in 24,000 households. In the same time span, it supported the construction of approximately 28,000 toilets for 100,000 people and facilitated the preparation of WUMPs for 108 VDCs.

Over its lifetime, the approach used under WARM-P changed and adapted to changing circumstances. In recent years, the programme focused on making the WUMP approach more simple and affordable, to facilitate implementation by using local resources. Local authorities have increased their funding contribution to the preparation of WUMPs, which has helped to increase local ownership of the plan. Under the new federal structure of Nepal, introduced in 2017, it is no longer VDCs, but rural or urban municipalities that must take responsibility for WUMPs. Often this requires a consolidation of existing VDC-level WUMPs into municipal-level WUMPs, including additional ward (former VDC) WUMP processes as necessary. During the open defecation free/total sanitation campaigns, sanitation promotion has been strengthened substantially. Climate change adaptation and disaster risk reduction are emerging issues, which are addressed in the WUMP preparation process to draft, prioritise and implement water-related local adaptation and

conservation measures. Increasingly the programme also includes water treatment and storage as well as other aspects of water governance.

Stages of HELVETAS Nepal's Drinking Water Programme



Local Infrastructure for Livelihood Improvement (2004 – 2014)

In 2004, Helvetas devised a project focusing on water for irrigation, which ran parallel to WARM-P. The Local Infrastructure for Livelihood Improvement (LILI) project was initiated to address the increased pressure on rural livelihoods caused by the 10-year armed conflict that had severely affected Nepal's rural hill areas. It aimed to improve food sufficiency, generate income and provide access to essential public rural infrastructure for disadvantaged people in rural areas. The main activities of the project were the construction and rehabilitation of farmer-managed irrigation systems (both, canal and pond irrigation), the facilitation of public audit exercises, inclusive planning of irrigation water use and the promotion and capacity building of local service providers for rural infrastructure construction. LILI also supported efforts to develop small irrigation as an important sub-sector to improve the livelihoods of small farmers. From 2006 to 2014 the project received funding support from the Swiss Agency for Development and Cooperation, SDC, and the Department for International Development/UKAid, which greatly enhanced outreach and scale. By 2014, LILI had supported the construction of 606 irrigation systems, irrigating roughly 5,000 hectares of land for about 31,000 households. The technologies promoted through LILI - particularly pond irrigation systems – were also taken up by the WUMP process. That is, they are identified, prioritised and implemented parallel to the other technologies in the WUMP toolbox.

Outlook

The trend towards more integrative and universal planning - including but not necessarily limited to the water sector– is set to continue in the future. Helvetas will continue to support Integrated Water Resources Management, IWRM - encompassing all water related projects in the areas of drinking water supply, sanitation and hygiene, irrigation, water conservation and water governance.

PART 2: Water Resources Management Approaches

Part 2 contains the following factsheets on approaches to water resource management:

Water Use Master Plan (WUMP)
WUMP is a planning tool and process that adopts participatory rural appraisal tools. It focuses on water, its sources and uses and it applies an integrated water resources management approach. The WUMP considers water resources, water demands and potential uses in a broad and integrated way; hence the term "Master Plan". The planning unit is the decentralised local authority – until 2017, the VDC. Former VDC (now ward) plans will now be consolidated at municipal level. The emphasis is on local ownership over the plan and responsibility for its implementation. As a participatory and transparent planning process, WUMP empowers marginalised groups to accessing water, pursuing equitable sharing of water within and between communities.

Implementation of Water Supply and Sanitation Systems
This approach describes the implementation of water and sanitation systems, which were identified during the WUMP preparation. Through a participatory approach, gender balanced and socially representative user committees are formed, which are responsible for leading the scheme's implementation process. The approach includes training sessions for the users' committees and local service providers, to enable the community to operate, manage and maintain the systems. Public hearings, reviews and audits are held to gain the approval of the communities and to build transparency, shared commitment and ownership to use and maintain schemes responsibly.

Implementation of Irrigation Systems
This approach describes the construction and rehabilitation of farmer-managed irrigation schemes to improve income and food sufficiency of rural communities. The main additions to the elements contained in the above implementation approach are tailor-made equitable water sharing policies developed by the users, linking farmers to agricultural service providers and supporting them in choosing agricultural inputs and developing post-construction cropping patterns.

Sanitation and Hygiene Approach
This approach parallels the implementation approach of water supply systems and spells out the activities for raising sanitation and hygiene awareness among the communities. It forms an integral part of the construction process of every drinking water scheme.
Additionally, sanitation and hygiene awareness raising activities are conducted at local community level during open defecation free campaigns.

Socio-Economic and Political Context

While the Water Use Master Plan is a general concept, adaptable to different contexts, the approaches and technologies in this publication are specifically tailored to the Nepalese context, especially the hill region. In the following text, the pertinent socio-economic and political backgrounds are summarised. For an outline of the prevailing climatic conditions, please refer to "Hydrological Context of the Nepal Mid-Hills".

The total population of Nepal stands at about 28 million with a growth rate of 1.35 per annum. The sex ratio (number of males per 100 females) at the national level has decreased from 99.8 in 2001 to 94.2 in 2011. Nepal's huge social diversity features 125 caste / ethnic groups with 123 languages spoken as mother tongue within the country. The overall literacy rate (for population aged 5 years and above) has increased from 54.1% in 2001 to 65.9 % in 2011. (CBS, 2011)[3]

The economy of Nepal overwhelmingly depends on the agriculture sector, which accounts for about one third of the Gross Domestic Product (GDP) and employs two thirds of the workforce. About half of the working-age population is either unemployed or underemployed. Migration is a widespread phenomenon across the country, which manifests itself in different aspects: internal migration from rural to urban areas and from urban areas to the capital; overland migration to India; unskilled and semi-skilled labour migration to Gulf countries and Malaysia; and skilled migration to developed nations. Roughly half the households in the country receives remittances from at least one family member. This has contributed substantially to reducing economic poverty: the fraction of people living below the international poverty line of $ 1.25 a day came down to 31% in 2011 from 42% in the year 2004. Nevertheless, the social costs of migration are high, and still not fully understood or assessed. Labour shortages due to migration, as well as inadequate infrastructure, pose many challenges for different sectors, particularly for agriculture.

Although inequalities in Nepal between regions and social groups seem to be narrowing, the Mid-Western hills - the present working area of WARM-P - are still behind in human development. Most settlements in these regions do not have year-round road access, although road construction is a development priority and the road network is extending rapidly. The remoteness and difficult accessibility have caused deprivation of diverse sorts. Chief among them are massive unemployment, food shortages and a lack of basic services. Many settlements have severe water and sanitation management problems leading to frequent outbursts of diarrhoea in the recent past. Caste-based social discrimination is still prevalent in many parts of the region.

The promulgation of Nepal's new Constitution in 2015, followed by free and fair elections in 2017 establishing a federalised system of governance, have given new opportunities as well as challenges for decentralised decision-making and locally-driven development. The powers and responsibilities of the 753 rural and urban municipalities, seven states and one federal government have been clearly outlined, and the process of relocating administrative staff initiated. However, there is likely to be a period of transition during which processes are established, staff relocated, and the necessary infrastructure put in place. Implementing a process of devolved power and resources to sub-national governments takes time, as does the development of new relationships with citizens, quality service delivery mechanisms, and governance systems.

The socio-cultural context remains dynamic. As a result of greater external exposure and individual opportunities, collective action and social cohesion are tending to decline. The 2017 elections have given women and the socially marginalised new opportunities for representation in local government – yet gender and caste-based discrimination remains an important socio-cultural issue. The position of women and girls is further challenged by an increasing workload (due to male out-migration), and higher incidents of reported violence (although this may reflect previous under-reporting).

