Food and Agriculture Organization of the United Nations

Strengthening agricultural water efficiency and productivity on the African and global level

WATER HARVESTING

Cover photo: © FAO/Laura Guarnieri

The project

Africa is a rural continent, with agricultural production accounting for 17 percent of the GDP, and it relies on agriculture as a driving force for its social and economic development. The agricultural sector employs about 60 percent of the total labour force and most smallholders depend on rain-fed production for their livelihoods.

At the same time, irregular and unreliable rainfall is a main contributing factor to low agricultural productivity. Improved Agriculture Water Management (AWM) is thus crucial to increasing production levels and improving food security.

The **GCP/INT/231/SWI project, "Strengthening Agricultural Water Efficiency and Productivity on the African and Global Level",** strives for reducing hunger and poverty by focusing on improved AWM practices on the African and global level and mainstreaming AWM in national frameworks and processes.

In particular, **Output (3)** of the project aims at **"Enhanced water harvesting (WH) capacity for agriculture in the three countries"**, through:

- Carrying out an **assessment of the status, performance and scope for improving WH** for agriculture and developing a portfolio of technologies with their suitability and feasible application to countries' conditions;
- **Implementing on-ground pilot projects**, building on in-country existing experience;
- Developing and **implementing a training program on WH** to build the capacity of farmers, agricultural water extension agents and professionals at relevant ministries;
- Developing **methodologies/strategies for WH for agriculture** that serve as input to national agriculture and water resources strategies.

Kamadaogo village chief in a project meeting

The overall approach of the project was a combination of **bottom up and top down activities** in the field of AWM and at different levels, from micro, working with extension agents and farmers' representatives; to meso, with research institutes and regional governance structures; up to macro levels, liaising with national governments. The commitment showed by national governments and the support of a relevant network of stakeholders ensure the **project's sustainability** and the most effective dissemination of results. Furthermore, to achieve a long term impactof the project's outcomes, the in-country findings and processes of common nature are synthesized in order to, on oneside, **scale them up at national level** and, on the other, **scale them out to other countries**, in a regional (South-South)cooperation process.

Women farmers of the Kamadaogo village

The project development approach

An **integrated approach of AWM was applied** to all of the project activities related to the WH component.

The project combined the **conjunctive use of surface and groundwater** and **solar lifting** with **in/off-situ WH and agronomic practices** to enhance crop production at small-scale.

To ensure **sustainability of the results** and to promote **ownership among relevant beneficiaries and authorities**, the project ensured the **involvement of all stakeholders** and **drew on local and traditional knowledge to strengthen capacities at all levels.**

National assessment of WH	• Present a number of WH practices, already existing or implemented in other countries, their main features, benefits and limitations • Evaluate performances with respect to several biophysical, technical, and socio-economic criteria • Guide decisions on the employment of a single or a combination of several WH technologies focusing on positive impacts on the environment, socio-economic development, and agricultural productivity and profitability
Capacity building at national level	• Existing WH technologies adapted to the various agro-climatic conditions of the country • Conceptual and practical approaches to WH at landscape/watershed scale • Use of Geographical Information System (GIS) and Remote Sensing based applications for planning, managing and monitoring WH systems • Hydrological modelling of WH techniques using SWAT • Social and economic suitability of WH systems • Soil health and regenerative practices for effective WH • Agroforestry systems for microclimate management and effective WH
Pilot projects	• Providing different uses of water from an improved WH system by rehabilitating the current valley tank (Uganda)/Tamda (Morocco)/Bouli (Burkina) system and providing water for agriculture, livestock and domestic purposes • Implementing a combination of in-field WH and Soil Water Conservation (SWC) techniques and improved agronomic/forestry practices on collective pilot fields around the macro-catchment system • Conducting field trainings and demonstrations with the contribution and participation of beneficiary farmers and organizing study visits • Supporting the development of WH (for agricultural use) sub-sector strategies and policies

The methodology

The **selection of the pilot sites** took place in two stages:

1. Remote short-list of feasible sites in consultation with national stakeholders and on the basis of a preliminary analysis, leading to the selection of target sub-basins within the focus regions
2. Site assessment during field investigations against a set of pre-determined criteria and application of a **Multi-Criteria Analysis** (MCA).

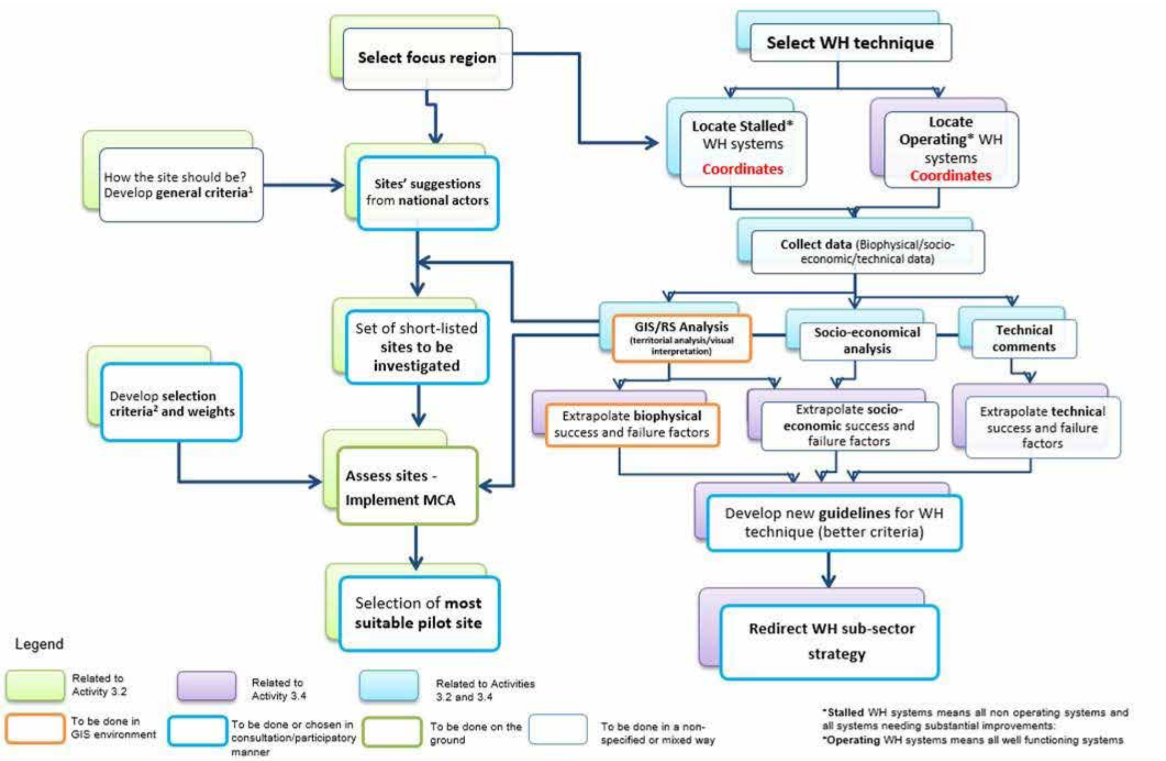
GIS-based applications were constantly used during the site selection phase and an analysis was performed using **satellite data** (images, digital elevation models), available hydrological data and all relevant and available socio-economic and biophysical mappable data.

Once a preliminary set of sites was short-listed, a more detailed territorial analysis was performed to **get more detailed biophysical and socio-economic information of each short-listed site.** The extrapolation of qualitative and quantitative data supported the assessment of the sites' suitability during the implementation of the MCA.

Finally, the hydrological analysis of the sub basin of the pilot area was performed under GIS environment.

The implementation of the pilot project started with the **rehabilitation of a surface storage WH system** with a focus on existing systems in need of substantial improvements. Further investigations were performed on socio-economic and biophysical aspects as well as on technical characteristics that enabled highlighting critical factors (failures and successes).

