IWMI Working Paper

147

Investing in Agricultural Water Management to Benefit Smallholder Farmers in Ghana

AgWater Solutions Project Country Synthesis Report

International Water Management Institute

RESEARCH PROGRAM ON Water, Land and Ecosystems

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Investing in Agricultural Water Management to Benefit Smallholder Farmers in Ghana

AgWater Solutions Project Country Synthesis Report

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Project

The AgWater Solutions Project was implemented in several countries in Africa and Asia between

2009 and 2012. The objective of the project was to identify investment options and opportunities in agricultural water management with the greatest potential to improve incomes and food security for poor farmers, and to develop tools and recommendations for stakeholders in the sector including policymakers, investors, NGOs and smallholder farmers. This report synthesizes the research findings and contributions made by the team and stakeholders in Ghana over the project period.

The leading implementing institutions were the International Water Management Institute (IWMI), the Food and Agriculture Organization of the United Nations (FAO), iDE, the International Food Policy Research Institute (IFPRI) and the Stockholm Environment Institute (SEI). The organizational partner in Ghana was the Ghana Irrigation Development Authority (GIDA) of the Ministry of Food and Agriculture (MOFA).

For more information on the project or for detailed reports, please visit the project website (http://awm-solutions.iwmi.org/) or contact the AgWater Solutions Project Secretariat (AWMSolutions@cgiar.org).

Contents

Summary

This Working Paper summarizes research conducted as part of the AgWater Solutions Project in Ghana between 2009 and 2012. The government believes that agriculture has a central role to play in promoting growth and poverty reduction in the Ghanaian economy. Agriculture makes up about 40% of Ghana's gross domestic product (GDP) and employs over half the economically active population. Two-and-three-quarter million households are involved in farming. Smallholder farms account for 80% of the nation's agricultural output using only 40% of the available agricultural land.

Ghana is endowed with substantial water resources. Estimates of the country's irrigation potential range from 0.36 to 2.9 million hectares (Mha) depending on the degree of water control. Yet, the country is largely dependent on rainfed agriculture, particularly in the north, and there is considerable variability across the country in terms of available water resources. This means that there is significant scope for investing in multiple water management options to reach millions of farming households. Ghanaian farmers already use a wide range of agricultural water management methods, mostly private irrigation systems in the form of emerging systems initiated by entrepreneurs, as well as conventional systems such as communal surface irrigation initiated and managed by the government or NGOs.

Researchers from the AgWater Solutions Project conducted studies on the potential for inland valley rice production, groundwater utilization, the use of motorized pumps, management of small reservoirs and out-grower schemes. Research methodologies included rapid rural appraisals, interviews, survey questionnaires and literature reviews.

The main findings indicate the following:

- Inland valleys can be used to increase the extent of rice cultivation. Improving water management, agronomic and post-harvest practices will all be required for success.
- For groundwater to be a viable resource, more work needs to be done to understand where groundwater is available, map aquifers and share the information with farmers.
- Motor pumps can increase yields and incomes but problems need to be overcome in areas such as financing, cost reduction (e.g., electricity supply), distance to pump suppliers, poor operation practices and maintenance.
- Small reservoirs need better management at all stages to reduce costs and improve equity.
- Out-grower schemes could provide a means to support smallholder farmers, including women, but they need facilitation, regulation and support.

INTRODUCTION: SMALLHOLDER AGRICULTURAL WATER MANAGEMENT

Across Africa and Asia, a growing number of smallholder farmers are finding ways to better manage water for agriculture to increase yields and income, and diversify their cropping and livelihood options. Farmers buy or rent irrigation equipment, draw water from nearby sources, and individually or collectively build small water storage structures. This development is often overlooked by external investors, yet the smallholder agricultural water management (AWM) sector is contributing to food security, rural incomes, health and nutrition. While small-scale AWM practices could potentially benefit hundreds of millions of farmers, this potential is far from being realized.

The AgWater Solutions Project examined this trend together with the opportunities and constraints associated with smallholder AWM in five countries in Africa, Ghana, Burkina Faso, Tanzania, Ethiopia and Zambia, and two states in India, West Bengal and Madhya Pradesh. Through this, the project identified a number of ways in which the potential of the smallholder AWM sector can be realized, including:

- **Building supportive institutional structures:** Existing governing bodies typically cater for public irrigation systems and are often not adapted to capitalize on the opportunities and to handle the challenges posed by this alternative mode of irrigation development. Traditional agricultural institutions rarely focus on market-oriented smallholder crop production, such as high-value vegetable production in the dry season.
- **Overcoming value chain inefficiencies:** Market inefficiencies negatively affect farmer decision-making and access to technology. Inefficiencies include: poorly developed supply chains; high taxes and transaction costs; lack of information and knowledge on irrigation, seeds, marketing and equipment; and uneven information and power in output markets.
- **Improving access to technology for all sectors of society:** Better-off farmers have greater access to information and technology than their poorer counterparts and women who face several hurdles: high upfront investment costs, absence of financing tools, and limited access to information to make informed investment and marketing choices.
- **Managing potential trade-offs:** While smallholder AWM can be beneficial for an individual farmer, its uncontrolled spread can have unexpected consequences. If not managed within the landscape context, the many small dispersed points of water extraction, can negatively impact downstream users and cause environmental damage.

Addressing these challenges requires a fresh look at new and existing AWM technologies, products and practices to enhance the potential of the smallholder AWM sector and find solutions.

WHY INVEST IN SMALLHOLDER AWM IN GHANA?[1]

Agriculture makes up nearly 40% of Ghana's GDP and employs over half the economically active population (Kundell 2008). Smallholder farms account for 80% of the nation's agricultural output and 2.74 million households are involved in farming (MOFA 2008). These figures are all the more impressive considering that not quite 40% of the available agricultural land is cultivated and productivity is generally low (Oppong-Anane 2001; Namara 2010).

[1] Based on AgWater Solutions Project 2010.

The government views agriculture as playing a central role in promoting growth and poverty reduction in the Ghanaian economy. Agricultural water management is a key element in productivity growth and poverty reduction, especially in the North.

Ghana is endowed with substantial water resources: estimates of the country's irrigation potential range from 0.36 to 2.9 Mha, depending on the degree of water control (FAO 2005; Agodzo and Bobobee 1994; Namara et al. 2011a). If well managed, the country's surface water and, largely untapped, groundwater systems are sufficient to meet most domestic and irrigation purposes[2]. Yet, the country is largely dependent on rainfed agriculture, particularly in the North, and there is considerable variability across the country in terms of available water resources. As a result, while the production of major staple food crops is adequate in most years, seasonal food insecurity is widespread. This means that there is substantial scope for investing in multiple AWM options to reach millions of farming households.

Ghanaian farmers already use a wide range of AWM methods, including emerging private irrigation systems initiated by entrepreneurs and conventional systems such as communal surface irrigation initiated and managed by government agencies or NGOs. These systems include:

- shallow groundwater irrigation using hand-dug wells, mainly for vegetables;
- Seasonal shallow wells, usually in low-lying areas;
- Permanent shallow wells, used throughout the year for vegetables, livestock and domestic purposes;
- Shallow tube wells;
- Communal borehole irrigation;
- River and stream water-lifting systems for commercial and 'out-grower' schemes';
- Small reservoirs and dugouts, both private and communal;
- Inland valley water capture systems for paddy and sometimes dry-season vegetables;
- River diversions and river pumping to gravity fed irrigation systems;
- Reservoir-based gravity fed irrigation systems; and
- Surface water pumping and sprinkler irrigation.

