“Field experiences”

Challenges and opportunities for agricultural water management in West and Central Africa: lessons from IFAD experience

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Enabling poor rural people to overcome poverty

IFAD

“FIELD EXPERIENCES”

Challenges and opportunities for agricultural water management in West and Central Africa: lessons from IFAD experience

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IFAD

Enabling poor rural people to overcome poverty

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Abbreviations and acronyms

AfDB	African Development Bank
AWM	agricultural water management
CP	Collaborative Programme on Investment in Agricultural Water for Poverty Reduction and Economic Growth in Sub-Saharan Africa
CPM	country programme manager (IFAD)
FAO	Food and Agriculture Organization of the United Nations
IWMI	International Water Management Institute
M&E	monitoring and evaluation
PTA	Policy and Technical Advisory Division (IFAD)
PTA-Water	PTA Water and Institutions Desk
RIMS	Results and Impact Management System (IFAD)
SPA	Special Programme for Sub-Saharan African Countries Affected by Drought and Desertification
SSA	sub-Saharan Africa
SWC	soil and water conservation
WCA	West and Central Africa Division (IFAD)

Note: Acronyms for IFAD-supported projects in West and Central Africa are listed in Table 2, section 4.

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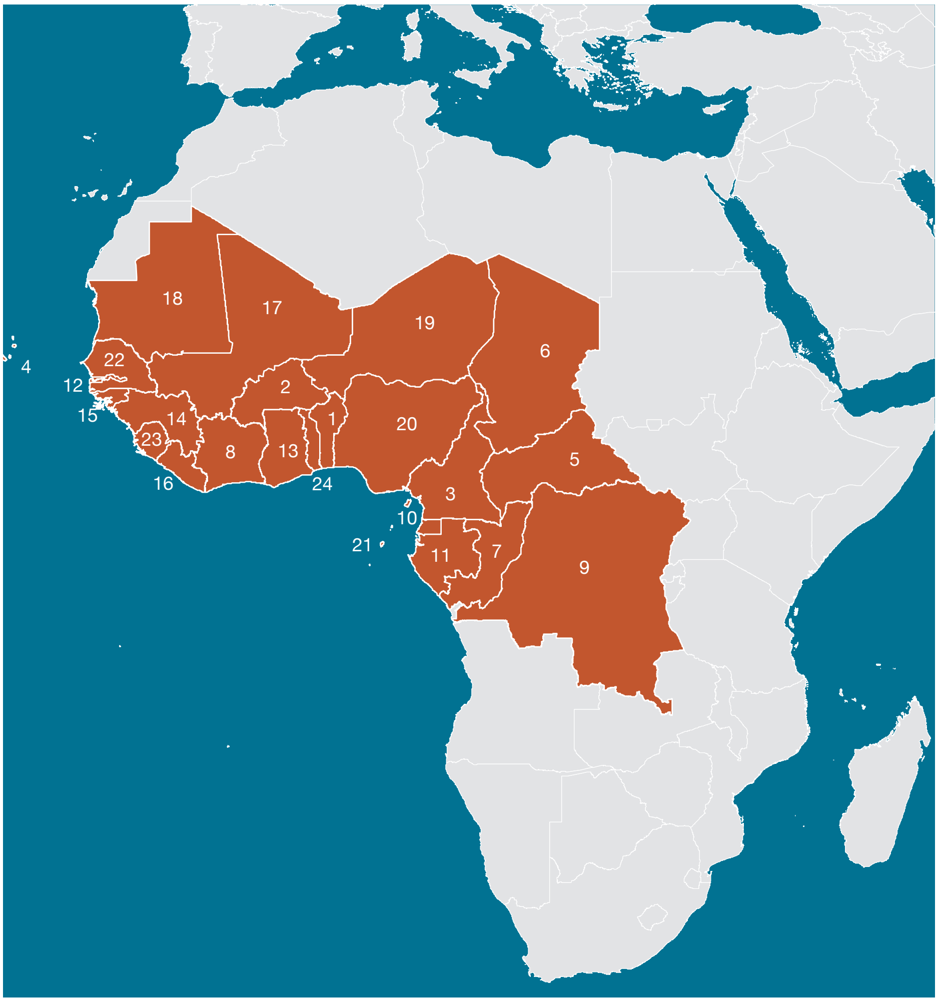
Countries covered by IFAD's West and Central Africa Division

1) Benin
2) Burkina Faso
3) Cameroon
4) Cape Verde
5) Central African Republic
6) Chad
7) Congo
8) Côte d'Ivoire
9) Democratic Republic of the Congo
10) Equatorial Guinea
11) Gabon
12) Gambia (The)
13) Ghana
14) Guinea
15) Guinea-Bissau
16) Liberia
17) Mali
18) Mauritania
19) Niger
20) Nigeria
21) São Tomé and Príncipe
22) Senegal
23) Sierra Leone
24) Togo



Foreword

Farmers in West and Central Africa have the potential to increase production and lead the way to the type of robust growth and development needed in Africa. But we recognize that this cannot be achieved without improving the management of available water resources in the region.

IFAD, through its West and Central Africa Division (WCA), has invested, and continues to invest, significantly in supporting farmers and farmers' organizations to achieve household food security and respond to growing market demand through activities that strengthen their ability to manage risk and increase returns. WCA works with farmers to improve rainfall capture, groundwater and surface water use, and land management practices. Despite progress, there is always room for improvement.

This review is part of a wider effort within the division to capitalize on the wealth of experience and knowledge among our staff, and to improve the ways in which we share knowledge and use it to enhance future project design, direction and strategy.

I hope that readers of this review, from headquarters staff, to IFAD field staff, to others working in this area, will find it useful and informative, and will be encouraged to use the results in their work, build on lessons offered and continue to ask questions, share stories and propose solutions.

Ides de Willebois
Director, West and Central Africa Division, IFAD

Summary

The West and Central Africa region has a wealth of renewable water resources, but relatively few are being used, with countries in the region only withdrawing between 1 and 14 per cent of available resources and only around 3.5 per cent of cultivated land under some form of water management. This paradox offers a great opportunity. Increasing the level of water management in the region could help farmers to achieve more reliable, profitable and sustainable production, be better prepared to deal with increasingly erratic climate patterns, and respond positively to the large and growing regional and global food demand.

IFAD and its West and Central Africa Division (WCA) have a long history of work in agricultural water management (AWM), supporting a range of activities in the area. Levels of investment in AWM have steadily increased and, in view of this, it is important for the organization to evaluate how to make the greatest impact with its investment. To this end, a review was undertaken, consisting of a broad literature review, a capitalization workshop with staff from eight projects, visits to five AWM-intensive projects, and interviews with staff and other experts in the field. A synthesis of the outputs from these sources points to the need for the division to rethink the distribution of attention and funding offered within projects, and to work to deliver more effectively the support needed to make AWM technologies viable, profitable and sustainable.

To achieve this, the following should be considered:

- The achievement of profit at farm level should be driving project design and implementation more so than it is currently. Given its importance to the sustainability of AWM activities, profit to farmers should be measured annually and used as an indicator of progress.
- Environmental and market connectivity factors need to be more systematically considered when deciding on AWM project and site locations, and in choosing which technologies to promote.
- Exclusively targeting the poorest and most vulnerable people results in reduced effectiveness in many AWM interventions in West and Central Africa.
- It is useful to make a progression of technologies available, which farmers can select from based on their environmental, financial and technical needs and abilities.
- Specific performance indicators are required for user participation and management to enable this important aspect to be monitored and prioritized during project implementation.

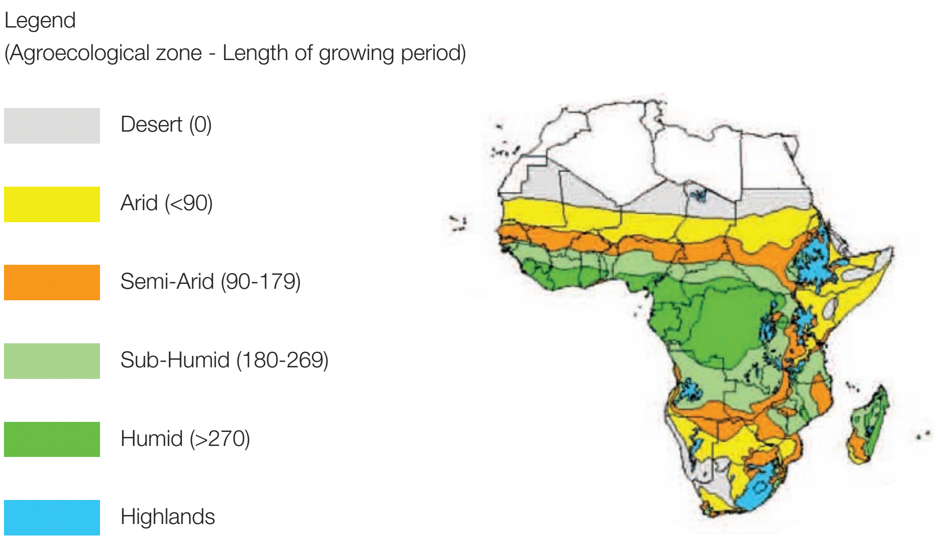
- Transfer to community management requires effective and ongoing local support, often over longer time periods than those planned under projects.
- Projects must ensure sustainable mechanisms for access to complementary inputs such as appropriate seeds, fertilizers, tools and crop protection measures in order to achieve the anticipated results of AWM activities in terms of improved incomes and livelihoods.
- It is vital for projects to utilize sufficient local technical support services during design, implementation and monitoring, and to support AWM users drawing upon these services beyond the life of projects.
- Project staff and farmers need more technical orientation regarding AWM options so that they can better evaluate private- and public-service provider bids and work. This could be achieved through more exchange visits, workshops and knowledge-sharing.
- Because of the importance of user engagement and satisfaction for the success of AWM efforts, monitoring and evaluation systems should be centred on participatory approaches.
- While some level of external support and subsidy may be needed to initiate AWM and complementary agricultural productivity activities, project design needs to be improved to anticipate phasing out of subsidies and the introduction of alternative financing mechanisms that can be sustained without project or government intervention.

Introduction

Most farmers in sub-Saharan Africa (SSA) live in areas with relatively abundant water resources. Large areas of the continent receive more than 1,000 mm of rain each year and possess significant groundwater resources with high rates of recharge (over 100 mm/year). There is also a network of rivers, streams, tributaries and lakes covering the region. The availability of these water resources, however, is extremely seasonal because of the patterns of the annual rainy season(s), and most areas in SSA experience significant fluctuations not only in rainfall, but also in groundwater and surface water availability.

The region can be divided into six agroecological zones, differentiated by the length of the potential growing period for rainfed agriculture. The variation is driven by the dramatic differences in annual rainfall, from more than 2,000 mm/year in Central Africa to less than 400 mm/year in arid areas (figure 1). This precipitation serves to recharge rivers and groundwater basins, as well as directly water rainfed crops. As a result of natural variations in surface water resources and upstream human use, as well as hydrogeological structures, total renewable water resources also vary greatly; from for example 800 billion m^3/year in Congo, to 80 billion m^3/year in similarly sized Côte D'Ivoire (figure 2).

Figure 1. Agroecological zones in SSA.



Source: *Global Agro-ecological Assessment for Agriculture in the 21st Century: Methodology and Results*, Fao 2002

Figure 2. Renewable water resources in countries in West and Central Africa. Note that totals subtract the overlap between surface water and groundwater (FAO 2011).

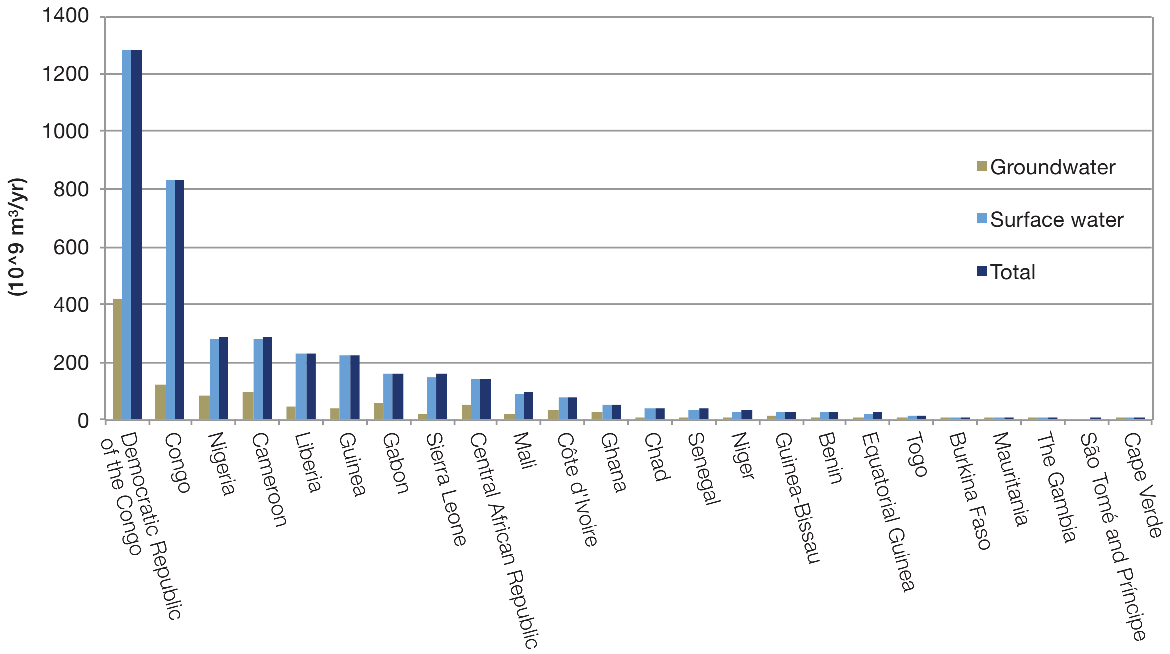
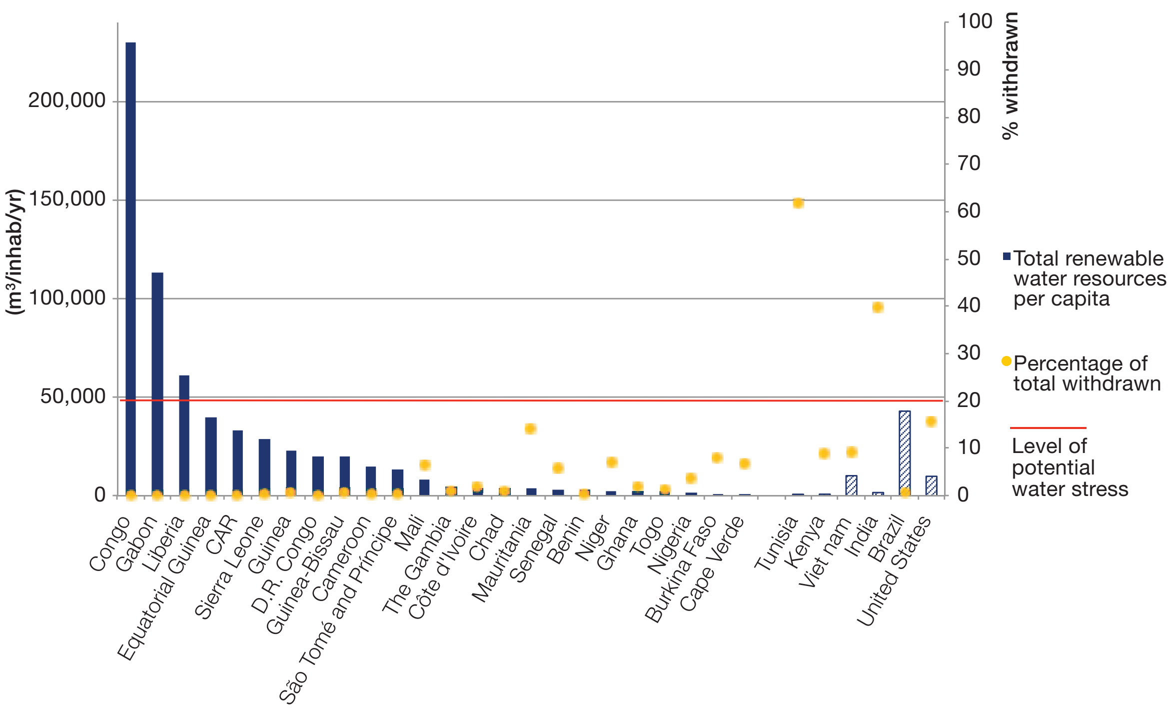


Figure 3. Per capita water resources and withdrawals in West and Central African countries and comparative countries.