Conceptual model for the selection of the WH pilot site and the orientation of the WH sub-sector with the support of GIS applications and remote sensing data



Source: Laura Guarnieri/Mohamed Sabir

The country at a glance

Climate

- Two main seasons, with hot winds from Sahara in the dry season and intense rainfall and moist winds from South during the rainy season

Agro-ecological zones

- The northern region, with an average annual rainfall of 300-600 mm between October and June; the central part, with an average annual rainfall of 600-900 mm between June and October; the south, with an average annual rainfall of 900-1200 mm along 6-7 months

WH techniques

- Highly common in the country, particularly in the Central Plateau region. Since 1960's local practice (i.e. "zaï") have been supported by more recent ones (i.e. WH ponds and the "Vallerani" System – "Delfino")

Soil moisture storage techniques

- Proven WH technologies, well accepted by technicians and farmers alike

> **Constraints**: the cost of inputs (e.g. stones for stone lines) and design faults; the lack of biomass and organic fertilizers

> **Need**: integration of soil organic matter and soil fertility management with WH techniques

Irrigation

- Growing consideration over rain-fed agriculture and importance of rainwater management at both local and government level

> **Constraints:** lack of coordination of implemented activities; missed adaptation of techniques to local contexts

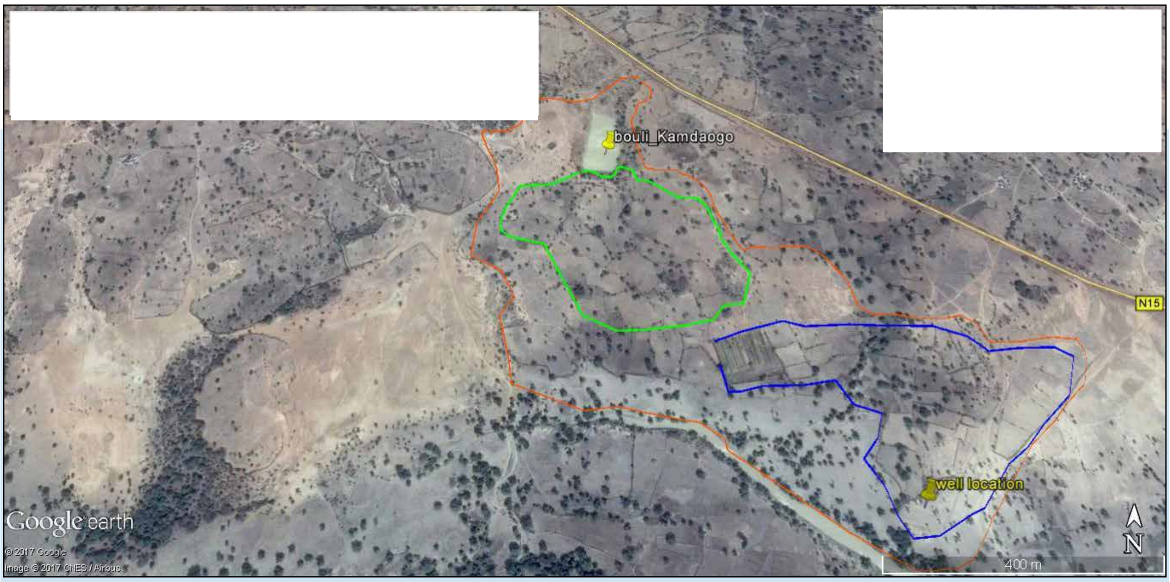

The bouli

Woman farmer in an agroforestry farm in Burkina Faso

The pilot site – Kamdaogo-Goundrin

Overview

- **Location**: District of Boussouma, Province of Sanmatenga, Central North region of Burkina Faso. It takes its name from the village of Kamdaogo-Goundrin
- **Background**: Created due to excavation for road construction materials, transformed by the population in a pastoral bouli over the years, the existing reservoir is a borrow pit. In 2004, it was rehabilitated and reinforced to reach its current capacity and to allow its multi-purpose utilization
- **Physical characteristics**: The maximum area of the reservoir (highest waters) including the overflow is 9 934 m2, the approximate maximum volume is 25 000 m3. The bouli is almost permanent throughout the year, however, in dry years, it can evidently decrease between the months of May and June
- **Operational**: The reservoir is completely free and the routine maintenance work is community initiated by the village chief, in charge of the work
- **Socio-economic context**: The current population is around 1 428 inhabitants, mainly employed in the agricultural and pastoralist sectors. Communities around the reservoir are also engaged in crop production
- **Assessed needs**: Growing demand to employ water from the bouli for irrigation purposes, also for agricultural land around the reservoir (suitable for the main food and vegetable crops).



The pilot site - Kamdaogo Goundrin - Sanmatenga Province

Source: Yapi Sinare

The pilot site – Kamdaogo-Goundrin

Scope

Following the application of a **Multi-Criteria Analysis (MCA)** to the pre-selected sites in the in Plateau Central, Centre-Nord and Centre, the pilot site of Kamdaogo was selected as it represented the **most suitable location for the pilot site for WH technologies.**

- **Opportunities for WH application**
- **Availability of land for cultivation in the area nearby the water source**
- **Current use of water in the reservoir**
- **Potential of community involvement and benefits**
- **Land tenure**

The pilot was designed and operated through a **participatory process at national and local level**. To ensure the **alignment of the pilot project** with the Government's relevant strategies, **relevant stakeholders** working on WH were **involved since the scoping/field mission.**

> Implementation of on-site and off-site WH

> Soil conservation techniques to increase the in-soil water storage and soil regeneration

> Agronomic and enhanced forestry practices

Results:

- **higher water productivity** of crops
- **reduced need for irrigation**, using water from the reservoir
- relevant **environmental aspects included:** soil regeneration, forest conservation, socio-economic aspects

Main objectives of the pilot

Rehabilitation of *bouli* and development of groundwater to increase water availability for different uses (small-scale irrigation, households, livestock)
Implementation of small-scale irrigation for high-value crops and employment of a combination of in-field WH techniques (SWC techniques and/or improved agronomic/forestry practices) on collective pilot fields around the *bouli*
Conducting field trainings and demonstrations with the contribution and participation of farmers and organizing study visits to reach out to the broader community
Helping the development/redirection of water harvesting (for agricultural use) sub-sector strategies and policies at national level

Outcomes

Pilot actions and experiences

Enhancement of existing storage WH infrastructures:

- Solar-powered lifted water to provide full irrigation to profitable crops and supplement irrigation during dry seasons

©Yapi Sinare

©Yapi Sinare

Improvement of in-situ WH methods:

- Agronomic/SWC/agroforestry practices applied to increase productivity of land and market garden crops

Full employment of groundwater resources through solar-powered lifting:

- Separation of water uses for livestock and households ("tap for women")

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Capacity building:

- Training farmers and agricultural extension agents on WHT, demonstrations and exchange visits

The country at a glance

Climate and rainfall distribution

- Semi-arid country, with cold and humid winters and warm and dry summers.
- Rather irregular rainfall, with frequent season and pluri-annual dry spells and damaging floods. Higher rainfall in the North, making rain-fed farming possible; lower in the South, making irrigation essential for agriculture

Agro-ecological zones

- 7 areas: desert; Atlantic and Eastern arid steppe; arid mountains; Atlantic and Mediterranean plains and plateaus; Semi-arid mountains; and humid and sub-humid mountains

Irrigation

- Only 16 percent of the cultivated land is irrigated
- Remaining areas are rain-fed and rely on irregular rainfall and frequent dry spells
- **Constraints**: low agricultural productivity levels

WH techniques

- Wide range of WH techniques developed over the centuries
- WH infrastructures integrated in the country landscape

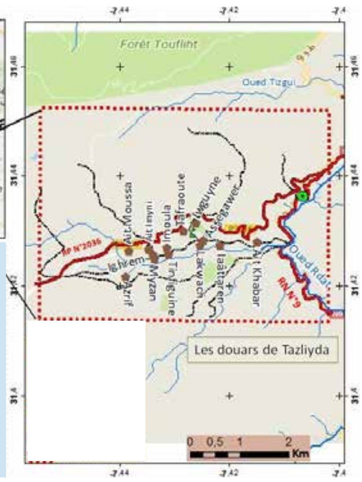
> **Constraints**: degradation of land and water resources as well as socio-economic drivers nowadays result in gully erosion and landslides

- Shift in WH interventions: from large-scale infrastructures to decentralized, small-medium scale
- Locally adaptable and manageable techniques, varying between regions and communities
- Poor attention to endogenous knowledge and traditional expertise caused the failure of a number of past projects

> **Needs**: deeper understanding of local socio-economic and agrarian context, of the regional diversity of WH techniques, and of SLM practices in place

Source: Mohamed Sabir

The pilot site
Imtsen - Tazlida site - Souk El Had Zerkten Commune, Al Haouz Province



Source: Mohamed Sabir

The pilot site – Tazlyida

Overview

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- **Location and climatic conditions:** south-east of Marrakech, in the semi arid region of the Tensift basin. Rainy season between October and April; dry from May to September and high need for irrigation
- **Water sources:** resurgences located along the banks of the wadis and the chaabats, charged by the upstream limestone plateau of Ifarwane. The waters are of good quality and mainly employed for the irrigation of the terraces and, to a lesser extent, for the feeding of the livestock
- **Storage system and management:** 17 basins (Tamda) of different dimensions. Communal use and centuries-old verbal water right to regulate the duration of access, the water flow and the succession in the village (douar)
- **Agricultural practices:** mixed farming system between plant and livestock production. Due to limited agricultural areas (only terraces) and lack of irrigation water, the latter is slightly predominant. Highly difficult to meet production needs of the fast growing population
- **Cultivated crops:** cereals (soft wheat, barley) and maize. Forage crops, alfalfa and bersim (clover), also play an important role in crop rotation. Vegetable crops limited to small, domestic surfaces

Existing micro-catchment WH system in Tazlyida

Photos: ©Mohamed Sabir

The pilot site – Tazlyida

Scope

Following the application of a **Multi-Criteria Analysis** (MCA) to the 10 pre-selected sites in the Al-Haouz region of Marrakech, the pilot site of **Tazlyida** was selected.