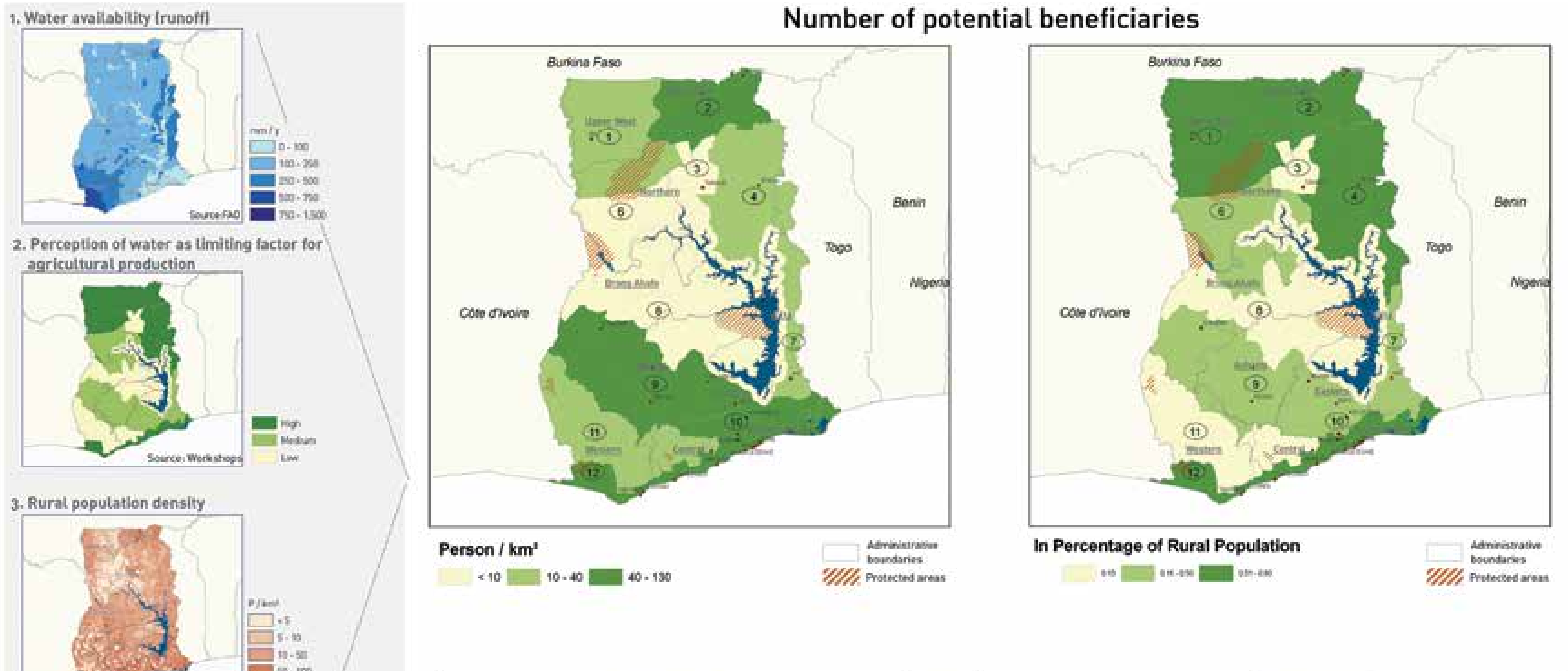
Private irrigation is now used by more farmers and covers a larger area than public and communal irrigation schemes.

The constraints common to all systems are shown in Table 1. Chief among these constraints are land tenure, access to credit and extension services, and lack of adequate infrastructure and market chains. The constraints are easy enough to identify. The challenge lies in how to address them.

The Agwater Solutions Project mapped the potential for AWM to improve the livelihoods of smallholder farmers in Ghana and found that, based on perceptions of where water is a limiting factor for agricultural production, just over 7 million people (almost half the rural population) could benefit from agricultural water management (Figure 1).

[2] Ghana is drained by the Volta, southwestern and coastal river systems, with a mean annual runoff of 39.4 billion cubic meters (BCM). In 2000, approximately 652 million cubic meters (MCM) of water was used for irrigation, approximately 66% of total withdrawals.

FIGURE 1. Potential beneficiaries of agricultural water management in Ghana.



Livelihood zone		Water availability: IRWR/cp (m³/p/y)	Rural population			Perception of water as limiting factor for agricultural production	Potential beneficiaries	
No	Name		Total (,000)	Density (p/km²)	% poor (underweight)		Person (,000)	in % of rural population
1	Cereal-based (sorghum/millet), legumes, yam, livestock (cattle)	5,669	779	29	31.4	High	623	80%
2	Cereal-based (sorghum/millet), legumes, yam, livestock (small ruminants and guinea fowl)	2,418	1,259	76	35.9	High	1,007	80%
3	Maize, rice, tree crops (mango), livestock	2,630	336	41	38.2	Moderate - Low	50	15%
4	Eastern corridor and Upper Volta: yam, cassava, livestock	6,671	929	34	36.7	High	743	80%
5	Volta lake: fishing, maize, yam	4,585	940	40	27.8	Moderate - Low	141	15%
6	Tubers (yam/cassava), maize, cashew, livestock	9,025	380	18	32.8	Medium	190	50%
7	Middle Volta area: tree crop (cocoa/coffee), cassava, small ruminants	3,998	298	83	24.7	Medium	149	50%
8	Maize (commercial), cassava and small ruminants; bimodal rainfall	4,892	1,071	48	24.2	Moderate - Low	161	15%
9	Tree crop (cocoa/oil palm/citrus), poultry (commercial)	1,944	3,672	100	24.4	Medium	1,836	50%
10	Rice (commercial) and livestock	466	1,731	147	22.8	Medium	865	50%
11	Timber, tree crops (cocoa/oil palm/rubber), mining	5,326	1,550	69	25.7	Moderate - Low	233	15%
12	Coastal zone: fishing, vegetables, salt	1,915	1,543	192	22.2	High	1,235	80%

Source: FAO 2012a

TABLE 1. Constraints to emerging and conventional AWM systems.

	Groundwater irrigation and emerging systems	Conventional irrigation systems
Policy and institutions	• land tenure insecurity, which discourages farmers from digging wells • inadequate technical knowledge for proper operation and maintenance (O&M) • poor AWM extension services	• disputes between livestock owners and farmers over land
Costs and financing	• limited access to inputs, including water-lifting technologies and affordable well-drilling • high labor demand • lack of credit facilities	• lack of equipment and funds to develop the entire potential area • lack of credit
Infrastructure	• frequent failure and restrictive irrigation schedules in communal systems • inadequate storage facilities and markets; the cost of fuel and electricity to run pumps	• poor infrastructure (either from the outset or due to inadequate O&M) • limited crop storage
Biophysical	• pests and diseases	• siltation • long distance between farmland and water source or storage unit

Source: Namara 2010.

AWM Investment Opportunities in Ghana

The AgWater Solutions Project identified many existing AWM practices that could support the realization of this estimate that just over 7 million people could benefit from agricultural water management. In Ghana, after consultation with a variety of stakeholders, the following practices were reviewed in detail:

1. **Water-lifting technologies,** which can be owned and operated by smallholders, privately or communally, and by commercially oriented large-scale farmers.
2. **Small reservoirs and dugouts** that can be owned communally by smallholders or privately by commercial farmers.
3. **Innovative institutional arrangements** for accessing water for agriculture and output markets, including out-grower schemes and public-private partnerships.
4. **Groundwater use** for agriculture, including shallow and deep groundwater using different drilling and pumping techniques.
5. **Development of lowland/inland valleys.**

A series of recommendations were made as to how to increase smallholder farmers' adoption and sustained use of these options (Table 2).

TABLE 2. Summary of AWM solutions, recommendations, potential beneficiaries and estimated cost.

AWM solution	Beneficiary households (% of rural households)*	Area in hectares (% of total agricultural land)*	Estimated investment costs (USD)
Inland valleys can be used to increase the extent of rice cultivation. Improving water management, agronomic and post-harvest practices will all be required for success.	261,000-377,000 (7-10%)	391,000-565,000 (2-3%)	600/hectare (ha)
Motor pumps can increase yields and incomes but problems need to be overcome in areas such as financing, cost reduction (e.g., electricity supply), distance to pump suppliers, poor operation practices and maintenance.	564,000-730,000 (16-20%)	451,000-584,000 (2-3%)	400/household
Small reservoirs need better management at all stages to reduce costs and improve equity.	74,000-163,000 (2-4%)	74,000-163,000 (1%)	750,000/cubic meters (m^3) of water stored
Out-grower schemes could provide a means to support smallholder farmers, including women, but they need facilitation, regulation and support.	Not calculated	Not calculated	Not calculated

Source: This study; all data: FAO 2012a.

