









African Union

Framework for Irrigation Development and Agricultural Water Management in Africa



2020

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Foreword

It is very appropriate that irrigation and agricultural water management issue is again, being orchestrated at such auspicious time when there is a resurgence of interest in African agricultural intensification. The challenge of feeding a rapidly rising populations is quite daunting. Equally formidable, are challenges of overcoming low productivity of agricultural resources in the face of rapid urbanization, increased climatic variability, fast globalizing trends and changing diets as well as the need to create dependable employment opportunities to curb out-migration. The huge potentials of the agricultural sector in the continent in furnishing sustainable and improved livelihoods, agro-led industrialization and overall economic development cannot be achieved without productive input intensification. Indeed, crops needs water and not rain. Building resilient capacities in Agriculture livelihoods is key to achieving most of the development goals as enunciated in the Agenda 2063 and the UN' 2030 SDG. It is, therefore, not out of place that the African Union through the 2014 Malabo Declaration defines the immediate future of most African economies around agricultural growth and transformation.

The African Union's Framework for Irrigation development and agricultural Water management (IDAWM) was conceived against the backdrop of increasing climatic shock with associated negative agricultural production impacts and reduced livelihoods capacities of rain-fed agriculture in the Continent. A series of Decisions and Declarations of African Heads of States and Government on the need to adopt and out-scale sustainable irrigation and agricultural water management as well as the widespread and rapid expansion of irrigation, especially, among market-oriented smallholder farmers were push factors that birthed the IDAWM Framework.

There is no gainsaying the fact that adoption of irrigation and agricultural water management practices will address the problem of water access and input intensification in agriculture. To ensure reliable access to water which is needed to increase crop production and mitigate drought, the Framework sets forth four broad (not mutually exclusive) development pathways for Agricultural water management in the Continent. The Framework addresses cross-cutting social and technical development issues. It takes into cognizance the varying ecological, climatic and socio-economic conditions across the continent. Hence, for each of the Pathways the Framework addressed, from the perspective of lessons learnt from previous development efforts, the implementation challenges and sustainability elements.

I wish to express my appreciation to AU-SAFGRAD Team for taking the initiative to develop this blueprint. It is my pleasure to recommend the IDAWM Framework to all agricultural Actors and planners at national, regional and continental levels of development. It is hoped that the framework will inspire and galvanized interests, at scale, in irrigation development and agricultural water management as we advance agricultural transformation through resources' intensification in the Continent. To achieve impact, I call on Partners to mobilize support for the implementation of the Framework.



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The IDAWM Framework benefited from the quality inputs and comments of a wide range of experts and stakeholders. Particularly, our gratitude goes to Mr Jonathan Denison, the Consultant, for the professionalism he displayedand for providing the pictures and cover page graphics. We recognize the invaluable contributions of experts from FAO, IFPRI, IWMI and World Bank (Water Global Practice) amongst others. The contributions of experts from continental and regional organizations, RECs and Members States who participated in the review workshops are duly acknowledged. Our thanks goes to individual irrigation and agricultural water management experts that volunteered time and resources in the independent review of the draft and, also, to the experts that participated in the AU-SAFGRAD's in house review exercise.

Executive Summary

Reliable access to water is essential to increase crop production and mitigate drought across Africa. This is all the more so as climate change brings greater uncertainty and the demand for food escalates with population growth. The African Union (AU) has responded actively to these challenges. For example, it has established the Comprehensive Africa Agricultural Development Programme (CAADP) and the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods. This is the vehicle for agricultural development across Africa and supports the first aspiration in the AU Agenda 2063 of "*A prosperous Africa based on inclusive growth and sustainable development"*.

On the ground, Africa is seeing widespread and rapid irrigation growth especially among market-oriented smallholder farmers. The total area under Agricultural Water Management (AWM) in Africa, including irrigation and other water-management technologies, is officially estimated to be 18.6 Mha[1]. However, emerging evidence clearly reveals this as an under-estimation. For example, farmer-led irrigation development (FLID) covers an extensive area that is not officially recorded and included in national databases. While the remaining potential for AWM expansion on the continent is substantial, it is limited by local environmental and economic constraints. The remaining potential areas are in line with projections of the expansion of the AWM area that is needed to meet food needs by 2050. While such targets seem modest, the investment financing that is required to achieve this is substantial. The framework for Irrigation Development and Agricultural Water Management (IDAWM) in Africa aims to support regional and national strategies and project implementation to achieve continental targets, by promoting country-level initiatives in AWM. Key issues and opportunities are identified in the framework. This provides a basis for ongoing discussion of agricultural water priorities leading to more evidence-based knowledge.

The framework is structured around four strategic AWM areas or agricultural water developmental pathways and includes: AWM in rainfed farming; farmer-led irrigation; scheme development and modernisation; and waste-water recovery and reuse. The cross-cutting issues address themes and actionable areas that should be emphasized and supported to reap the benefits of AWM as well as to promote its expansion and sustainability. The framework calls for a broad view of opportunities, while considering national peculiarities, and the need to address parallel pathways, to accelerate adoption of water and climate-wise AWM methods. The challenge for national policymakers is to use institutional reform to facilitate and enable the process that supports farmer-led irrigation development, technology, financial and agro-market access, and secure land and water tenure, particularly for private-sector and community partnerships.

Acronyms

ADB	Asian Development Bank
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AU	African Union
AUDA	African Union Development Agency
AU-SAFGRAD	African Union Semi-Arid Food Grains Research and Development
AWM	Agricultural water management
B2B	Business to business
B2C	Business to consumer
CAADP	Comprehensive Africa Agriculture Development Program
CSA	Climate smart agriculture
EIRR	Economic internal rate of return
FAO	Food and Agriculture Organisation of the United Nations
FLID	Farmer-led irrigation development
Fintech	Financial technology
GPS	Global positioning satellite
I&DA	Irrigation and drainage agency
IDAWM	Irrigation Development and Agricultural Water Management
IFPRI	International Food Policy Research Institute
Insurtech	Insurance technologies
IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
Mha	Million hectares
MS	Member states

MOM	Management, operation and maintenance
NEPAD	New Partnership for African Development
OECD	Organisation for Economic Co-operation and Development
P2P	Peer to peer
PAYG	Pay-as-you-go
PPPs	Public private partnerships
RECs	Regional Economic Communities
RWH	Rain water harvesting
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
UNDP	United Nations Development Program
WBG	World Bank Group
WRM	Water Resource Management
WHC	Water harvesting and conservation
WUOs	Water user organisations

1. Introduction

1.1 The Framework in context

Reliable access to sufficient quantity and quality water is a critical constraint to agricultural production and a priority in the drive to eradicate poverty. Globally, governments and farmers are facing new water quality and quantity related challenges due to the fast-growing population, urbanization and pollution, climate-change and climate variability impact on water resources and increasing cross-sectoral competition for water. Improving water accountability and AWM to respond to these challenges and subsequently, contribute to livelihood improvements and drive economic development is a priority for the African continent.

There is strong interest amongst policymakers at all levels to advance irrigation development and practices as a catalyst for economic and rural development, particularly given heightened farming uncertainties resulting from climate-change. AWM can be a quick response to reducing the consequences of increased and more severe drought by doubling or tripling farming intensification and increasing water, land and crop productivity. Labour productivity and household incomes are increased due to the multiple cropping cycles and extended cropping periods that are facilitated by adopting IDAWM practices. The second Sustainable Development Goal (SDG#2) is to end hunger, achieve food security and improved nutrition and promote sustainable agriculture. SDG#2 can be achieved by doubling agricultural productivity and the incomes of smallholder food producers. In addition, one can ensure sustainable food production systems through implementing resilient agricultural practices that increase productivity and production. AWM is part of the larger agricultural system; substantially increasing water-use efficiency across all sectors and implementing integrated water resources management (IWRM) at all levels are mechanisms to "ensure availability and sustainable management of water and sanitation for all" (SDG#6).