Selection criteria:

- the **highest potential** for adopting a holistic WH approach
- significant **network of farmers and associations** which showed high interest in the project
- good **opportunities to scale-up** a regional agricultural/WH strategy to the upper and middle valleys of the High Atlas.

The main objective of the pilot project was to support **small-scale agriculture** among the **scattered rural communities** and thus increase the income of the most vulnerable farmers, particularly in mountainous and unfavourable areas

Strengths:

- largely drawn on **local experience**
- adopted a **participatory technology development approach**
- responded to **new challenges** while **preserving social and economic balance**
- deeper coordination and linkage between **training/education, research and extension**

The overall objective of the pilot project is the **implementation of combined WH techniques in a participatory and integrated manner,** upon the rehabilitation (or improvement) of an existing macro-catchment WH system.

Main objectives of the pilot

Rehabilitation/improvement of *tamda* and related water transport systems
Implementing a combination of in-field WH techniques (SWC techniques and/or improved agronomic/forestry practices) on collective pilot fields around the *tamda*
Conducting field trainings and demonstrations - also through Field Farmers School (FFS) - with the contribution and participation of farmers and organizing study visits
Helping the development/orientation of water harvesting (for agricultural use) sub-sector strategies and policies, in the upper and middle valleys of the High Atlas

Outcomes

Pilot actions and experiences

Enhancement of existing storage WH infrastructures:

- Increased water availability through the rehabilitation of the Tit al Ain source
- Improved water transport system through the rehabilitation of theTaboumenkaret Seguia
- Enhanced water storage for irrigation through the rehabilitation of TamdaTaboumenkaret



Photos: ©Mohamed Sabir

Capacity building and knowledge sharing:

- Capacity building program for farmers of Ait Inimy and Assegawer douars
- Demos on FFS and study tour (study visits and exchange of experiences with Ourika Valley producers with ancestral experience in the development of sustainable farming of the local soil and in rainwater harvesting techniques)


Photos: ©Mohamed Sabir

The country at a glance

Climate and rainfall distribution

- Equatorial, dry and sub-humid climate, with slight differences in annual rainfall and temperatures
- Average rainfall higher in Southern Uganda, mainly between March-June and November-December

Agro-ecological zones and economic activities

- 4 main agro-ecological areas: a) the High altitude zone; b) the pastoral arid and semi-arid zone; c) the northern and eastern grassland areas; d) the southern and western tall grassland zones
- Agriculture, farming and pastoralism widely practiced throughout the country
- 80 percent of the population employed in these sectors, representing 33 percent of the GDP

Integrated water conservation techniques and Solar Irrigation practices

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- WH for banana plantation
- Integrated Soil Fertility Management (ISFM)
- Vegetated fanya juu/ contour bunds/trenches
- Improved agronomic techniques in banana-coffee intercropping
- Small-scale solar irrigation: solar irrigation pumping water from the tank

WH techniques

- Unevenly performed in rainfed areas (trash-lines, terracing and in-situ WH for banana plantations)
- In pastoralists areas some WH techniques currently implemented (valley tank)
- In mountainous areas communities adopted terracing in sloping lands. Currently also at lower heights
- Main WH system to be rehabilitated/improved: valley tanks and submerged pumps

> **Needs**: a) Capacity building to draw on traditional knowledge and introduce innovation; b) strengthened governance to harmonize approach at national level

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Layout of the pilot scheme in Kinoni, Mubende District

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Existing WH system in Kinoni

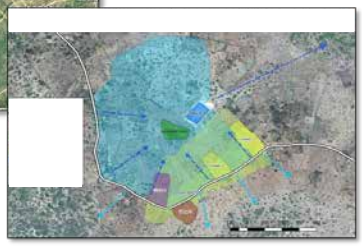
The Pilot site – Kinoni

Overview

Location and climate:

Central Uganda, in the Mubende district. Bimodal and unevenrainfall.

The pilot site Mubende District, Kiganda sub-county, Kinoni Parish, Lwenyange village



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Highly variable morphology and undulating hills. Evident soil moisture deficits due to rainfall uncertainty, in particular between January-March and June-August

Implemented on-field WH/Soil Water Conservation (SWC) and agronomic techniques:

- Organic Mulching (mainly with crop residues)
- Planting pits (square pits for banana plantation 4*4 feet; small round pits for maize and coffee)
- Trenches and soil bunds on contour lines
- Agro-forestry (wild trees and mangos)
- Conservation Agriculture
- Road WH for banana plantation (WH from rural track/water diversion from earthen channel)
- Small WH ponds for livestock
- Rooftop WH for domestic use (in small plastic tanks)
- Composting (can be improved) and manure (from livestock)
- Intercropping (can be improved)
- Supplemental, localized irrigation (with small plastic bottles, about 1.5 l/m2/week)

- Smallholder farmers depend on rain-fed agricultural production
- Crop yields below the achievable potential

High potential for increasing agricultural production through IWRM

The pilot site – Kinoni

Scope

The WH pilot project aimed at implementing an integrated small-scale system of **multiple water uses** from a newly constructed valley tank and at developing pilot plots for **demonstration** and **training** of local farmers groups.

In the specific, the pilot focused on:

(a) Soil and water conservation (SWC) and in-situ WH techniques;

(b) Integrated soil fertility management (ISFM);

(c) Solar water pumping from the tank for small-scale localized irrigation of high value crops.

The vast majority of smallholder farmers in Kinoni work with less than 2 hectares (ha) of land and showed high interest in:

> increasing yields by **intensifying crop management** in their limited land holdings

> enhancing yields of both **banana and coffee crops.**

Small scale irrigation + **Water harvesting from runoff** + **Improved agronomic measures** = **- Improved food security and diversification**
- Increased income of farmers by selling high-value crops

Main objectives of the pilot

Multi-usage of the valley tank and employment of water for small scale irrigation
Increased crop productivity through a combination of **in-field WH and SWC techniques** and improved **agronomic and forestry practices** on collective pilot fields
Increased farmers' skills trough **field trainings and demonstrations** and study visits
Supporting the development of WH (for agricultural use) sub-sector **strategies and policies**

Outcomes

Experiences and lessons learned

Training with focus on on-farm techniques of WH

Three farmers groups and around 75 farmers of Kinoni are becoming aware of the **potential of integrated water harvesting measures and smart agriculture practices** to mitigate the rainfall uncertainty.