“Yet despite this apparent abundance of unutilized resources, surface water is often concentrated in a seasonal window and can be extremely variable from year to year. However, the problem is thought not to be an absolute water scarcity but rather a lack of infrastructure to regulate supplies for use in dry seasons and dry years” (Peacock 2007, 11).

With SSA's relatively low population density, total renewable water resources per capita are also quite high in many areas, from the overly abundant 230,000 m^3 per person per year in the Congo (lower only than the small region in South America of Guyana, French Guiana and Suriname) to much lower values of around 2,000 m^3 per person per year in countries such as the Niger, Ghana and Nigeria. However, even in areas with relatively low water resources, no country in West and Central Africa comes even close to overwithdrawing their available water. Water users in SSA currently only withdraw on average about 3 per cent of available water resources (including industrial, agricultural and domestic use). Withdrawal rates exceeding 20 per cent of available resources are often used as an indicator of water stress (figure 3). Average withdrawal rates are around 36 per cent in Asia and 51 per cent in the Middle East and North Africa region. The highest users in SSA are Sudan and South Sudan at 58 per cent, South Africa at 25 per cent, Zimbabwe at 21 per cent, and Mauritania at 14 per cent. Many countries in West and Central Africa are using less than 1 per cent of available water (FAO 2011).

However, despite this relative abundance, most SSA farmers do very little to manage water strategically in order to maximize crop productivity, and this contributes to the very low rates of water withdrawal in the region. On average, only around 3.5 per cent of cultivated land in SSA is under some form of water management, compared with 44 per cent in South and East Asia, 14 per cent in the United States and 8 per cent in South America. This, of course, varies across the continent, with countries in dryer regions typically having higher levels of water control out of necessity, such as Mauritania with 15 per cent of land under water control. However, many other West and Central African countries with low and erratic rainfall are using water control measures on less than 1 per cent of cultivated land (Burkina Faso, Cameroon, Ghana, Liberia, Niger, etc.). Water scarcity in the region is thus primarily economic rather than physical water scarcity.

While other regions have steadily increased the amount of water-managed agriculture over past decades (and correspondingly increased yields and value earned per hectare), growth in SSA has been extremely low. The average rate of increase in agricultural land under some form of water management across SSA (40 countries) from 1988 to 2000 was 43,600 hectares per year, an average of 1,150 hectares per country, or only 0.6 per cent per year (IPTRID 2001).

Climate variability and change

While the statistics above show the most recent yearly averages, all of these figures are dynamic, due to natural and human-led change. Farmers across the world have always had to cope with climate and weather variability, both small seasonal changes and large disruptive events. Dry spells cut crop yields in two out of every three years in SSA countries, and droughts cause complete crop failure in 1 out of every 10 (Wani, Rockstrom and Oweis 2009).

Large events such as droughts and floods have been hitting particularly hard and frequently in recent years, with droughts in the Niger in 2005 and 2010, in the southern United States in 2011 and in East Africa in 2011 being very recent reminders.

Climate forecasting and modeling can only give possible scenarios for future change, and current climate predictions for Africa are particularly uncertain. There is a wide spread of results, with some projecting increases in rainfall and temperature, others decreases, and all showing varied effects across the continent. There is agreement, however, that weather patterns will most likely become more severe and erratic, with changes difficult to predict. More frequent floods and droughts are also expected.

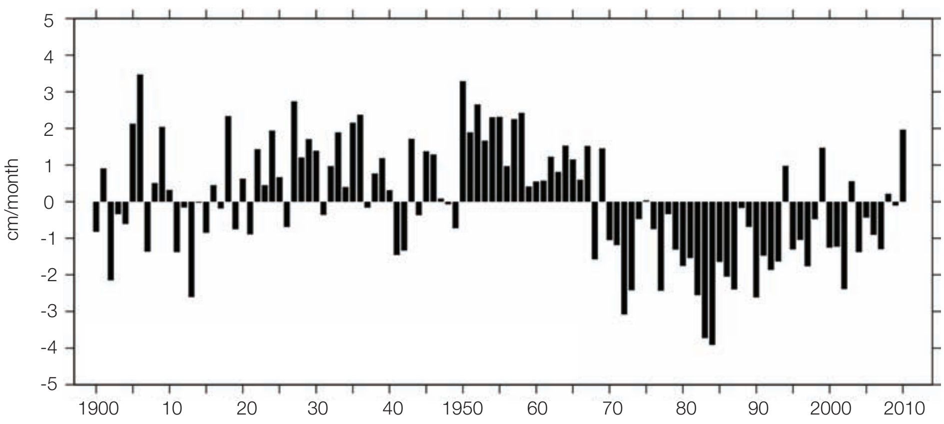
The Sahel region is especially affected by changing climate patterns. The area has always experienced multidecadal variability in rainfall, determined by changes in the sea surface temperatures of the Pacific, Indian and Atlantic Oceans – the El Niño southern oscillation and Atlantic multidecadal oscillation effects. The wet conditions in the 1950s and 1960s, and the extreme dry conditions of the 1970s to 1990s are among the largest climate fluctuations anywhere (figure 4). As these weather phenomena continue to evolve, there is every reason to believe that the climate in the Sahel will be affected concurrently. Precipitation intensity is also predicted to increase significantly in the more humid areas of SSA, including across the southern half of the West and Central Africa region (IPCC 2008).

Adding to these new challenges will be increased water demand resulting from population growth in the region. Water stress is predicted to increase in some areas simply as a result of projected population increases, without even adding the effects of climate change. Areas currently with low, but sufficient, water resources per capita could come closer to experiencing constraints by 2025, for example in West and Central African countries such as Burkina Faso, Cape Verde, Ghana, Nigeria and Togo.

While the exact changes that will occur are uncertain, especially because of a lack of sufficient monitoring and forecasting in the region, what is clear is that changes are already occurring and will continue to occur. In these circumstances, it will be fundamentally important for farmers to have more control of the water resources available to them in any given season (Brown and Hansen 2008) (IPCC 2008) (Conway and Waage with Delaney 2010).

"A mass exodus, an emptying of half a country, is an unprecedented, biblical event. What triggered it? The immediate cause was drought. Rains failed last October in East Africa, then again in April, and by early August, the UN was putting the number of people at risk from hunger at 12.4 million … Half a century ago, rainfall was sparse, but droughts occurred only once a decade. Today they come every two years, and in areas where El Niño and La Niña also disrupt the seasons, there haven't been good rains in 10 years. This is climate change now – severe and lethal"
(Perry 2011)
(in TIME, A famine we made?, September 5 issue).

Figure 4. Sahel precipitation anomalies 1900-2010 (JISAO 2011).



Source: University of Washington, Joint Institute for the Study of the Atmosphere and Ocean

Need and potential

The West and Central Africa region has areas of both water scarcity (low rainfall, low water tables and little surface water) and water excess (high and often intense rainfall, high water tables and surface water available in lakes and rivers), with a broad spectrum of localized situations in between.

Each area in the region is faced with unique challenges. In water-scarce areas, in particular across the Sahelian countries of West Africa, it is beneficial to use each rain event more efficiently – water loss from run-off and evaporation often leaves less than 50 per cent of rainfall or irrigated water available for crops, if not explicitly managed. In these cases, farmers could benefit either from groundwater or surface water irrigation to supplement the low and erratic rainfall, and from the use of techniques that help to capture the rain that does fall more effectively.

In contrast, in areas with more rainfall, such as in the more humid Central African countries, or in areas with steep slopes or insufficiently vegetated land, intense rains cause soil erosion, land degradation and surface water pollution if management measures are not put in place. This can lead to loss of soil fertility, a problem that greatly affects crop yields over time. In these areas farmers need assistance in implementing field drainage measures as well as soil conservation practices, such as planting trees or grasses, or building small structures to slow down and channel rainwater run-off.

As described above, the land area under some type of water management in SSA is quite low, and land equipped for controlled irrigation is even smaller, at less than 3 per cent, or about 7 million hectares, with only about 70 per cent of that actually irrigated in a given season (FAO 2011). Non-staple food crops are the most highly irrigated, with only about 19 per cent grown under rainfed conditions, compared


©IFAD/David Rose

The Niger - Project for the Promotion of Local Initiatives for Development in Aguie - 2006 with 93 per cent of cereals and 99 per cent of non-cereal staples (i.e. cassava, potatoes, plantains) (2015 projections). Rice production accounts for the most extensive irrigated area, with more than 1.5 million hectares as of 2003 (Riddell, Westlake and Burke 2006).

Bringing crops under some form of water management, be it in-field soil or water conservation measures, supplementary irrigation using groundwater, or canals channelling surface water to needed areas, has the potential to increase yields. Rainfed cereals with low inputs, for example, obtain average yields of around 2 tons per hectare, while the use of optimal inputs can bring yields up to approximately 3 tons per hectare. However, even with low inputs, irrigated crop yields tend to average around 4-5 tons per hectare, and with high-yielding varieties and high inputs, irrigated outputs can be as high as 8 tons per hectare (FAO 2002).

Not surprisingly, the crops farmers tend to irrigate are usually of higher value. As of 2003, about 25 per cent of the gross value of food in SSA was produced under irrigated conditions. However, as noted, this is produced on less than 3 per cent of the land, a value-to-land ratio of around 7 to 1. As noted in a 2009 report by the International Food Policy Research Institute on irrigation performance in Africa, the comparable ratio for the world is around 2 to 1. The report notes that "this suggests a huge impact stemming from water control in Africa. Improving the quality of both formal and informal irrigation would be expected to raise this value further" (Svendesen, Ewing and Mgangi 2009, 26).

Guinea - Fouta Djallon Agricultural Rehabilitation Project - June 1991

Expansion of water management and irrigation in SSA is an exciting area. According to the 2007 Comprehensive Assessment of Water Management in Agriculture, SSA is the only region rated as having a high potential for irrigation area expansion (Comprehensive Assessment 2007). This fact has not gone unrecognized, with many governments in Africa setting targets in this sector. The Africa Water Vision 2025, issued by the Economic Commission for Africa, the African Union and the African Development Bank (AfDB) in 2000, set targets to expand the area under irrigation by 25 per cent by 2005, 50 per cent by 2015 and 100 per cent by 2025. If one takes the figure of 7 million hectares equipped for irrigation in 2000 as a baseline, this would mean 10.5 million hectares by 2015 and 14 million by 2025. The Comprehensive Africa Agriculture Development Programme also prioritizes agricultural water management. Its first pillar aims to "extend the area under sustainable land-management and reliable water-control systems." The potential and will is there, the question is how to achieve it.

Methodology

This review was undertaken as part of a broader knowledge management exercise within IFAD's WCA division to explore in greater detail specific themes that cut across numerous projects managed by the division. To draw out lessons from IFAD's extensive experience, especially that of project field staff, WCA launched a series of capitalization workshops in 2011. The workshops, run by a facilitator from the Senegal-based West Africa Rural Foundation, engaged project staff in a process of documenting their experiences around a chosen theme, sharing them with others and generating knowledge that can contribute to programme design and strategy.

Based on experiences from previous workshops, more extensive review work was conducted on the topic of agricultural water management (AWM) both before and after the workshop, as a way of maximizing the workshop platform and generating practical recommendations for the division.

The review consisted of the following exercises:

- A desk-based review of the WCA project portfolio and selection of projects with significant activities in agricultural water management. Fifteen projects were chosen, and are listed in table 2, page 31;
- Meetings with the IFAD Policy and Technical Advisory Division (PTA) Water and Institutions Desk (PTA-Water);

Women in The Gambia show us the new rice-growing areas made possible by the construction of dykes as part of the Participatory Integrated Watershed Management Project.

- Interviews with IFAD headquarters-based staff either currently or previously involved with 1 of the 15 chosen projects;
- Field visits to five of the chosen projects in June and July – the Agricultural Value Chains Support Project (PAFA) and the Agricultural Development Project in Matam (PRODAM) in Senegal, the Participatory Integrated Watershed Management Project (PIWAMP) in The Gambia, the Sustainable Rural Development Programme (PDRD) and the Small-scale Irrigation and Water Management Project (PIGEPE) in Burkina Faso – accompanied by Magatte Wade, a Senegalese AWM specialist.
- A six-day capitalization workshop in Ouagadougou, Burkina Faso, with staff from the above five projects (PAFA, PRODAM, PIWAMP, PDRD, PIGEPE) and from the Community-based Poverty Reduction Project (RCPRP) in Sierra Leone, the Northern Rural Growth Programme (NRGP) in Ghana and the Support to Rural Development in North Lower Guinea Project (PADER/BGN) in Guinea;
- Interviews with experts in the field from other aid organizations, NGOs and research centres working on AWM in the West and Central Africa region; and
- A broad-based literature review on the topic, spanning publications from the 1980s through to 2011.

Staff and a farmer from the Small-scale Irrigation and Water Management Project in Burkina Faso brainstorm during the workshop in Ouagadougou.

Agricultural water management: what is it and why do it?

This section provides an overview of the AWM sector, including the terms used, the objectives, a brief history of work in this area to date and discussion on future directions.

Definitions

Various terms are often used in relation to water for crops. In order to avoid confusion, the following are the definitions employed in this report:

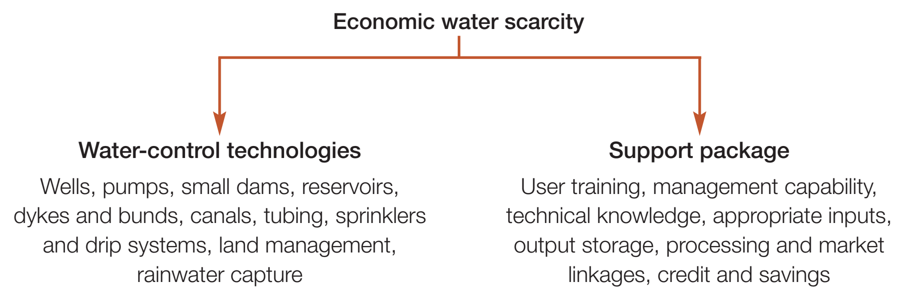
Economic water scarcity: Water scarcity can be both absolute and economic. Absolute water scarcity refers to a situation where the physical supply of water is below needs. Economic water scarcity occurs as a result of the inability to finance the costs of making use of available water from rainfall, surface or ground sources (Nepvue 2011) – which is generally the case in much of West and Central Africa. Thus, economic water scarcity can be tackled through increased investments in water-control technologies and infrastructure. However, as discussed further in the section on the history of AWM, investments in the physical components alone are not enough to ensure that the technologies contribute to sustainable improvements in water management. Figure 5 illustrates a simple framework for thinking about how economic water scarcity can be addressed. It demonstrates that while technology components are important, it is the elements of the support package that keep these technologies running.

Agricultural water management: The planned development, distribution and use of water resources to meet predetermined agricultural objectives. AWM is the overarching term that covers all of the following specific management practices:

Soil and water conservation (SWC): Activities that maintain or enhance the productive capacity of the land – preventing run-off, inducing water infiltration, minimizing evaporation, and collecting and concentrating rainfall. These activities are intended to make best use of rainfall.

Irrigation: The artificial application of water to soil, confined in time and space, for the purpose of crop production. Irrigation is intended to augment the water supply from rainfall.