[3]National Population and Housing Census 2011, The Central Bureau of Statistics of Nepal

Water Use Master Plans as Tool for Integrated Water Resources Management at the Local Level

Integrated Water Resources Management Defined

"*Integrated water resources management is a process, which promotes the co-ordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems.*"[4]

Traditionally, governments and donor agencies have been prone to apply a sectoral approach to water resources management, often leading to duplication of efforts and fragmented development. Competing interests may also instigate conflicts over water including the type of its use or ownership rights. Water related conflicts are likely to intensify in the future, as the growth of the population and economy as well as progressively higher living standards will raise demand, while the available resources remain constant at best.

Integrated water resources management - or IWRM - is a concept put forward by various actors to meet the challenge of planning and allocating water resources under competing interests of different stakeholders. It is based on the notion that all uses of water are interdependent and that the sustainable management of water demand and supply entails an inclusive and cross-sectoral perspective.

Dublin Principles on Water Management

Among the numerous concepts and guidelines on integrated water resources management, the four Dublin principles postulated in 1992 stand out as particularly influential on past reforms in the water sector.

I. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.
II. Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.
III. Women play a central part in the provision, management and safe-guarding of water.
IV. Water has an economic value in all its competing uses and should be recognised as an economic good.

These four principles have guided Helvetas' activities in the water sector. Their influence can be traced throughout the WUMP framework.

Water Resources Management in Nepal

The diagnosis of fragmented planning and management in the water sector also applies to Nepal. Drinking water supply and sanitation, irrigation, forest and soil conservation as well as hydro-electricity are under the authority of different government bodies and frequently addressed through independent development projects by a multitude of donors. Symptoms of the fragmented sector are manifold: lack of coordinated planning; failure to adequately involve disadvantaged people in decision-making; frequent source disputes and poor functionality; and sustainability of water schemes.

In response to these problems, an effective water resources management framework has three inter-related elements: (i) an enabling environment, (ii) institutional roles and (iii) management instruments (see box below).

[4]Global Water Partnership Technical Advisory Committee."Integrated water resources management."*TAC Background Papers* 4 (2000).

Elements of Effective Water Resources Management (GWP, 2010)

Integrated water resources management is often associated with the overriding goal to negotiate outcomes which satisfy the criteria of sustainable development, namely *social equity*, *economic efficiency* and *ecological sustainability.* To achieve such outcomes consistently, a water resources management framework cannot rely on interventions along a single axis, but needs to be based on complementary elements, which are developed and reinforced in parallel. These elements include:

- *Enabling environment*: A general framework of national, provincial or local policies and regulations that ensures rights and assets for all water resources stakeholders. The enabling environment establishes the "the rules of the game" which allow stakeholders to take part in the development and management of water resources in accordance to their respective roles.
- *Institutional roles*: The roles and functions of the different administrative levels and stakeholders which deal with policy, regulations, implementation, execution and oversight. Institutional development and capacity-building are vital for the actors' understanding of their respective roles and their ability to deliver on them.
- *Management instruments*: The tools and methods that support decision-makers to make informed and rational choices between alternative solutions. The selection of instruments should be adapted according to existing social and political consensus, available resources, and geographical, social and economic contexts.

General Framework of Integrated Water Resources Management (IWRM) with overriding Criteria and Important Elements

Source: Global Water Partnership Technical Advisory Committee. "Integrated water resources management." TAC Background Papers 4 (2000).

In Nepal numerous national water resource acts, rules, strategies and plans by different ministries and departments pronounce the requirement for water resources planning and management. The Local Self-Governance Act (1999) delegated this management task to local governmental institutions (district and village development committees). However, the implementation of these regulations at local level was often poor, due to bureaucratic uncertainties and inertia. More crucially, the local bodies were dissolved in 2002 and replaced by government officials. Under the new federal system, the rural and urban municipalities have clear responsibility for the planning and implementing of local water resources. Development efforts thus need to focus on enhancing

municipal capacities to plan and implement municipal water resources use in an integrated and participatory manner, building on experience from such planning processes at former VDC level.

Concerning the third element, management instruments, one of the main challenges is finding tools and processes that facilitate greater coordination and cooperation on the local scale without incurring unjustifiable transaction costs. Moreover, these tools should be appropriate for use by the new rural and urban municipalities.

Extending the "tool box": WUMP as an IWRM Instrument

The WUMP is a planning and management tool that was developed with the aim to meet the challenge of realising the vision of integrated water resources management on the local level. The purpose of a WUMP is to ensure that water resources are used rationally and shared equitably among and within communities in a sustainable manner. While developing their WUMP, the former VDCs were capacitated to lead and coordinate the process of identifying the available water sources, planning their potential uses and prioritising the water schemes for implementation. The approach thus combines participatory and inclusive assessment and planning of water resources and their use with the strengthening of the local institutional capacity. It also provides a platform to disadvantaged groups so that they can claim their right to share water resources equitably.

The WUMP approach has been replicated by many agencies in as well as outside Nepal, including Pakistan, India and Ethiopia. Recognising WUMP as a promising approach for IWRM, the Ministry of Water Supply and Sanitation and the Ministry of Federal Affairs and Local Development jointly prepared the national guideline on WUMP preparation in 2016.

Human Rights, Target Service Level and Water Hardship Ranking

In 2010 the United Nations' General Assembly Resolution 64/292 explicitly recognised the human right to water and sanitation and acknowledged that clean drinking water and sanitation are essential to the realisation of all human rights. The UN stipulates that water supply and sanitation facilities shall be i) sufficient, ii) safe, iii) acceptable, iv) physically accessible, and v) affordable. Helvetas recognises this declaration as a guiding principle in planning and implementing water supply and sanitation schemes. The new constitution of Nepal, 2015, includes access to drinking water and sanitation as fundamental rights for all.

Along these lines, Helvetas employs a consistent set of criteria to measure and define the current and target service level for every household in its water supply projects. Some of the criteria follow governmental provisions (distance to source, water quantity and water quality). They are supplemented with the programme's own standards (on reliability, continuity and accessibility of the source).

Service level	Average Fetching Time / Accessibility [min]	Quantity [l/c/d]	Reliability of Source	Continuity of Source [h per d]	Quality
Good (target level)	<= 15	>= 45	12 months	>= 6	No contamination
Moderate	15 – 30	25- 45	> 11 months	>= 5	Moderate contamination
Poor	30 – 45	15 -25	> 10 months	>= 4	High contamination
Very Poor	> 45	< 15	< 10 months	< 4	Very high contamination

These service level criteria are employed to calculate the water hardship score, an indicator that is used by various rural water supply and sanitation programmes in the country. The water hardship level is calculated for all settlements and is factored in when prioritising alternative water schemes later. The score is calculated as follows:

Water Hardship score = Percentage of households with moderate service level x 1 +

Percentage of households with poor service level x 2 +

Percentage of households with very poor service level x 3

Illustrating Multiple Water Uses – the Water Resources Management (**WARM) Chair**

WARM-P uses the Water Resources Management Chair to illustrate the idea of the multiple uses of water at the local level. Each leg represents one particular use of water:

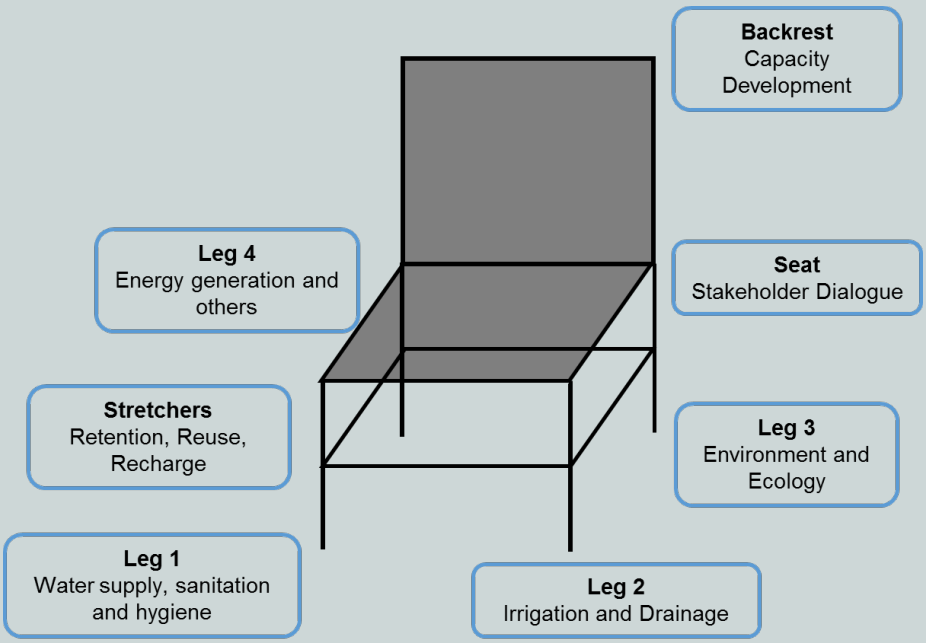
(i) Water supply and sanitation including activities such as construction of piped water supply or rainwater harvesting schemes; environmental sanitation and personal hygiene; source improvements; repair and rehabilitation of existing structures

(ii) Irrigation and drainage; including proper drainage of waste water; productive use of overflow; micro-irrigation for kitchen gardening; drip, sprinkler and canal irrigation

(iii) Environment and ecology; including source conservation; soil conservation and forest management; stream bank stabilisation and gully control; tree nurseries and plantation

(iv) Other uses; including electricity generation; cottage industries; water mills; livestock; fisheries; recreational and religious uses

In addition, the chair consists of stretchers, a seat and a backrest. The stretchers represent retention, recharge and reuse opportunities, while the seat symbolises the stakeholder dialogue. Finally, the backrest represents the capacity development support for the local government and the community, facilitating a smooth WUMP development process



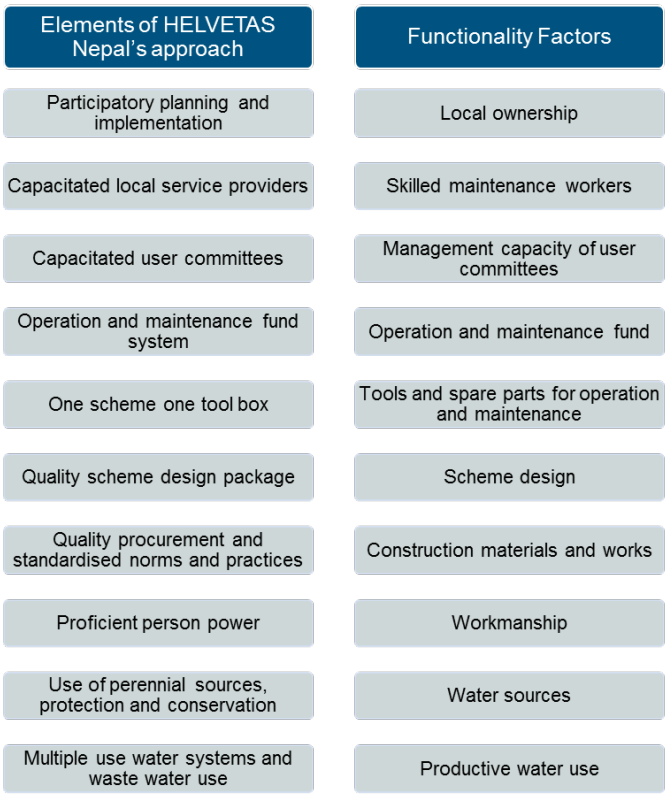
While water uses can be grouped in many different ways, the chair model is one that is simple and easy to explain. Without four legs, the chair falls - without sufficient attention to all four components of water use, water resources management cannot be efficient or sustainable.

WOCAT FACTSHEET: WUMP

Implementation Approach of Prioritised Technologies

The last few decades have seen substantial progress in the Nepalese water supply sector. In 2006, the national water supply coverage was 77%; by 2014, it had reached 84%[5]. These macro-level figures seem promising and encouraging. However, they do not tell the whole story; particularly they do not paint an accurate picture of the functionality levels in the country. Only about a quarter of the water supply schemes are physically intact, without the need of either minor repairs (36%), major repairs (9%), rehabilitation (20%) or complete reconstruction (10%)**Error! Bookmark not defined.**. Faced with malfunctioning schemes, users have to revert to less safe sources of drinking water, such as unprotected springs, ponds or streams, giving rise to a multitude of health problems.

As the two succeeding fact-sheets covering implementation approaches point out, this challenge of creating effective and sustainable operation and maintenance mechanisms also pertains to Helvetas work in Nepal. The Helvetas approach to implementing water supply and sanitation systems includes multiple elements to strengthen the long-term functionality of the systems. These elements and their related functionality factors are displayed in the figure below, and are outlined in the fact-sheet on the implementation of water supply and sanitation systems. A more detailed discussion is available in HELVETAS (2013)[6].



While much effort is put into making water facilities more sustainable, the results do not always measure up. In 2011, a post-completion study by Helvetas analysed the functional status of 98 drinking water and sanitation supply schemes constructed by WARM-P between 2000 and 2005. Of the total, 23% were functioning well, 48% needed minor repairs (within user capacity), 22% major repairs (beyond user capacity). The remaining schemes required either rehabilitation[7] (5%), reconstruction (1%) or were not fit for re-operation (1%). Although these numbers compare favourably to the national average (NMIP, 2011)[8], there is evident room for improvement. This

[5]Department of Water Supply and Sewerage (2014).Nationwide coverage and functionality status of water supply and sanitation in Nepal.Final Report.National Management Information Project.Panipokhrari, Kathmandu: Department of Water Supply and Sewerage.
[6]HELVETAS (2013) The Effectiveness and Outcomes of Approaches to Functionality of Drinking Water and Sanitation Schemes. Lalitpur, Nepal: WARM-P/HELVETAS
[7] Schemes are classified as "in need of rehabilitation" if they are functioning at their design level, but are not able to meet the present demand in quantity and/or quality
[8]National Management Information Scheme, Department of Water Supply and Sewerage. 2011. Nation-wide Coverage and Functionality Status of Water Supply and Sanitation in Nepal.

resulted in HELVETAS comparing the old and a new operation and maintenance model (see below).

Conventional Operation and Maintenance Model

Why is it that some schemes fail prematurely? In theory and according to Nepalese policy provisions on rural infrastructure, three actors share the operation and maintenance duty in community managed systems: (i) user committees, (ii) maintenance workers and (iii) local institutions, such as the VDCs. Users' committees are responsible for the formulation of local operation and maintenance policies, the mobilisation of maintenance workers for regular monitoring and minor repair works, and for reaching out to local institutions (or development organisations) in case of major repairs. In addition, the users' committees oversee the collection of user service fees to remunerate the maintenance workers, and cover contributions to the operation and maintenance fund. Local institutions have a supplementary yet important role, as they must provide support for maintenance needs beyond the communities' financial or technical capacity, i.e. major maintenance or rehabilitation works.