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Participatory process and adaptation to local practices

The **inclusion of local institutions and existing social networks enhanced ownership** of the project among participants and **allowed innovative interventions**, even more thanks to the presence of a local NGO (C-CARE)

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The valley tank represented a community project and the water use committee that was created accordingly, with members from the three farmers groups, mitigated the risk of conflict on multiple water uses (pastoralists and farmers)

Baseline Survey

Scope

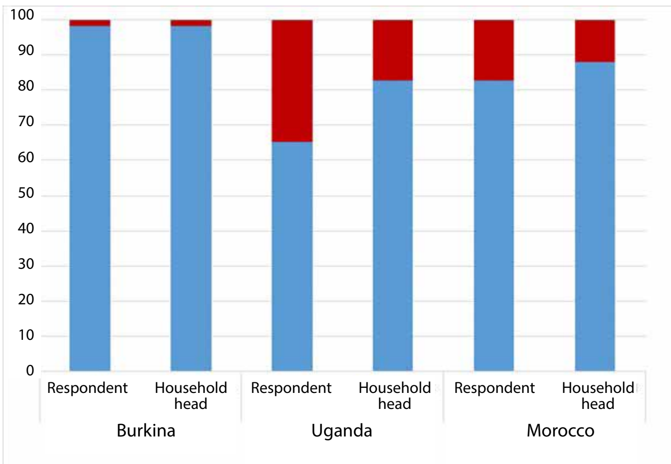
A household survey was conducted in the three countries to investigate the direct and indirect effects of the WH component of the project on the beneficiary communities:

- **Direct income effect** derived from the ability of expanding the range of marketable crops, thanks to irrigation, and moving into cash crops
- **Indirect income benefits** within the broader community due to improved agricultural practices, including promotion of cash crops
- **Increased access to water** to satisfy livestock's needs leading to an increase in animal produce and improved animal health in Burkina Faso
- **Increased uptake of in-field water harvesting and Soil and Water Conservation (SWC) techniques,** as well as **improved knowledge of best agronomic practices** and irrigation practices across the community
- **Direct employment effect** as community members might be employed as casual or seasonal labor to carry out agricultural and irrigation operations, as well as marketing
- **Decrease in the proportion of youth migrating** from the community to seek employment in larger towns.

The evaluation also **generated an evidence-base for decision-making through sharing of lessons learned and recommendations to improve the future performance of similar projects.**

In all three countries, the household survey targeted a sample of beneficiaries, both direct and indirect, of the water harvesting project, for a **total of 183 households.**

Uganda		
Group/village	Listed HHs	Sample
Total	146	52
Burkina Faso		
Quartier	Number of ménages	Sample
Total	171	56
Uganda		
Tamda	Number of users	Sample
Total	123	75



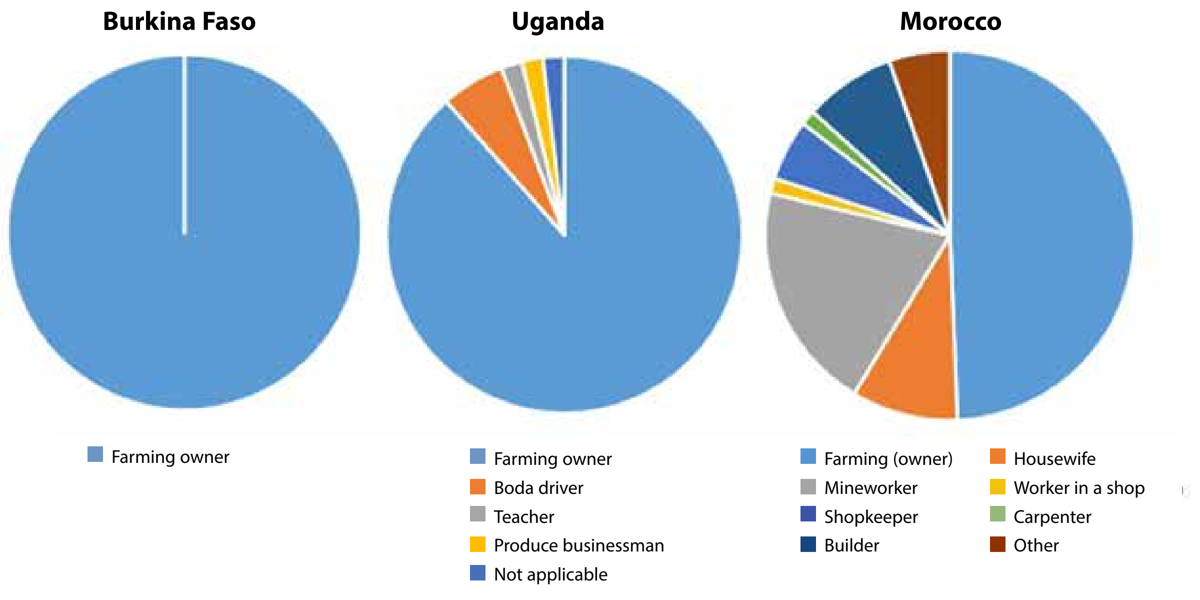
Source: FAO, 2018

While in Burkina Faso 98% of both household heads and respondents are men, in Uganda and Morocco a larger portion of respondents (34.6% and 17.3% respectively) and household heads (17.3% and 12% respectively) are female

The main indications stemming from the three surveys have been compiled into a comparative assessment and aggregated according to the following components:

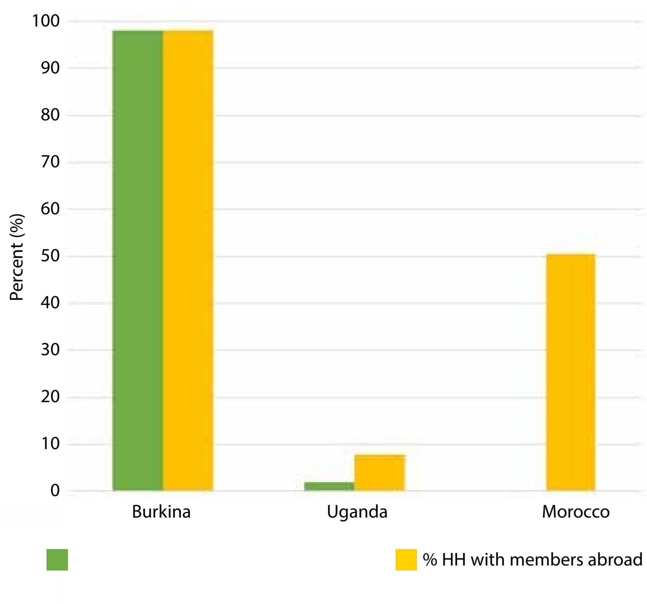
- **Demographic characteristics**
- **Water use practices**
- **Governance**
- **Agricultural activities**
- **Agronomic practices**

Demographic characteristics



Primary occupation of the household heads

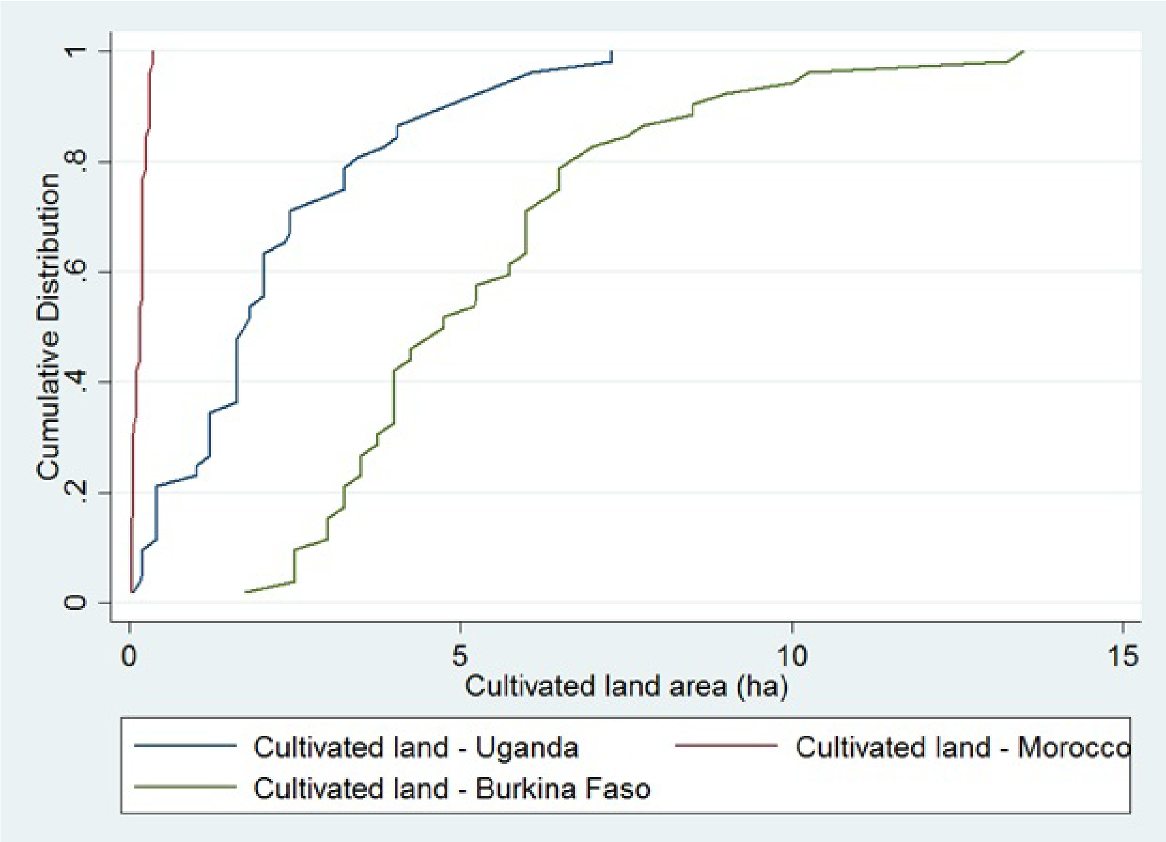
In Burkina Faso the primary occupation of all the household heads is farming. Similarly, in Uganda 89% of the household heads are primarily farmers, while 6% are primarily boda (motorbike) or piki (bicycle) drivers. In contrast, in ***Morocco*** *only 49% of the household heads list farming as their main occupation and 20% are primarily mineworkers*