Note: * Figures assume that out of the total potential beneficiary households calculated, 50% adopt the AWM option.

These findings are derived from an approach that combines primary and secondary data collection, stakeholder involvement and mapping. Details of the approach taken by the AgWater Solutions Project and the related studies are given in Box 1 and elaborated in subsequent chapters. Further information, including case studies and mapping data, can be found on the project website (http://awm-solutions.iwmi.org).

Box 1. AgWater Solutions Project approach.

Situation analysis and selection of AWM options: An initial analysis was undertaken of the conditions in each country and the AWM practices already being undertaken. These were reviewed with stakeholders and some of the most promising practices were selected.

Field-scale and community-level case studies: Researchers used a participatory opportunity and constraint analysis and methodology to understand the complex interaction among social, economic and physical factors that influence the uptake and success of AWM options, and to identify technologies appropriate to different contexts in each of the project countries.

Watershed-level case studies: Researchers used a multi-disciplinary approach to look at how the natural resource base impacts on, and is impacted by, AWM in four watersheds in Tanzania, Burkina Faso, West Bengal (India) and Zambia. The analysis concentrated on the hydrological impact of current and potential AWM interventions; the current resource-based livelihoods and dependencies on sources of water and water management practices; an

(Continued)

Box 1. AgWater Solutions Project approach (Continued).

impact assessment of potential AWM scenarios; and a review of formal and informal institutional capacity to deal with AWM interventions and potential emerging externalities.

National AWM mapping: Maps were developed to help assess where AWM will have the greatest impact within a country or state, and where specific interventions will be most viable. The steps followed were to use a participatory process in which experts defined the main livelihood zones based on farming typologies and rural livelihood strategies, and the main water-related constraints and needs in the different rural livelihood contexts. Using this, the potential for investment in water to support rural populations could be mapped based on demand and availability of water. A further step was to map the suitability and demand for specific AWM interventions, such as motor pumps or small reservoirs, and to estimate the potential number of beneficiaries, application area and investment costs. These allow investors to choose entry points and prioritize investments in AWM that will have the most beneficial impacts on rural livelihoods.

Regional AWM analysis: Researchers used geographic information system (GIS)-analysis, crop mix optimization tools and predictive modeling techniques to assess the regional potential for the 'best-bet' AWM technologies in South Asia and sub-Saharan Africa in terms of: potential application area (in hectares), number of people reached, net revenue derived and water consumption. Scenarios were also developed to factor in climate change and potential changes in irrigation costs.

Stakeholder engagement and dialogue: An integral part of the entire project was the engagement of stakeholders from the initial assessment of AWM opportunities through to the identification of possible implementation pathways. The dialogue process was used to ensure that project results reflected stakeholder perceptions and addressed their concerns. National and sub-national consultations, dialogues, surveys and interviews were fed into all stages of the project.

AWM OPTIONS REVIEWED

Inland Valley Rice Production[3]

Vast areas of Ghana's inland valleys are currently not under cultivation, and those areas that are under cultivation often have low yields. Extending rice production and improving surface water management in inland valleys could bring much-needed profitability to smallholder farmers.

[3] Based on Namara et al. 2011b; and AgWater Solutions Project 2011a.

Where the opportunity lies

The government has shown an interest in revitalizing its domestic rice sector to meet growing demand, reduce imports, and contribute to poverty reduction and youth employment. Inland valleys are a low-cost, high-potential option (Box 2).

Box 2. Definition of inland valleys.

Inland valleys are defined as the upper reaches of river systems in which river alluvial sedimentation processes are absent. They are composed of valley bottoms and minor floodplains, which may be submerged for part of the year. In these small valleys, alluvial sedimentation processes are of minor importance and watersheds are generally limited in extent. This definition excludes other agro-ecosystems, such as alluvial plains, mangrove swamps, deltas or lagoons.

The area covered by inland valleys is about 28,000 ha and lowland valleys cover another 1.9 Mha, or 12% of Ghana's land area (Otto and Asubonteng 1995; FAO 2005). The suitability analysis carried out by the AgWater Solutions Project, based on biophysical suitability and livelihood zones, calculated that there was potential to develop 780,000 to 1.2 Mha (FAO 2012a).

Inland valleys have high potential for rice cultivation given the relative ease of water access, availability of water in the wet season, soil moisture content in the dry season and the relatively fertile soil. Their development comprises of the construction of water capture and delivery structures by which farmers can provide supplemental irrigation and improve soil-moisture retention. Several government- and donor-funded projects are already targeting these areas for development.

The research

Interviews with approximately 500 farmers in Ashanti and Northern regions confirmed the potential to increase inland valley cultivation, but farmers face several challenges:

- High labor requirements (Table 3).
- Low rice yields (Figure 2) due to poor agronomic practices and stresses such as pests. In Ashanti, for example, over 80% of farmers had yields of 2 tonnes per hectare (t/ha) or less.
- Low profitability – gross margins GHS 45-80/acre (57-101 USD/ha) compared to over GHS 160/acre (251 USD/ha) for irrigated rice in the same region.
- Limited access to technologies such as power tillers to maximize yields.
- High costs of credit and insufficient financing options.
- Inadequate extension services and information sources.

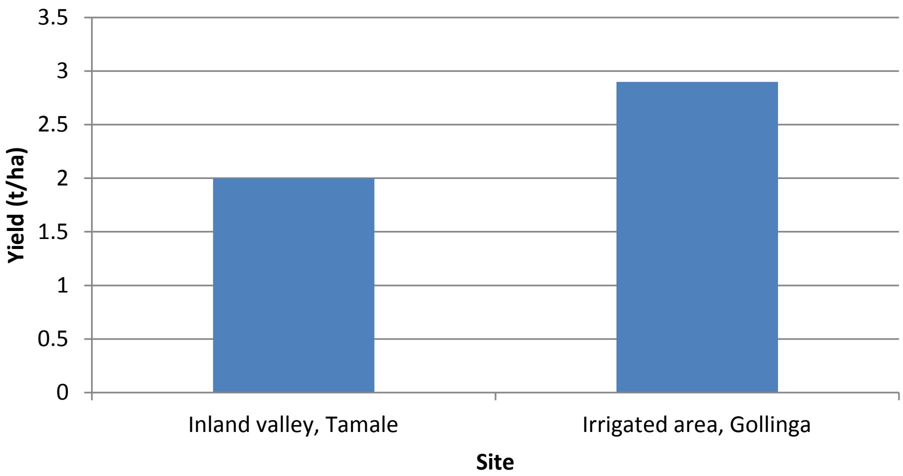
TABLE 3. Labor requirements of inland valley rice cultivation based on two case studies.

	Labor requirement for case 1*: (approximate man-days per hectare)	Labor requirement for case 2†: (approximate man-days per hectare)
Land development and preparation	126	116
Water management	114	125
Agronomic practices	60	63
Crop protection required	132	69
Harvesting and threshing required	145	75
TOTAL per hectare	577	448

Source: Namara et al. 2011b.

Notes: *Case 1: In Amoakokrom, six farmers were organized to develop rice on a 1.3-ha field. The labor requirement was monitored by the district extension personnel of MOFA, Ghana. †Case 2: In the Afari community, a farmer has joined a project to develop a 1.7-ha rice farm in the inland valley.

FIGURE 2. Comparison of yields from un-irrigated inland valleys and irrigated land.



Source: Namara et al. 2011b.

Where to invest

Inland valley rice production has huge potential. A plan of action to capitalize on that potential will include the following action points:

- In the Northern Region, focus on full irrigation, as opposed to supplementary irrigation, to allow for dry-season cropping.
- In Ashanti, focus on supplementary irrigation during the region's two rainy seasons.
- Ensure tenure security through improved tenancy agreements.
- Initiate capacity building for researchers, extension personnel and farmers in appropriate agronomic practices for inland valley rice farming.
- Improve agronomic recommendations for fertilizer application rates, crop varieties and water application, based on field experiments, and technical and economic criteria.