Figure 5. Framework for decreasing economic water scarcity (author, based on (Nepveu 2011)).



Irrigation is the term most often thought of when it comes to the management of water for agriculture. However, farmers, particularly in regions such as West and Central Africa, employ a wide variety of practices, sometimes even using multiple methods on the same field. A good way to think about the range of options is as part of a spectrum, such as the one in figure 6, developed during the Comprehensive Assessment and adopted by the PTA-Water (Comprehensive Assessment 2007) (IFAD 2009).

It shows that the options range from purely rainfed production, through to controlled groundwater and surface water irrigation. The following terms also appear in this chart:

Water harvesting: The collection and concentration of rainfall for direct application to a cropped area, either stored in the soil profile for immediate uptake by the crop (SWC), or stored in a reservoir for future productive use (irrigation);

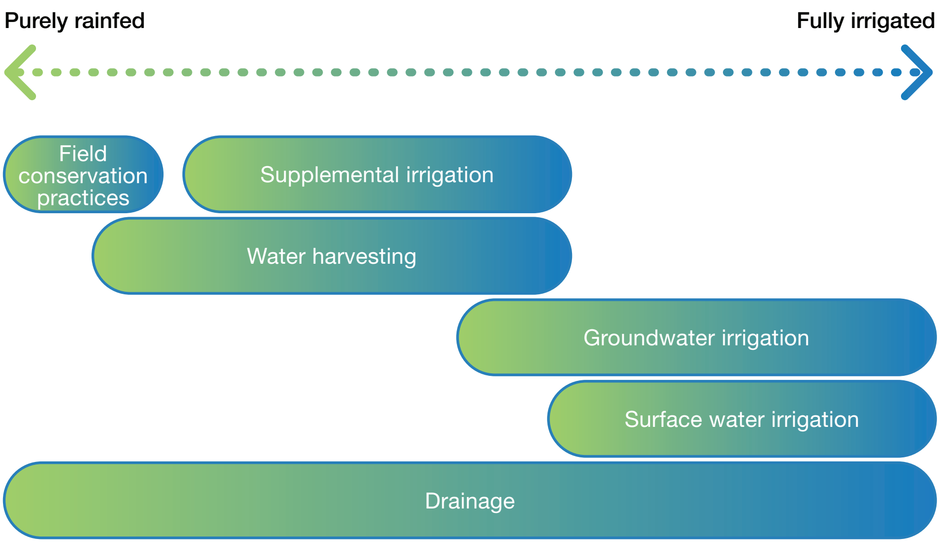
Supplemental irrigation: The practice of adding water to crops only during dry spells between rains, especially during important crop growth stages such as flowering/grain filling; and

Drainage: The natural or artificial removal of surplus surface or subsurface water from agricultural soils to improve plant growth.

Within each of these areas, there are a variety of specific techniques. The Food and Agriculture Organization of the United Nations (FAO) Land and Water Division, for example, has developed a typology for monitoring water management practices worldwide, which is used in the AQUASTAT database (figure 7) (FAO 2005) (Peacock 2007). This is a useful starting point for seeing the range of practices in use, and these categories are used for some of the statistics and tables in this report. A more detailed typology is included at the end of this report.

In the West and Central Africa region, the main forms of water management are, in order of level of control: full control irrigation (surface, sprinkler and localized); equipped lowland areas (wetlands, inland valley bottoms, flood plains and mangroves with water control structures for irrigation and drainage); flood recession cropping areas (flood water used for crops without structures for retention); and non-equipped

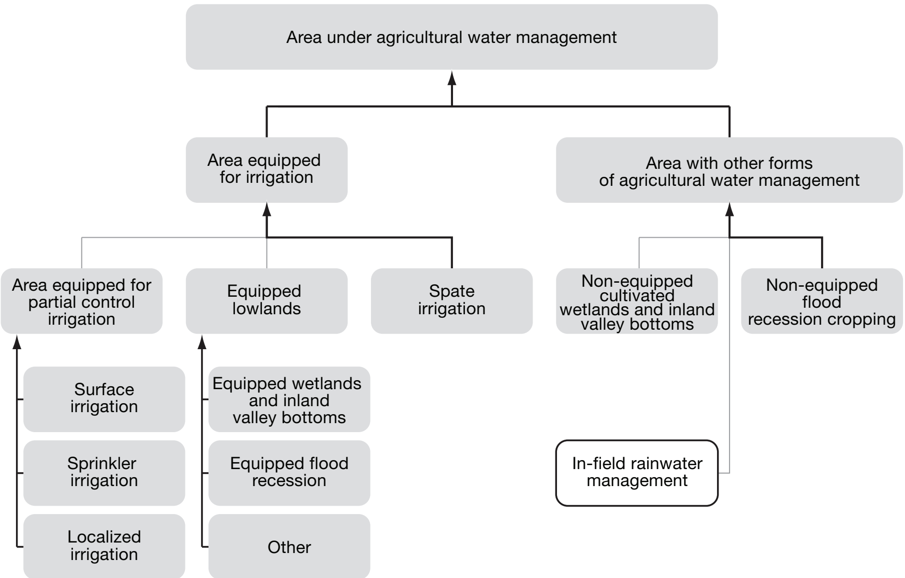
Figure 6. The spectrum of water management.



wetlands and inland valley bottoms (often with traditional water regulation measures). Farmers are also using other SWC and in-field rainwater management techniques, such as conservation agriculture or in-field planting pits, however; reliable statistics on the coverage of these methods are not available. Figure 8 shows the area covered by the various practices in West and Central African countries, as tracked by FAO.

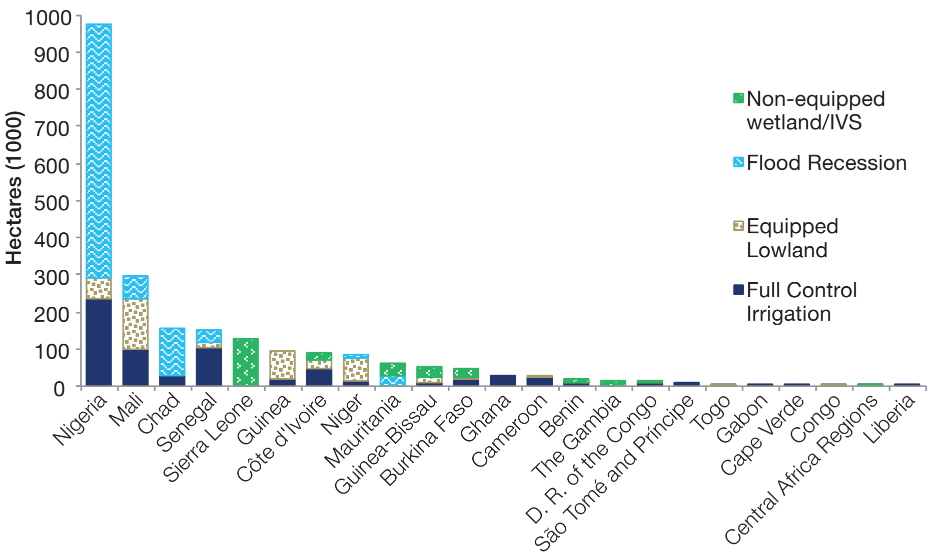
Additional differentiating factors for AWM include the size of the area under water management, and the ownership or control of the land and water. Irrigation schemes are often classed by size, divided between large-scale (more than 100 hectares),

Figure 7. Modified FAO AWM typology.



Note: Areas in grey correspond to the FAO typology. In-field rainwater management was added by Peacock in his 2007 report for IFAD.

Figure 8. Land under various types of water management in West and Central Africa.



Note this does not include SWC techniques for which statistics are not available.

medium-scale (20-100 hectares) and small-scale (less than 20 hectares). While there is a significant amount of land covered by large-scale irrigation schemes in West and Central Africa, especially in Mali and Nigeria, the managed area is often divided into small private plots farmed by individual households. The following definitions are therefore important:

> **Small-scale irrigation:** Plots irrigated are small and privately owned: typically a farmer has between 0.1-2 hectares, but this can be part of a larger irrigated area. Distribution of water can be managed either by the farmers or by an outside group.
>
> **Smallholder irrigation:** Plots are small and owned by individuals or farmer groups. Farmers or farmer organizations have responsibility for managing the distribution of water, rather than an outside or government group (this can be split into smallholder private irrigation and smallholder community-managed irrigation).

Smallholder irrigation is therefore a specific type of small-scale irrigation, where farmers have control of both land and water management. This type of irrigation now accounts for the majority of irrigated area in West and Central Africa. In Burkina Faso, Mali, the Niger and Nigeria, for example, smallholder irrigation accounts for about 75 per cent of the irrigated area (World Bank 2011). This proportion would be even greater if all forms of water management were included.

This report will concentrate on smallholder irrigation, or more generally, smallholder AWM, as this is the area that covers the greatest number of poor rural people, is expanding most rapidly and has the potential to continue to do so. It is also the area in which IFAD concentrates.[i]

Objectives

Why support AWM?

The fundamental questions that can serve to guide investment in the development of AWM are: what is the objective? What are farmers, or those who support them, trying to achieve?

According to the literature and field-visit experience, AWM can:

- **Increase and intensify production** – increase production quantities and/or yields and allow for production during dry seasons, leading to greater surplus production and increased incomes;
- **Reduce risk** – provide protection from crop failure resulting from inadequate or unpredictable rainfall, leading to higher productivity;
- **Diversify production** – increase the diversity of products grown in order to increase value and market income and improve nutrition;
- **Increase efficiency and save time** – increase quantity and value produced in relation to water quantity, labour and work time;
- **Renew/sustain natural resources and sequester carbon** – prevent, mitigate or rehabilitate landscapes and ecosystems through flood mitigation, groundwater recharge and erosion control, and increase carbon sequestration by improving efficiency and increasing carbon storage in soils.

i The report also focuses on water for crops, rather than for livestock or fish.

Objectives should, as much as possible, be clear, well thought out, and agreed on by all participants. There are some cases where multiple objectives may be contradictory, and trade-offs and priorities need to be discussed (for example saving time by using a motor pump to distribute water may bring new risks (such as pump breakdown) or increase production expenses).

However, and as will be argued later in this report, the overarching objective of investing in improvements in water management for agriculture for organizations such as IFAD should be to increase incomes and reduce poverty (AfDB; FAO; IFAD; IWMI; World Bank 2007) (Peacock 2007). The benefits listed above are each means to achieving this goal, a goal that is directly in line with IFAD's mandate.

History

What has already been done?

Farmers throughout the world have been managing water for crop production since the development of planned agriculture in western Asia, India and the Nile region 11,000 years ago. Techniques developed along with civilizations, and ranged from soil and water conservation and water-harvesting techniques, to flood-plain irrigation, to complex networks of canals and water-lifting devices. Locally led techniques have continued to evolve over time, incorporating modern technologies such as drilled wells, pumps and cement canals. Many innovations have come about as local coping responses to drought conditions.

In SSA, agricultural practices, including water management, were shaped by the arrival of European colonists beginning in the 1800s. The colonists established large-scale plantations for export cash crops and local food crops, bringing European-style production techniques to the continent. After the independence movement of the 1960s, European and American aid projects attempted to improve agriculture in the region, and efforts included a range of large-scale, high-cost irrigation schemes. Most were high-tech projects led by foreign engineers. Management was formally structured, with farmers often treated as labourers. By the 1980s, it was apparent that this approach was largely failing, with most schemes falling into disrepair, experiencing management problems, and, above all, not producing efficiently or earning a profit (IPTRID 2001) (World Bank 2011).

Based on this experience, emphasis in the 1980s turned towards a more bottom-up approach, focusing on low-cost technologies and concentrating on community participation and capacity-building. Activities in this area gained ground in many countries through locally led and small-scale government and NGO initiatives. At the same time, African governments began to relinquish state control of the irrigation sector. Liberalization gave more power to producers, but also offered them less support. Large-scale donor-funded schemes suffered without support from the state, profitability declined further in many cases without government or private-sector control measures, and donor interest in the irrigation sector in SSA as a whole declined (IPTRID 2001) (IPTRID 2004).

In the 1990s, the global water community turned its attention towards environmental and natural resource conservation, and AWM was placed within this broader context. The Dublin Statement on Water and Sustainable Development, adopted in 1992 in Dublin, Ireland, by the International Conference on Water and the Environment, recommended treating water as a finite resource and advocated for economic efficiency in water use and adoption of the so-called whole catchment approach in management planning. Integrated water resource management was inspired by this work.

We have now reached a point where there is a broad range of successes and failures to learn from. While a few large-scale irrigation schemes have realized either short- or long-term success (such as on the Niger Delta in Mali), there are more numerous scattered small-scale successes, usually either farmer-led or in which farmers are given high levels of choice and control. There is also today, as a result of these mixed experiences, a diversity of views on the best way forward. Opinions range from the idea that SSA most urgently needs more large-scale infrastructure, to the view that we should be backing away from more construction and concentrating on ecosystem restoration.

The fact is that we need both of these. Agriculture takes place in the context of a wider ecosystem, and management of water for crop production is necessarily part of a catchment-wide water management process (Conway 1997). The primary resource in this system is rainwater, which should be treated as the first ingredient, to be managed in fields and as a recharge for both surface water and groundwater sources (Comprehensive Assessment 2007). In addition, surface water and groundwater are inextricably linked; withdrawals from one in a given area will usually affect the local supply of the other, and they need to be managed together (box 1). Thus, when correctly conceived, agricultural infrastructure that stores or channels water can play a part in the management of healthy ecosystems, if the changes are made in such a way as to conserve overall ecological functions and dynamics. While catchment management considerations are more important in water-scarce regions, or where larger volumes of water are involved, it is always important to be aware of the wider environment in which any water-resource modification is taking place.

Future and learning

There is a real need to enhance overall learning in the AWM sector and improve strategic direction. Numerous reports and reviews have pointed to the fact that while there is a wealth of experience, the sector has lacked an effective way of sharing knowledge and learning from past and ongoing efforts. This type of sharing is needed to enhance institutional memory and enable smarter and more effective interventions. In addition, while there are many location- or technology-specific manuals and guides available, there is no comprehensive knowledge base for decision-makers and project managers to draw upon. Many have pointed to the need for more practical decision-making tools that bring together the available technology options. Box 2 includes a range of views from various sources calling for this type of action. With these needs in mind, this report attempts to make a start in filling this gap, with a particular focus on the West and Central Africa region, but drawing on methods and lessons that can be applied elsewhere.

Box 1. The connected nature of water resource management

"Conjunctive use of ground and surface water aims to optimize their joint use over time" (IFAD 2001, 150).

"It is time to abandon the obsolete divide between irrigated and rainfed agriculture" (Comprehensive Assessment 2007, 19).

"This [training] approach should be part of a holistic vision linking the development of irrigation and environmental protection" (World Bank 2011, 53).

Box 2. The need for more systematic knowledge management, sharing and learning in AWM

"Over the past 20 years a great deal has been written about what has or has not been done for smallholder irrigation. The literature available is comprehensive … but there is still much that is not in the public domain, which may be of considerable benefit to others and resides as 'grey' literature in the archives of various organizations. Indeed, there is a fear that a great deal of knowledge and experience is 'lost' simply through changes in international agency and government staff, thus reducing 'corporate memory' to little more than a decade" (IPTRID 2001).

"The vast body of knowledge and wealth of experience in SWC remains scattered and localized. There is still a rich untapped SWC diversity that is not readily available to land users, those who advise them, or planners and decision-makers. Thus the basis for sound decision making is lacking, mistakes are being repeated, and 'the wheel is being reinvented'" (WOCAT 2007, 49).

"One of the reasons for underdevelopment of the subsector is that there has in the past been a lack of strategic vision linking agricultural water development to poverty reduction and growth" (AfDB; FAO; IFAD; IWMI; World Bank 2007, xxii).

"After 20 years of smallholder private irrigation development in West Africa, there is a lack of knowledge sharing and capitalization of experience" (World Bank 2011, 48).