In the same vein, the African Union, through a number of decisions and declarations made by the heads of states and governments, has always put water resource management (WRM) and irrigation on the front burner of its development agenda. These include: a) the Comprehensive Africa Agriculture Development Programme (CAADP) that made sustainable land management and reliable water control systems the first pillar for the development of the agricultural sector in Africa; b) the Sirte Declaration 2004 {Ex/Assembly/AU/Decl 1(II)} that recommended the strengthening of Centres of Excellence and /or networks and their establishment where they do not exist, for water

management. In addition, the Sirte Declaration supported the African Ministerial Council on Water (AMCOW) in its role of preparing plans and policies related to WRM; c) the Abuja Summit on food security in Africa, held in Nigeria in 2006 emphasised the promotion of public sector investment in agricultural related infrastructure including water and irrigation among others; d) The heads of state and government commitments for accelerating the achievement of water and sanitation goals in Africa during their 11th ordinary session in 2008 in Sharm Elsheikh, Egypt (Assembly/AU/Decl.1 (XI)); e) the later Sirte Declaration (2009) on investing in agriculture for economic growth and food security that stressed the importance of financing to scale up adoption of sustainable land and agricultural water management {Assembly/AU/Decl.2(XIII)}; f) the Malabo declaration that re-emphasised efficient and effective irrigation-based water use and management systems as one of the main strategies to end hunger in Africa by 2025; and g) the African Union Agenda 2063 and its 10 year Action Plan of moving towards the "Africa we want", that highlighted irrigation as key to achieving modern agriculture for increased production, productivity and value addition. These decisions and declarations are centrally important to achieving the number 1 aspiration of Agenda 2063 titled "A prosperous Africa based on inclusive growth and sustainable development". In 2018, the African Union Commission in collaboration with the African Union Development Agency (AUDA-NEPAD), Regional Economic Communities (RECs), technical institutions and CAADP non-state actors, released the inaugural Biennial Review Report (BRR) on the Implementation of the 2014 Malabo Declaration. The inaugural BRR reported that the growth rate of the size of irrigated areas increased from the year 2000 by values of 407.7%, 328.7%, 42.6%, 91.4%, 160.4% and 199.4% in Central Africa, East Africa, North Africa, Southern Africa, West Africa and the whole of Africa respectively.

1.2 The Rationale

The African rate of population growth is estimated to be over 3 percent per year while the global average is only 1.2 percent per year. Food production has not kept pace with the population growth rate in Africa and this has resulted in high food and nutritional insecurity and increased the food import bill for the continent. The International Water Management Institute (IWMI) estimates that 29 percent more irrigated land will be required by the year 2025 in order to sustain food production and reduce poverty on the continent. There is, therefore, high pressure on agriculture, and particularly the irrigation sector, to ensure food security for Africa. The development of irrigation systems is, therefore, high on the Africa political agenda.

The Framework:

- An expression of African Union Member States' interest in AWM and a description of opportunities and challenges.
- Consolidation of the most relevant approaches and priority actions for irrigation development and AWM in Africa.
- A blueprint to align and harmonize regional and national policies to accelerate agricultural growth through sustainable AWM practices.
- A framework to reinvigorate interests, promote strategic thinking and redirect investments in sustainable AWM practices.
- Continental guidance on irrigation development and AWM for partners, donors and investors in Africa.

The African development Agenda, Agenda 2063, and other related decisions and declarations of heads of states and governments called for increased interventions to boost irrigation development and sustainable AWM. The benefit of this is to increase agricultural production and productivity and ultimately lead to wealth creation. Key intervention indicators of Agenda 2063 include: increase 2013 levels of water productivity from rain-fed agriculture and irrigation by 60%; harvest at least 10% of rain water for productive use; and recycle at least 10% of waste water for agricultural and industrial use. Member States (MS) are requested to promote the development of irrigation through appropriate policies and implementation capacity to meet the set targets.

The IDAWM framework draws from the wider policy environment and aims to support regional and country teams to strategically focus efforts in pursuit of higher-level AU and country targets in AWM. It is expected to stimulate irrigation and agricultural water development by providing a suite of development options that can be exploited. It hopes to act as a catalyst for new AWM ideas an5d details regional and country institutional interventions and project plans. The framework presents an articulated continental guidance and vision on irrigation development and AWM, which should

stimulate interest and assist MS in undertaking schemes and harnessing the benefits. It offers a basis for commitment by RECs and MS to formulate and operationalize a comprehensive irrigation development and AWM framework at regional and national levels.

1.3 Methodology and structure of the framework

The IDAWM framework was developed through a broad-based consultation with experts and stakeholders to address the technical, environmental and political feasibility of the approaches suggested. The proposed key interventions for the cross-cutting issues benefited from input from field actors, scheme implementers and end users. An extensive literature search and reviews of published literature, continental, regional and national policy and strategy documents in relation to irrigation development and AWM was also conducted. The initial draft was presented in two-day expert review workshop that held in Addis Ababa, Ethiopia, December 2018. Following the expert presentation, the draft was subjected to both internal and invited external reviews to ensure that the IDAWM Framework comprehensively addressed all issues relating to AWM in Africa. The final draft was subjected to a continental validation review that took place in Ouagadougou, Burkina Faso July 2019. The IDAWM Framework was endorsed as a continental document by the relevant organs of the African Union; the 3rd Specialized Technical Committee (STC) of African Ministers of Agriculture, Rural development, Water and Environment (ARDWE) 21-25th October 2019 and the Executive Council {EX.CL/1187(XXXVI)} 6-7th February 2020, Addis Ababa, Ethiopia.

The framework is structured into three chapters. Chapter one sets forth the introduction, rational and key challenges and development opportunities for AWM in Africa. Chapter two highlights issues surrounding irrigation development and AWM in Africa. Chapter three identifies the development pathways, key interventions needed for their successful implementation, the seven cross cutting issues and ends with the conclusion and recommendations.

1.4 Categorization of the agricultural water management spectrum

There are many different kinds of AWM practices and categorization is necessary to collect and analyse data and to understand their status, types and scale. Categorization is complicated because, in many instances, different techniques are combined on the same plot of land, and many variations of techniques are practiced. AWM practices are most easily understood when viewed to exist on a spectrum[2]. On the one [1]extreme there are non-equipped management practices that increase water availability to the root zone, and on the other, fully-controlled high-tech irrigation. In between are a range of flood recession, water harvesting, shallow-groundwater, supplementary irrigation, full irrigation and related drainage technologies. The scope of the IDAWM framework covers the whole agricultural water spectrum. FAO[2] divides the AWM spectrum into two

main groupings, namely areas equipped for irrigation and areas with other forms of AWM (i.e. non-equipped) shown in Figure 1.1.

Area equipped for irrigation: includes all areas that are equipped for full-control irrigation plus those areas that are partially-equipped, usually in lowlands areas.

- ***Full or partial control irrigation technologies*** including overhead irrigation systems such as sprinkler, drip, trickle, micro-sprinkler irrigation and surface irrigation systems such as basins, furrows, and border strips.
- ***Equipped lowlands and spate irrigation***, such as cultivated wetlands, inland valley bottoms and water harvesting involving water-control and/or drainage structures. The category also includes flood recession farming where bunds or structures retain the receding water.

(1) **Other forms of AWM:** these are non-equipped areas where cropping is reliant on soil-water management in different forms. It typically takes place in wetlands, inland valley bottoms and flood recession cropping areas, but without water conveyance structures in place. Water harvesting (i.e. in-field techniques) and soil-water management also fall into this category.

(2) **AWM area (3) = (1) + (2)**

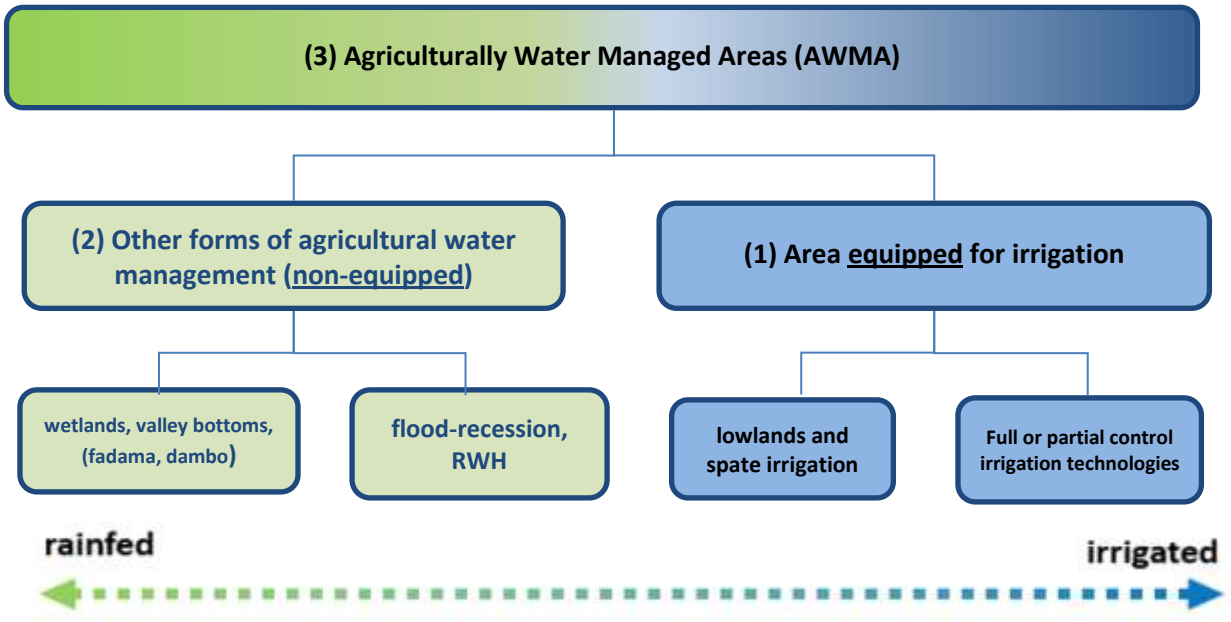


Figure 1.1: FAO categorization of irrigation and agriculturally water managed areas shown as a spectrum (Source: FAO[1], amended by authors to align with the concept of a spectrum, after Molden (2007)[2])

1.5 Terminology – ensuring common understanding

It is important to clarify the meaning of terms to ensure a common understanding of the framework across diverse individuals, organisations, regions and countries. It is helpful to have clarity on terms and concepts and a list is shown in Box 1.1.