Migration flows

Burkina Faso *experiences the highest migration flow among the three countries, with around 6 family members per household who left native village. In* ***Morocco****, half of the households reported a member living outside the village but no one living abroad. As for Uganda, only 4 respondents reported a household member living outside the village or abroad*

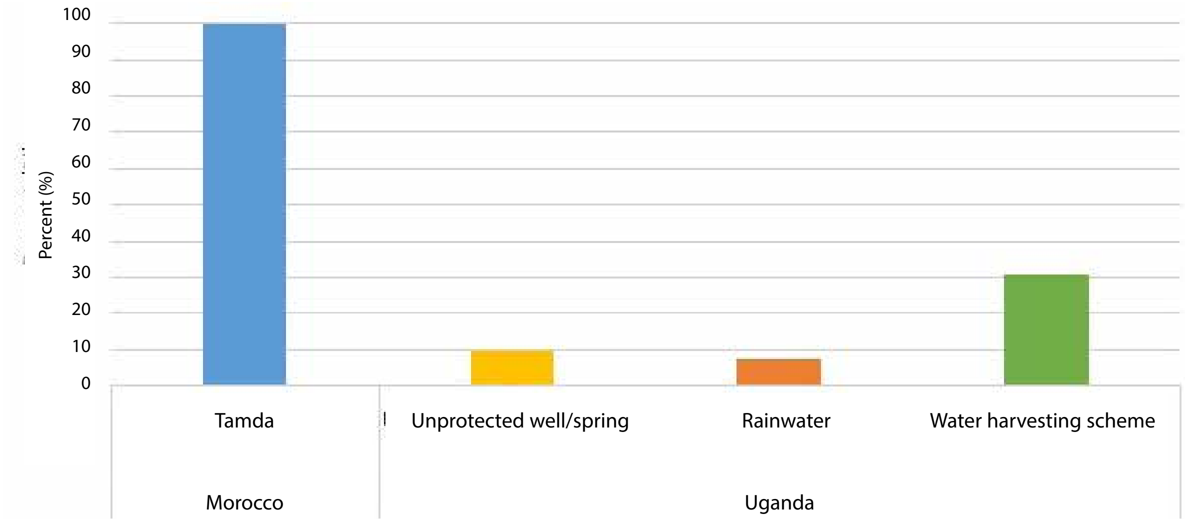
Agricultural activities



Cultivated land

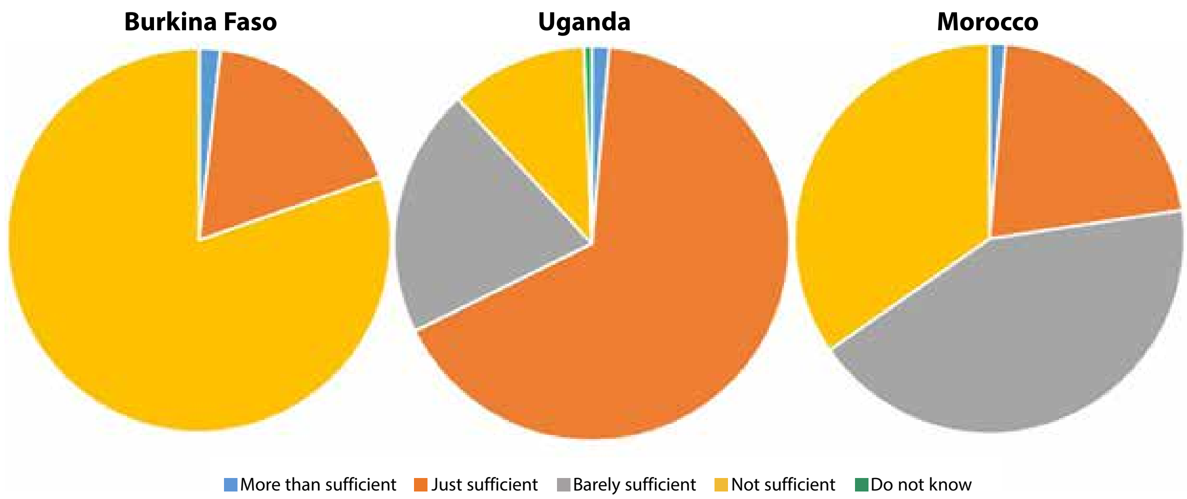
*The difference in terms of cultivated land between Morocco on one side and Burkina Faso and Uganda on the other is striking. In **Morocco**, farmers own or rent land in an area located in the mountains characterized by steep slopes and forests. Because of this particular landscape, farmers have little cultivable land at their disposal and they build and cultivate small terraces that are on average 0.19 hectares with a lower median of 0.15 hectares.*

Water use practices



Water resources for irrigation purposes

*While in **Burkina Faso** agricultural production is entirely rainfed, 35% of **Ugandan** and 100% of **Moroccan farmers** irrigate their lands*



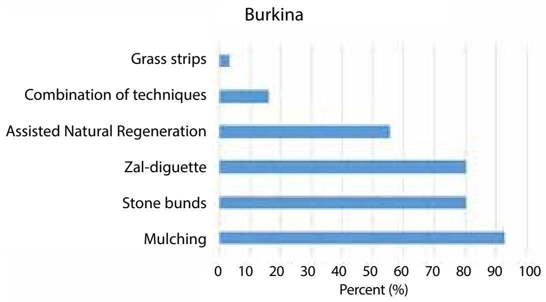
Satisfaction with water quantity

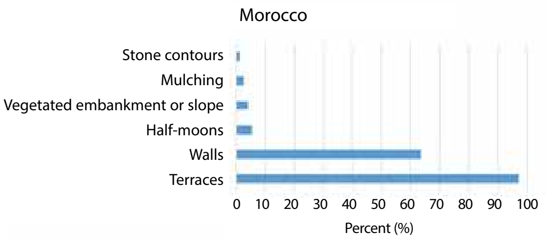
*Most respondents in Burkina Faso, Uganda and Morocco (98 %, 56% and 96% respectively) reported to have experienced problems with their source of water for domestic, pastoral or irrigation purposes. Indeed, in **Burkina Faso** farmers believe that the main issues are related to overuse of water resources, drought and competition among water users. Water quantity is also reported as not sufficient to satisfy needs due to, above all, overuse of water resources, too much livestock watering, competition among water users and insufficient rainfall.*

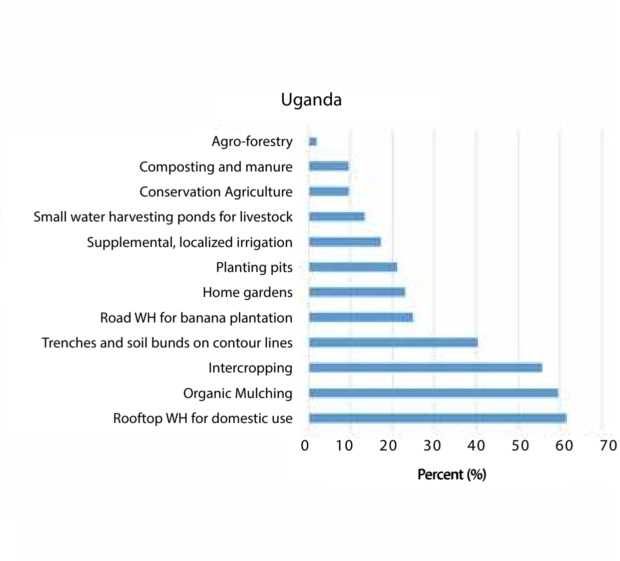
*In **Uganda**, farmers consider the major problems to be the long distance between the households, the fields and the water sources, pollution and contamination, and siltation. Nevertheless, the majority of farmers consider the quantity of water just sufficient to satisfy their needs, while unsatisfied farmers consider sharing the water source with livestock the main cause for limited water availability.*