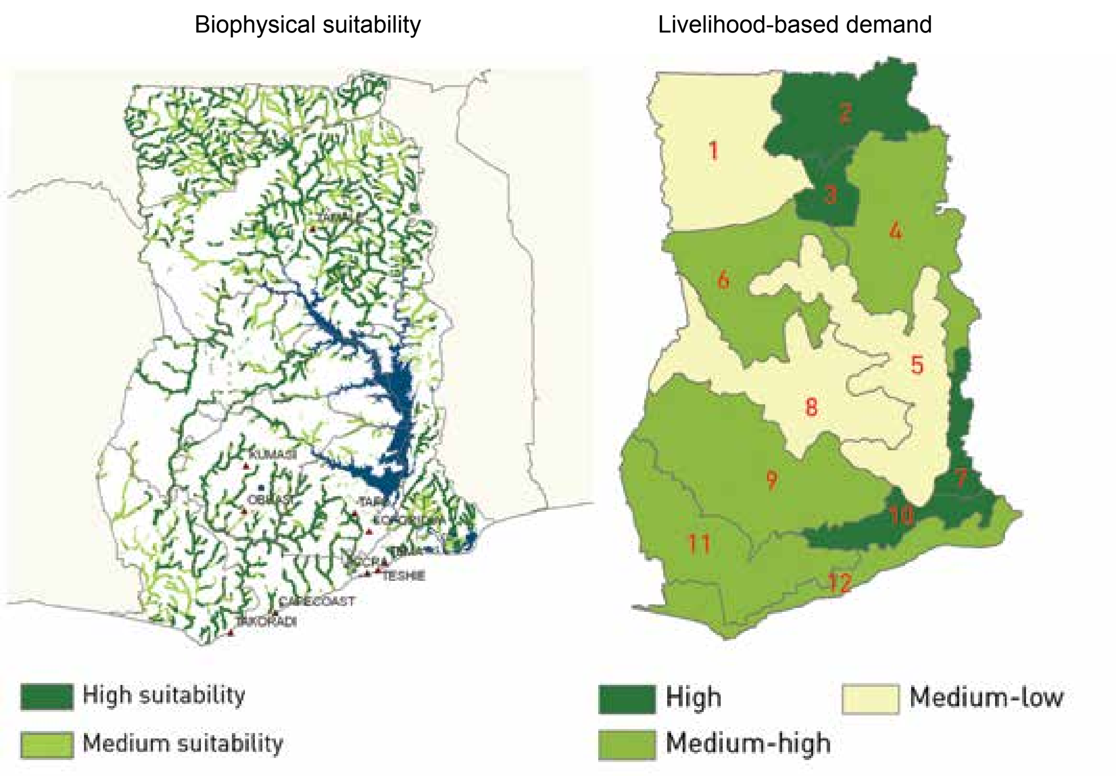
- Institute affordable, long-term financing mechanisms for input procurement and investment based on the economic viability of inland valley rice cultivation.
- Improve post-harvest handling systems, for example, introduce mechanical threshers.
- Improve the land management capability of farmers by introducing affordable equipment, such as power tillers.
- Assess the environmental consequences of scaling-up inland valley farming.

Who benefits and where

Biophysical criteria of proximity to markets and surface water, steepness of slope and suitability of land to cultivate rice were combined with livelihood-based demand, which is assumed to be greater in areas with a relatively high prevalence of rural poverty and rice-dominant livelihoods, to determine where inland valleys can be most beneficial. The AgWater Solutions Project estimated that, at a 50% adoption rate, inland valley rice production could benefit 261,000 to 377,000 households (7 to 10 % of rural households) in Ghana.

The potential application area in Ghana is 391,000 to 565,000 ha (2 to 3% of total agricultural land). For details on where inland valley rice production could have the greatest livelihoods benefits, see Figure 3.

FIGURE 3. Potential for inland valley rice production to improve livelihoods based on biophysical suitability (left) and demand (right).



Source: FAO 2012a.

Increasing Access to Shallow Groundwater[4]

Shallow groundwater irrigation has the potential to profit smallholder farmers. Achieving that potential requires better knowledge about groundwater availability, specialized extension services, and improved policy and strategic support.

Where the opportunity lies

Agriculture uses only 5% of the total groundwater consumed in Ghana. The cost of developing shallow groundwater for irrigation is relatively low, and farmers can achieve good returns for dry-season vegetable crops such as tomatoes and peppers. However, there is no specific policy on groundwater use. A combination of informed supportive policy and better hydrogeological data could significantly increase groundwater use with concomitant benefits for farmers and consumers.

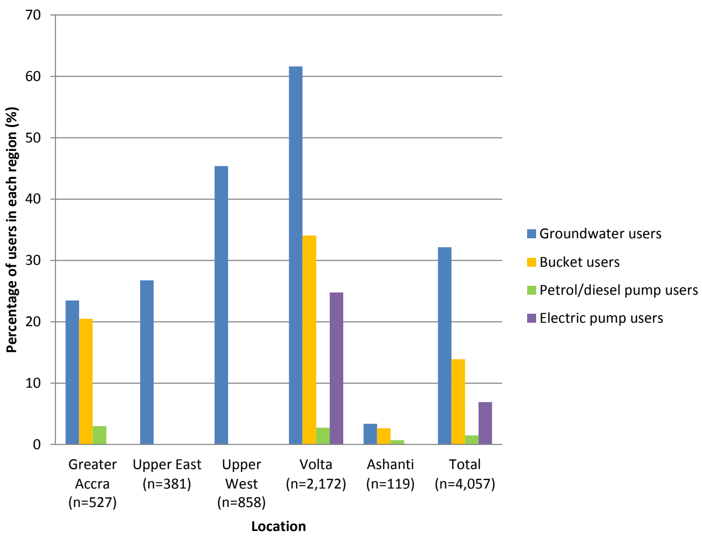
Approximately one-third of smallholder farmers in the Volta, Upper East, Upper West and the Greater Accra regions already make use of shallow groundwater, but several limitations must be overcome to encourage more users. Limitations include: labor requirements for annual well-digging; high energy costs for pumping; limited access to affordable technologies, advice, credit and markets; insecure land tenure; and attacks from pests and diseases.

The research

Data was collected from communities in Upper East, Upper West, Ashanti, Greater Accra and Volta regions. The survey covered 12,620 households and was followed by in-depth interviews with 494 randomly selected farmers in Ashanti, Greater Accra and Volta.

The study found that 32% of the farmers in the sample use groundwater, with most using buckets. Groundwater use is greatest in the Volta Region, where AWM technologies are more varied. Electric pumps are only used in the Volta Region (Figure 4).

FIGURE 4. Percentage of farmers using water-lifting devices to access groundwater.



Source: Namara 2011.

[4] Based on Namara 2011; and AgWater Solutions Project 2011b.

Increasing access to groundwater: Costs and benefits

Investment costs of developing shallow groundwater for irrigation vary by system and location but are generally low. In-field seasonal and riverine seasonal systems are least costly at GHS[5] 26 to 160 while un-lined shallow wells are GHS 120 and permanent lined shallow wells are GHS 150. The major crops are tomatoes, peppers and vegetables. Using an analysis based on tomatoes, seasonal riverine systems are most profitable (Table 4). Labor is a major component of the cost.

TABLE 4. Profitability analysis for tomatoes irrigated with shallow groundwater in the Upper East Region (in GHS).

	In-field seasonal	Riverine seasonal	Permanent
Gross income	859.0	1,478.0	348.0
Total variable cost	601.7	702.4	524.6
Fixed cost	7.9	48.2	48.7
Total cost	609.6	750.6	573.3
Gross Margin (GM)	257.4	775.6	-176.6
GM excluding labor costs	554.9	967.2	274.6

Source: Namara 2011.

Where to invest

Increasing the use of groundwater is predominantly about obtaining and sharing better information about where groundwater can be found and easily tapped. This will also reduce the cost of drilling and pumping. Specific measures include:

- improving knowledge of groundwater availability and use;
- developing easily accessible and easy to read groundwater maps;
- formulating an explicit groundwater irrigation policy and strategy;
- providing extension services that cover groundwater irrigation issues and related agronomic information, such as types of crops to grow and irrigation schedules;
- providing agronomic and on-farm water management research support; and
- aligning the country's rural energy policy to the special needs of groundwater irrigated agriculture, e.g., provide electricity connections to farmers and apply a reduced tariff.