IFAD and AWM: what is IFAD doing and why?

IFAD has been working to help farmers better manage water for agriculture since its inception in 1977. Initially activities were part of the global response to the Sahelian drought of the early 1970s. The organization's mandate is to "enable poor rural people to improve their food security and nutrition, raise their incomes and strengthen their resilience." In its Strategic Framework 2011-2015, IFAD approaches this goal through five objectives, the first of which is to work towards "a natural resource and economic asset base for poor rural women and men that is more resilient to climate change, environmental degradation and market transformation." This demonstrates IFAD's recognition of the fundamental importance of helping farmers to improve the management of water, along with land, in the achievement of its overall goal. Further objectives commit IFAD to working to help poor people access poverty-reducing services and manage profitable and resilient enterprises – both undertakings in which more effective control of water can play a key part (IFAD 2011).

The organization has highlighted natural resource management and productive agricultural technologies in its strategies through the past decade. The 2007-2010 Strategic Framework made natural resource management (land and water) and improved agricultural technologies IFAD's first two (of six) objectives, and the 2002-2006 Strategic Framework adopted as one of three objectives, improved access to productive natural resources and technology. What is new is the shift towards a focus on environmental and climate change as well as on raising incomes, responding to market demand and building resilience.

IFAD-supported programmes on water management

From its early focus on increasing agricultural production, IFAD has funded AWM activities through its support to hundreds of projects in Asia, Africa, the Near East and Latin America. It has also at times, either through country-level projects or broader regional initiatives, focused specifically on improvements in water management. IFAD has a desk dedicated to the topic of water, PTA-Water, which provides sector-specific and technical support to all of the regional divisions, and works to advance IFAD communications, strategy and partnerships in the area of rural water management.

Special Programme for sub-Saharan African Countries Affected by Drought and Desertification (SPA)

In 1986 IFAD, in partnership with the Belgian Survival Fund, launched the SPA to assist governments in SSA in responding to the drought conditions of the 1980s. The SPA ran through to 1995 in countries across SSA, and worked broadly to develop smallholder agricultural systems that were more resilient to environmental stress. A subprogramme of the SPA focused on small-scale irrigation and water control. An in-depth evaluation of IFAD's activities in this area through the SPA was undertaken by FAO for the

IFAD Office of Evaluation in 1998. The evaluation team reviewed 20 SPA projects with major small-scale irrigation and water control components. These included communal gravity or pumping schemes (62 per cent), community-based water retention and storage schemes (28 per cent) and individually owned pumping (10 per cent).

The review concluded that the programme had been successful in expanding the area under improved water management, making more water available to farmers during the dry season, mitigating the problems associated with erratic rainfall and supplementing water during the rainy season. They observed that the most successful projects were those that improved on already existing technologies and that were in the control of the farmers.

However, they also concluded that, given the amount of time and money spent, achievements could have been significantly greater. The review also identified a number of problems, most of which revolved around what the team called "unrealistic assumptions and expectations," including problems establishing effective water-users' associations, achieving real participatory or demand-driven processes, and obtaining the level of participatory labour expected. Recommendations are listed in box 3.

As this review was based on a long-lasting and wide-ranging IFAD-led programme, the conclusions and recommendations should have had an impact on IFAD's approach to small-scale irrigation and water-control activities in SSA in the years following its release in 1998. Some of the lessons articulated from this early experience were internalized, such as the re-evaluation of community contributions, improving the understanding of land-tenure processes and gender issues, and working to employ more local staff with participatory mindsets. However, based on this review of current WCA initiatives, it is evident that many of the same challenges still remain, in particular those regarding the need for a clear action plan and delegation of responsibilities agreed on by all participants, for pragmatic site-selection and targeting criteria, and for the achievement of real farmer participation at all stages.

Box 3. Recommendations from the 1998 evaluation of IFAD's small-scale irrigation and water control activities as part of the SPA

- Allow for a longer design and implementation process;
- Formulate detailed action plans with clear responsibilities;
- Improve and evaluate in a "more realistic and pragmatic manner" site-selection criteria and targeting procedures;
- Re-evaluate how community contributions are sought and communicated, including assumptions regarding the willingness and/or ability of farmers to contribute time and labour;
- Work to achieve real farmer participation at all stages. In the reviewed projects, "participation remained, in many instances, rhetorical, theoretical and non-effective";
- Improve understanding of land-tenure decisions and related gender dimensions;
- Seek out more technically skilled local staff (with a participatory mindset) – SPA projects had an "over-optimistic assessment of the effective implementation capacity of the implementing agencies."

A collaborative programme on agricultural water

Following a stakeholder's workshop in Harare in 2001 reviewing the state of agricultural water development in SSA, IFAD agreed to collaborate with the World Bank, AfDB, FAO and the International Water Management Institute (IWMI) on the Collaborative Programme on Investment in Agricultural Water for Poverty Reduction and Economic Growth in Sub-Saharan Africa (CP). The aim of the CP was to conduct a review of experience gained in SSA, learn lessons and develop recommendations for the design of new AWM investment projects that might perform better than those in the past, thus leading to a reversal of declining investment, particularly from the World Bank (AfDB; FAO; IFAD; IWMI; World Bank 2007).

Programme participants who advocated for IFAD's participation also hoped that the study would have an impact on IFAD's work in this area. However, in the end, those involved changed roles and there was no significant uptake within IFAD. Conversely, the study did have an impact on the World Bank's strategy, leading to renewed research and investment in this area, including its recently published study on smallholder private irrigation in West Africa (Peacock 2011) (World Bank 2011).

As part of the CP, a number of smaller component studies were also commissioned, including a study on AWM for poverty reduction in the Eastern and Southern Africa region. The study was led by Zimbabwean agricultural water specialist Tony Peacock, but although completed in 2007, it was never published. However, because of the similarity of the work to this current analysis, the author shared the final draft of his unpublished material. The study looked at 10 case studies in the East and Southern Africa region, consisting of a mix of projects funded by IFAD, the United Kingdom's Department for International Development, Danish International Development Assistance and the European Development Fund. The results of this work are used as comparative and supportive evidence within the synthesis and conclusion sections of this report. A few key points from the review are summarized in box 4 (Peacock 2007).

AgWA partnership

Since the completion of the CP review, a new joint initiative, the Partnership for Agricultural Water in Africa (AgWA), was launched at a meeting of 130 stakeholders in Ouagadougou in 2007. It consists of a coalition of African governments, donors and

Box 4. Findings from the 2007 study on AWM in East and Southern Africa

- Most of the projects reviewed, while formerly presented as success stories, actually resulted in only very small incremental increases in farm-level income. Actual cost-benefit ratios were lower, and in some cases much lower, than expected.
- There was a widespread overuse of the public sector in technical design and construction, which led to mistakes and a lack of accountability.
- Recommendations included:
  - Increase focus on efficiency, profitability and viability;
  - Adopt more inclusive targeting so that users can take advantage of water-control interventions;
  - Increase collaboration with the private sector;
  - Improve project management and monitoring and evaluation.

civil society organizations including AfDB, FAO, IFAD, IWMI, the New Partnership for Africa's Development and the World Bank. AgWA's overall objective is to "increase food production, generate wealth, and contribute towards achieving MDG 1 by supporting countries, national and international organizations, and donors to re-engage in Agricultural Water Management for Africa." It is seeking to achieve this through a combination of advocacy, resource mobilization, knowledge-sharing and harmonization of partner programmes. One of the goals is to both increase and harmonize monitoring and evaluation (M&E) in the sector across SSA, potentially through integration of additional indicators into the Comprehensive Africa Agriculture Development Programme, with monitoring conducted by the Regional Strategic Analysis and Knowledge Support System (AgWA 2011) (Peacock 2010).

AgWater in challenging contexts

Another recent addition to the IFAD and PTA-Water portfolio is the AgWater in Challenging Contexts project, in which IFAD is working with IWMI to identify challenges and provide evidence on how AWM in challenging environments can be improved. Challenging environments include areas with institutional or infrastructural barriers. The project is concentrating in Burkina Faso (with PIGEPE as a case study), Ethiopia, Ghana (with NRGP as a case study), Nepal and Sri Lanka.

AWM in the WCA project portfolio

The WCA division has been working on AWM activities, as noted above, since the beginning of IFAD's operations. The large-scale SPA programme focused activities during the 1980s to the mid-1990s on drought response, land recuperation and broad soil and water conservation practices. PDRD in northern Burkina Faso and the work in Aguié, Niger, for example, are still building on this original foundation. Even during the SPA work, the AWM portfolio consisted of a diverse range of activities, from larger community-managed small dam or pumping schemes, to irrigated rice-growing areas, to making more efficient use of rainwater through soil conservation, to garden irrigation through individually owned pumps.

At the end of 2009, PTA-Water calculated that WCA was managing 54 loan projects in 21 countries, of which 47 included some sort of water-related activity. Table 1 contains the agriculture section from the analysis, which shows that a high 59 per cent of WCA-managed projects included irrigation activities and 33 per cent included SWC components.

This clearly illustrates the high level of resources being put into AWM in the region. A review in 2006 also analysed the amount of funding IFAD, and each division, was putting into various water-related activities and how this funding had changed over time. It compared financing commitments during the period 1990-1994 to 2000-2004, and found that total IFAD financing for agricultural water had increased by 50 per cent. Trends in financing for AMW varied greatly by division, with the increase in AWM funding relative to the total regional portfolio being the greatest in WCA out of the five divisions. Total financing for WCA-managed AWM increased by 89 per cent between the two periods, from approximately US$97 million to US$183 million, and by 55 per cent relative to the divisional portfolio (see figure 9).

This review was conducted by a consultant who is no longer at IFAD and the exercise has not been repeated. However, using the breakdown of projects by type in the appendix of the 2006 review and comparing it to the 2009 figures (table 1), it can be seen that the number of projects with irrigation components increased from 21 out of 47 (45 per cent) in 2006, to 32 out of 54 (59 per cent) in 2009, and the number with rainfed water management activities from 12 out of 47 (26 per cent) to 18 out of 54 (33 per cent). It can therefore be concluded that the trend in increasing commitment to AWM in WCA has continued.

To get a more detailed picture of AWM activities in WCA's portfolio, a quick review was done of all ongoing projects to identify those with components focusing on agricultural water. Following this, results were validated through discussions with relevant country programme managers (CPMs) in order to obtain more details on how activities were progressing and to supplement the information in project reports. As of March 2011, 15 projects either ongoing or very recently closed within the portfolio had AWM as a significant part of their programme. This number is lower than that identified by PTA-Water because only projects with enough AWM activity to merit further research and discussion were selected. Table 2 shows the projects chosen.

Table 1. WCA-managed agricultural water-related projects, by type, end-2009.

		Number of projects with activity	Percentage of 47	Percentage of 54
Agriculture	**Rainfed** Activity related to soil and water conservation or water harvesting in the field	18	38	33
	Irrigation Activity related to irrigation	32	68	59
	Livestock Activity related to water for livestock	26	55	48
	(Inland) fisheries and aquaculture Activity related to water for inland fisheries	14	30	26

Figure 9. IFAD agricultural water financing commitment trends.

Increase in agricultural water financing commitment, from 1990-1994 to 2000-2004 (%)

Division	Western and Central Africa	Eastern and Southern Africa	Asia and the Pacific	Latin America and the Caribbean	Near East and North Africa	Total
Absolute	89	150	51	-20	34	50
Relative to total divisional portfolio	55	16	-1	-28	13	n.a.

Table 2. AWM in IFAD-supported projects in West and Central Africa.

	Country	Project	Activity	Technologies
	SAHEL			
1	**Mauritania**	Maghama Improved Flood Recession Farming Project – Phase II (Maghama II / PACDM II) (2003-2011)	Creation of flooded area along the river for maize and sorghum production	Small dam with valves to control water level
2	**Mauritania**	Oasis Development Project – Phase II (PDDO) (2004-2013)	Irrigation using groundwater to water date palms and garden crops	Solar-powered pumps, drip irrigation system
3	**The Niger**	Project for the Promotion of Local Initiative for Development in Aguié (PPILDA) (2005-2013)	Irrigated gardens, restoring degraded land	Garden wells, tree planting
4	**The Niger**	Agriculture and Rural Rehabilitation Development Initiative Project (IRDAR) (2009-2014)	Irrigated gardens	Garden wells and pumps (restored)
5	**Mali**	Northern Regions Investment and Rural Development Programme (PIDRN) (2006-2013)	Irrigated rice production along the river and market gardens	Motorized pumps for the rice zones, treadle pumps for the gardens
6	**Burkina Faso**	Small-scale Irrigation and Water Management Project (PIGEPE) (2008-2014)	Small-scale garden irrigation and improvement of inland rice valleys	For gardens: reservoirs and dams for water retention, and treadle pumps and drip irrigation kits. For lowlands: land grading and water control through dykes and bunds
7	**Burkina Faso**	Sustainable Rural Development Programme (PDRD) (2005-2014)	Restoration of degraded land, small garden irrigation, rainfed rice irrigation	Water conservation using *zais* (micropockets) and *demi-lunes* and vegetation, stone and earth bunds. Well construction in gardens. Land management and dykes in lowlands
8	**The Gambia**	Participatory Integrated Watershed Management Project (PIWAMP) (2006-2014)	Integrated watershed management, including management of lowland rice zones and upland cereal zones	Retention dams and bridges in lowlands. Erosion control in uplands (dykes, bunds, use of vetiver grass)
9	**Senegal**	Agricultural Development Project in Matam – Phase II (PRODAM-II) (2003-2012)	Irrigated rice production, irrigated gardens (large up to 40 ha each)	Motorized pumps, canals and earth bunds for the rice zones, diesel pumps with drip irrigation for the gardens

	Country	Project	Activity	Technologies
	SAHEL			
10	**Senegal**	Agricultural Value Chains Support Project (PAFA) (2010-2016)	Planning to rehabilitate and irrigate garden areas and improve water management in lowland areas for vegetable production	Potential to use small boreholes with hand/solar/motor pumps, dykes/small dams for retaining water, other measures for soil conservation
11	**Cameroon (north)**	Commodity Value Chain Development Support Project (PADFA) (2010-2018)	Irrigated rice production, irrigated onion production	Dykes and canals when near surface water, and pumps when using groundwater
12	**Ghana (north)**	Northern Rural Growth Programme (NRGP) (2008-2016)	River irrigation of cereals, high-value fruits and vegetables, and seeds (double and triple cropping)	Motorized pumps, drip, sprinkler and furrow irrigation, multifunction dams
	SUB-HUMID / HUMID			
13	**Côte D'Ivoire (north)**	Small Horticultural Producer Support Project (PPMS) (2001-2012)	Irrigated rice and small gardens in both uplands and near rivers	Motor pumps and canals for rice. Channelling rainwater in lowland gardens and pumping river water and groundwater and using drip irrigation in upland gardens
14	**Sierra Leone**	Rehabilitation and Community-Based Poverty Reduction Project (RCPRP) (2006-2014)	Inland valley swamp rehabilitation and development. Year-round production of rice, legumes and vegetables in swamps through land clearing and improved water and soil management	Land clearing, surface water control by gravity using basin and furrow irrigation with canals, terracing, diversion structures and drainage. Irrigation with groundwater during dry season from boreholes with pumps and rubber hoses for distribution. Soil/watershed conservation through tree planting
(11)	**Cameroon (south)**	Commodity Value Chain Development Support Project (PADFA) (2010-2018)	Irrigated rice production, channelling of river/stream water	Dykes, canals (restored)
15	**Guinea**	Support to Rural Development in North Lower Guinea Project (PADER/BGN) (2005-2013)	Management of lowlands for rice production	Conservation agriculture and soil and moisture conservation in dry areas, reservoirs with canals, wells, and drainage in areas with available/excess water

As can be seen, a wide range of activities is currently being carried out throughout the region. Even so, there is considerable overlap in the type of techniques and technologies being used, and the type of crops they are being used on. Table 3 groups the activities in the projects listed above into four main categories. The distribution shows how WCA's current AWM work is concentrated relatively uniformly across irrigated upland gardens, improvement of lowland areas and river irrigation of cereals. Many projects combine both an upland garden component with a river irrigation component in order to reach two different populations in a project zone. While only three projects have SWC activities, those that do are implementing them over large areas and, as described above, are often building on a long history of similar work in the those regions.