*In **Morocco**, finally, farmers regard drought, pollution and contamination of the water sources and loss of water due to infiltration as the main issues. The quantity of water is deemed not sufficient or barely sufficient by most farmers with the main reasons being insufficient rainfall and loss of water due to infiltration.*

Agronomic practices

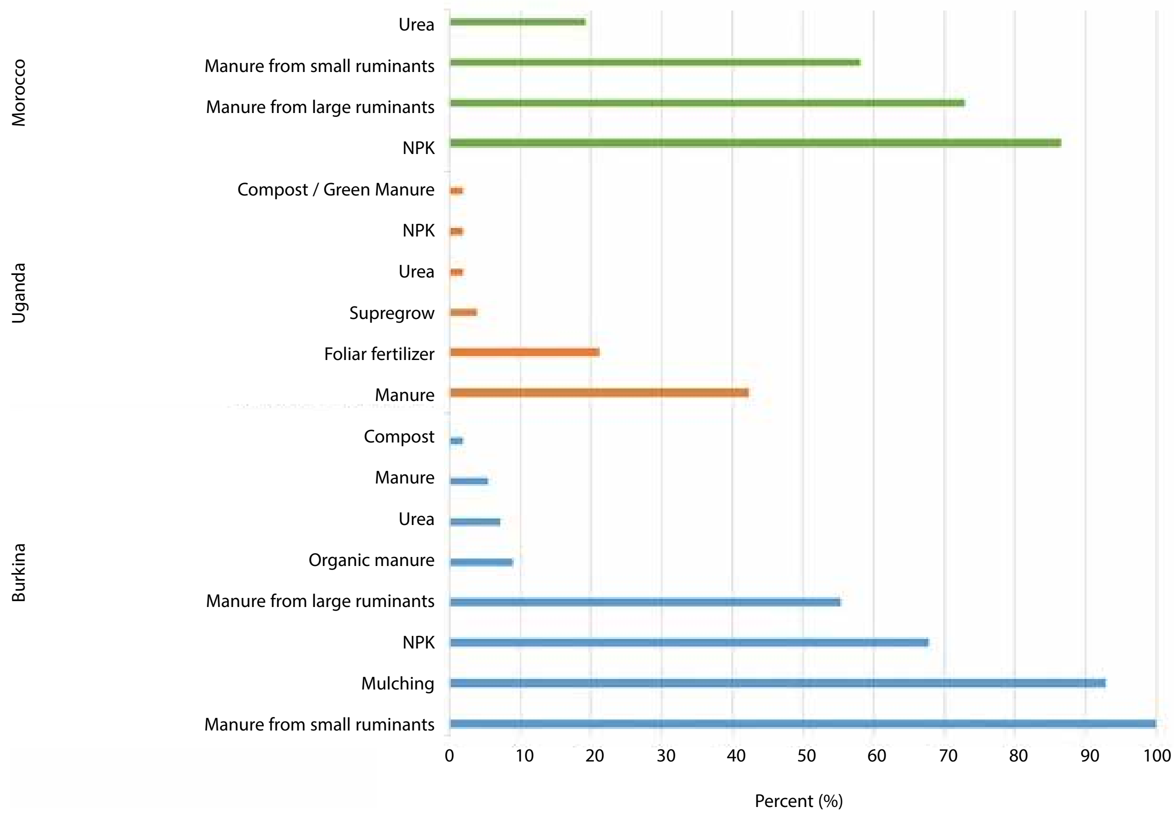






Sustainable Land Management (SLM) and Soil and Water Conservation (SWC) technologies

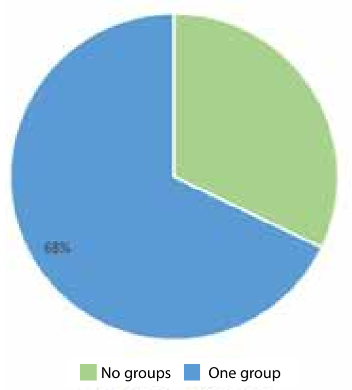
Although each of the three communities applies specific SLM and SWC techniques reflecting particular climatic, environmental, socio-economic and cultural conditions, some water harvesting and soil conservation techniques are common to the three case studies. These techniques are often called with different local names and have slightly different technical characteristics, but are based on the same physical principles.

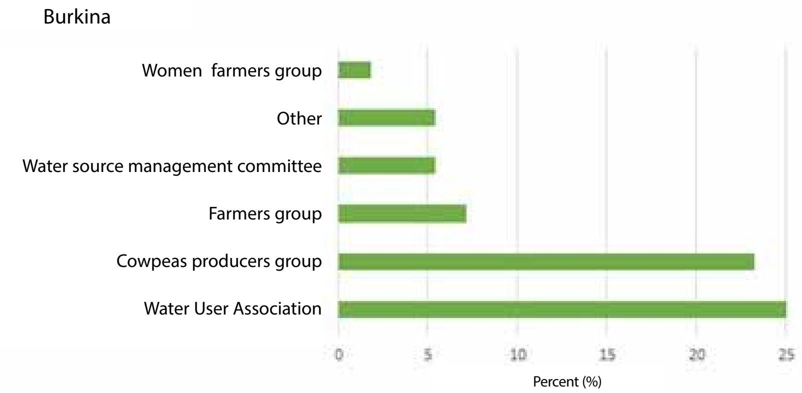


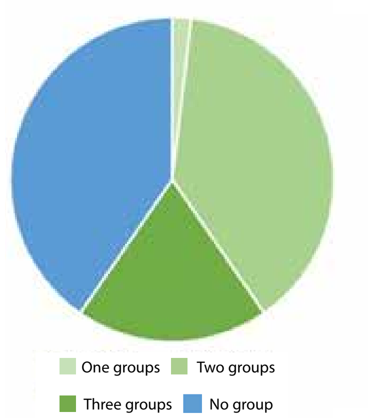
Employed fertilizers

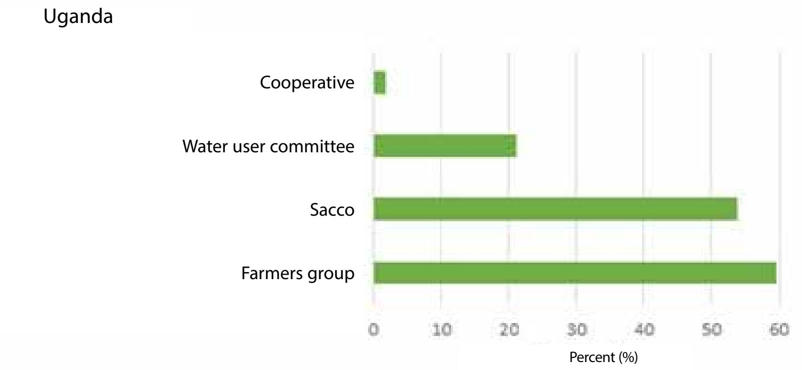
*While in **Burkina Faso** and **Morocco** all farmers in the sample reported to use at least one fertilizer, in **Uganda** the percentage decreases to 56%.*