Who benefits and where

More efficient use of groundwater would have practical benefits for smallholder farmers, the agricultural sector and the national economy.

- The total value added from shallow groundwater irrigation is estimated to be USD 1.2 million over a period of 3 to 4 months of the year.

[5] At the time of writing, USD 1 = GHS 1.92.

- Shallow groundwater irrigators have lower incidences of poverty than farmers who depend solely on rainfall.
- Shallow groundwater use would stimulate job creation, especially for young people and particularly during the dry season. Fewer people would be forced to migrate in search of work.

Although farmers use a wide range of water-lifting technologies, diesel and electric pumps offer the greatest potential to increase efficiency and household income. The benefits would be similar to those outlined in the next section, *Increasing Access to Small Motorized Pumps.*

Stakeholder recommendations.

- River pumping is the most common method of irrigation, but there is potential to develop groundwater use in some areas.
- Use of appropriate technologies and better physical explorations could reduce high drilling costs.
- Rural electrification could reduce the cost of pumping as electric pumps are less expensive to run than diesel pumps. The current rural electrification strategy and pricing policy does not consider agriculture. Electric pumps should be promoted and the government should extend power to potential sites and reduce the cost of power for agricultural use.

Source: FAO 2012b.

Increasing Access to Small Motorized Pumps[6]

More affordable and easily available motorized pumps would dramatically improve the productivity of farmers in Ghana's poorest areas.

Where the opportunity lies

There are an estimated 1.85 million farm households in Ghana, with an average of 1.5 ha of potential irrigable land per household. There were nearly 170,000 petrol and diesel pumps and 5,000 electric pumps in use in 2009, and based on the trends over past years it can be assumed that this has risen (Figure 5). If each of these pumps was owned by a separate household, just 12% of farming households would be pump owners.

Many households use water-lifting technologies, mainly to grow vegetables in the dry season. Farmers using motor pumps grow significantly more vegetables than bucket users and dry-season yields are higher for pump users.

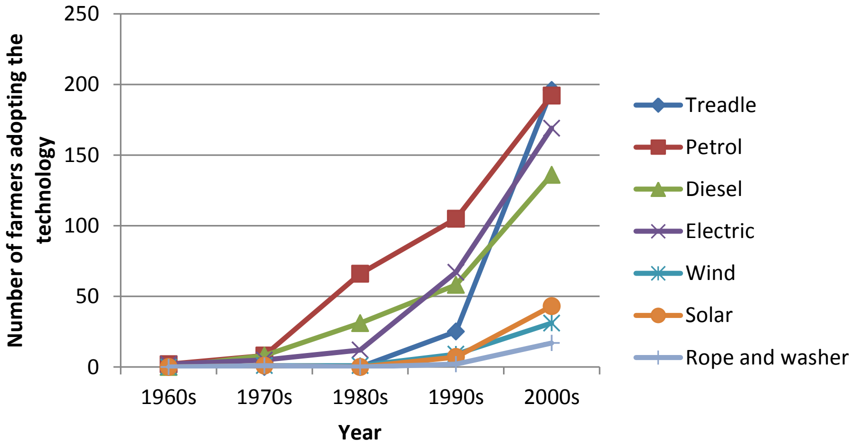
The research

Research carried out by the AgWater Solutions Project team identified the current conditions, trends and constraints around pump use. Farmers with landholdings of all sizes are benefiting

[6] Based on Namara et al. 2012c; and AgWater Solutions Project 2011c.

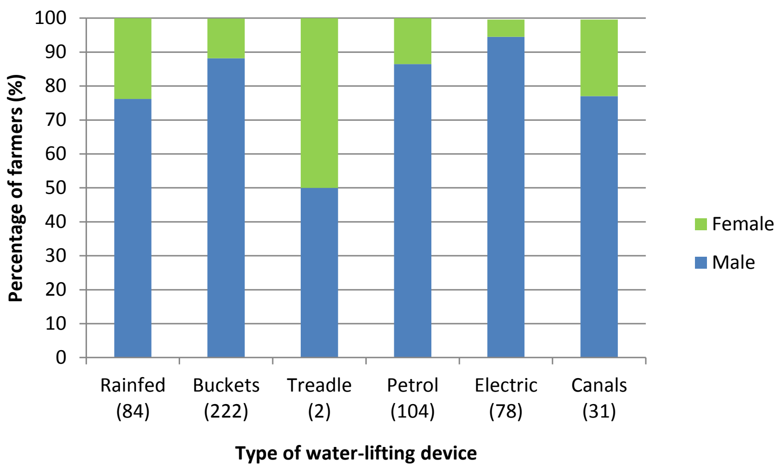
from motorized pumps, but users tend to be male, younger and better educated. Women tend to be better represented in public irrigation systems, perhaps due to government interventions (Figure 6).

FIGURE 5. Increase in motorized pump use.



Source: Namara et al. 2012c; figures based on a sample survey carried out in Ashanti, Greater Accra and Volta regions.

FIGURE 6. More men use motorized water-lifting devices than women.



Source: Namara et al. 2012c.

Most farm inputs are available reasonably nearby, but pumps are not. Most farmers buy their pumps from outside the country or rent from neighbors. Pump imports for agricultural use are exempt from certain taxes, but the process of getting the exemption is lengthy and the actual benefits may not reach the farmer.

To fund the cost of purchasing pumps, most farmers use their own money or borrow from informal sources such as market traders at high interest rates or by selling back their produce at a predetermined price or in-kind. Pump rental is also an important way of accessing irrigation water, especially for petrol pumps (Figure 7; Box 3).

Box 3. Irrigation service providers.

Irrigation service providers are private entrepreneurs who rent out small pumps and offer support services to farmers who want to irrigate dry-season crops.

In many sub-Saharan countries, millions of smallholder farmers earn extra cash income from irrigated vegetable cultivation during the dry season. Most use simple hand-watering methods which are time consuming and limit the area they can cultivate. Some farmers use small pumps to expand their cultivated area and with it their profit, but only relatively well-off farmers can afford the initial investment costs and have the means to run and maintain a pump. Women farmers, in particular, face trouble accessing motorized pumps. An alternative is to hire a pump for the time required to irrigate.

An irrigation service provider owns one or more portable motorized pumps along with hoses, pipes and other accessories. The service provider rents a pump set to an individual or a group of farmers for a fixed period of time, and takes care of the running costs, and operation and maintenance of the pump set. Farmers pay a fixed rate per hour that covers all costs and leaves a profit for the service provider. Depending on the need and the level of skill and motivation of service providers, they can extend their services to offering loans for agricultural inputs, agronomic advice and credit.

Benefits:

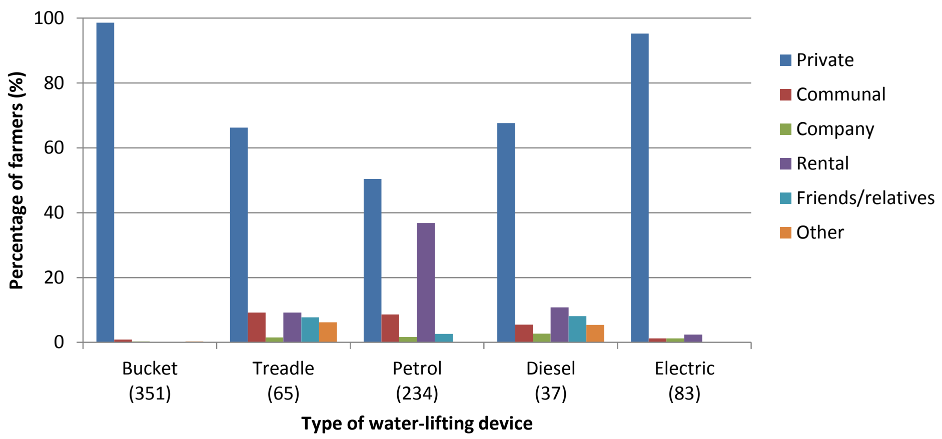
- For local entrepreneurs: a profitable business opportunity.
- For farmers: affordable access to motorized pumping as individuals (no need to organize into a collective); potentially related services (agronomic and marketing advice, and credit); and higher profits from vegetable farming due to larger areas and better water supply.