To provide a better feel of how these projects are distributed throughout the region, figure 10 presents them on a map of SSA. Projects are mapped over a background showing water resources in the region, with larger lakes and rivers shown, and groundwater availability illustrated through the background colour. The blue areas represent major groundwater basins, with the darker blue indicating higher groundwater recharge (mm/year). Brown areas indicate local and shallow aquifers, again with darker colours meaning higher rates of recharge (WHYMAP 2011).

While WCA works across the entire West and Central Africa region, one can see both from the project descriptions and the map that it is currently concentrating most of its agricultural water work in the West African/Sahel region. This is in many ways sensible, since it is the area in which farmers struggle most with supplying sufficient and reliable water to their crops. However, as mentioned above, water resources across the West and Central Africa region are highly seasonal and at times intense and unpredictable, with problems related to inadequate drainage, soil erosion and land degradation. These issues are being addressed by WCA in localized areas of the Sahel where they have arisen, such as in PIWAMP in The Gambia, but more may need to be done in the Central African region and other locations with these challenges, especially as the climate continues to change.

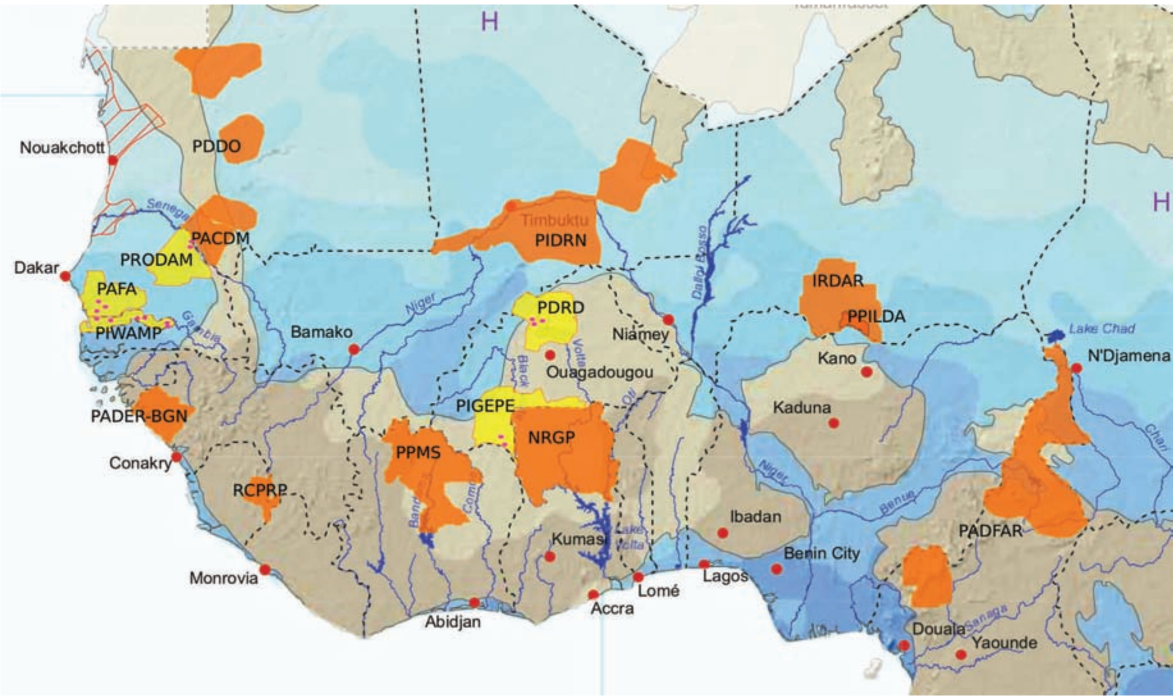
IFAD's work in the area of AWM is clearly deep-rooted, far-reaching and diverse. While the organization, and WCA in particular, has achieved many successes over the past 30 years, there are still many areas in which it can continue to improve, expand and become more effective. The following section provides a synthesis and analysis of the material reviewed for this exercise and highlights areas for improvement.

Table 3. Main types of AWM activities in WCA-managed projects

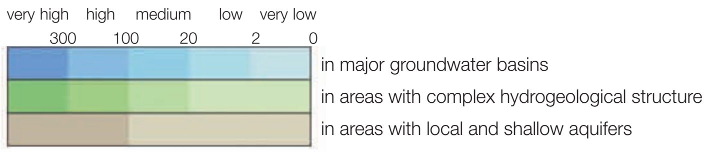
Activity	Techniques/technologies used	Projects with this type of activity
Irrigated upland gardens	Reservoirs or wells with/without pumps, drip irrigation, watering can/calabash, fencing	9
Improved water management in lowland (*bas-fond)*/inland valley swamp areas	Small retention dams, dykes, bunds and access bridges	7
Irrigated rice, cereal, seed (and some vegetable) areas along rivers	Small dams, flood recession, motor pumps, canals	6
Rainwater and soil/erosion management for cereals (SWC)	Earth and stone bunds, conservation farming, tree planting, rainwater harvesting, catchment management, grazing management	3

Figure 10. WCA-managed projects with significant AWM components.

Orange and yellow areas indicate project zones, yellow showing projects visited during this review.
Pink dots indicate sites visited.



Groundwater resources and recharge (mm/year)



Synthesis and analysis

Taking material from the literature review, interviews, project visits and the capitalization workshop, it is possible to identify a number of key issues and trends. In the section below, material is synthesized and grouped into nine areas for further discussion. The final section will draw conclusions and recommendations based on this analysis.

Objectives

What should the objectives for AWM be? Why? Are they being met?

Discussions with project staff revealed unanimous agreement that the objectives for their respective projects were appropriate and well targeted. Further, project designs show a well-developed awareness of specific subregional challenges, such as PIWAMP choosing to focus on sustainable watershed management in order to combat the erosion and flooding problems in the area, and NRGP focusing on helping northern Ghanaian farmers to produce a surplus of the products in demand in the more populated south.

While at the global level AWM often focuses on water conservation or improving water-use efficiency, there was little to no mention of this as an objective in the WCA-managed projects surveyed. This is appropriate considering that, as highlighted in the first section, countries in West and Central Africa are withdrawing well below their sustainable limits of available water resources. This lack of need to focus on water productivity in West and Central Africa, and in SSA overall, is supported in the literature (Keller, Keller and Seckler 1996), (Naugle 2011), as well as in the 2007 review of projects in East and Southern Africa (box 5).

However, while sources from literature, interviews and the workshop all stressed the necessity of making long-term financial viability and farm-level profit the overall objective of AWM interventions, many of the projects reviewed are not successfully carrying this objective through to field-level decision-making.

All other objectives, such as increasing or diversifying production, reducing risk, increasing capacity, are worthy in themselves, but if they do not ultimately lead to farmers earning a higher profit than before the intervention, farmers will not want to invest their time, labour or money in the activity. Participants felt that many WCA-managed projects have not been operating with this principle in mind, as expressed in the views in box 6. This issue is discussed further in the section on sustainability.

Box 5. Water-use efficiency is not a priority in most of the region

"In the Sahel, in most cases, there is enough water, they just need to use it better" (WCA CPM 2011).

"While increasing water productivity may be a desirable objective in areas of water scarcity, it may not necessarily be economically viable or profitable at the farm level and it may not be a priority for farmers" (Peacock 2007, 79).

- AWM component objectives, as described in project M&E frameworks, are largely appropriate and well targeted.
- Projects are sensibly not focusing on water-use efficiency where it is not currently an issue.
- The achievement of profit at the farm level should drive project design and implementation more so than it currently does.

Placement and targeting

Where should AWM interventions be placed? To whom should they be targeted?

Placement: While a number of factors go into the choice of IFAD loan project areas, evidence from this review points to the need for more thought to be put into where particular interventions are promoted and why. This is particularly so when it comes to AWM activities that:

- Are intrinsically linked to surrounding environmental variables;
- Are technically complex;
- Require producers or organized groups of producers to invest time, labour and money into the operation and maintenance of new techniques and technologies; and
- Only become worthwhile and profitable with accompanying accessible input and output markets.

Environment: AWM activities have in common that they attempt to improve the control of water resources: rainwater/run-off, surface water and groundwater. The tools required to make these improvements, however, vary depending on the surrounding environment and the type of water resource being managed. Variables include land factors such as soil fertility and structure, elevation, land slope and surface condition,

Box 6. Neglect of sustainable profit as an objective in IFAD-supported projects

"Farmers do not currently know the cost-benefit ratio of the water-management activities that they are doing or that we encourage them to do. The economic aspect of investments is not included in project design or monitoring" (WCA CPM 2011).

"We need to figure out if the activities we are implementing lead to profit" (WCA CPM 2011).

"Because of the relatively small amount of investment in each subproject (such as small irrigation schemes within IFAD-supported projects, for example), their technical feasibility and financial viability are sometimes not seriously analysed" (Morardet, et al. 2005, 15).

"Future designs and investment decisions should be based solely on considerations of economic viability, farm-level profitability and sustainability. Unviable investments for so-called 'social' or 'strategic' purposes should be avoided" (AfDB; FAO; IFAD; IWMI; World Bank 2007, xxix).

and water factors such as annual precipitation levels and variance, distance to and seasonal flow of surface water sources, depth and recharge of groundwater, and water quality and contamination levels.

The ease in which water resources can be managed and applied to improve crop production depends on factors such as these. Water retention structures, for example, need to be larger in more arid areas in order to retain sufficient water for crop production, and are therefore more expensive. Drilling boreholes that will yield reliable, quality water is more difficult in areas with salt water intrusion or highly seasonal groundwater recharge. While IFAD supervisory and project staff are conscious of the particular environmental realities in their project zones, it is not evident that these variables are often taken into consideration when choosing project areas or sites. A greater awareness of local environmental constraints and opportunities would allow for more strategic placement of activities.

Connectivity: The type of AWM activity promoted should be linked to connectivity variables such as the distance to quality roads and transport, markets or urban centres, and also to overall regional population density, food demand and land pressures. Isolation of communities or entire project zones increases the cost of seeds, fertilizer, fuel, replacement parts for technologies and repair services. It can also lower the quality of inputs – fuel, for example, often decreases in quality in more rural areas, resulting in higher repair rates for motor pumps and other machinery. Isolation can also make items impossible to obtain altogether unless specific measures are put in place to have them produced locally.

Isolation increases the cost of transport to markets, with areas far away from large urban centres being the most disadvantaged. It also increases the need for storage facilities so that produce not immediately sold can be stored. Analyses of project viability should consider how location affects the cost and technical complexity of any proposed activity. The design team must look closely at operating and maintenance costs per hectare as well as transport, storage and marketing costs, and compare them with expected gains from consumption and sales. In all of the projects reviewed, a significant number of communities targeted by the projects were located far from markets and on badly maintained roads. They were in some cases, however, implementing or planning relatively complex and costly AWM interventions.

Targeting: IFAD's mandate is to assist poor rural people. In West and Central Africa, about 74 per cent of the total population and 87 per cent of the rural population earn on average less than US$2 a day (IFAD 2011). Therefore, it is not difficult to target the poor when working in rural areas in the region. IFAD, however, makes an additional effort to ensure that its interventions reach the most poor and vulnerable, and tries to target those with the fewest resources and those who often have less power – such as women and young people.

This targeting approach is important and commendable. It is a more difficult path, and one that many other large international financing institutions do not pursue. The poorest and most vulnerable rural groups can often miss out on the benefits of development project activities. However, if this approach is carried through to all components of all IFAD-supported projects, there is a risk that there will be a trade-off in effectiveness, as such exclusive targeting may mean working with users who are not well placed to take advantage of the interventions being promoted.

This trade-off was evident both during discussions at the capitalization workshop and during some of the site visits. Staff at the workshop stated that, while they were supportive of the mandate to target the most poor, this approach made their work more difficult, as these target groups were often less organized, lacked leadership, had lower literacy rates, did not have secure access to land, and were more isolated, physically and from information and power flows. Site visits confirmed these obstacles. We repeatedly met with groups who appeared very dependent on project staff and lacked the capacity and leadership to take the initiative when it came to the maintenance and repair of the technologies in place, or to access inputs, credit or savings without project assistance. Training and capacity-building activities can help to address these shortcomings, but they take time and may not achieve the needed effects until near project close unless capacity building is given more attention, or projects are run for longer.

This idea is also supported in other reports that have looked at AWM targeting, with authors stating that for AWM interventions in particular, a more inclusive target group should be used. They argue that the group should include not only the poorest people but also poor people with more connections, as they will be better able to put to use the full package of practices needed to achieve benefits from water-management investments in the short to medium term.

Efforts should be made, however, not to exclude or disadvantage the poorest, and to provide extra support so that they can adopt the new techniques as these become more engrained in the region (box 7).

For each AWM initiative both location and user-group decisions must be made together. For this reason, it makes sense to try to find areas in which a high potential for poverty reduction through AWM interventions exists in terms of both a promising location to work and a user group that can take advantage of the support.

Box 7. Trade-offs in targeting the poorest for AWM

"Investments that promote productive and efficient agriculture tend to favour the wealthy, while investments and policies that promote more equitable agriculture are not necessarily productive" (de Fraiture, Molden and Wichelns 2010, 500).

"Effective targeting is essential, and targeting the appropriate partners is equally important: trying to focus directly on the poorest of the poor in an irrigation project may not be the best way to reduce poverty" (Morardet, et al. 2005, 42).

"More inclusive targeting was found not only more practical to implement and more likely to result in successful development, but it also resulted in those 'captured' by the investment being drawn mainly from among the extreme poor anyway (since the latter formed the majority of the rural population)" (Peacock 2007, iii).

"It would be easier to work with other target groups – information would pass more easily and there would be fewer land-tenure issues, but the vulnerable and women are the target group of IFAD" (PIGEPE staff).

- Environmental and market connectivity factors need to be more systematically considered when deciding on AWM project and site locations and in choosing which technologies to promote.
- Exclusively targeting the poorest and most vulnerable results in reduced effectiveness within many of WCA's AWM interventions.

Technology choice

What types of AWM technologies should WCA promote?

Technology fit: While some practices discussed during the workshop and seen during field visits seemed to be carefully and appropriately chosen, in other instances the technologies being used were clearly decided on during the early design phases of a project by a team without sufficient information, or influenced by extraneous political or institutional factors. Project staff stressed the need for the techniques or technologies being used to be appropriate for the local context. While this may seem obvious, it was clear both from this review and from the literature, that improvement is still needed in this area.

Snell states, for example, in his 2004 report on appropriate water-lifting technologies for West Africa, that "many of the problems with newly introduced technologies have been the result of bad matching" (Snell 2004, 3). The issue also arose in discussions with CPMs:

> "We need to think about the income, asset level and isolation of target groups when deciding on an appropriate technology. A high-cost technology like a motor pump might work well for well-connected, well-off farmers as they can figure out how to use it to quickly turn a profit (e.g. northern Mali project), but it may not be appropriate for more isolated, poorer farmers (e.g. northern Ghana project)" (WCA CPM 2011).

While part of any AWM technology decision may be clear from the start (if, for example, the area was chosen because of its erosion problems, an erosion control technology must be chosen), even within each technology type a range of options are likely to exist. Incorrect technology fit can result in, at best, a practice that can be moderately useful when promoted with sufficient support, and at worst, one that is abandoned either during or shortly after project support ends.