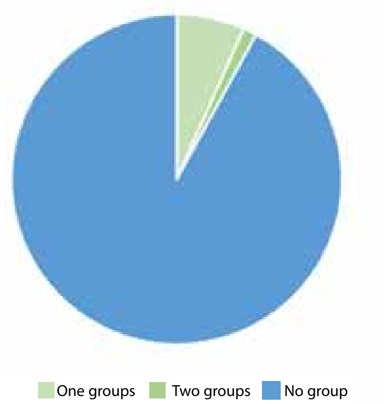
Governance

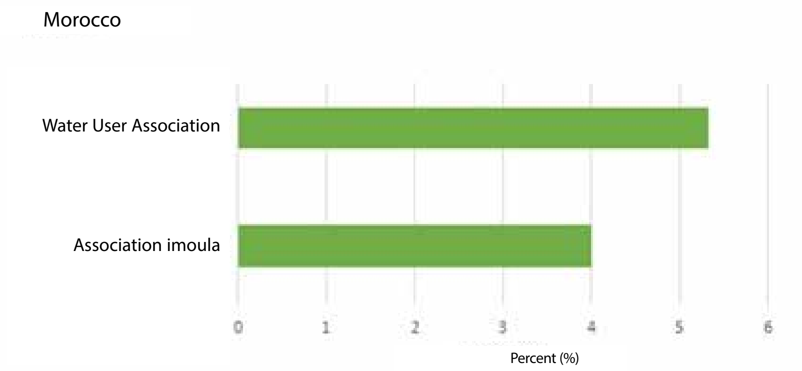








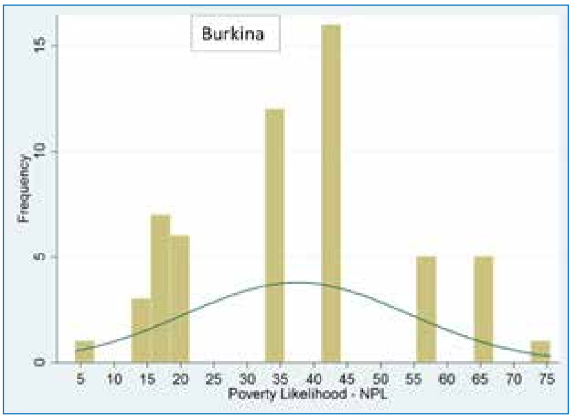


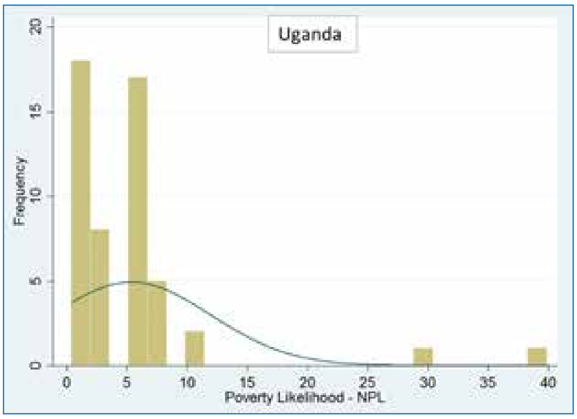


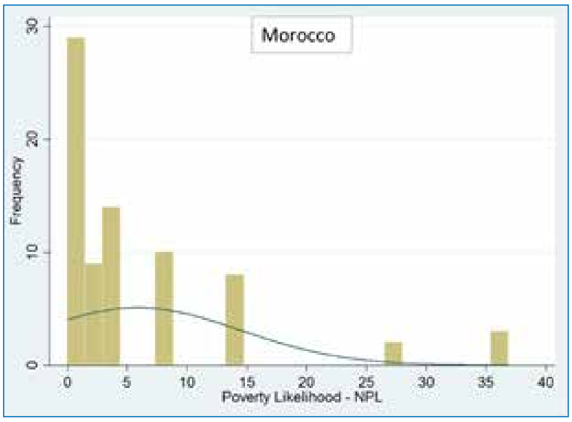
Membership into groups related to agriculture

*An additional section of the survey explored the participation of farmers in groups related to agricultural activities. While in **Burkina Faso** and **Uganda**, associations are very common, in **Morocco** only seldom farmers are members of an organization. In Burkina Faso, 68% of farmers in the sample belong to one group and none of the farmers surveyed belongs to more than one group. 25% of the interviewees are members of the Water User Association and 23% are members of the Cowpeas Producers Group. In Uganda, 40% of farmers in the sample do not belong to any group and the rest participates in one or more groups. 60% of the interviewees are members of farmers groups and 54% are members of Sacco or other community saving system. Only 21% are members of the Water User Committee. In Morocco, only five respondents are members of an organization and one farmer is member of two organizations. Specifically three farmers are members of the Imoula Association which is an old and big association that deals with a wide range of activities of the douar, such as water, electricity, health, mosque, agriculture, breeding, etc. Four farmers are members of a Water User Association.*

Poverty level and wealth







Distribution of poverty likelihood – National poverty line

In order to avoid overly relying on self-reported measures of income, we also analyzed the Poverty Probability Index® (PPI®). The PPI is a poverty measurement tool specific to each country that uses a survey and scoring system to estimate the likelihood that a household is living below national and international poverty lines.

We can determine the poverty rates of our sample by averaging the poverty likelihoods of all the households (Figure 1.13). According to the "National Poverty Line" categorization of poverty likelihood probabilities specific to Burkina Faso, the estimated poverty rate is the households' average poverty likelihood of 37.5%. This means that roughly 37.5% of farmers in our sample are below the "National Poverty Line".

According to the "National Poverty Line" categorization of poverty likelihood probabilities specific to Uganda, the estimated poverty rate is the households' average poverty likelihood of 5.35%. Finally, according to the "National Poverty Line" categorization of poverty likelihood probabilities specific to Morocco, roughly 5.88% of farmers in our sample are below the "National Poverty Line". The PPI is a public good powered by Innovations for Poverty Action (IPA): www.progressoutofpoverty.org

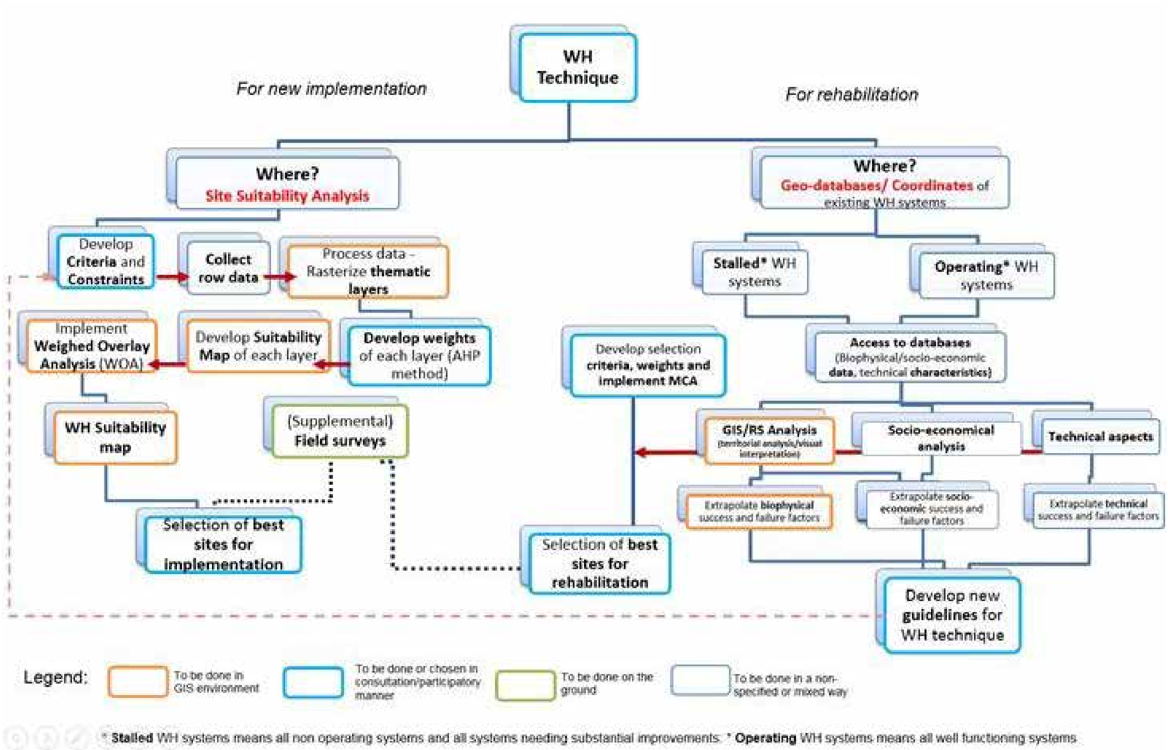
Scale-up

In the agricultural sector, a vast range of WH techniques is available and applicable to different geographical conditions. However, the **poor matching of WH practice with its technical and socio-economics requirements** and the **lack of knowledge and tangible information** on areas where WH can be applied effectively can be considered major reasons for the poor effectiveness of WH projects and slow adoption of WH techniques.

A robust, low-cost methodology to enable the assessment of the potential of WH through ground surveys and remote-sensing data was thus developed.