Farmers that irrigate with motor pumps generally have higher gross margins than bucket or canal users in both the dry and wet seasons (Figure 8).

Although incomes can be good for vegetable farmers, nearly 80% sell their produce at the farm gate at low prices, particularly in the Volta Region. Price variability from season to season is high. This is an impediment to the livelihoods of existing pump users and to those wishing to enter the market.

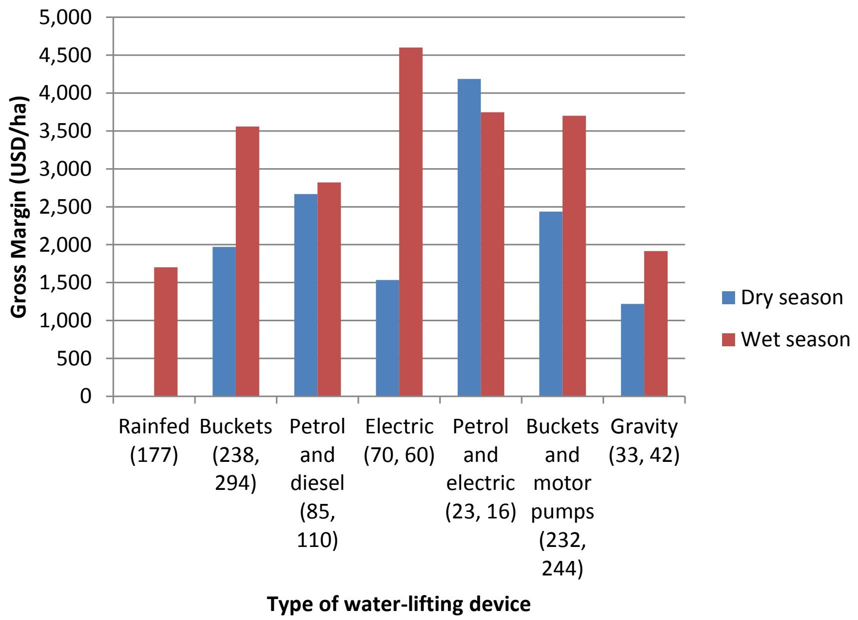
In summary, the major constraints to the adoption of motor pumps are lack of financing options, supply of pumps, unreliable water sources and the high cost of labor.

FIGURE 7. Private ownership and rental are the main forms of access to motor pumps.



Source: Namara et al. 2012c.

FIGURE 8. Gross margins of vegetable producers using different water-lifting devices or sources of irrigation.



Source: Namara et al. 2012c.

Where to invest

There is already a large network of motor pump dealers in Ghana. Getting more and better pumps into the rural hinterlands is largely a matter of logistics and policy resolve. These simple measures would help:

- Communicate the benefits of water-lifting technologies through farmer field days and the mass media.

- Improve the supply chain for pumps by drafting registries of existing importers, dealers and retailers, and potential after-sales service providers.
- Institute a product quality assurance system.
- Incorporate basic technical training on small motorized pumps into school agricultural syllabi.
- Prepare a training manual for use by dealers, retailers, extension professionals, maintenance service providers and farmers.
- Help farmers get the most out of their pumps by offering training on pump selection and maintenance, crop selection and agronomic practices, the handling of crops after harvest and the marketing of produce.
- Provide access to affordable loans on reasonable terms or improve financing mechanisms.

Who benefits and where

To determine where motor pumps can be most beneficial for livelihoods, biophysical criteria and livelihood demand were combined. Biophysical criteria used were travel time to markets (defined as towns with 20,000 inhabitants or more), and proximity to surface water using the proxy of the presence of soils with shallow groundwater potential (fluvisols, gleysols, gleyic sub-units). The AgWater Solutions Project estimated that motorized pumps could benefit 564,000 to 730,000 households (16 to 20% of rural households) in Ghana, at a 50% adoption rate.

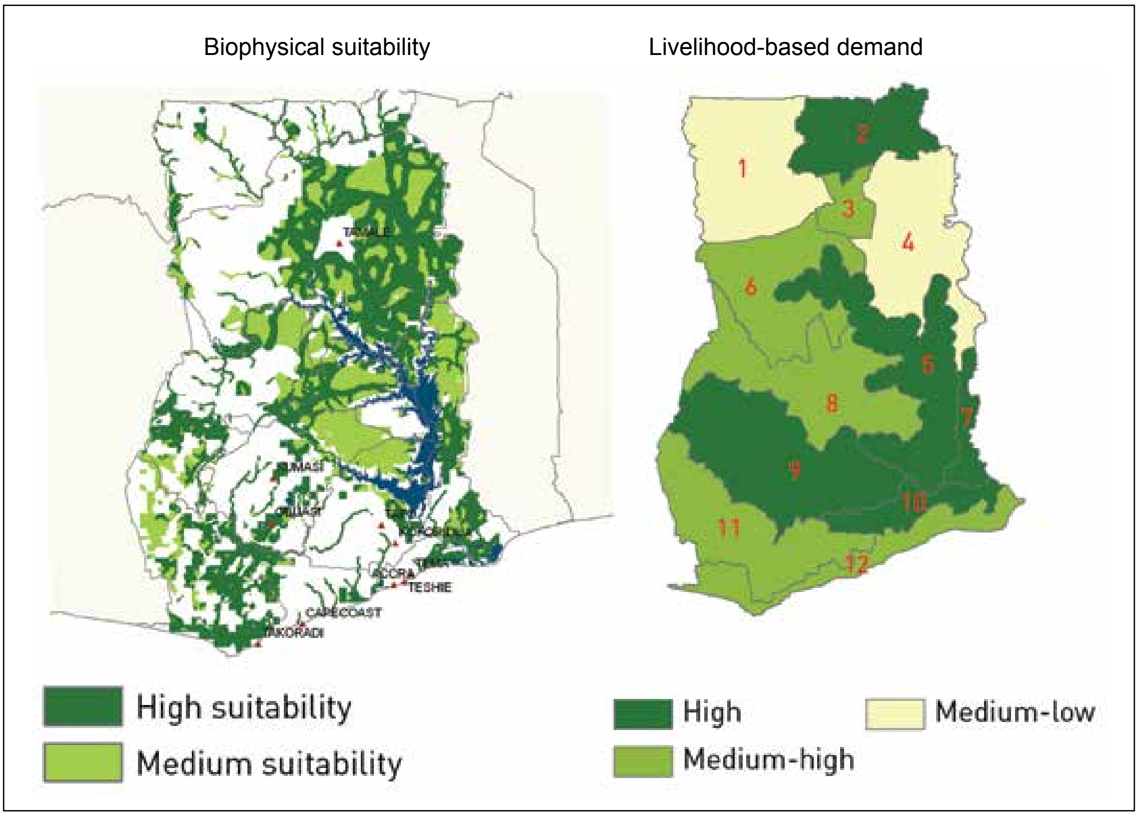
The potential application area in Ghana is 451,000 to 584,000 ha (2 to 3% of total agricultural land). For details on where motor pumps could have the greatest livelihood benefits, see Figure 9.

Stakeholder recommendations.

- Address large price and quality variations by providing information on: pump types, prices, quality and specification through registries of pump dealers; and on financing possibilities.
- In the medium term, MOFA and District Assemblies could procure and sell pumps and accessories.
- Irrigators often make poor decisions with regard to the acquisition and use of pumps and pipes. They should be able to consult MOFA or GIDA personnel, private companies and NGOs.
- Lack of irrigation extension by MOFA/GIDA is hampering the adoption of pump use.
- The government should consider a subsidy and credit system for electric pumps.
- Although pump rental markets are not yet widely accepted in Ghana, there is potential.

Source: FAO 2012b.

FIGURE 9. Potential for motorized pump use to improve livelihoods.



Source: FAO 2012a.