Box 1.1: Working definitions and terms

Agricultural water management (AWM) is the inclusive term for farmer-interventions that increase water availability to the root-zone, over and above naturally infiltrated rainfall. AWM thus includes: shallow-aquifer farming (dambos, fadamas, wetlands etc.), mulching, conservation agriculture, bunding, flood-recession farming, water-harvesting and irrigation and drainage. AWM includes the management of both blue-water (withdrawals) and green-water (in plants).[2]

Blue and green water: Blue water is in rivers, dams or aquifers that is used for irrigation and is transported to fields via an *irrigation system* in order to irrigate. Green water is held in the soil after precipitation.[2]

Irrigation: The transport and application of blue-water to the plant root zone using an irrigation system.

Irrigation scheme: A *scheme* comprises a group of irrigation farmers who share a hydraulic system that provides irrigation water. A *scheme* requires collective management of the shared irrigation system.[4]

Water harvesting: The collection and concentration of rainfall and surface runoff on the farm and into the soil-water reservoir using ponding and infiltration techniques (e.g. through pitting, bunding, humus or standard compost application, trenching and swales), or into storage structures (roof-water tanks, household (farm) ponds (unlined or lined with UV resistance plastic) and small earth dams).[5]

Farmer-led irrigation development (FLID): is "A process where farmers assume a driving role in improving their water use for agriculture by bringing about changes in knowledge production, technology use, investment patterns and market linkages, and the governance of land and water"[3]. Farmer-led irrigation relates mainly, but not only to smallholder farmers and is not confined to any one technology.

Small, medium and large-scale schemes: The concept of *large-scale* or *small-scale* is used here as a relative descriptor regarding individual farms, schemes or programs. It is important to appreciate that many small-scale interventions, such as famer-led expansion, involving hundreds-of-thousands or millions of smallholders effectively combine to a massive large-scale development footprint.

Large-scale public irrigation schemes: Large-scale public irrigation schemes in Africa have two defining characteristics: they are built with Government investment and infrastructure/assets are state-owned; and Management, Operations and Maintenance (MOM) of the bulk-supply and distribution system involves an Irrigation and Drainage Agency (I&DA), government department, or private operator. Water Users Associations are often involved at secondary or tertiary level.[6]

Climate Smart Agriculture (CSA): Integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges. It is comprised of four main pillars: sustainability, adaptation and resilience building, and where possible reducing and/or removing greenhouse gases emissions.[7]

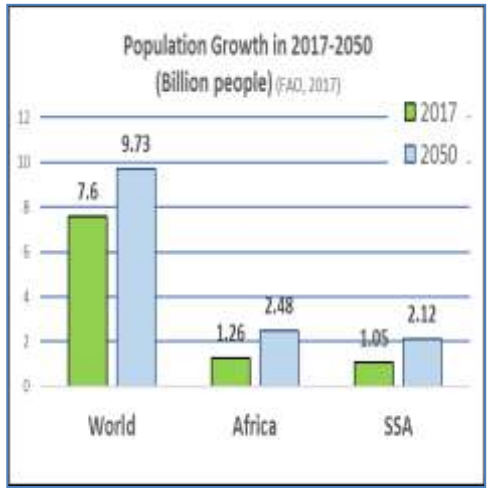
2. Challenges, opportunities and lessons-learned

Irrigation agriculture comprises many factors and processes that interact in a complex system comprising human, social, environmental, technical and biological elements[8]. In addressing challenges and identifying opportunities, it is important to assess the 'hard' technical elements of AWM as well as the 'soft' social and organizational elements, and their interaction with wider externalities of the irrigation-farming system. This section highlights some of the key challenges and opportunities for AWM in Africa and provides context for the strategies that are described in Section3.

2.1 Challenges and opportunities

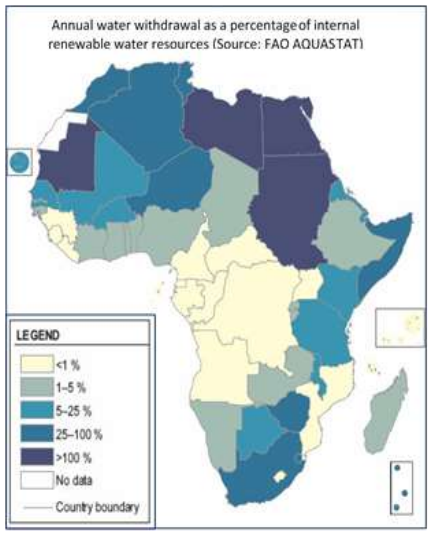
2.1.1 Population growth and increased food demand

Global population is expected to increase by an additional 2.2 billion people by 2050, equivalent to a 28% increase from a 2015 baseline[9]. More than half that growth, estimated at 1.2 billion people, will be in Africa. It is estimated that agricultural production will need to increase by 34% to meet the 2050 food needs of North Africa, and 112% for Sub-Saharan Africa from a 2015 baseline[1]**.** Better AWM presents an opportunity to reduce the high food import bill, expand and intensify regional agricultural production and trade across the continent, and support competitive regional agricultural value chains through the African Continental Free Trade Area (AfCFTA).



2.1.2 A trend of increasing water stress across Africa

Africa is endowed with significant but underutilised water resources that are unevenly spread across the continent. While cross sectoral competition, driven by urbanisation and industrial growth, is placing increasing localised pressure and stress on water sources, issues of water quantity and quality are significant stress elements in AWM. Rainfall variability on the continent is approximately twice that of temperate regions and droughts episodes are more frequent than anywhere else in the world. Africans also face relative water poverty, illustrated by the fact that they withdraw only a quarter as much water for human usage as the rest of the world. This has a marked effect on production and the general livelihood economy. The relatively low access to water is accentuated by very different levels of investment in AWM infrastructure across the continent. Over 80% of documented irrigation is concentrated in just 10 countries in North, West Africa, and South Africa[1]. There is an opportunity for innovations to emerge out of water stress, and a need to invest in a better understanding of the resource potential, disaggregated by sources and spatial geography.



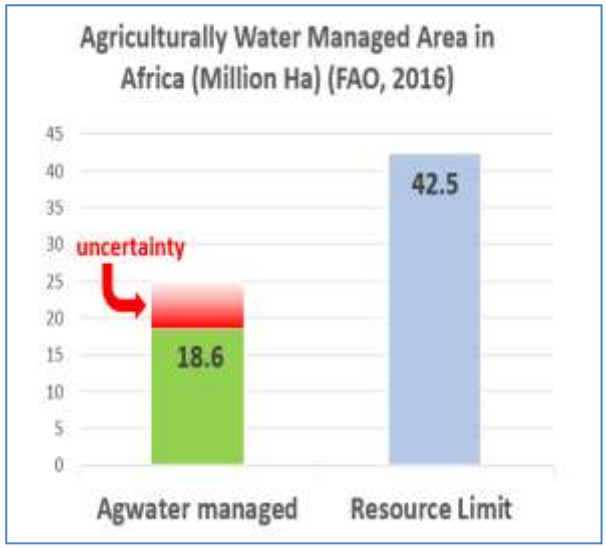
2.1.3 Urbanisation and new markes

Africa, like the rest of world, is urbanising rapidly with migration of mainly youth and men from rural to urban areas. This is driven by limited rural income opportunities that are compounded by low labour productivity due to low-intensity farming. Urbanisation is associated with higher incomes and changing lifestyles, which leads to shifts in food preferences; mainly increased demand for high value products such as meat, dairy, fruit and vegetables. The changes in food preferences leads to increased markets for crops with higher values, and these also demand more water for production. The pull-factor of urbanization thus accelerates irrigation uptake and presents an opportunity for the introduction of new irrigation technologies, such as more energy efficient solar pumps, and improved water application systems associated with peri-urban farming. These entrepreneurial drivers present an opportunity for market-oriented farming and explains most of the irrigation expansion across Africa in the last two decades[5, 10].