Individual or group: A further choice must be made between the promotion of technologies that can be managed and operated by individual farmers as against those that require group management. Individual or private technologies such as treadle pumps and very small water distribution systems (hose, drip, etc.) for gardens, or practices such as the digging of *zais/tassas* or *demi-lunes* on individual cereal fields, can be paid for, executed and maintained by even a single farmer, or more typically, one farm household. These types of technologies do not require group formation, decision-making/consensus, funding, etc., and therefore often allow farmers who are able to take advantage of them to quickly achieve individual gains. However, not all areas can be improved using such measures, including large lowland areas that require dyke and canal systems to manage the water captured. Some more expensive investments also need to be purchased and managed by farmer groups to be cost-effective, such as motor pumps used to irrigate large rice-growing areas.

Both of these types of technologies have a role to play in improving water management in the region. However, what was clear from discussions with IFAD project staff was the absolute necessity of strong group cohesion for the success of group-managed projects. While this is something that can be improved over time with project support, some farmer organizations are naturally more organized and proactive than others, and there is evidence that groups set up specifically for projects tend not to be successful (box 8). Water-management groups need to be able to meet regularly and agree on objectives, operating processes and regulations. This type of group may be found anywhere, but these characteristics may be less likely to occur in groups consisting primarily of the poorest and most vulnerable, or in communities that lack overall unity, resulting, for example, from in- or out-migration, conflict or ethnic tensions. For these reasons, group-managed projects are not appropriate everywhere, and they should only be initiated in places where the required support structure exists.

Technology progression: The choice of technology does not have to be a fixed, unchanging decision; on the contrary, technology choice and use can and should be fluid. Farmers must start somewhere, by using the AWM tool that is most appropriate to their or their group's situation at that time. However, if they are successful in increasing their production and income, they may decide to use some of their savings, or take out credit, in order to expand the amount of land managed, or invest in a technology that is more efficient or powerful.

For this reason, it is important for any project team that is supporting farmers to have the possibility of progression in mind from the start, and to work to supply information and establish a supply network that will make a range of technologies available in the area. In project areas in which farmer asset levels are varied at the outset, offering a range of tools that may be appropriate to the different target users allows for the type of more inclusive targeting discussed above. While most WCA-managed projects visited had not reached this level of differentiation, the NRGP team from Ghana shared their success in

Box 8. The importance of strong group dynamics for group-managed activities

"In a group, everyone does not see things from the same angle. It is necessary to have a dialogue and a strong awareness of this, and to strive to have the whole team working towards the objectives that are in the best interest of the group and that lead towards better management of the area, the infrastructure and the water available" (PADER-BGN team).

"Cooperative undertakings by farmers only work well if they trust each other and everyone has an interest in the success of the venture. Cooperative arrangements imposed from outside, for instance by a government agency or an aid project, seldom have the necessary level of trust to keep going for long" (Snell 2004, 18).

"Technical options should also be adapted to the state of social organization (for example, if the design requires strong cohesion of the farmers' group, which does not exist before the project, difficulties in operation and maintenance are likely to occur" (Morardet, et al. 2005, 43).

offering farmers in their area a choice of irrigation options. The need for this type of model is also supported by authors from recent reviews as well as through the experience of organizations such as the Kenyan NGO KickStart (box 9).

Technologies also need to be appropriate for the given climate, and this in itself can change, and is changing. As discussed above, it is predicted that the West and Central Africa region will experience significant climate changes in the coming decades, and water-management practices and infrastructure will have to change accordingly. Being able to support a range of technology options will help IFAD to be better prepared to support farmers in this transition.

Who should make the choice? A final consideration is what role organizations such as IFAD should play in the choice of technologies. Should the situation be analysed by the design team, and the best practice, or group of practices, be chosen based on this analysis? Or should outside groups merely play a supporting and information-giving role, and allow farmers to choose which product works best for them? IFAD and WCA currently tend towards the first approach; however, many in the field feel that farmers are better equipped: "IFAD should be providing choices, not making the choice" (Naugle 2011). At the same time, this raises the question of whether farmers have enough information available to them to make informed choices, and whether the options currently available to them in most settings represent good investments. It may be that development organizations should be seeking to play more of a testing, advisory and facilitative role: "A more valuable use of funds, though in effect a form of indirect subsidy, is to test the available equipment and provide clear and reliable information for people to make informed choices" (Snell 2004, 20).

- More attention should be paid to ensuring that technologies promoted are consistent with environmental conditions and farmer management capacities.
- It is useful to make a progression of technologies available that farmers can select from based on their environmental, financial and technical needs and abilities.

Box 9. Technology progression

"Probably the single most important need, especially with regard to resource-poor people, is for a progression of technologies with manageable steps" (Snell 2004, 17).

"Rain, treadle pumps and motor pumps are like walking, biking and driving. If you compare whether someone likes to ride a bike to some place or drive there, most people would probably like to drive there. A more relevant comparison for us [KickStart] is whether someone likes to bike there or walk there – in most cases, biking is easier than walking" (Chan-Lizardo 2011).

"In some settings low-cost technologies can be viewed as a stepping stone – they are simple and can be rapidly implemented, reaping quick gains in food security and income for many people. And with favourable institutional and market conditions, other options will arise, such as larger-scale irrigation. But the first step is important " (Comprehensive Assessment 2007, 3).

Community participation and management

In what ways is participation important? Is it being achieved?

User participation and ownership is crucial in any development project, but this is particularly true for AWM projects in which the techniques and technologies being used require farmers to have the skills, time and desire to operate and maintain the technology over time. Research for this report raised concerns over the achievement of real participation, the use of community labour, and successful transfer to community-led management.

User participation: While farmer participation and capacity-building is a central written objective of all WCA-managed AWM projects, the reality in the field depends greatly on project and service-provider staff. Observations during field visits revealed that while some project staff had a good relationship with community members and seemed to be prioritizing their participation and understanding of the process, in other projects there was a clear disconnect between project staff who were there to get something done, and community members who were there to take hand-outs. This same issue was observed in the 2007 review of East and Southern African initiatives: "The implementers and their supervisors regarded participation as the end rather than the means to the end. Approaches tended to be rushed, superficial and somewhat mechanistic" (Peacock 2007, iii). It was also brought up by a number of WCA CPMs (box 10).

While many project staff would like to prioritize community participation, these same individuals are also responsible for ensuring that project funds are received and spent, and project indicators are met according to project timelines. And, unfortunately, spending for hardware and infrastructure can be accomplished more quickly and result in more money disbursed, while community capacity-building and decision-making activities require more time and use fewer project funds. This reality can often distract from efforts to work closely with communities, no matter how good the intentions.

Box 10. CPM views on the importance of community participation and management

"With water-management projects, community ownership of the infrastructure, no matter what it is, is vital. Without it, after the end of the project, the infrastructure will not be maintained. We need to work with the communities to assess their priorities, and implement what they feel is needed. We then need to follow through and help them with project planning, use, maintenance, accounting, having a functional committee for these, etc. Community-driven development has for a long time been a key IFAD approach, but I fear we are getting away from this. No matter what you call it, without community-driven design and ownership, AWM projects will not work" (WCA CPM 2011).

"The African Development Bank is often our partner on irrigation infrastructure, as they like to do concrete activities like this, but they focus mostly on the technical side, and the management side gets neglected" (WCA CPM 2011).

"The problems with AWM activities are not physical, they are management issues. Issues such as managing water collectively, regulations and by-laws, and the cost (who pays? should it be subsidized?) and maintenance are what continually give us trouble" (WCA CPM 2011).

Community labour: Asking community members to contribute labour means that they become more involved, but how can they be expected to give significant time and energy to the process when they also have many other things to do? A key recommendation of the 1998 FAO review was for IFAD to be more realistic in its expectations in this area. Has this happened? PIWAMP had to switch midstream to a process that required less labour when it discovered that the men and women did not have enough time to do the work required, and that, in the dry season when they did have more time, the soils were hard to work. PRODAM, on the other hand, had most of the heavy work done by outside providers, but it now expects the community to carry on with maintenance. While it is difficult to make any general statements, what is clear is that community contributions need to be discussed clearly with user groups at the beginning of the project, and a reasonable division of responsibilities should be agreed upon, and continually monitored and altered as needed.

Transfer to community management: As discussed above, group schemes require strong management committees for success. However, even with a cohesive group in place, is it reasonable to expect a village to take over full management of an activity after years of project support? This depends first of all on what other support the community will receive after the project concludes. Most project teams plan to turn over institutional leadership to a government agency or other local group after completion, so the ability of this group to provide effective support can strongly affect sustainability. In addition, many projects in the WCA portfolio are operating in contexts where there is a long legacy of dependence on donor financing, and in these cases handover from donor management can be difficult. This may be easier if the process is done gradually, and is certainly more likely to succeed if the water-management practices introduced are productive and profitable for the user group.

- Specific performance indicators are required for user participation and management to enable this important aspect to be monitored and prioritized during project implementation.
- Community labour contributions need to be realistically considered, discussed and agreed on.
- Transfer to community management requires effective and ongoing local support, often over longer time periods than those planned under projects.

The whole package

What complementary measures are needed to make AWM investments effective?

AWM activities increase the level of control farmers have over the water resources available to them. This can make it possible for farmers to cultivate previously unusable land, to grow crops not previously possible, or to increase the yield achieved for a crop that they were previously growing. However, while new water-control techniques will almost always bring small improvements on their own, it is evident from this review that they will not, in most cases, bring about the best possible results if they are not accompanied by other measures to increase productivity.

It is possible to argue that the incremental gains achieved from AWM measures alone are worthwhile, and thus any accompanying investments in inputs, such as improved seeds or better pest control, are beneficial add-ons, but not wholly necessary for the success of a water-control intervention. However, in cases where farmers are investing time, labour and resources into achieving better water control, or will be expected to at some point during or after project completion, the pay-off needs to be sufficient to warrant the additional effort. And for this to occur, it is necessary to work towards the highest productivity possible, and always to keep in mind that the larger the investment required in water-management techniques, the greater the pay-off needs to be to make it worthwhile, profitable and sustainable in the long term.

This issue was repeatedly raised during the capitalization workshop, with project staff identifying specific inputs or services that, in their experience, were (or were not) essential if farmers were to achieve gains through better water management. These included: quality seeds and fertilizers or seeds adapted to the new water environment; fencing or other closure to protect the improved areas; tools to prepare, weed and harvest the additional land and crop; tools to maintain water-control structures; access to credit or savings services to help farmers invest in these inputs and tools; and post-harvest and processing facilities to handle the increased production.

While staff were well aware of these needs, they commented that they were not always able to meet them, either through project funds or by referring farmers to other local services. Few staff, however, seemed to have taken on board the idea that achieving the type of productivity that is possible when factors such as those above are in place, may not just be better, but may also be necessary for the viability of the AWM intervention. In Senegal, for example, PRODAM project staff assumed that their rice-irrigation scheme, already in operation for 15 years, was necessarily sustainable:

A rice farmer participating in PRODAM in Senegal shows two rice grains from their dry season crop. They were grown using different seed varieties, and the farmers hope to use more of the seeds that produced the bigger grain next year.

"They (the canals) have already lasted 15 years, so where is the problem?" However, it was clear from visits to the field that while the works are indeed still in place, little attention is being paid to ensuring that the necessary maintenance is done to keep them operating at full potential. This staff attitude pointed to an underlying problem, particularly with a project that has been supported by the state for those 15 years, but at some point will be expected to operate at least partially on its own.

The need for attention to a full package of inputs and services is well supported in the literature on this topic (box 11). As pointed out in the Comprehensive Assessment, the reverse is also true – inadequate water control can reduce the productivity of other productive inputs such as improved seed varieties or fertilizers. Bringing together all of these variables, however, is not an easy task, which may contribute to project staff regarding the attainment of such a full package as more of a 'nice dream' rather than a necessary and achievable objective. Certain measures could in fact make this dream easier to achieve for WCA project staff, including more strategic project placement and targeting, as discussed above, as well as a set of M&E indicators that prioritize field-level profitability over time, which will be discussed below.

- Projects must ensure effective and sustainable mechanisms for access to complementary inputs such as appropriate seeds, fertilizers, tools and crop protection measures in order to achieve the anticipated results of AWM activities in terms of improved incomes and livelihoods.

Box 11. The need to accompany AWM investments by supporting inputs to ensure productivity

"Inadequate access to or control of water has an important indirect impact by reducing the potential pay-off from other productivity increasing inputs such as fertilizer, improved seed varieties and even education" (de Fraiture, Molden and Wichelns 2010, 497).

"Clearly, providing irrigation water alone will not guarantee increased productivity: not only must water supplies be reliable but they must be provided as part of a comprehensive and sustainable package that empowers farmers to commercialize their yields and production, as well as giving them incentives to do so including improved access to input and output markets" (AfDB; FAO; IFAD; IWMI; World Bank 2007, xxii).

"No investment in costly infrastructure should be planned without having beforehand implemented the conditions for its beneficial use: secure land access for poor farmers; reasonable access to financial services (savings and credit); analysis of market opportunities and risks; where appropriate, enhanced collective organization of farmers; organized access to quality inputs; and training of farmers in new agricultural practices and irrigation management at individual and collective level. Countries and regions where these basic conditions are in place should be given priority. In other cases, specific activities to strengthen these aspects should be included within projects or developed as parallel programmes" (Morardet, et al. 2005, 43).

Technical knowledge and skills

What knowledge and skills are required? Where do gaps exist?

While IFAD has a wealth of experience in agricultural development in West and Central Africa, and a strong network of project staff and consultants in the region, as an agency it does not have in-house technical expertise in agricultural water engineering or construction. It therefore needs to be supported by specialists in this area, either by partnering with implementing agents or service providers in-country, or by seeking out short- or long-term consulting services from technical experts. This is already how IFAD operates for AWM projects; however, based on the results of this review, it can be argued that the division needs to be more selective when choosing technical partners and rely more regularly on technical assistance.

While, at some of the project sites visited, the water-management structures or technologies were clearly well designed and constructed, at many others this was not the case. During site visits, we observed a variety of engineering and design problems, ranging from areas in which the level of run-off and erosion had been underestimated and thus structures had been underdesigned, to the use of the wrong type of materials for the local environment, to the placement of boreholes in areas with unmanageably low water tables.

This problem is not unique to WCA or to IFAD: mistakes such as these can be, and have been, made by every agency operating in this sector. During the same trip, we saw structures, financed by other organizations, which had fallen into complete disrepair. Engineering and design for AWM is not easy, as it depends on such a large number of both environmental and social factors. For this reason, it is critically important for the team responsible to be both familiar with the local context and technically competent in the areas required. It is also important for both project staff and farmers to be able to evaluate work being done in a knowledgeable way and have access to the information and tools they need to make informed decisions. These types of design and evaluation decisions are likely to become more difficult with time, as infrastructure will have to be built for the changing regional climate, or be climate-smart.

In most of the WCA-managed projects reviewed, technical services were being provided by government agencies or groups. While the capacity of these groups varies greatly, it is likely that IFAD will continue to work with such public-sector agencies. When this is considered the best option, it is important for a system of checks to be put in place, to ensure that the work is being performed as requested and that the agency is in fact accountable to both the project and to the farmers if the service it provides does not meet standards. The need for such a system was pointed out both by Moradet et al., who ask, "If farmers invest in contributing to the capital costs and the works do not physically function because of an engineering design fault, where do they obtain recourse?" (Morardet, et al. 2005, 36) and by Peacock in his review of projects in East and Southern Africa:

> "Thus it will no longer be sufficient to continue to prop up inefficient, unaccountable public-sector service providers: these will need to be replaced by more efficient, demand responsive private-sector providers – geared to increased productivity and profitability, paid by and accountable to farmers and their organizations" (Peacock 2007, viii).