Realizing the Benefits of Small Reservoirs[7]

For investors in small reservoirs, the challenge lies in coordinating and integrating multiple users and social groups around a common resource. Limiting costs through improved procedures and financial management is also critical.

Where the opportunity lies

In sub-Saharan Africa, the term 'small reservoir' refers to the water stored behind an earthen or cement dam less than 7.5 meters (m) high. They can store up to 1 MCM of water and sometimes have a downstream irrigation area of up to 50 ha. Capital investment is, generally, externally driven and community management is the norm.

A well-designed reservoir can sustain multiple uses including livestock, fisheries, domestic needs and small businesses. Small reservoirs support soil and water conservation, drought proofing and small-scale community irrigation. In many cases, small reservoirs are assets in which significant investments have already been made by governments, donors, NGOs and communities. They are in high demand, fit with national strategies and policies, and attract funding from international development agencies. In many cases, they perform below expectations for irrigation but have multiple-use benefits that are often unaccounted for.

[7] Based on Venot 2011; and AgWater Solutions Project 2011d.

The research

Studies were conducted on small reservoirs across the country, including Zanlerigu Reservoir, Nabdam District, Upper East Region (UER); Tiiwi Dam, Sisala West District, Upper West Region (UWR); Tempane Dam, Garu-Tempane District, UER; Sankana Dam, Nadowli District, UWR; Dorongo Dam, Bolgatanga Municipality, UER; Bongo Central Dam, Bongo District, UER; and Baleofiili, Wa West District, UWR. The approach to analyze the performance of reservoirs used qualitative evaluation based on the ranking of respondents. The rankings related to four main indicators: the status and functioning of dam infrastructure; effectiveness of management of the reservoir; benefits of the reservoir to users; and equity in the institutional arrangements for the use and management of the reservoir.

Controlling costs

Storing surface water is an expensive way to invest in AWM, but is sometimes the only way to provide people in rural communities with water. High costs can often be traced back to poor design, construction and management (Figure 10). Investment costs can be controlled by improving procedures, more detailed feasibility studies and strict accountability to decision-makers.

Account for all uses

To effectively evaluate small reservoirs and to compare them to other AWM interventions, a cost-benefit analysis needs to be considered per capita and for the entire lifetime of the project. If managed well, then costs are comparable to investments in other types of AWM interventions. Benefits are greatest when multiple uses, existing farming systems, water recharge and direct pumping are taken into account.

Effective management

To be effective at providing livelihood benefits, small reservoirs also need a strong and inclusive institutional component. Water user associations (WUAs), for example, tend to ignore de facto or planned multiple uses other than irrigation. There needs to be multiple organizational options for communities, and coordination with traditional and local authorities.

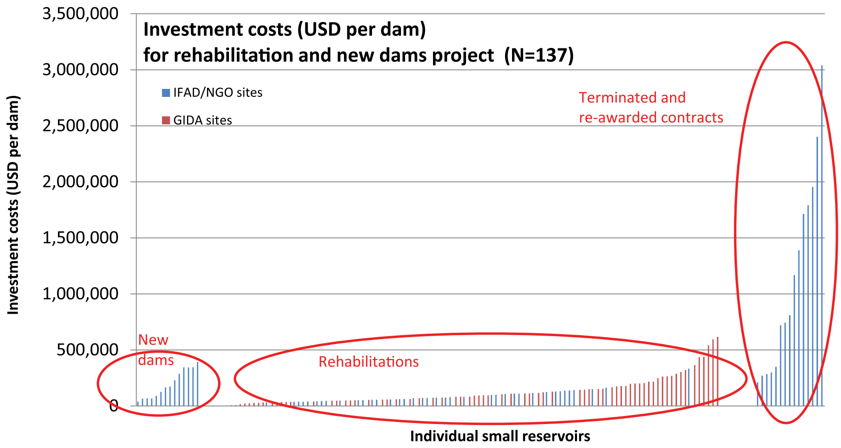
Where to invest

There are a number of promising approaches to improving the use and efficiency of small reservoirs.

- Coordinate and integrate multiple users ‘spatially’ around the small reservoir/watershed and ‘temporally’ throughout the project cycle.
- Facilitate multiple institutional arrangements.
- Strengthen existing policies, procedures and links within organizations.
- Introduce a step-wise approach to assess feasibility and needs when planning rehabilitation or new construction.
- Establish pre-qualification standards for contractors and better compliance with existing procedures for awarding contracts.

- Develop guidelines for contractors on the design of multiple-use reservoirs.
- Build capacity for extension workers, especially regarding multiple-use systems and social aspects.

FIGURE 10. Investment costs of dams and reservoirs with flaws in the design, procurement and construction stages are a costly venture.



Source: Venot 2011.

Who benefits and where

Better information generally leads to more effective decision making. Improved planning processes would reduce investment costs with a positive impact on performance as will adopting a multiple-use perspective for monitoring. Overall, there would be a better return on investment.

A 'suitable' area for small reservoirs is defined as an agricultural area where the Aridity Index (yearly precipitation divided by yearly reference evapotranspiration) is between 0.2 and 0.65, i.e., semi-arid to dry sub-humid. A higher livestock density is assumed to be correlated with enhanced multiple uses of small dams. Using these criteria, research carried out by the AgWater Solutions Project estimates that small reservoirs could benefit 74,000 to 163,000 households (2 to 4% of rural households) in Ghana, at a 50% adoption rate.

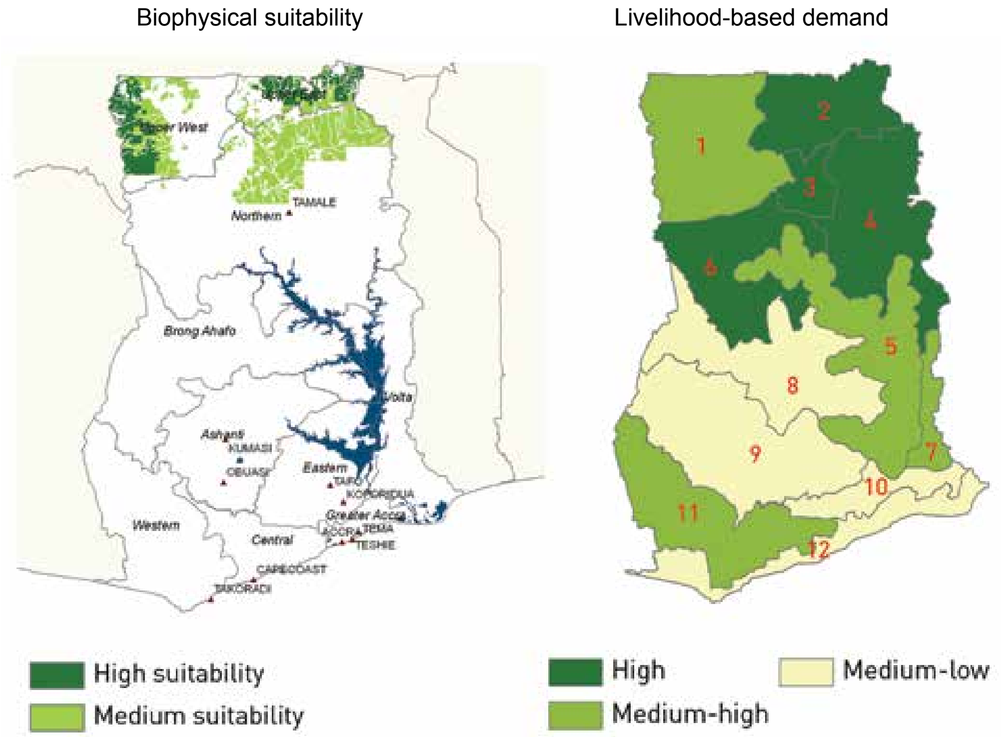
The potential application area is 74,000 to 163,000 ha or approximately 1% of total agricultural land (Figure 11).

Out-grower Schemes and Contract Farming[8]

Multinational agribusinesses and large supermarket chains are turning to out-growers to secure their supplies. Donors are also showing interest and offering support for schemes and associated farmers' organizations. However, some question whether out-grower schemes are a suitable model for improving access to water and incomes for poor farmers.