2.1.4 Underutilised irrigation resources

The FAO AQUASTAT database provides the best consolidated information on AWM and irrigated areas for the whole of Africa. However, the actual irrigated areas are known to be underestimated due to unrecorded farmer-led development whose coverage is largely undocumented. In West, East and Southern Africa these irrigators cover significant aggregated areas, in some cases even larger than the formally recorded irrigation-equipped areas.[5] Estimates of North African countries are likely to be more certain due to the limited expansion of farmer-led irrigation that has been responsible for most growth in the rest of Africa. The AQUASTAT data shows that the total cultivated area for Africa is approximately 271 million hectares (ha). About 18.6Mha represents the area under AWM management (irrigation and non-equipped AWM). The non-equipped areas include wetlands and valley bottoms. The areas equipped for irrigation as percentages of total cultivated and AWM areas in Africa represent about 5.7% and 83.1% respectively. It must be noted that there are wide variations between and within regions in Africa. North Africa has 47% of the recorded continental irrigation-equipped area, but very little non-equipped area[2].

Irrigation development is an important catalyst for increased agricultural growth. While available potential is almost fully developed in the rest of the world, Africa has much of its potential underdeveloped. Data on agriculturally managed water and irrigation equipped areas is uncertain. Uncertainties are large because of undocumented expansion of farmer-led irrigation. However, available data indicates that the agriculturally water managed area in Africa is only 36% of the estimated 42.5 Mha irrigable potential[2]. The available water and land resource is an important opportunity for expanded AWM to meet the food demands of the future.



2.1.5 Rainfed agriculture: tackling low productivity

The majority of poor people on the continent live in rural areas and are dependent on rainfed agriculture for their livelihoods. The cultivated area in Africa is estimated at 271 Mha, of which 242 Mha is in Sub Saharan Africa (SSA)[2]. Most smallholders practice rainfed agriculture, farming under erratic rainfall and in water-scarce conditions where dry spells can reduce yields. Rainfed farming is responsible for 58% of total food production in Africa and in SSA for 99% of the production of the main cereals, such as maize, millet and sorghum[11]. Generally, SSA is the least agriculturally productive region of the world, with a yield gap of 76%, compared with an average of 50% in most low-income countries, and only 11% in Asia[9]. AWM techniques that can improve crop production are underutilised. There is an opportunity for irrigation and climate-smart AWM technologies to support intensification, and to increase water-use productivity.

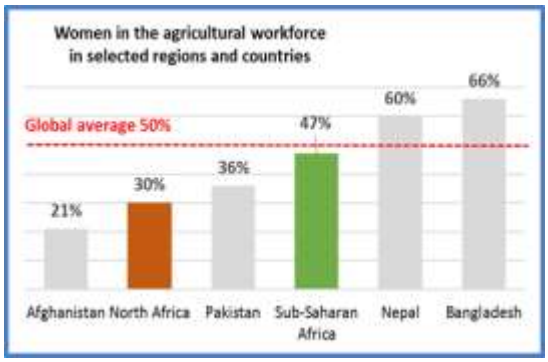
AWM technologies can help intensify rainfed farming

Rainfed farming produces most of Africa's grain but yields are only 24% of what is technically possible. Fertility management, seed selection, and agricultural water technologies, such as water-harvesting, are key climate-smart interventions to achieve intensification and farming system resilience.

2.1.6 Climate change and variability impacts on African agriculture

Africa is already experiencing variability in dry and wet-season rainfall, increasing desertification and more water related disaster risks. Where higher temperatures are expected to occur, this will exacerbate extreme climate events of droughts and floods[7, 12]. The most consistent observation is that there is a direct correlation between rising temperatures and increased water demand. The consequent reduced water availability will have the greatest impact on rain fed agriculture. Optimistic projections of global warming, which potentially underestimate negative impacts, suggest that climate change could reduce the five major grain crop yields in most parts of Africa. AWM interventions from water-harvesting in rainfed farming, to full-scale irrigation, are a priority opportunity to increase resilience by mitigating against climate shocks.

2.1.7 The feminization of farming and agricultural water management practices



Wider cultural and social changes, including urbanization and outmigration impact the gender balance in farming. Aggregate data shows that women comprise approximately 30% to 47% of the agricultural workforce across Africa. This varies across regions, countries and cultures (see insert graphic)[13]. The most significant growth in women's involvement in farming has taken place in North Africa, with a doubling of women's involvement. The feminization of farming calls for a transformative social approach to facilitate access to productive resources, especially irrigation and AWM assets. A facilitative social approach in membership and management of irrigator organisations; technology adoption and technical skills development; land-tenure and administration; and time-saving and labour-saving innovations, is an opportunity to significantly improve women's lives and household food security.

2.1.8 The rapid expansion of farmer-led irrigation development

Farmer-led irrigation development (FLID) has gained increasing importance in Africa in the last 20 years and is identified as the dominant process driving agricultural water expansion in Africa[14]. This sector comprises individuals and small groups who make their own investments to advance irrigation and AWM practices. They are mostly smallholder, market-oriented producers; typically farming horticultural crops for urban markets. FLID has expanded rapidly in West, East and Southern African regions and studies have identified that the areas under AWM are likely much larger than what is officially recorded[15].

The rapid growth, entrepreneurial character, and market-orientation of the FLID sector present an opportunity for support through more secure access to land and water, and improved access to technology. The uptake of new irrigation technology is limited by high capital and operational costs of fossil-fuel pump technologies, and the difficulty of organizing fuel, spare parts, and technical support. One opportunity for increasing profitability is to enable irrigation pump and equipment markets and reduce the triple challenge of high initial cost, high risk and high service/maintenance costs associated with petrol and diesel pumps[16]. Solar pumps for smallholder irrigation, linked to digital finance innovations are already available in East and West African markets. These and other tech-enabling interventions can overcome the triple challenge facing smallholder irrigators, and quickly increase profitability due to energy savings**.** A second opportunity follows from the inherent

unregulated character of the farmer-led irrigation sub-sector. Technology innovations, and agricultural support interventions, that lead to increased productivity and profitability can be aligned with basin management activities. In this way, technology adoption to reduce water abstractions, incentivised by increased farm profitability and benefits to farmers, can support stronger basin regulation, reduce water stress, and improve water allocation planning and compliance.

2.1.9 Information management systems and capacity of development agencies

The FAO AQUASTAT database provides the best consolidated official information on agriculturally water managed and irrigated areas in Africa. The data is however known to have significant uncertainties with different timelines (1987 to 2013), varied accuracy of source information, and with results that are modelled or aggregated. The actual irrigated areas are also known to be underestimated due to the phenomenon of farmer-led development of irrigation whose coverage is not well documented (see above). Strategic decision-making in AWM can be improved by driving a data collection agenda and establishing accessible information management systems, particularly for identifying the areas farmed under AWM as a result of FLID. In addition to the dearth of good information on AWM areas across Africa, and particularly in SSA, the capacity of Governments and agencies responsible for irrigation is limited by personnel shortages, lack of digital technology, limited skills, and a shortage of funding for AWM development. There is thus an opportunity to improve the human resource capacity in regard to AWM through a renewed emphasis on: formal AWM training in technical and agricultural colleges; promoting Young Professional programs in AWM interventions; and ensuring that the 'soft' organizational and institutional aspects of irrigation projects are allocated meaningful budgets in investment projects.

2.1.10 Multiple water use

In reality, people use water that is supplied by a water or irrigation system for different uses. The multiple-use systems (MUS) approach recognizes this and aims to ensure that domestic water supply or irrigation supply systems are designed and managed with multiple uses and multiple users in mind. The approach acknowledges a set of diverse users that share the infrastructure and water resource, often using engineered systems that were not intended to do so[17]. Awareness of MUS practice at different scales is important[18] including: i) at the household scale, MUS includes domestic consumption, garden irrigation, and small-livestock watering; ii) on irrigation schemes MUS can include domestic water supply to villages and urban settlements; fish and water-poultry production; livestock watering; groundwater recharge; laundry and bathing; swimming and recreation; and environmental needs and impacts; and iii) at watershed scale, MUS covers multi-sectoral use

including agricultural, hydropower, urban-domestic, industry, mining, and recreational sectors. A MUS view offers a more complete picture of water-management requirements and facilitates more responsive solutions to resource management and service provision challenges[19]. Addressing these competing multiple water use needs in a water-stressed world is an opportunity to achieve better service delivery and increased equity for the multiple users of the systems, and to achieve greater returns from AWM investments.