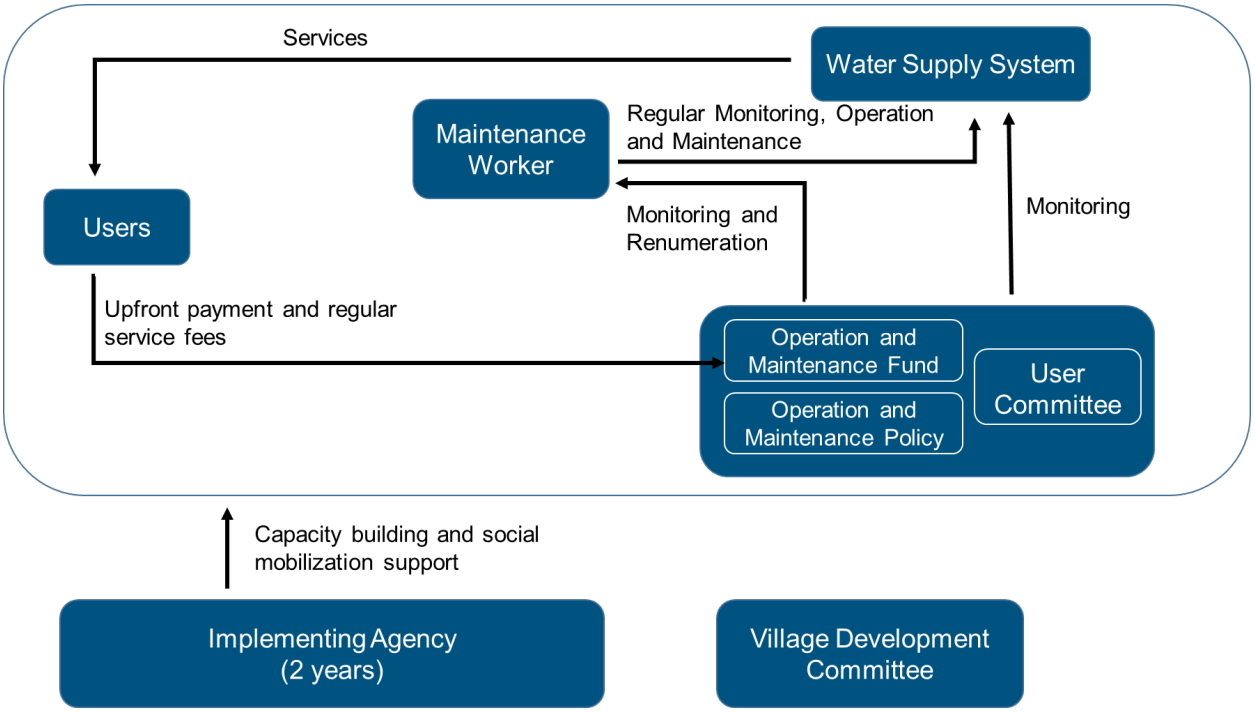
In practice, this way of operation and maintenance faces some challenges. Acharya et al. (2014)[9] recapitulates the following difficulties in community managed rural water supply systems in Nepal:

- User committees generally do a good job in the construction phase, that is, they formulate the operation and maintenance policies well, manage construction and establish the operation and maintenance fund. However, the activity of the users' committees tends to decline in the post-construction period, with committee meetings and fee collection becoming irregular at first and eventually even ceasing to continue. Essentially, they operate well as "construction committees" but have difficulties in assuming the longer-term role and responsibilities of a "managing committee". For instance, the Rural Water Supply and Sanitation Project in Western Nepal (RWSSP-WN) reports that only 55%, of a total of 412 schemes collect water tariffs and pay maintenance workers on a regular basis (RWSSP-WN, 2013). The project identified inadequate revenue collection as the most critical single risk factor for the long-term sustainability of the water supply schemes (RWSSP-WN, 2016). On the one hand, this failure of the "managing committees" may be an indication of weak ownership; on a more general level, it may disclose the limits of what a voluntary institution is able to shoulder in terms of responsibility and work-load.
- For trained maintenance workers (seasonal) migration becomes an attractive option, as they tend to find better income opportunities in urban areas. Related to the above, discontinuation of user fee collection by the users' committee usually also implies terminating the reimbursement of the maintenance workers. Unsurprisingly, a substantial fraction of the trained village workers is absent or inactive 5 to 10 years after scheme completion.
- The linkage between users' committees and local institutions is often weak with no systematic technical or financial support forthcoming from the local bodies. As a result, development organisations often fill in and provide post-construction support in the form of social mobilisation (re-activation of dormant users' committees) as well as capacity building for the users' committee and maintenance workers in the first few years after scheme completion. While these post-construction follow-up and support efforts may alleviate these deficiencies for some time, they are bound to expire as project cycles end or programmes phase out.

The following figure shows the present day conventional organisational set-up in rural water supply schemes in rural Nepal. The figure does not show an idealised setting but includes the above-mentioned shortcomings.

[9]Acharya, N.; Jeevan K.C; and Thakur, T. (2014). Post Construction Management of Rural Infrastructure, potential models for better functionality. Draft Version. Dhobighat, Lalitpur: HELVETAS Swiss Intercooperation, Nepal.

*Conventional Organisational Operational and Maintenance Set-up in Water Supply Schemes in Rural Nepal.**



**Adapted from Acharya et al. (2014)[9].*

Limitations of Community Management?

Other development scholars have reflected on the limits of what community management can realistically achieve, given that it is an approach based on informality and voluntarism. Moriarty et al. (2013)[10] emphasise the following elements to achieve more sustainable service delivery:

- To support community management entities to move away from voluntary arrangements towards more professional service provision;
- To extend regular and structured post-construction support to community-based service providers, which goes beyond ad hoc technical assistance;
- To recognise and promote a wider range of service delivery models in addition to community management;
- To strive for sustainable financing of all costs, focusing particularly on financing capital maintenance (asset management).

New Service Provider Model

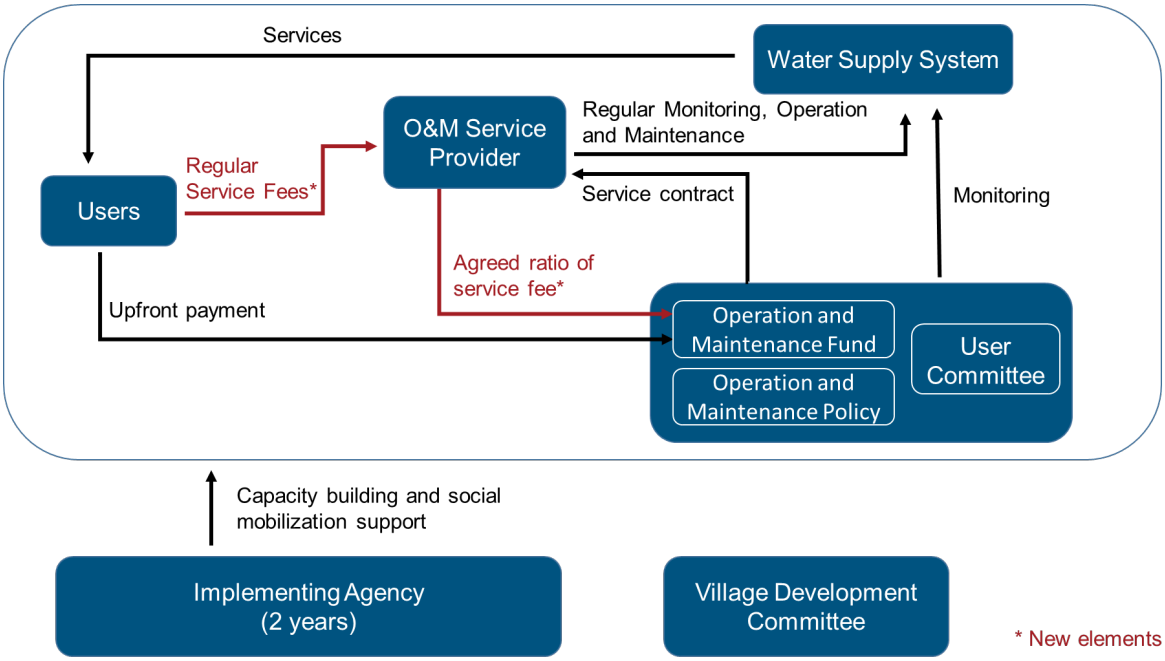
In more recent years, Helvetas experimented with new methods of operation and maintenance of drinking water schemes under WARM-P. From 2012 onwards, WARM-P piloted a service provider model, introducing a small private sector element into the existing operation and maintenance framework (mirroring the one shown above). In this revised model, the users' committee largely outsources operation and maintenance duties to a local service provider, the village maintenance worker. This village maintenance worker is – as under the conventional model above - responsible for operating the infrastructure as well as minor maintenance works. As a new task, s/he also takes on the responsibility of collecting service fees from the users. A fixed ratio of the service fees is passed on to the users' committee, which deposits it in the operation and maintenance fund. The other fraction represents the wage of the service provider. The user fees and wage-to-fund-ratios are negotiated and fixed for each scheme individually on a case-by-case basis, as they account for the workload of the village maintenance worker as well as the community's ability to pay.