Such a methodology, thanks to the creation of WH suitability maps to support decisions on the implementation of new WH structures or the rehabilitation of existing priority ones, **could finally support the development of national guidelines for specific WH techniques and allow the streamlining of WH policies into AWM programs at all institutional levels.**

A methodology for the planning of WH schemes and the development of WH strategies with the support of GIS applications and remote sensing data



Source: Laura Guarnieri/Mohamed Sabir

Scope and employment of GIS and remote sensing applications	
For new implementation by mapping potential/suitable areas according to the spatialized Multi-Criteria analysis (MCA) and integrated field surveys	**For rehabilitation** of existing WH systems as a decision-making **support tool**

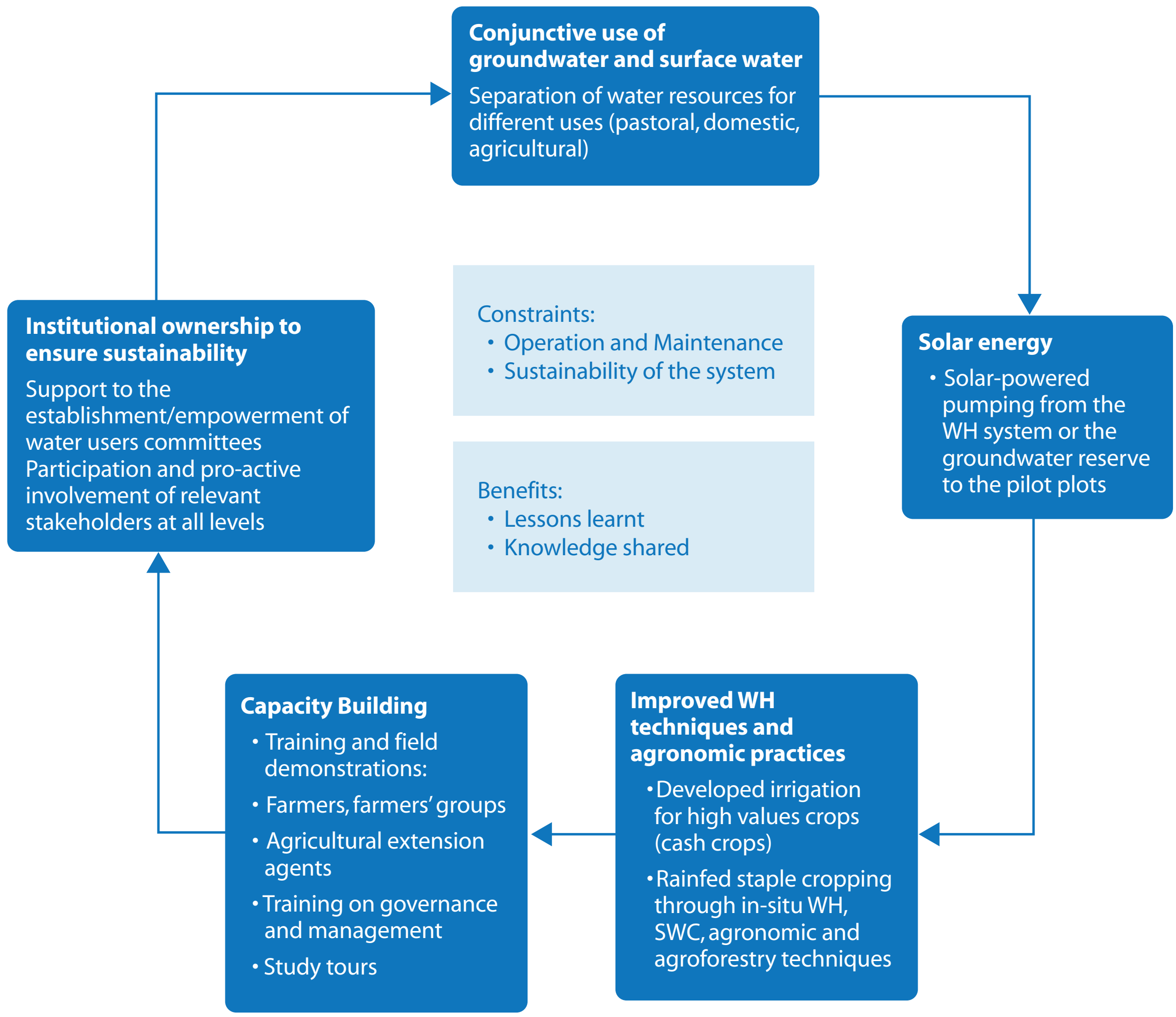
Scale-out

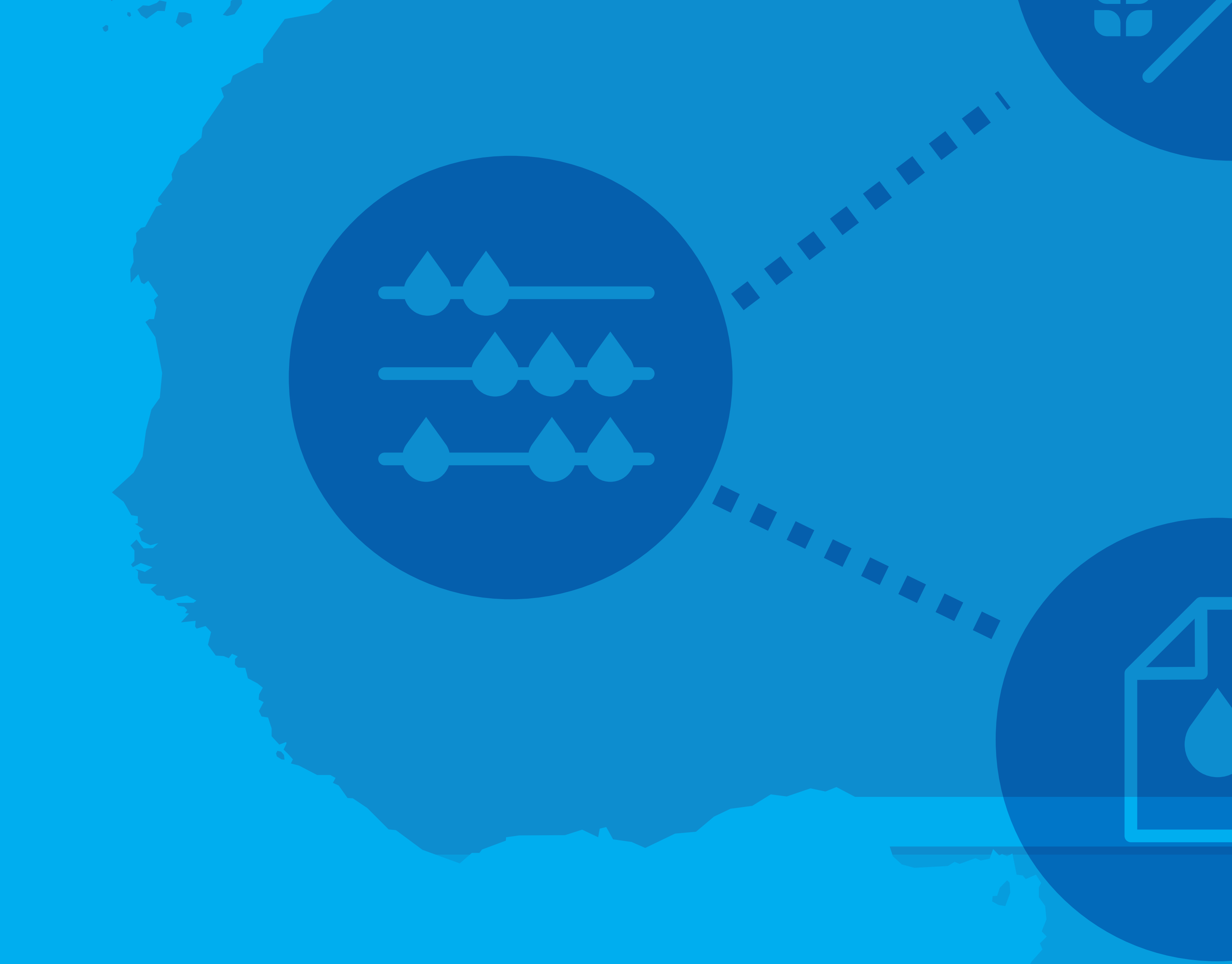
WH embraces an extensive **range of techniques applicable to various geographical conditions and suited to one or more water uses** – domestic, irrigation, livestock, aquaculture and ecosystems.

All WH solutions can be used as stand-alone measures, however, if combined in a systematic way at the landscape scale, their effect on the overall water buffer is more substantial.

Enhancing WH capacity for agriculture, therefore, requires **planning and management of landscape to meet multiple objectives and stakeholders' needs**, including agricultural production, livelihood improvement and ecosystem conservation.

Determining which WH technique, or combination of techniques, have the best performance in a specific context requires a **detailed analysis of its physical, technical, and socio-economic factors.**





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Partnership for agricultural water for Africa

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