2.1.11 Land tenure

Informal tenure is often, but not always, a constraint to irrigation development. Farmer-led irrigation development has, for example, expanded across SSA despite the limitations inherent in customary land systems. There are often customary provisions for temporary use of areas such as wetlands and for specific groups such as youth and women[5]. On irrigation schemes and in situations where non-mobile irrigation investments are needed (such as buried pipelines, or concrete works) land tenure insecurity is a significant disincentive to investment. [20,21,22] When farmers are unsure about whether they have rights of use, they are hesitant to invest in hard assets such as fencing, irrigation infrastructure, agricultural equipment and resources (mechanization, storage etc.), as well as in soil-resource management such as soil fertility and structure.

There is reason to consider the situation of independent farmer-led irrigators, who often use easily-transportable equipment (such as pumps, flexible pipelines, and bucket-and-rope) differently from scheme irrigators who share fixed hydraulic infrastructure. *S*chemes exhibit particular problems caused by a lack of land-exchange mechanisms which include low land-utilization because farmers who are unable to farm have no secure way to lease or sell their land, and cannot be motivated to moved off the land and generate a rental income. There is also the issue of land fragmentation due to inheritance practices, where lack of land exchange mechanisms limits successful farmers consolidating small plots to pursue business-oriented market farming and thereby benefit from economies of scale[23]. The opportunity that presents itself is to develop formalized land-exchange mechanisms which can be built on traditional and customary practices, and national laws where these are available. Increased tenure security can increase irrigation scheme resource utilization and incentivize private investment.

2.2 Lessons learned

2.2.1 Irrigation lifts people out of poverty and makes economic sense

Evidence reveals that adoption of irrigation and other AWM practices has significant positive wealth creating and food security impacts on households as well as a positive developmental impact on the general economy. There are both obvious and hidden as well as private and public economic benefits derived from household investments in irrigation and AWM practices. Initial local benefits are construction jobs and services. However, investments are justified by the gains for individual farmers and the wider economic returns. These individual and economic benefits depend on the actual increase in farm production made possible by providing farmers with improved access to water for cropping. Household incomes are recorded across many studies in developing countries to be increased between approximately 1.5 to 3 times[24]. Economic and welfare benefits associated with health improvement, land protection, import substitution, social protection and rural development are enabled by investments in irrigation and AWM practices. At an economic level the performance of irrigation schemes globally has been positive. There are also positive ripple effects, with economic multipliers in the range of 2.5 to 4[25]. These multipliers are derived from support industries, services and activities in the input and output value chains, wage labour demand, and the construction industry.

2.2.2 AWM leads to increased land- and water-productivity

Irrigation can support an increase in cropping intensity by as much as 300 percent in areas where rainfall only supports a single crop per year, where water is available, and temperatures are conducive. This equates to producing the same or more food on a third of the land thus reducing land pressure, and potentially reducing loss of biodiversity by limiting the need for rainfed agricultural expansion. Irrigation farming is also associated with greater water productivity (crop per drop) due to the greater intensification involving higher-yielding seeds, the related adoption of good cropping practices, and the higher harvestable ratio to vegetative matter[7, 26] .

2.2.3 Small-scale irrigation has higher economic returns than large-scale irrigation

The likely returns on investment in small-scale irrigation across Africa are much higher than those in large-scale development. The average EIRRs projected for large-scale irrigation development in Africa was approximately 6 percent, versus an average EIRR of 28 percent for small-scale irrigation[27]. However, while small-scale expansion is one priority, investments in large-scale public schemes also have a role to play. These major infrastructure investments are always planned around the natural resource base, such as existing major dams, reservoirs and major rivers, where there is irrigable

land. Targets for irrigation expansion are unlikely to be achieved without some large-scale public scheme development[10]. The most successful irrigation development approach is through large-scale programs driving the development of many small-scale irrigation and agricultural water systems. Where large-scale public schemes dominate the irrigation landscape, the emphasis will necessarily be on driving technical upgrading, alongside legal reforms in water-law, and the modernisation of water scheme management organisations. Such modernisation interventions need to address water transmission and energy efficiencies, along with operational restructuring to ensure that institutions and governance arrangements are modernised alongside technology improvements.

2.2.4 Small-scale irrigation has greater resource potential for viable expansion

The land and water resource availability identified that 23.5 Mha in Africa could be developed with better than marginal EIRRs[27]. The report also shows that potential for possible expansion (92%) was outside Northern Africa. The results suggest that small-scale irrigation development is likely to be most suitable for 70-80 percent of the future expansion area, and large-scale public schemes likely comprise the balance of 20-30 percent.

2.2.5 There is a high risk of failure of pumped schemes operated by groups

Experiences show that, for groups of farmers using shared irrigation infrastructure, gravity schemes have a much greater chance of success than pumped schemes. Pumping challenges include high operational costs, technical problems at intake, a lack of technical operational support, weak water-management organizations for MOM, and the inability to meet shared energy payments (availability and enforcement of by-laws). The issue is not the pumping technology per se, but management of collective pumping. Individual pumped irrigation is known to be highly successful across Africa and India[16], while schemes less so. Small-group schemes are vulnerable to the challenges of technical complexity and high running costs and require effective Water User Organisations (WUOs). Experience suggests that pumped schemes when supplying groups of smallholders should be implemented mainly for the production of high-value crops, and be supported by farm-production, marketing and WUO establishment initiatives.

2.2.6 Water harvesting and conservation methods add resilience in rain-fed farming

The total water and land resource in Africa has the potential to boost agricultural productivity by at least 50 percent, yet the majority of the continent's food production is entirely rainfed. Soil-water management practices such as water harvesting and conservation (WHC) can greatly improve rainfed farming outcomes. These AWM practices increase plant-water availability as well as water and crop productivity. They help mitigate the negative impacts of variable climate and are

particularly responsive to climate-smart innovations which conserve resources. In addition, they facilitate increased plant diversity and the closing of the nitrogen cycle (to limit excess fixed nitrogen and reduce negative environmental impacts) and are associated with environmental co-benefits such as reduced waste and pollution.[4] While successes and positive impacts are widespread and convincing, there is some need for caution around an over-optimistic expectation that WHC techniques can ensure drought-proofing, as no rain means no runoff. Water stored in a soil-water reservoir can only go so far, particularly in lighter-textured soils and locations with a high aridity index. Thus, hybrid systems with localized storage, combined use of ground and surface water, and supplementary irrigation are important in certain locations. WHC practices thus need to be planned with attention to particular site conditions and cropping systems.

2.2.7 Yields can be greatly increased through intensification

Although agricultural innovations and rapidly developing technologies continue to boost productivity, the rate of increase in crop yields has slowed substantially. AWM practices increase intensification of land resources as multiple cropping can be supported. Major benefits associated with resource intensification under AWM is that the returns on land and labour are increased, nutrition is improved, and consumption is stabilised as the lean periods are eliminated or reduced. There is high potential for yield increases in most African countries given their current low yields under AWM. The IWMI's comprehensive assessment of AWM benefits assessed that 75% of additional food in the next decade could come from the world's low-yield farmers, increasing their production to 80% of the amount achieved by high-yield farmers.[28] Irrigation also offers opportunity to develop integrated farming that supports nutrient exchange and efficient water use. Intensification of production input through mixed farming, under irrigation, reduces the overhead cost of idle productive resources as well increase efficiency of used resources. Irrigation scheme planning combining crop-livestock/aquaculture/poultry farming have been tried at varying scale and found to enhance sustainability of irrigation schemes. Examples of sustainable enterprise combinations that can be exploited at scale include rice/fish, poultry/fish/rice and rice/water ducks combinations.

2.2.8 A watershed approach facilitates strategic planning

The planning and coordination of multiple initiatives brings IWRM challenges. Water scarcity and competition demands higher levels of regulation at larger spatial scales across catchments. Planning for intensification of water-use in rainfed farming, and for irrigation needs, is best considered through a watershed or landscape approach. Such an approach ties in with the CAADP emphasis on improved catchment and basin management. A watershed approach allows for practical boundaries

to be established so that inclusive, farmer-centred processes can be organised based on practical boundaries for water-assessment, and for institutional initiatives aiming to strengthen user rights and regulations. To be practical and cost-effective, hybrid water-management arrangements, customary law provisions, and tiered permitting and enforcement can be used to enable more equitable and secure water.