This relatively simple change in the operation and maintenance system is expected to lead to higher motivation and activity levels of the maintenance workers. For one, the village maintenance workers are now directly responsible for collecting their wage (and contributions to the operation and maintenance fund). They thus have a high incentive to collect the user fees regularly and are less likely to become inactive. In addition to more regular salary payments, the negotiated average monthly wage of the village maintenance workers - agreed upon with the community upfront – may be slightly higher as it accounts for her/his (small) increased workload in the new model.

The increased activity of the maintenance workers in turn could help to keep other actors more engaged. While regular visits of user households to collect service fees could keep the community members aware and sensitive of the need of on-going operation and maintenance of the water supply systems, the regular payments into the operation and maintenance fund may help to keep the users' committee more vigilant. Although this set-up brings about a reduced workload for the users' committee, it does not absolve them of practising institutional control over the system, i.e. to monitor the service providers, manage the operation and maintenance fund and enforce the operational and maintenance guidelines. The pilot framework thus represents a small shift towards more professional service provision, while still accounting for the resource scarce setting and limited capacity of local institutions. The following figure illustrates the changes introduced by this new service provider model.

[10] Moriarty, P., Smits, S., Butterworth, J., and Franceys, R. (2013). Trends in rural water supply: towards a service delivery approach. *Water Alternatives*, *6*(3), 329-349

New Service Provider Model Piloted by Helvetas under WARM-P



The change in the organisational operation and maintenance set-up has led to encouraging early outcomes in the pilot schemes. The new service provider model has resulted in a considerable increase in the regularity of village maintenance worker remuneration. In accordance, the pilot schemes experience more active maintenance workers and decreased village maintenance worker turnover rates. This in turn seems to stimulate the user committees to assume a more proactive role and keep up with their (slightly reduced) duties.

WOCAT FACTSHEET: Implementation approach for water supply and sanitation systems

WOCAT FACTSHEET: Implementation approach for irrigation systems

Raising Sanitation and Hygiene Awareness

Nepal has made significant progress in basic sanitation services, with 62% coverage in 2011 (Census 2011, CBS) compared to 30% in 2001. Following the launch of the National Hygiene and Sanitation Master Plan in 2011, Nepal has witnessed a robust momentum in the improvement of sanitation and hygiene situation, with many settlements and municipalities being declared open-defecation free (ODF). Coverage of basic sanitation facility has now reached 81% of the population (Department of Water Supply and Sewerage annual progress review, 2015). Despite the apparent sustainability of the ODF campaign, it remains to be seen if any subsequent action is needed for behavioural change to achieve total sanitation.

Helvetas participated actively in the ODF campaign under WARM-P, especially in mid and far western areas, where all settlements covered by the project have been declared ODF. The programme has therefore extended its support to local communities to achieve total sanitation through social marketing, with a special focus on hand washing and use of household water treatment and safe storage.

WOCAT FACTSHEET: Sanitation and Hygiene promotion approach

PART 3: Water Resources Management Technologies

Hydrological Context of the Nepal Mid-Hills

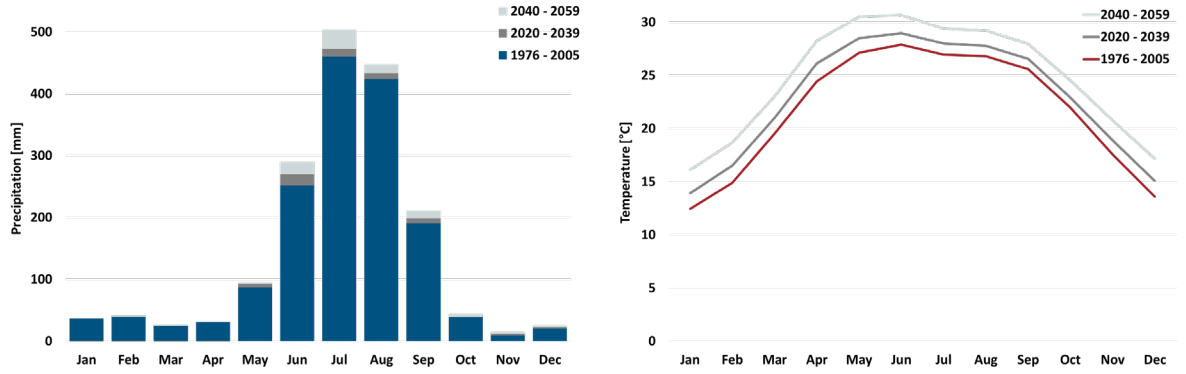
In much the same manner as HELVETAS Nepal programme design is better understood if regarded against its political and socio-economic backdrop, the composition and application of the programmes water technology toolbox becomes more evident if the prevailing hydrologic conditions are taken into consideration.

Current and future climatic conditions[11,12]

The annual precipitation in the Nepal mid-hills averages 1,600 mm, but there is high seasonal variation, including a pronounced dry period. In general, over 80% of the annual precipitation is concentrated in the months of June to September. Through this monsoon period, rainfall is intense, often resulting in floods and landslides. On the other hand, most regions face spells of water scarcity towards the end of the dry period, during October to April.

The current hydrological regime of extremes is likely to be reinforced by future climate change. Temperature increase is expected to be most pronounced during the dry months (December - May). Precipitation forecasts are less certain; precipitation rates are expected to stay constant or slightly decrease in winter, and increase during the summer monsoon. Accordingly, the winter drought – summer flood cycle is likely to intensify in the future.

Current and Future Mean Monthly Precipitation (left) and Temperature (right) in the Mid-Hills of Nepal[13]



Spring Hydrology[14]

Most farmers in the mid-hills of Nepal rely on springs as their primary water source. Following the trend of strong variations in seasonal precipitation, the ground water table in the mid-hills fluctuates substantially over the year. Annual oscillations range between the peak level observed towards the end of the monsoon season in August/September and the low point reached during the dry season in March/April. As a result, many spring sources - especially in higher regions along ridgelines – are short-lived and dry out in the winter season. Local farmers are known to classify springs according to when they typically dry out. By observing the timing of the onset of spring flow or drying up, farmers are able to detect and assess drought conditions early on. When moving to lower elevations in the valley floors, perennial spring sources become more common. However, even communities with access to perennial sources often have to tap several sources, as the majority of the perennial springs have inadequate discharge to cater to a whole community.