The alternative to working with government providers is to partner with international or local NGOs that specialize in AWM. IFAD and WCA have experimented with this approach on a number of occasions. WCA is currently working with KickStart for pump supply in PIGEPE, and with organizations such as IWMI and ARID (Association Regionale pour l'Irrigation et le Drainage en Afrique de l'Ouest et du Centre - Regional Association for irrigation and drainage in West and Central Africa) for research and knowledge dissemination services. As there is a large number of organizations with valuable experience and expertise in this area working in the West and Central Africa region, it may be advisable to increase the frequency of partnership with NGOs such as International Development Enterprises, KickStart or private engineering firms, which can serve as accountable technical implementation partners. WCA headquarters staff also suggested proactively looking into the availability of expertise on the design of locally appropriate climate-smart AWM technologies as this becomes increasingly important.

Many project staff commented that they would like to have more technical backstopping from individuals or small groups. This is a service that could be provided by local experts, in particular by those from one of the institutes in the region such as the National Advanced School of Agriculture in Senegal or the International Institute for Water and Environmental Engineering in Burkina Faso. While water-management or infrastructure experts are sometimes included in project design or supervision teams, there was a view that the extent of interaction was in most cases much too short, and that teams needed more regular assistance. It was also observed during the supervision mission undertaken as part of this review that even when a technical specialist is included, his or her contributions can be overshadowed or brushed aside in the interest of completing a list of succinct recommendations in a short time.

It is equally important for project staff and farmers to be able to evaluate the technical services and products offered and to be able to make informed investment decisions. This fact is well recognized in many WCA AWM project designs, with technical training and capacity-building built into project plans. Staff attending the workshop, however, felt that even more could be done in this area, and that training should focus on more practical elements, and include more farmer-to-farmer and staff-to-staff exchange visits within the country and the region.

Technical knowledge and decision-making could also be improved through access to more clear and practical information on the topic of AWM. While there is a wealth of information about this subject, much of it is either site-specific or not presented in a sufficiently practical way for project staff or farmers to use. For example, if farmers in the West and Central Africa region want to decide the best way to water their small gardens, they must rely on advice from family and friends or information from groups on one or two specific technologies. This problem is brought up in the literature and was raised during the capitalization workshop and field visits, and many CPMs stated during initial discussions that they would like to have access to better resources in this area (box 12).

While the development of a 'how-to' typology for the region was suggested by some during this review, it was evident from further discussions that this is not something that IFAD itself can initiate or keep updated, in particular because it does not have sufficient technical staff. Typologies are also limited in that each project site contains unique challenges, and the options should ideally be evaluated collaboratively by local AWM experts and future users. However, it also became clear that the required decision-making tools and skills are in fact largely available from international, regional and local experts and institutions, and that what would be most beneficial for the division would be to tap into this knowledge supply more regularly and systematically.

- It is vital for projects to use sufficient local technical support services during design, implementation and monitoring, and to support AWM users in drawing on these services beyond the life of projects.
- Project staff and farmers need more technical orientation regarding AWM options so that they can better evaluate private- and public-service provider bids and work. This could be achieved through more exchange visits, workshops and knowledge-sharing.
- In the case of public-sector service providers, accountability mechanisms need to be integrated into projects that allow users to assess and approve the quality of works and services provided.

Box 12. More AWM information tools needed

"There are lots of reports out there, but we need a more practical 'how-to' typology for decision-making in this sector" (World Bank Report reviewer 2011).

"Government and financing institutions would both benefit from the development of a knowledge base on agricultural water management, which will gather, store and disseminate useful information at operational and decision-making levels on best practical models for designing and implementing agricultural water development projects. This knowledge base can be developed either at national or regional levels, according to the interest and state of reflection in the considered countries" (Morardet, et al. 2005, 48).

"Our research findings suggest that farmers' ability to make their own informed AWM investment decisions can be enhanced through an improved technology supply chain and information flows" (de Fraiture, Principle Researcher, IWMI West Africa 2011).

"It is very important that IFAD works on a framework for agricultural water … we need assistance in decision-making, and in knowing what types of interventions are working" (PAFA staff, 2011).

Project management and time frame

Why is project management important? How long do AWM projects need to run to be successful?

The backbone of any AWM intervention is project management. This topic came up in discussions with IFAD supervisory and field staff, and was an ever-present issue during field visits. Many both within and outside IFAD feel that AWM interventions, which tend to be on average more complex, demand both more attentive management and longer-lasting and more flexible donor support.

Project management: Smart and efficient management and supervision of project implementation is important to the success of any community development project, but it becomes even more crucial for more complicated projects. While not all AWM projects are complicated, most are. This is because of the need for strong group management; the introduction of a technology or system that requires technically backed design, construction, operation and maintenance; the unpredictability in quantity and intensity of rainfall; the need to ensure a full package of support measures to attain profitability over time; or some combination of these factors.

It is important to note that since "agricultural water development and management projects rank among the most complex and unpredictable" (Morardet, et al. 2005, 52), good management, including decision-making, scheduling, budgeting and timely delivery of goods and services, is a key factor for success. As stated in a review of irrigation project planning done as part of the CP, "project management should not be viewed as an overhead that is to be minimized, but an essential feature of successful projects, with potentially huge pay-offs" (Morardet, et al. 2005, 40).

Funding periods: The question of how long an AWM intervention needs to be supported to eventually be self-sustaining and successful is a difficult one. The answer depends on the type of project, and the nature of the technology or practice. Most water-management interventions do require significant time, with benefits often only accruing in the medium to long term. These include, for example, projects that involve any type of land-management practice such as soil conservation measures or the promotion of new agronomic techniques. The World Overview of Conservation Approaches and Technologies review of soil and water conservation initiatives estimated that donors need to "commit to a minimum of five years and preferably ten or more" (WOCAT 2007, 55).

The introduction of new products or technologies also takes time. Support is usually needed until the new product is being used by a critical mass of people, the product and its name are becoming well known and a network of supply and repair is established. The NGO KickStart, for example, estimates that the "tipping point for self-sustaining profitability for treadle pumps will be met when sales reach 15 to 20 per cent of the total market potential, and that it can take between 12 and 14 years from market entry to tipping point" (KickStart 2011).

Many sources in this review felt that the time that IFAD, and other donors, currently devotes to AWM projects is too short. Often projects are judged complete shortly after the delivery of physical components, or projects are expected to increase in scale or add on new components as part of a new phase, before they have finished building the needed foundation in one area. This is not to say that all AWM projects should, for example, be given 10 years of support, as those that are not meeting necessary benchmarks should not be continued. However, many argued for both more flexible and longer-term support overall (box 13). Project time frames could potentially be shortened with better learning and knowledge exchange, or through access to more technical expertise, as discussed above.

- Given their complexity, AWM activities require project managers to be able to effectively manage budgets, donor and farmer calendars, and contracting and supervision of works and technical assistance.
- AWM projects often need longer and/or more flexible funding periods than the typical four-to-six-year projects.

Box 13. The need for a flexible, long-term approach to AWM project funding

"Common stumbling blocks include repeated underestimation of the time, effort and investment required to change. Particularly for reforms tied to time-bound, donor-funded projects, there is a tendency to expect too much too quickly. The result: reforms are prematurely judged unsuccessful and are left incomplete or abandoned (Comprehensive Assessment 2007, 34).

"Water-management projects require a long-term approach, usually 10 to 12 years, especially for larger-scale water management, or water use that requires sharing. This is not usually built realistically into project design. IFAD used to have something called a flexible lending mechanism where a project had 12 years and could be designed in phases, with benchmarks set for each phase. It has now discontinued this mechanism, and projects now normally have a duration of four to six years. Projects can go into a second phase, but often when they go to the Independent Office of Evaluation of IFAD, it wants the second phase to cover more areas or add more components – when the first phase has concentrated on building a foundation in the original area. This is often a mistake" (WCA CPM 2011).

"Many key informants interviewed feel that financing institutions' support stops too early after the achievement of the physical components" (Morardet, et al. 2005, 22).

Monitoring, evaluation and learning

Have M&E efforts been useful? What should be monitored? Who should do it?

The only way to reliably understand how well an AWM project is achieving its objectives is to have an M&E system in place. The manner in which this process is conducted can determine how well project implementers and users can react to problems and fix them, how the project is judged by those outside and thus how staff are reviewed and funds are allocated. It also affects how well lessons from the project can be shared, understood and used by others for future project planning and strategy.

International financing agencies such as IFAD have progressively made strides in the quality of project M&E. However, this review turned up what seem to be some problems with the way that AWM efforts have been, and continue to be, monitored and evaluated.

As discussed above, the overall objective of most AWM activities is to increase food availability and incomes of the rural poor by improving productivity, decreasing risk, better managing natural resources and diversifying livelihoods. Yet almost all AWM activities are monitored using output indicators such as the number of hectares of land improved, the number of wells or pumps installed or the number of farmers trained. While these are useful metrics to monitor, using them as indicators of project success or failure can lead to an over-commitment of efforts to the achievement of these outputs, and neglect by staff to work towards the real project objectives and accurately monitor success. Box 14 gives voice to a sampling of views on this from reports and interviews.

Interestingly, all field staff attending the workshop stated that their M&E systems were functioning well and measuring the right things (perhaps not surprisingly as

Box 14. M&E needs to be improved

"We currently have a bad approach to water management in projects. We view irrigation as an objective, rather than a tool. Measures of success should be based on increases in productivity (quantity, yield, number of crops being grown, profit), not on the number of hectares of land irrigation" (WCA CPM 2011).

"Monitoring and evaluation in SWC projects/programmes must be improved. It needs to do more than just monitor the timely delivery of project outputs; it should also evaluate whether the expected environmental and development benefits have been realized in a cost-effective manner" (WOCAT 2007, 50).

"The general lack of effective M&E of implementation and subsequent performance of the investment to date is likely to have had a negative impact on project outcomes because those responsible have not been alerted to weaknesses soon enough to enable them to take effective remedial action" (AfDB; FAO; IFAD; IWMI; World Bank 2007, xxvii).

"Despite the importance attached to it in project documents and design manuals, monitoring and evaluation has been consistently neglected or failed to monitor any meaningful indicators of poverty reduction (i.e. increased incomes), such as yields, production, costs and producer prices. Neglect of M&E not only made it impossible to evaluate development effectiveness but probably also contributed to reducing it, since farmers were unable, for example, to judge the performance of improved technologies while project implementers were unable to spot any need for corrective action" (Peacock 2007, vi).

stating otherwise would mean admitting they were doing something wrong). This confidence was shaken later in the workshop when they were required to give more detailed evidence on their experiences and they reflected that more accurate baseline data and measurements of additional factors would be useful to them.

Another issue discussed was that of roles and responsibilities in an M&E system. The way in which M&E is currently carried out is left to the discretion of individual project design teams and implementing agencies, and therefore is not uniform across projects. Some West and Central African projects reviewed, for example, leave the majority of M&E to a government agency or to another service provider, while others hire an in-team M&E lead to design a programme that is largely carried out by project staff. Many projects have picked up on the wider trend to move towards more participatory M&E, and are involving users in various ways in the collection and analysis of data.

In all cases where participatory M&E was mentioned as being used, project staff felt that it was beneficial and worthwhile. They brought up, for example, the fact that involving farmers in M&E was an important part of equipping them with the skills needed to establish farm-level operating budgets and processes for themselves. PDRD, for example, appeared to be making real and effective efforts to enable farmers to lead their own M&E, which was visible in the presentations given by user groups during the workshop field visit day. The PIWAMP staff, on the other hand, mentioned that they would really like to initiate more participatory M&E, but they did not feel that they had received the training or resources to be able to do so.

Indicators: IFAD uses a system of M&E called the Results and Impact Management System (RIMS). Established in 2003, the system consists of a series of three levels of measurement. The first corresponds to project activities and outputs (tangible immediate results that are produced through the implementation of activities); the second level measures project outcomes (short- and medium-term effects of an intervention's outputs); and the third examines project impact (long-term effects). Third-level impacts are measured through malnutrition and household asset metrics. While RIMS is meant to be a component of a project's overall M&E system, because of its extensive requirements it plays a large role in shaping the monitoring of any IFAD-supported project.

First-level AWM-related indicators, which focus on outputs, include metrics such as the number of people trained in infrastructure management, the number of hectares served by canals or the number of hectares constructed to collect run-off (table 4).

Authors of the RIMS acknowledge that these metrics alone do not provide information on whether, for example, the new techniques contributed to improved production, or the training succeeded in transferring knowledge to participants. These outcomes are measured in the second level. Second-level RIMS indicators are aimed at measuring the effectiveness and likelihood of sustainability of an activity. Rather than assigning specific targets in this area, outcomes are given a rating from one to six (with one being highly unsatisfactory effectiveness or very weak sustainability and six indicating very satisfactory/very strong). Ratings are provided at the time of a project's mid-term review and updated thereafter.

Applicable second-level indicators for AWM include those such as the effectiveness of productive infrastructure and the likelihood of sustainability of the infrastructure and user groups. Suggestions for ways to rate effectiveness include, for irrigation

Table 3. Excerpt from the RIMS handbook. First- and second-level indicators for natural resources (land and water) projects (IFAD 2007).

1st level results		2nd level results	
Natural resources (land and water)			
1.1.1	People trained in infrastructure management (*)		
1.1.2 1.1.3 1.1.4	Groups managing infrastructure formed and/or strengthened People in groups managing infrastructure (*) Groups managing infrastructure with women in leadership positions	2.1.1	Likelihood of sustainability of the groups managing infrastructure formed and/or strengthened • Number of groups operational/functional
1.1.5 1.1.6 1.1.7 1.1.8	Land under irrigation schemes constructed or rehabilitated Livestock water points constructed or rehabilitated Rainwater harvesting systems constructed or rehabilitated Fish ponds constructed or rehabilitated	2.1.2 2.1.3	Effectiveness of productive infrastructure • Percentage of delivered versus required water • Number of farmers with secure access to water • Incremental hectares of crop grown Likelihood of sustainability of productive infrastructure • Number of functioning infrastructure • Number of farmers with secure access to water resources • Number of fishers with secure access to resource base • Number of fishing ponds operational after three years
1.1.9	People trained in NRM (*)		
1.1.10 1.1.11 1.1.12	Groups involved in NRM formed/strengthened People in NRM groups(*) NRM groups with women in leadership positions	2.1.4	Likelihood of sustainability of the NRM groups formed and/or strengthened • Number of groups operational/functional
1.1.13 1.1.14	Environmental management plan formulated Land under improved management practices	2.1.5	Effectiveness of NRM and conservation programmes • Hectares of land improved through soil/water conservation methods
1.1.15	New Other productive infrastructure constructed/rehabilitated		

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The head of a farmer organization participating in PDRD in Burkina Faso shows the results from their monitoring of yields and income from the previous season.

infrastructure for example: technical aspects (adequate water supply and intake); economic aspects (yields, change to higher-value crops, employment levels, land productivity/area, changes in cropping patterns); and social aspects (quality of life). For items such as the sustainability of user groups, suggestions include the group exit rate, the number of groups that are operational and the number of groups registered as legal entities.

While allowing for a level of flexibility is useful, letting projects choose which second-level indicators they feel are applicable and what type of information they are going to gather to arrive at a rating means that there is no standard evaluation of effectiveness or sustainability across AWM projects. Furthermore, despite the fact, as argued above, that AWM activities need to be financially viable over time at farm level to be worthwhile and sustainable, there is not even a suggestion in the RIMS framework that farmer income should be measured. The closest suggestions are crop yield, land productivity and quality of life. The only mention of financial viability or operational self-sufficiency is the measurement of the effectiveness of service providers. Farm-level cost-benefit analysis is currently only performed at project design stage.

There is therefore no direct link back to the overall objectives of the activity, except perhaps by the third-level nutrition and assets indicators, which are not always used and are difficult both to measure and attribute. Getting the indicators right for activities such as these is vitally important for improving project outcomes, as staff will naturally act according to the criteria used to monitor their performance (Morardet, et al. 2005).

- Considering the need for user engagement and satisfaction for the success of AWM efforts, M&E systems should be centred on participatory approaches.
- Indicators for measuring and reporting success in AWM need to be clearly linked to overall objectives through the inclusion of farm income measurements in higher-level M&E indicators.