2.2.9 Plan in accordance with affordability and willingness to pay

Business principles and strategies are essential in irrigation farming to enable operation, maintenance and reinvestment in infrastructure. Smallholder farmers can afford to pay for maintenance MOM if a market-oriented and value-chain development approach is taken. This is a pre-requisite to being able to afford, and be willing to pay, irrigation service fees. The irrigation service fee is typically less than 10 percent of the total crop budget but can be double that in the case of small petrol pump and pipeline systems. Independent farmers across Africa, using petrol or diesel pumps, continue to operate from year to year despite the high operating costs, highlighting the affordability of irrigation. Affordability unfortunately does not equal willingness to pay. Awareness raising, lobbying and strategic measures to achieve attitudinal change are essential to translate affordability into willingness to pay. Government officials, scheme technical personnel and local traditional and religious leaders are key players in the attitudinal change process. Many individual smallholders use their own capital financing for irrigation equipment, but on large-scale schemes capital repayment for the investment in irrigation infrastructure is less common. Where policy requires full cost recovery for capital investments and MOM, cost recovery models would need to include long-term low-interest financing to smallholders. However, within the context of the IDAWM framework, economic factors should not be the only consideration. It would also be sensible to explore possibilities to include large-scale commercial entities as ‘anchor tenants’, as they have higher ability to pay. Profitability is an important pillar in irrigation scheme’s sustainability planning. The use of desalinized sea water for irrigation, though it offers a veritable source of water for irrigation development, the energy cost of desalting and conveying the water must be weighed against the expected social and private benefits. As the costs of desalting abstracted sea water and conveyance to production site becomes cheaper, relative to other sources of water use, it is expected that desalination practices for irrigation will become widespread especially in coastal countries.

2.2.10 Integrated agricultural water management projects are more successful.

Global and African lessons show that the success of projects has been widely associated with an increased emphasis on integrated projects, which takes into consideration all of the engineering, institutional and agricultural factors, including financing and marketing. The need for integrated projects has to be balanced with implementation capability and capacity, as complex projects have greater implementation challenges. Success factors include the following:

- Projects that invested in the 'softer' institutional components involving water, land and agricultural-enterprise development, alongside infrastructure, achieved better results;
- Higher rates of return were strongly associated with projects that had a lower investment cost per hectare, high crop productivity, and adequate institutional design;
- Projects supporting farmer-managed or jointly-managed irrigation systems had lower unit investment costs and performed better than projects with systems managed solely by a government agency;
- Schemes that allow for the combined use of surface and groundwater have improved performance due to greater reliability;
- Gravity smallholder schemes have the highest likelihood of success, and conversely, pumped group-schemes have higher risks of failure;
- Projects supporting farmers using their own independent systems are more likely to succeed; and
- An approach of developing many small-scale schemes under a large-investment program will likely lead to better results than developing large-scale schemes.

It was also found that the economic returns from large-scale schemes have improved over time, meaning that failures can be associated more with the techno-centric focus of decades past, than with the integrated programs of the recent past[29].

The opportunities and lessons from the discussion in Chapter 2 have informed the formulation and description of the strategic pathways in Chapter 3.

3. Development pathways and interventions

3.1 Introduction

In the future agricultural water development will have to respond to widely varying opportunities, involving different target groups and using varied strategies. This will involve small and large-scale, formal and informal, modernization of old and construction of new, and conventional irrigation alongside water harvesting in rainfed agriculture. Planning and implementation will have to incorporate a mix of conventional resource-based approaches and approaches that are more catalytic in nature and can enable dynamic market and social processes. In pursuing an AWM and irrigation development agenda, the concept of development pathways is used. These combine to facilitate growth and development in the agricultural sector in alignment with the CAADP and Agenda 2063 objectives. North Africa will tend to have more of a modernisation focus on existing irrigation schemes because most of the resources are utilised. The other regions of Africa have high potential for expansion of irrigation. Expansion and modernisation are, therefore, both important.

The four pathways are listed below and are presented over the page:

PATHWAY 1: Improved water control and watershed management in rain-fed farming

PATHWAY 2: Farmer led irrigation development

PATHWAY 3: Irrigation scheme development and modernization

PATHWAY 4: Unconventional water use for irrigation

3.2 PATHWAY 1: Improved water control and watershed management in rain-fed farming

Description of the AWM Pathway	Typical farm-enterprise character
Improved water control and watershed management in a rain-fed environment. The potential for growth and wealth creation through rainfed agriculture is vast. WHC approaches, and CSA practices are centrally important to actualizing these objectives in a rainfed environment. This pathway calls for planning and implementation at scales that need a watershed approach. Adoption of soil and water conservation practices to intensify production are key technical success factors.	• Rainfed smallholder plots and farms with mixed farming purpose. • Includes flood recession farming and shallow-aquifer use. • Dominant crops are grains, legumes and tubers. • Intercropping using tree-crops, fodder and other shade demanding crops is common. • Opportunities for crop-livestock synergies and farm-rangeland integration. Family labor is the main labour source.

Rationale: Rain-fed agriculture covers more land than the irrigated areas in Africa. Rain-fed agriculture is the dominant production system practised by the majority of smallholders, which represents over 80% of farm producers in dispersed farm locations in the rural areas. Rural areas are home to a majority of Africa's poor. There is an enormous potential to close the yield gap and achieve significant socio-economic benefits through AWM measures that enhance the production intensity and resilience of this most vulnerable group. Water harvesting and sustainable land-management practices, combined with a range of CSA practices and implemented in a watershed framework, is an approach that has demonstrated positive results across Africa. The scale of potential impact on area and numbers of farmers, combined with high EIRRs and low implementation costs compared to large-scale irrigation development, make this intervention important.



Water harvesting infiltration trenches



Key Interventions: These include mainly WHC technologies and institutional reform initiatives to achieve better coordinated local water resource use in surface and groundwater situations (flood-recession farming etc.). Technologies and practices include micro-scale methods, with diversion works and flood-spate basin techniques, ponds, bunds, infiltration swales, mulching, drainage/erosion management, and conservation-agriculture at farm and field levels. Others include:

- Adoption of AWM technologies including *in-situ* rainwater harvesting, watershed planning and implementation approaches with participative scoping and WRM and planning.
- Better targeting of investment to high opportunity irrigation and AWM localities, as well as forest and soil conservation hotspots, with an emphasis on the linkages between upstream water and land-use and downstream irrigation abstraction requirements.
- Introduction of water harvesting techniques in response to landform, climate and cropping preferences through piloting, and knowledge-and-awareness interventions.
- Use of CSA principles and promotion of the related suite of approaches tailored for local conditions, cropping patterns and markets.
- Application of the ecotype concepts that are important for efficient large-scale planning and out-scaling of AWM technologies.[30,31]

3.3 PATHWAY 2: Farmer led irrigation development

Description of the AWM Pathway	Typical farm-enterprise character
Individual (private) irrigation for high-value crops. This group comprises farmers who assume a driving role in improving their water use for agriculture. They are characterized by their independent entrepreneurial nature, private financing, and higher appetite for risk. **Small-scale community-managed irrigation** These are small-group schemes and are mainly developed through integrated rural development, natural resources management, community-driven development (CDD), or social fund projects.	• Typically grow high-value crops for urban, peri-urban and in some cases, export markets. • Typically irrigate small plots of 0.5 ha-2 ha. • Often, but not only, use pumped systems (small-petrol, diesel, solar pumps). • High reliance on shallow tube-wells in the case of individual irrigation systems. • Mainly horticultural crops. • Multiple cropping and market-oriented. • Family labor on smaller plots and use of employed/paid labor on larger farms.

Rationale: In Africa, farmer-led irrigation development processes have dominated irrigation expansion in the last two decades. Farmer-led irrigation involves many different technologies and has a distinct entrepreneurial, self-financing, and market-oriented character. Physical resource evaluations show that there is substantial potential for expansion of such small-scale blue and green water irrigation systems and EIRRs are high. Programs supporting this group need to target constraints to entrepreneurial growth. These kinds of interventions are relatively low-cost compared to large scale irrigation, which requires major investments in infrastructure.