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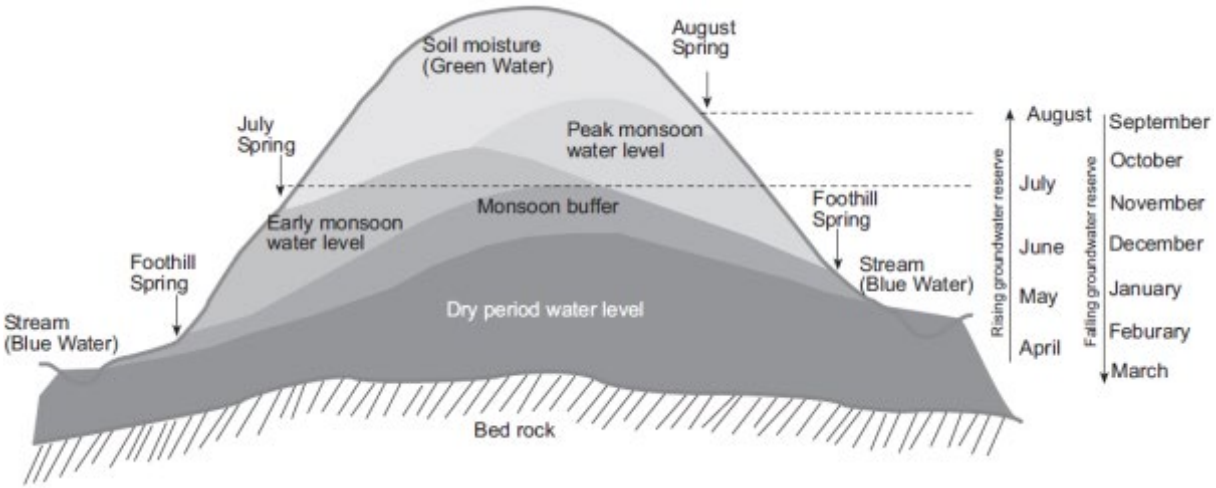
[11]Practical Action Nepal Office. Temporal and spatial variability of climate change over Nepal (2009);
[12]The World Bank Group.Vulnerability, Risk Reduction and Adaption to Climate Change, Nepal. *Climate Risk and Adaptation Country Profile* (2011).
[13]Historical climate is drawn from local observational records. Future T and P anomalies are based on the ensemble median of 15 climate models employed in IPCC AR4 representing the SRES B1 emission scenario, Source: World Bank Climate Change Knowledge Portal
[14]Ministry of Federal Affairs and Local Development, Department of Local Infrastructure Development and Agricultural Roads. Recharge Ponds Handbook for WASH Programme (2013).

Typical Seasonal Variation of Ground Water Table of Mid-Hills of Nepal[15]



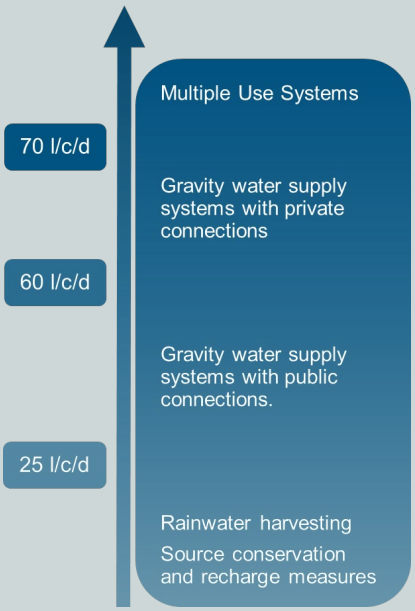
These characteristic oscillations in spring hydrology influence the selection of appropriate water technologies, and confine their area of application. In some areas this leads to a technological stratification: rainwater harvesting technologies are implemented in the upper, drier zones while gravity supply systems – which rely on perennial sources – are constructed in lower elevated regions.

[15]Figure taken from: Ministry of Federal Affairs and Local Development, Department of Local Infrastructure Development and Agricultural Roads. Recharge Ponds Handbook for WASH Programme (2013).

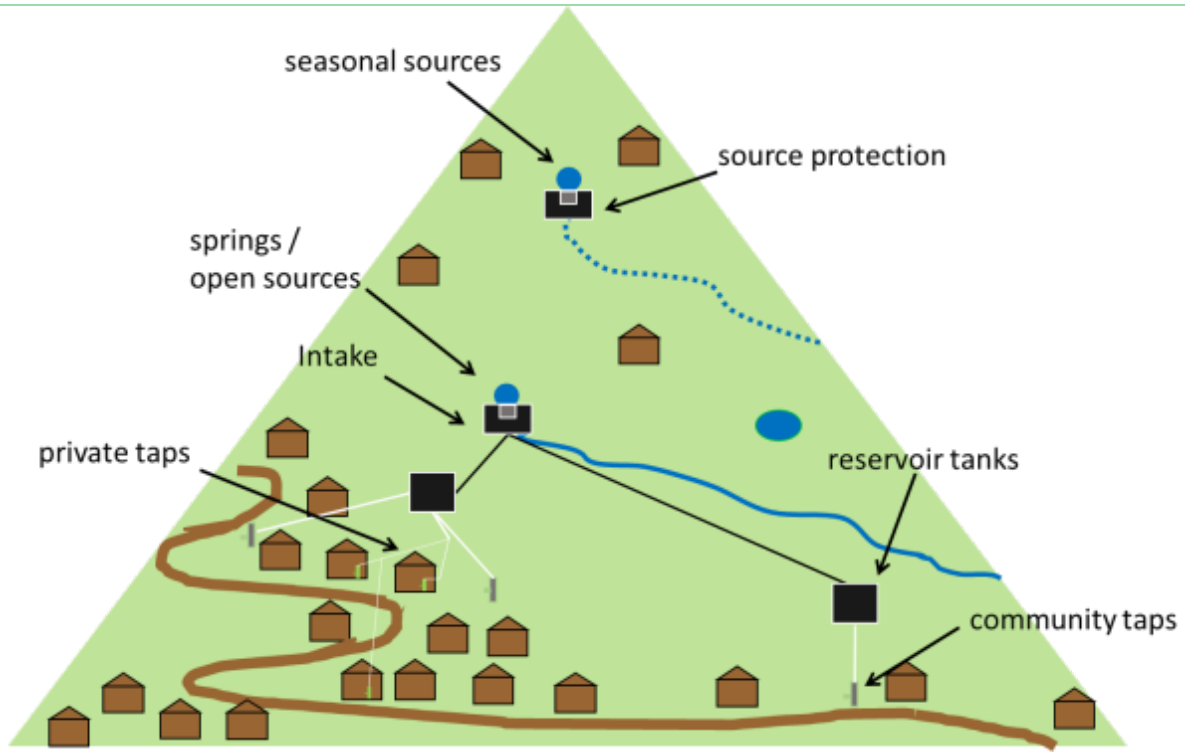
Technology Selection as a Function of Source Discharge

An important criterion for technology selection is the safe yield guaranteed by available water sources over the whole year. Source measurements are carried out towards the end of the dry season, to determine the minimum source discharge. While the available water supply informs technology selection, the numbers below are not hard and fast rules, but rather act as a decision support system.

- Gravity supply flow systems are designed to provide at least 45 litres (l) per capita (c) and day (d) for domestic uses at community taps. The absolute minimum supply for gravity systems to be considered feasible is 25 l/c/d.
- Private taps - associated with a larger demand - are only considered, when a safe yield of at least 60 l/c/d is guaranteed.
- If the source discharge is higher than the domestic demand (> 70 l/c/d), multiple use systems - often referred to as multiple use systems (MUS) - may provide water for both, domestic and irrigation purposes. For the Programme's standardised design, the average presumed irrigation demand is 1 l/m^2/d.
- If the safe yield of spring sources is less than 25 l/c/d, rainwater harvesting jars as well as source conservation and recharge measures are taken into consideration. Note that rainwater harvesting jars are not expected to completely replace existing sources with insufficient yield, but rather to complement them (average supply of 10 l/c/d for a 6.5 m^3 jar and 15 m^2 catchment area).