Sustainability

What does sustainability mean in this context? How can it be achieved and measured? How can donor support and subsidies play a positive role?

Sustainability may be defined in many ways, the most simple being: “the ability to be sustained or supported”. However, in order for sustainability to be a useful objective, it is necessary to define the concept more precisely as it relates to AWM activities.

During the capitalization workshop, participants debated what they thought sustainability meant. They eventually agreed that it could not be defined merely as something that “lasts a long time” but instead was something that “conserved the environment,” or “was profitable for everyone involved” or “was able to be maintained.” This is, in fact, in line with IFAD’s new Strategic Framework (2011-2015), which states that sustainability includes “institutional, economic and social sustainability, as well as the pursuit of greater resilience in the face of climate- and market-related shocks” (IFAD 2011).

A concise working definition may therefore be: “A sustainable system is one that maintains its own viability by using techniques that allow for continuity.”

The debate at the capitalization workshop on sustainability ultimately focused on the need for profitability. Participants argued that poor smallholder farmers are primarily interested in increasing their annual incomes, and, therefore, the activity must be profitable for them to be interested in maintaining it. This interest is essential, as without it the work promoted and supported, whether improved land, technologies such as pumps, or infrastructure such as small dams or reservoirs, will fall into disrepair and become unusable.

It is relatively easy for a farmer to achieve high profit in a given year, by, for example, buying expensive inputs on credit, asking family and friends to pitch in as extra labour, or planting soil-depleting crops that will flourish in the short run. These strategies only lead to short-term success, however. They are not economically, socially or environmentally sustainable, and unless the strategy chosen meets all of these criteria, profits will begin to decline and in time will most likely disappear altogether. The system will not be able to maintain its own viability as a result of the techniques chosen.

It is important, therefore, to think not just about profit in general, but average profit over time, or normalized profit. Agriculture is inherently a business with variable annual profits, as income each year depends on local weather, prices and markets, and on regional and international changes as they affect global market demand. Many of these variables are expected to become more volatile in coming years, making a long-term perspective even more important. In a region such as West and Central Africa, other factors such as labour availability (affected by illness, migration, etc.), infrastructure and transport availability (affected by washed-out roads, trucks failing to show up, etc.), and local or regional conflict, can also come into play.

Therefore, the objective of any AWM intervention must be to improve a farmer's average profits over time, either through increasing productivity and, it is hoped, profit in the good years, or by decreasing risk and, again it is hoped, losses in the bad years, or a combination of both. Project staff and farmers alike have a more forward-looking strategy than those described in the hypothetical example above, and thus the question is how improvements in water management can fit into, and improve these approaches.

Viability and sustainability are interdependent: sustainability cannot be achieved without profitability at the farm level, and economic viability cannot be achieved without sustainability over the intended economic life of an investment" (Peacock 2007, i).

"It's all about the profitability of the intervention. I think that is the key to sustainability" (Roy Ayariga, project coordinator NRGP).

Profit calculations: In order to evaluate AWM project viability more easily, it is useful to break down the components of annual farm income. A simple equation might be something like:

$$\textit{Profit} = \textit{revenue}^{ii} - \textit{expenses}^{iii}$$

However, in most industries, and especially in a risky one such as agriculture, business owners also invest in some type of insurance. A restaurant owner, for example, will pay an insurance premium either monthly or annually as a protection against the risk of major losses from property damage, power interruptions or crime. Farmers or ranchers in high-income countries also often take out some level of insurance, whether only for their property and machinery or to cover seasonal losses. In regions such as West and Central Africa, however, there are currently no insurance companies available for farmers to use.

ii As some projects are working with communities that do not currently have enough food year-round, food consumed at the household level should be counted in revenue calculations and factored in at the market price, since by increasing food production the household did not have to purchase it from elsewhere.

iii This should cover all expenses, including maintenance and repair.

Instead, farmers insure themselves against seasonal fluctuation by, for instance, saving grain for later use, buying livestock that can be sold later, diversifying into other livelihood activities, or by choosing not to invest in activities that may fail, i.e. not taking risks. This is ultimately very much like paying an insurance premium, as farmers designate a certain amount of annual revenue to risk-reduction strategies. The equation then looks like this:

Profit = revenue – (expenses + insurance)

Farmers everywhere invest in some type of insurance in the expectation that there will be years when profits are low or non-existent. Those who do not may find themselves left completely destitute in a year with less than ideal rainfall or low market prices. If the rains fail two or three years running, for example, only farmers with robust insurance strategies will be able to continue.

So how then do AWM activities fit into this picture? Improved management of water resources, as described above, can help increase the profit side of the equation in a number of ways. First, it can increase crop yields, cropping intensity or the ability to grow higher-value crops, thus boosting revenue. It can also act as a type of insurance, as better control of water will lessen the negative impact on farmers of poor, overly intense or untimely rainfall, and improve confidence in long-term revenues. This in effect lowers the amount farmers need to invest in insurance activities each year (or, if they were using an insurance company, would lower their insurance premiums). However, most AWM activities will also increase operating expenses, and therefore it is important that attention is paid to the full equation.

Calculating annual farm-level profit margins is already a part of M&E in some WCA-managed projects, and in general it is an indicator that can be monitored. To do so, however, requires farmers to keep track of all operating expenses, and also to record end-of-season revenues. This may be complicated in areas where farmers do not traditionally share this information with others, but should be possible if anonymity is worked into the process.

Calculating insurance gains is, of course, much more difficult in areas where farmers are not paying an actual fixed insurance premium. Farmers could be asked to quantify how much money they invest in risk-reducing or savings measures, such as livestock purchase or grain storage, but this would not be easy. It would also be possible to try to calculate the inverse, or the benefits farmers accrue as a result of having less risk, such as the ability to invest more in inputs and technologies, to expand onto more land, or to put money into other assets such as housing, health care or alternative enterprises. However, this would also be problematic.

An in-depth investigation into risk-reduction calculations was not possible as part of this review, but it may prove to be an interesting area for further exploration. A quick search did yield some studies on farmer risk-reduction strategies and impacts, including a 1992 paper by Rosenzweig and Binswanger, which states that: "A one standard-deviation decrease in weather risk (measured by the standard deviation of the timing of the rainy season) would raise average profits by up to 35 per cent among farmers in the lowest wealth quartile" (Rosenzweig and Binswanger 1992). This measurement was done for farmers relying solely on rain, but it provides a good example of how reductions in weather risk achieved through better water management may increase overall profits.

In the absence of an easily achievable insurance measurement, the use of the first equation, averaged over time over a given cycle, or normalized, should give project supervisors, as well as farmers, a good idea of whether they are making progress towards the overall objective. Projects that do not appear to be progressing towards sustainable profit after a reasonable time period should be adjusted, or support should be withdrawn.

Subsidies: Participants at the capitalization workshop were also asked how they thought subsidies and other types of project support affected project sustainability. The almost unanimous response was that they felt some level of subsidization and support was necessary in order to get projects off the ground, particularly for the target user groups they were working with. Various project staff pointed out, however, that the current approach was not necessarily sustainable. The reason was that many users might not be able to benefit fully from the interventions put in place after the project closed because they would not be able to afford the necessary inputs.

While designing a sustainable support plan is undeniably a challenge, a number of strategies have been suggested in the AWM literature that may prove useful to projects in the WCA portfolio. These include the use of targeted or tiered subsidies, where the level of support is tuned to the different income or vulnerability levels within the target population, so that those who do not need extra support are paying a market price for products from the beginning. Subsidies may also be increased or decreased over time, either for the entire user group, or for subgroups. A project team, may, for example, choose to start offering a particular product, such as a pump, at full cost and build up a critical mass of users and product recognition, and then later extend support to the poorest groups that are unable to afford it.

- Given its importance to the sustainability of AWM activities, profit to farmers should be measured annually and used as an indicator of progress.
- While some level of external support and subsidy may be needed to initiate AWM and complementary agricultural productivity activities, the design needs to be improved to anticipate the phasing out of subsidies and the introduction of alternative financing mechanisms that can be sustained without project or government intervention.

Conclusions and strategic recommendations

The West and Central Africa region possesses significant renewable water resources. Countries in humid Central Africa have available up to 200,000m^3 per person per year, and even more arid countries to the north, with closer to 2,000m^3 per person per year, are only withdrawing between 1 and 14 per cent of their available resources. At the same time, the region suffers from persistent poverty (74 per cent below the official poverty line), and not only repeated attention-grabbing famines, but also ongoing and widespread hunger and malnutrition. More than half of the population is rural, and around half of the total population is involved in agriculture.

This paradox offers a great opportunity. If more of the water resources available to farmers in the region could be managed and used for reliable, profitable and sustainable production of food, millions of farmers could benefit. At present, only around 3.5 per cent of cultivated land in SSA is under some form of water management, and while productivity has increased in a few areas, crop yields are still well below potential levels. This is not because of lack of demand – food consumption is above production levels in Western and Central African countries and imports are high and increasing. The population of the region is also growing substantially. It is predicted to grow more than any world region between now and 2050, from 430 million to around 1 billion (130 per cent growth).

All of this is occurring in the context of a changing global climate. The Sahel is particularly affected by changing climate patterns because of its location, and while predictions of future change for the region are still largely uncertain, it is clear that changes are already underway, and will likely bring more variable, and in places more intense, rainfall patterns. Farmers in West and Central Africa have a long history of adapting to weather fluctuations, but new patterns make variations more extreme and unpredictable. While producers in the region have historically expanded onto new land in order to increase production, population increases, along with urbanization, mean that much of the land still available is either not ideal for cultivation, or far from infrastructure, roads and urban market centres.

Agriculture in West and Central Africa, therefore, needs to become more effective, efficient and climate-resilient, producing more food from the same amount of land in a more volatile environment. AWM is a necessary component in this transition, and better use of available water resources is needed for farmers to create and maintain businesses that can respond to the huge and growing demand in the region.

IFAD has been working towards this goal since its inception. Starting with the Special Programme for Sub-Saharan African Countries Affected by Drought and Desertification in the 1980s, continuing with its collaborations with other agencies, through to its ongoing support of hundreds of small projects, IFAD's commitment to AWM activities has steadily increased over the years. Funding for AWM activities increased by about 50 per cent from 1990-2004 to 2000-2004. WCA had the largest increase of any division, with AWM funding rising by 55 per cent during this time period relative to the total divisional portfolio. As of 2009, some 59 per cent of WCA-managed projects included irrigation activities and 33 per cent included SWC components.

While these efforts have brought about numerous successes, there is always the potential to improve. Considering both the level and increasing trend of resources being committed, along with the high potential impact that improving water management could have in the region, it makes sense to evaluate past efforts and to outline a strategic path for going forward.

IFAD's role: IFAD is a funding organization with a broad reach and a large mandate to improve the lives of the rural poor. It is important, therefore, for IFAD, and WCA in particular, to keep in mind what the organization's strategic advantage might be in the area of AWM in the region, and where it should let others take the lead.

IFAD possesses a unique combination of high-level influence, including at the level of national policy, and significant funding resources. It also has a considerable and increasing presence on the ground through its regional offices, project staff and links with local partners. This enables it not only to see the bigger picture and make impacts at a national and regional level, but also to have a solid understanding of the needs and realities of the poor rural people with whom it works.

IFAD does not, however, specialize in water-resource management or water-infrastructure engineering or design. The organization only has a small group of staff, less than five, concentrating on supporting all of its water work across the divisions. For this reason, IFAD seeks support for the technical components of its AWM activities from outside service providers and short-term consultants.

It is therefore vital for a division such as WCA to have a clear idea of the influence it would like to have, and the support it needs to achieve this goal. There are numerous other organizations working in the region, each specializing in specific areas. IFAD should avoid adopting too narrow a focus in its support to agricultural water improvements, but should instead work to develop a better awareness of how AWM fits into the type of projects it supports.

Recommendations: WCA should consider how it can make an impact over the next 5 to 10 years through more effective support to AWM interventions. This involves taking a step back and looking at what is working, what is not, and what should be continued or increased. It also means evaluating the division's objectives in this area, thinking about where and on whom to focus, identifying gaps in knowledge and expertise, and coming up with tools and partnership arrangements to address them.

Based on the outcomes of this review, it is clear that the biggest challenges in reducing the widespread economic water scarcity in the region lie on the support-package side of the equation. Very few people complained about the funding or delivery of technologies themselves, whereas many voiced the need for more support to technology design and choice and to activities that make water-control efforts worthwhile, such as training, input delivery and market analysis. WCA therefore needs to rethink the distribution of attention and funding offered within projects, and to work to deliver more effectively the support needed to make technologies viable, profitable and sustainable. To achieve this, the following should be considered:

- Making profits at the farm level should be driving project design and implementation more than it is currently. Given its importance for the sustainability of AWM activities, profit to farmers should be measured annually and used as an indicator of progress.
- Environmental and market-connectivity factors need to be more systematically considered when deciding on AWM project and site locations, and when choosing which technologies to promote.
- Exclusively targeting the poorest and most vulnerable results in reduced effectiveness for many WCA-managed AWM interventions.
- It is useful to offer a progression of technologies that farmers can select from based on their environmental, financial and technical needs and abilities.
- Specific performance indicators are required for user participation and management to enable this important aspect to be monitored and prioritized during project implementation.
- Transfer to community management requires effective and ongoing local support, often over longer time periods than those planned under projects.
- Projects must ensure sustainable mechanisms for access to complementary inputs such as appropriate seeds, fertilizers, tools and crop protection measures in order to achieve the anticipated results of AWM activities in terms of improved incomes and livelihoods.
- It is important for projects to make use of sufficient local technical support services during design, implementation and monitoring, and to support AWM users in drawing on these services beyond a project's life.
- Project staff and farmers need more technical orientation regarding AWM options so that they can better evaluate private- and public-service provider bids and work. This could be achieved through more exchange visits, workshops and knowledge-sharing.
- Because of the need for user engagement and satisfaction for the success of AWM efforts, M&E systems should be centred on participatory approaches.
- While some level of external support and subsidy may be needed to initiate AWM and complementary agricultural productivity activities, the design needs to be improved to anticipate phasing out of subsidies and the introduction of alternative financing mechanisms that can be sustained without project or government intervention.

Areas for further investigation or action: While the time afforded to undertake this review allowed for a relatively in-depth exploration of the topic of AWM and IFAD's work in this area in the West and Central Africa region, there are nevertheless a number of issues that it was not possible to investigate and that it may be useful to explore further. In addition, the review and subsequent discussion raised ideas that WCA may consider acting on in the near term. These include:

For investigation:

- **Project duration and support:** For how long do different types of AWM projects need to run, for how long do they need support, and of what kind? What types of subsidy approaches have worked elsewhere and could be tried?
- **Evaluating, measuring and monitoring:** What are the best indicators to use to measure success for various AWM practices, particularly in the West and Central African context? Is it possible to measure long-term profit, as was suggested by many during this review and recommended in this report? How can the costs and benefits of AWM interventions best be evaluated and monitored in an environment of both variable market prices and changing climate? Would it be possible to measure the risk-reduction impacts of AWM interventions and how could this be done in practice?
- **Adapting AWM technologies to the changing climate:** How well will the current water-management practices perform as the climate in the West and Central Africa region changes? How can technologies currently being designed and constructed be made more climate proof, especially when predictions of future climate patterns are uncertain?

For action:

- **Improving partnerships and technical support:** AWM requires more intensive, qualified technical support than many other agricultural activities. At the same time, many review participants felt that there was a shortage of qualified, experienced technicians available. In order to facilitate matching of skills with needs, potential partners and consultants with the appropriate technical qualifications and regional experience need to be identified and made available to project managers and AWM user groups.
- **Increasing knowledge-sharing:** The considerable number of existing AWM projects provides a rich fund of experience that can accelerate learning of project staff and farmers. Exchange visits and learning routes should be supported to facilitate practical peer learning around AWM development and sustainability issues.

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