Key Interventions: Access to affordable irrigation technology (including silt control) is a key challenge for smallholder farmers, along with access to finance, and land and water tenure security. Other interventions include:

- Promote appropriate business models for farmers operating at different scales;
- Eliminate or reduce import tariffs on pumps and irrigation equipment can generate greater econmic returns from accelerated irrigation production, than the tariffs themselves;
- Develop small-pump value-chains to achieve easier market access for technology buyers, and support spares and maintenance networks;
- Provide access to cost effective solar technology coupled with smart financial technology (via mobile money and smartphones) to reduce pumping energy costs and increase smallholder profitability;
- Develop National Standards to protect consumers interests with regard to pumping technology (petrol, diesel) and solar-energy technology;
- Promote adoption of low-cost improved soil management technologies;
- Promote use of proper landscaping for run-off and flood control and avoiding siltation of water pumps/reservoirs, use of properly networked run-off and flood conveyance structures;
- Formulate knowledge development and training programs on AWM, soil-water conservation, crop-intensification, and use and maintenance of technologies;
- Mainstream the farmer-led irrigation sector into watershed planning and management processeses to address equitable allocation, water stress and conflicts.

3.4 PATHWAY 3: Irrigation scheme development and modernization

Description of the AWM Pathway	Typical farm-enterprise character
Reformed and modernized irrigation schemes. In African countries, most of the public irrigation schemes are older with significant infrastructure rehabilitation needs. Modernization of infrastructure, *and* of the organizational *and* operational modalities, in addition to new scheme development is needed.	• Irrigation schemes include small, medium and large-scale farming enterprises. • Farming is often in transition from the original social project origins, to market farming. • Sustainable MOM, dependent on profitable market farming, is a key challenge.

Rationale: Institutional and other reforms are needed to make irrigation work. The high financial cost of providing reliable and sufficient water-services on large-scale public schemes necessitates an emphasis on market-based irrigation farming. Irrigation service fees, drawn from farm-revenue have to be allocated to routine and long-term operations and maintenance costs. Enabling legal reforms with regard to land-consolidation (as a pre-cursor to commercial partnerships), and to formalise WUO powers, are some of the elements of success. Modernisation of existing, rather than new schemes makes sense because of the sunk costs, lower unit-costs, and the likelihood of higher returns on investment.





Key Interventions:

- Promote a change of attitudes among farmers to move from subsistence agriculture to commercial agriculture. Farm profitability is the key incentive and will demand both reliable irrigation supply, and a value-chain approach, with agri-business development on the input and output value-chains;
- Initiate reforms that target policy and legislation to ensure WUOs and operators can function effectively, including measures such as compulsory membership in irrigation organizations, right to use of public infrastructure, and retention and utilization of irrigation service fees on the schemes;
- Include smart technologies in MOM administration reforms and support technical and organizational modernization to allow appropriate measuring and billing arrangements;
- Encourage metering with a specific focus on ground water abstraction;
- Institute private-sector or agency management of bulk-water supply systems on medium and large schemes (ie. to operate the supply, main and distributary canals), with a legally-established basis for regulation and equitable price-setting measures.
- Create awareness of the benefits of conjunctive surface and ground water use, supplementary irrigation and efficient water use technologies;
- Redesign hydraulically discrete secondary-level blocks with measured water releases and service-contracts with a bulk-operator or irrigation and drainage agency. Secondary-level irrigation canal and blocks can be managed and operated internally by WUOs;
- Promote general boundary/parcel mapping and land-administration systems to increase land exchange and utilization, facilitate consolidation and commercialization, and incentivise private-sector investment.

3.5 PATHWAY 4: Unconventional water use for irrigation

Description of the AWM Pathway	Typical farm-enterprise Character
Wastewater recovery and re-use Unconventional water use includes reclaimed wastewater from sewage treatment plants, urban runoff, and the desalination of seawater. Concern for human health and the environment are the most important constraints in unconventional water use for irrigation. While the risks need to be carefully considered, the importance of this practice for the livelihoods of countless smallholders has increasing importance in Africa.	• Unconventional water-use schemes can involve many small private irrigators or can be public schemes designed at the tail-end of water-treatment plants. • They are often located in peri-urban areas which are a major source of wastewater. • High value crops are targeted due to the relatively high costs of treatment.

Rationale: The use of sewage and urban waste-water for irrigation is a common practice in urban and peri-urban areas of most developing countries.[32] Water scarcity is an increasingly serious issues across Africa and rapid urbanisation presents an opportunity for waste-water re-use as an important alternative resource to blue-water. Untreated wastewater irrigation has risks related to environmental and health impacts that require strong management practices and high standards for quality control and protection. At the same time, wastewater contains nutrients that can boost crop growth and reduce chemical fertilizer use.


Waste-water treatment works



Key Interventions: Policy reforms are needed to prioritise waste-water irrigation opportunities and enable access to wastewater resources by irrigation farmers. Also:

- Initiate legal and regulatory reforms to ensure safe water quality related to different crops, on-farm practices, and technologies to ensure a safe working environment and adequately safe products;
- Formulate strategic responses that balance the essential regulatory mechanisms with the need to maintain benefits for the poor who rely on wastewater resources. The Stockholm Framework[33] is important as this suggests that countries should adapt guidelines to their own social, technical, economic, and environmental circumstances;
- Develop strong campaigns for awareness creation and public sensitization on the treatment and use of unconventional sources of water for irrigation;
- Establish reasearch, knowledge development and promote the application of measures to ensure the safe use of waste water for irrigation; and
- Share information, lessons learnt and best-practices on waste water recovery and reuse amongst Government agencies, irrigaiton practitioners and irrigation farmers.

3.6 Cross cutting development issues and key interventions needed

3.6.1 Inclusiveness in irrigation development and AWM

Agricultural production includes women, youths, minorities and other vulnerable groups, the roles of which are not often accounted for in economic and social terms. For instance, the contribution of women to farming is rarely acknowledged, which undermines their value as key contributors and relegates them to supporting roles. An enabling institutional and social environment can be created to facilitate inclusiveness in AWM. Inclusivity will provide a framework to better support every economic and social group to reach their full potential. FAO estimates that gender mainstreaming could produce 20-30% more food in Africa.[34]

Key Interventions:

a. National authorities to encourage inclusivity in access to productive resources, and undertake irrigation planning and design on an inclusive and consultative basis;

b. Conduct inclusive needs assessments and training interventions;

c. Schedule meetings according to both women and men's time preferences, to avoid conflict with traditional responsibilities;

d. Hold targeted workshops for women, youth and vulnerable groups in leadership and decision-making in Irrigation Organizations, and promote their involvement for stronger organizational functioning;

e. Encourage the youth to engage in the provision of technical support services through Young Professional programs, and through internships on AWM and irrigation development projects;

f. Conduct study tours to locations where women and youths play technical and leadership roles and are empowered to manage activities and take action in regard to WUO rules; and

g. Strengthen the technical training on irrigation management (on farm and irrigation system) and technology use and maintenance (of mechanization, pumps, agro-processing

equipment etc.) and encourage unskilled and semi-skilled labourers' engagement in AWM. Incorporate gender disaggregated data and reporting within project monitoring systems.

h. Include ICT and digital information in project monitoring systems.

3.6.2 Private sector involvement

Private sector involvement in various areas of water and agricultural production present opportunities for co-financing, and for increased market activity in the technical and financial aspects of irrigation operations. Private sector involvement imposes elements of sustainability and promotes competitiveness.

Key interventions:

a. Establish an enabling policy climate to attract private sector investments and participation in irrigation farming, irrigation operations, and related agricultural processing;

b. National governments to improve rural infrastructure such as feeder roads, rural electrification expansion, and ICT, to increase market access, reduce operational and transport costs, and increase farming profitability;

c. Mitigate risks in developing AWM partnerships by ensuring contractual clarity, fairness and equitable division of benefits between the private sector and local-farmer groups where operational or farming partnerships are established; and

d. Facilitate the development and cooperative arrangements among agricultural water users to offset risks and improve financial viability.

3.6.3 Climate change adaptation and resilience

Given that millions of hectares in Africa are cultivated through rainfed farming, there is high potential for increased productivity, building resilience and enterprise profitability across lowland and hillside production systems using a range of CSA approaches. CSA targets food security while achieving broader developmental goals under a changing climate. The approach aims to increase agricultural productivity and the resilience of farming systems while reducing greenhouse gases from the system in a sustainable way.

Key interventions:

a. Promote practices that build climate resilience which include:
   - diversification of farming systems to assimilate small and large livestock into the production and fertility management cycle;
   - introduction of water-efficient and usually low-cost small-scale irrigation;
   - soil and water conservation practices such as agro-forestry, micro- and macro-level water harvesting, bunding, mulching, composting and intercropping;

b. Bring a renewed emphasis on hillside and highland irrigation schemes, which require only suplementary irrigation as opposed to lowland plains, which generally have severe rainfall deficiency and comparatively limited resilience to climate change; and

c. Mainstream CSA[7] and watershed development approaches into regional and national agricultural investment plans.