Piped Drinking Water Supply Systems



Gravity Flow Water Supply Systems
Gravity flow water supply systems convey water from higher elevated perennial spring sources to public or private tap stands. They represent the cornerstone technology of the WARM-P to improve the water service level in the mid-hills. Source protection measures, which are part of every gravity system, are described in more detail in the factsheet “Water Source Conservation and Protection”.

Solar Lifting Schemes
A relatively young technology, which has been piloted by WARM-P in recent years. It offers the potential to implement gravity supply schemes in previously unfeasible areas due to unfavourable topographical conditions. It uses solar energy to lift water from a lower lying water source to distribute the water later through a conventional gravity flow water supply system.

Increasing Ownership through Private Connections in Gravity Supply Systems

Functionality surveys by WARM-P revealed that in some cases, users are reluctant to use and properly maintain community tap stands (catering to 5 - 7 households). They prefer to connect separate pipes from a community tap to convey water directly to their homes.

Piloting schemes with private connections revealed that users are more willing to pay operation and maintenance fees for private taps, even though they require higher connection charges and higher regular water tariffs (10 US$ connection charge and 0.6 - 0.8 US$ per month for private taps vs. 2 US$ connection charge and 0.2 US$ monthly fee for public taps). The community members generally take better care of their “own” private tap stand. Some make use of the reduced water fetching time and higher water availability to cultivate small kitchen gardens. The private connection system also simplifies equal water distribution, thereby reducing water related conflicts.

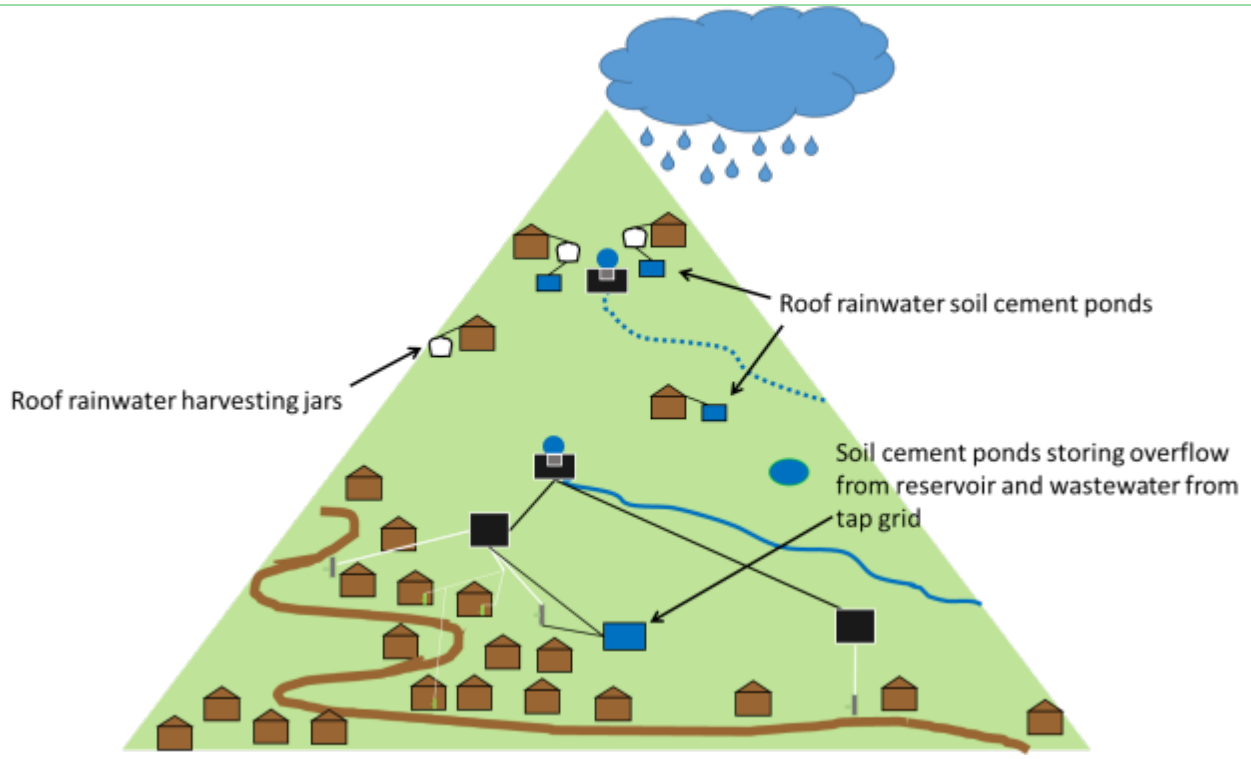
Water is not usually continuously available in piped gravity supply systems. The village maintenance worker opens the main valve once or twice a day during agreed times to ration the limited supply.

The programme now supports private tap systems on a case-by-case basis, subject to technical feasibility (water availability) and a socio-economic assessment of whether users are able and willing to pay for improved services.

WOCAT FACTSHEET: Gravity flow water supply systems

WOCAT FACTSHEET: Solar lifting schemes

Roof Rainwater Harvesting Systems



In areas where the construction of gravity supply systems is technically unfeasible (topography) or prohibitively expensive (distance/access to the next adequate source), rainwater harvesting systems can provide water close to home. The collection and storage of rainwater may further grow in significance as climate change leads to an intensification of the seasonal precipitation cycle: rainwater harvesting systems can support communities to cope with early depletion of sources in the dry period as well as a degraded water quality from spring sources, and infrastructural damage caused by high intensity rainfall during the monsoon.

Rooftop Rainwater Harvesting Jars

Rooftop rainwater harvesting system, in which rainwater falling on corrugated galvanised iron sheets is conveyed to 6.5 m^3 ferro-cement storage jars. It represents a supplementary source of water supply in water-scarce areas. The stored water may help to bridge supply shortages in the dry season, when spring sources diminish. Contamination risks can be minimised through proper design, operation and maintenance to consistently provide potable water.