3.6.4 Micro-credit and agricultural financing mechanisms

Micro-finance refers to the range of financial services provided to those with small or minimal financial capital, mainly but not only comprising people in poverty. Such services include credit, savings and insurance products. 'Micro-credit' refers to small loans provided to poor families to develop their economic activities. Such small-scale financial services are rarely provided directly by commercial banks in rural Africa because the returns on such small loans are low and the risks are high. Farmers often point to the lack of affordable and accessible credit arrangements as a critical constraint to gaining access to irrigation assets, particularly pumps. Where available, credit is usually short-term to purchase inputs, such as seed and fertiliser.

Key interventions:

a. Develop appropriate financial and insurance support systems through effective institutional support mechanisms;
b. Integrate technical and financial support for agricultural value chain development;
c. Develop and implement financing mechanisms that can provide such instruments as matching and revolving funds; and
d. Support marketplace platforms connecting customers, buyers and sellers in business-to-consumer (B2C) transactions, or business-to-business (B2B) transactions.
e. Strengthen the institutional capacity of microfinance institutions.

f. Create an environment that is conducive for innovative financing for irrigation development and AWM.

3.6.5 Policies, institutions and governance arrangements

It is essential that policies, laws and regulations are enabling to reap the major benefits that are available from under- and un-utilized irrigation and AWM potential. Supportive institutions, combined with effective and efficient management tools, can address key issues of energy availability, land and water security for multiple users, market linkages, and sustainable irrigation scheme operations. Insecure rights and/or a lack of physical access to water brings greatly increased risk that dis-incentivises private investment in irrigation. On irrigation schemes, permits must be addressed at scheme level with use-rights awarded to the appropriate scheme entity such as a WUO. River basin administration and water allocation is much more difficult in the case of multiple private irrigators using their own small irrigation systems. These farmers suffer uncertainty in most African countries as the administrative load is beyond the capability of government departments assigned to issue thousands of small-user permits[35]. This effectively criminalises individual water-users in addition to leaving them at greater risk and more vulnerable to water stress consequences.

Key interventions:

a. Align national, regional and continental policies;

b. Establish supportive policies, laws and regulations for the effective coordination of AWM at all levels;

c. Institute hybrid water resource regulatory arrangements that enable multiple small abstractors to increase their security of access[35]; these should promote water-use regulations that encourage high compliance and reduce transaction costs for smallholders, especially when abstractions are below certain thresholds;

d. Legally empower water management organisations (irrigation organizations and WUOs), particularly in relation to: use-rights of publicly owned irrigation infrastructure; compulsory membership of irrigation organizations and/or WUOs; and the right to collect and retain irrigation service fees at scheme-level to enable sustainable MOM;

e. Promote good governance in the functioning of organisational structures for water supply for irrigation and the provision of agricultural services;

f. Provide an enabling environment for the institutional development of land management; and,

g. Promote least cost energy options (renewable energy) and appropriate market linkages for irrigated agriculture.

3.6.6 Improving water and soil quality and other environmental problems

Poor drainage, water logging, eutrophication, soil salinity and acidity are common problems with AWM schemes. If not controlled these can lead to land unsuitability, scheme failure and associated loss of investments. There are many factors affecting water and soil quality. Lands that receive high rainfall or lands that are subject to continued irrigation can become acidic through leaching, they lose minerals over time because of continued crop harvest, or the parent material is acidic. Soil and water quality need to be emphasised in project design and ongoing operations to minimize loss of the natural resource.

Key interventions:

a. Promote the application of corrective measures to acidic soils such as the use of: agricultural lime; high quality compost; wood ash; and bone meal.

b. Encourage the routine leaching of salts through periodic heavy irrigation applications using fresh-water leading to deep percolation beyond the root zone, with treatments based on soil test results.

c. Promote investment in appropriate drainage systems.

d. Develop and impelemnt regulations for soil and water quality, including the use of fertilizers and pesticides.

e. Promote appropriate technologies and practices, and to control land degradation.

3.6.7 Research, monitoring, evaluation and knowledge transfer

The planning and regulation of new water related initiatives, whether these are focussed on intensification or expansion, requires much better data on the actual extent and potential expansion of existing AWM farming activities. There is significant uncertainty regarding the actual areas under AWM, including those equipped for irrigation and AWM without infrastructure. Similarly, with regard to innovative financial systems for farming, there is substantive early stage work unfolding in Africa. However, monitoring of experiences, amendment of approaches, and ongoing piloting is needed in countries across Africa to optimise the services in relation to the diverse needs of farmers. Ultimately, knowledge transfer through up-scaling and out-scaling is driven and facilitated by a good knowledge management system.

Key interventions:

a. Review and strengthen, as required, existing monitoring and evaluation systems at all levels to support comprehensive reporting on AWM;
b. Encourage and support R&D to continually improve the body of knowledge on AWM; and
c. Facilitate the establishment of relevant information sharing platforms and/or fora.
d. Account for ongoing regional initiatives and developing appropriate interventions in relation to knowledge of water resources, and the mobilization thereof for irrigation development and AWM.

3.7 Conclusions and recommendations

The sovereignty and sovereign equality of MS are duly emphasized in the Constitutive Act of the African Union. The implication of this is that all MS's have the right to decide on and adopt their own policies and sector development agendas. There is clearly a demand and opportunity for the expansion and intensification of AWM across the continent. Rainfed farming supported with agricultural water interventions and irrigation farming are both of high importance in AWM in Africa. There are many similarities in the challenges facing irrigation development and AWM across Africa, albeit in greatly diverse contexts. The options proposed in this framework are not binding upon nor do they assume mutual exclusivity as blueprints for irrigation development and AWM in MS. The framework recognizes the significant diversities in agro-ecological conditions, status of AWM schemes and the capacities for initiating, planning and implementing the options across the continent. Addressing the challenges of: technology access and finance for small-scale irrigators; institutional development in relation to land and water management; and private-sector involvement, are priorities. It is anticipated that country-level teams will elaborate each of these themes as appropriate to the opportunities.

The IDAWM framework proposes investment in four parallel pathways of development to achieve the 2014 Malabo Declaration targets. Seven cross-cutting themes need to be considered in relation to each pathway that together, will help inform policy reform and AWM program design. The framework calls for a broad view of opportunities with multiple parallel pathways that can transform agricultural resources and farmer potential, into a prosperous farming reality. Focal issues and opportunities have been identified and provide a basis for ongoing discussion at national level, for better-informed plans and leading to more evidence-based knowledge. It is hoped that the framework will support national strategies and project implementation to achieve the 2014 Malabo Declaration targets by promoting and accelerating country-level initiatives in AWM planning.

The key recommendations are:

Irrigation and AWM development must be a high priority: Irrigation needs to be elevated to a high priority in the allocation of government resources because it can make a major contribution to reducing poverty and enhancing food and nutritional security, given the increase in agricultural productivity that results from intensification.

Encourage and increase private sector involvement in water and agricultural production: The private sector is a critical player with opportunities for co-financing and/or supporting irrigation activity. These opportunities include different collaborative arrangements such as: out-growers in joint-ventures; management agents on community irrigation-farms; water-supply operators; technology supply and farming knowledge partnerships; or most simply as lessee's on a portion of the scheme generating income for landholders. Governments can reduce investment risks for the private sector and strengthen the investment climate through institutional reform interventions, and put in place incentives such as smart subsidies, tax waivers or financial securities.

Technology support and dissemination: Governments must support the definition of standards, technical training and irrigation equipment distribution networks, particularly for energy efficient small pumps and water-efficient irrigation equipment. Prime attention should be given to data collection, knowledge management and information dissemination.

Financial services and applications need to be encouraged in national policy and enabled in law. They can make a critical contribution in ensuring affordability of irrigation and farm technology, through easier and lower cost access to micro-finance.

Land tenure: Land-leasing on public schemes is limited by an absence of local institutions for leasing and exchange. Irrigation activity can be incentivised by lowering investment risks, for example by securing blocks of land for private-sector partnerships. Localised land-exchange interventions involving field mapping and local land registers provide a short-term option and can aid more secure land rentals and greater agricultural intensity.

Promote and strengthen water-management legislation and institutional reform: Water law enabling the participatory management of schemes through WUOs is weak in most African countries. Specific legal provisions are needed to ensure compulsory WUO membership on irrigation schemes, financial ring-fencing for MOM irrigation service fees at scheme level, and clear definitions of the technical and financial operational mandates.

Encourage and facilitate use of CSA practices will need to be a central feature driving intensification, increased resilience, productivity and profitability in rainfed farming. Such programs will benefit from using a landscape and watershed approach, which will help prioritise the types of AWM interventions best suited to targeted nodes, and aid the rationalisation of upstream and downstream water use priorities, and allocations.

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