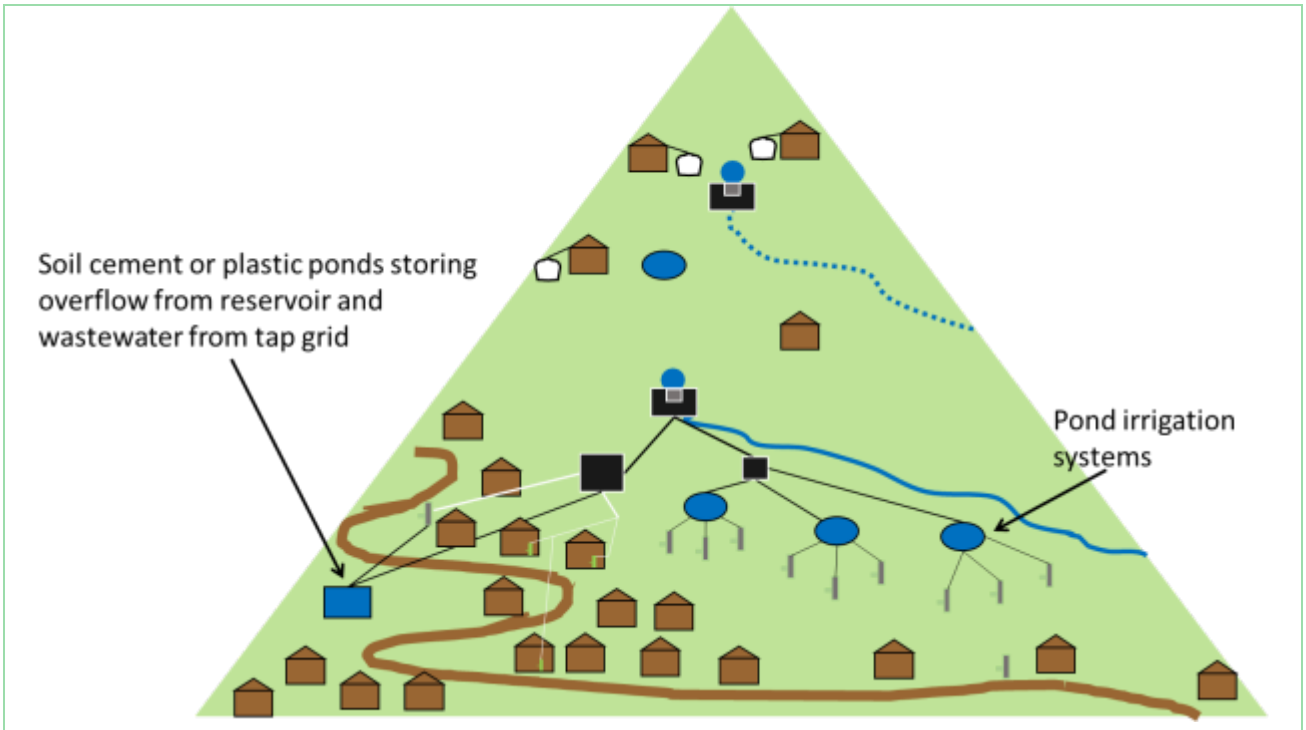
Soil-ferro Cement Retention Ponds

Soil-ferro cement ponds with ferro-cement lining complement rainwater harvesting jars at the household level by adding storage volume (3 m^3) to retain overflow and waste water from the water jars or from separate roof areas. Such ponds can also be implemented on a stand-alone basis at community level to capture surplus water from gravity schemes for agricultural use (usually with larger storage volumes of 6, 10 or 15 m^3; refer to the multiple use system factsheet for more information).

WOCAT FACTSHEET: RWH jar

WOCAT FACTSHEET: Soil cement ponds

Irrigation and Multiple Use Systems



If local water supply exceeds the domestic demand, this provides opportunities for so-called "productive" uses of water. In the Nepali context, this usually implies water for irrigation or cattle feeding. Given ample supply, conventional gravity flow systems may also cater to multiple purposes by default and do not have to be limited to domestic use. We refer to such schemes as "de-facto" multiple use systems. In contrast, the systems discussed in this section explicitly include irrigation water demands in their design.

Pond Irrigation Systems
Pond irrigation systems convey water from spring or open sources via a pipe network to one or several plastic lined ponds. Water taps connected to the ponds serve as irrigation outlets. The externally introduced decentralised irrigation facilities are geared towards small-holder farming households in higher elevated and water scarce areas.

Canal Irrigation Systems
Gravity flow canals carry water from small rivers, streams and rivulets to the cultivable area – usually located in the lower and wetter plains and valley floors. Activities are mostly concerned with the rehabilitation of mal- or non-functioning existing systems.

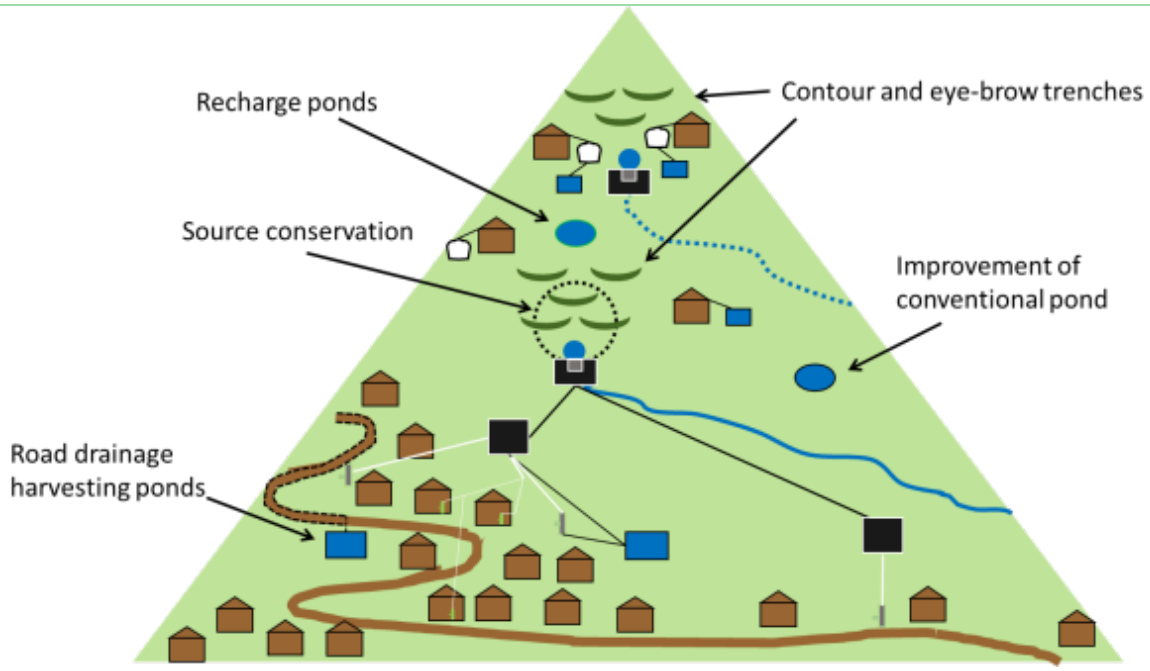
Multiple Use Systems
Multiple use systems are developed in gravity flow and rainwater harvesting schemes with abundant water sources (>70 l/cap/day). They cater to domestic and agricultural demand and typically feature additional storage facilities for irrigation water such as soil-cement, plastic or earthen ponds.

WOCAT FACTSHEET: Pond irrigation systems

WOCAT FACTSHEET: Canal irrigation systems

WOCAT FACTSHEET: Multiple use systems

Spring and Soil Moisture Recharge Measures



The technologies in this section were taken up by Helvetas in recent years (the exception being source protection chambers, which are part of every gravity flow system). They belong to a group of measures which promote the local Recharge, Retention and Reuse of water - often referred to as 3R. They represent local adaptation and mitigation options to the likely future intensification of the winter drought - summer flood cycle. Instead of reallocating scarce water, the technologies promote the decentralised storage of water by conserving and replenishing local soil moisture. By buffering water in the soil when it is plentiful and making it more readily available during dry periods, they supplement closed and open reservoir storage facilities (e.g. rainwater harvesting jars or soil-cement and plastic-lined ponds). Different 3R elements are discussed in Helvetas et al. (2015)[16]

Source Conservation and Protection
Source conservation and protection schemes include vegetative and structural measures at spring source locations and their surroundings to conserve the source yield and safeguard them from contamination over the long-term. The measures may include concrete source protection chambers, dead and live fencing; plantation, contour trenches and drainage ditches, gully plugging, check dams and recharge ponds.

Recharge Ponds
Earthen multi-purpose recharge ponds represent a low-cost option to replenish natural soil moisture and ground water reservoirs. In addition to recharging spring water sources, the collected water may also be used straight away for irrigation, watering animals or domestic purposes. Implemented pond types include newly excavated earthen ponds, improvement of existing conventional ponds and road-drainage ponds.

Contour and Eyebrow Trenches
Trenches are dug out along contour lines of equal elevation in uphill areas to promote local water infiltration and hence spring water source recharge. By breaking the slope, the trenches reduce surface flow velocity and may help to stabilise landslide-prone terrain. The increased soil moisture levels also create more favourable conditions for plant growth between the trenches.

[16]HELVETAS, MetaMeta and Aid Environment (2015) Water use master plan + 3R – Facilitator's manual. Kathmandu:https://assets.helvetas.org/downloads/water_use_master_3r_facilitator_s_manual_final_br.pdf

WOCAT FACTSHEET: Source conservation

WOCAT FACTSHEET: Recharge ponds

WOCAT FACTSHEET: Contour trenches