[8] Based on Amevenku et al. 2011; and AgWater Solutions Project 2011e.

FIGURE 11. Potential for small reservoirs to improve livelihoods.



Source: FAO 2012a.

Where the opportunity lies

Out-grower schemes provide a guaranteed market for smallholder farmers. Many offer participating farmers access to water, irrigation technologies, inputs and extension. In return, the smallholder agrees to sell his/her produce to the company at a fixed rate, usually paying a percentage to cover the cost of inputs and services provided by the company.

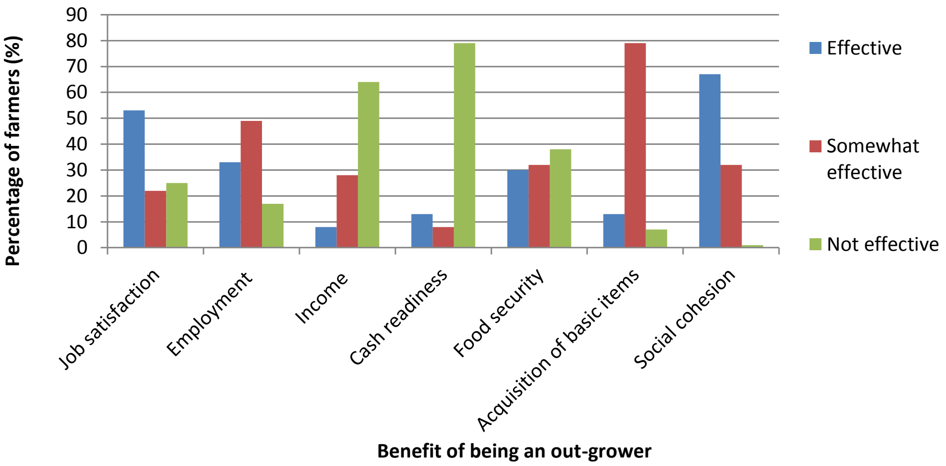
How farmers would benefit

Out-grower schemes offer a wide range of benefits:

- A guaranteed market.
- Access to inputs, including water and credit.
- Access to modern technologies and innovations, including high-tech irrigation solutions such as drip, center pivot and pump houses, which would otherwise be unaffordable.
- Information on improved farming techniques and production standards.
- Risk minimization through pooling of resources and cost sharing.
- Access to machinery and services for harvesting, land preparation, planting and pest control.

The biggest complaints from farmers are that the schemes do not provide enough income, do not pay in a timely manner and do not ensure food security (Figure 12).

FIGURE 12. Farmers' perceptions of the effectiveness of out-grower schemes.



Source: Amevenku et al. 2011.

Stakeholder recommendations.

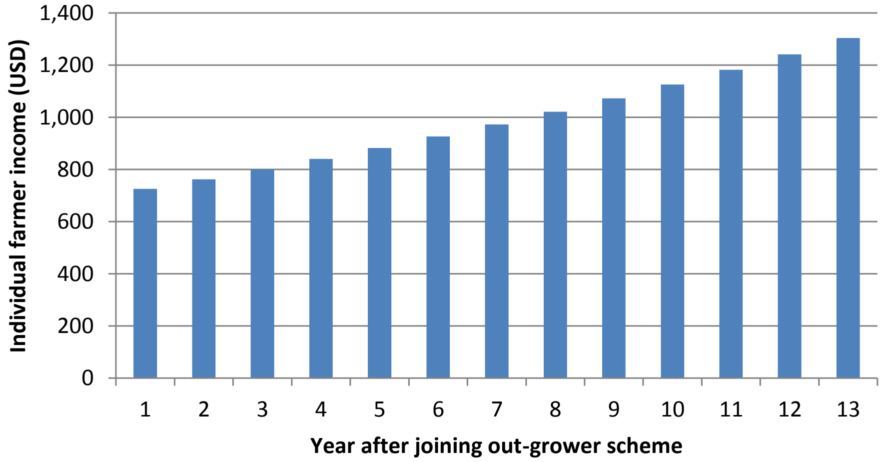
- The use of small dams for irrigation is relevant and cost-effective, and will contribute to food security and income generation in rural communities if managed well.
- Standard designs should be updated, published, disseminated and enforced by GIDA with stakeholder training on standards.
- GIDA should consider training staff and contractors and enter into performance contracts with them.
- There should be a leasing company with all the equipment available, facilitated by GIDA.
- Financial due diligence should be done by the funder on all contractors before contracts are awarded.
- Landownership should be taken into consideration before construction. Community by-laws and specific social criteria should be developed for the construction of community dams. The government should take responsibility and set regulations for water use rights.
- Cost over-runs and high labor and materials costs all contribute to raising construction costs. Better enforcement is needed.

Source: FAO 2012b.

Challenges: Trust, information, costs and incentives

Successful out-grower schemes illustrate the many benefits to both sides of the bargain, and even generate indirect benefits through economic growth and job creation in the area. Research shows that the longer farmers stay with an out-grower scheme, the higher their income (Figure 13).

FIGURE 13. Increase in incomes over a 13-year period of the farmers sampled.



Source: Amevenku et al. 2011.

However, even the best schemes are unlikely to reach the poorest farmers unless special measures are taken. Schemes naturally tend to select better-off male farmers who the contractors believe can bear the risks and make the commitments. Most successful out-grower schemes have also been limited to areas with good connections to export markets. The poorest farmers are often found in remote areas with poor transport infrastructure. Poorer farmers and women are more able to participate when they receive support from donors or NGOs. However, some people question whether such support amounts to subsidizing large agribusinesses.

Trust: If the smallholder is not 'market savvy' and the company is unscrupulous, the smallholder can be disadvantaged. Likewise, the company is taking a risk that the smallholders can and will hold up their end of the bargain. Both parties need a long-term perspective. Strong (democratically elected) farmers' associations or cooperatives help resolve potential tensions and mistrust. Donors can encourage companies to contract with smallholders by mitigating the risks, and governments can institute legal frameworks to clarify privileges and responsibilities.

Information: Smallholders lack access to market information and may have limited power to negotiate with contracting companies. Donors and development agencies can facilitate the formation of farmers' organizations or cooperatives to represent the interests of smallholders. L'Agence Francaise de Developpement, for example, provided training and financial support to establish an Organic Mango Outgrowers Association.

Costs and incentives: Dealing with a large number of smallholders means higher transaction costs for the company and smallholders often live in relatively isolated areas, making transportation and communication difficult and expensive. Networks of farmer-agents and mobile phones can help. Incentives offered by donors and governments can also offset disadvantages.

A role for public investors

International donors can help governments provide legal and institutional frameworks to enhance transparency and clarify benefits and responsibilities. Similarly, they can support farmer organizations to ensure their voices are heard and their interests served. The less well-off farmers will need help accessing affordable credit and getting repayment terms that match farming income cycles. This could take the form of monetary incentives for companies to invest in poor smallholder farmers and female-headed farm households.

GENDER AND AWM[9]

The AgWater Solutions Project conducted research to explore the diverse gender roles shaping farm management systems and, specifically, how men and women engage in small-scale private irrigation. By identifying gender-specific differences and barriers, investors can offer practical suggestions designed to improve the productivity of both men and women in sub-Saharan Africa.

Putting Gender on the Map

A gender mapping workshop held in Ghana in July 2010 resulted in the production of a map illustrating the gendered cropping systems of Ghana (Figure 14). The 12 experts at the workshop focused on the relative roles of men and women in farming, resulting in a graduated scale of decreasing women's involvement. The map illustrates that agroecological zones are a more important variable than ethnicity as an explanation for the differences in the gendered organization of cropping.

The humid southern transition zone and drier area to the north are related to wealth and poverty and to the resulting migration patterns. A further analysis of economic and migratory patterns, administrative regions and other factors led to the distinction of eight broadly defined areas in which the gendered organization of cropping has specific characteristics. This allowed for a relative ranking of the areas according to women's involvement in cropping processes and control over the outputs.

Gender and AWM Adoption

Both male-headed households (MHH) and female-headed households (FHH) in the Ashanti, Greater Accra and Volta regions actively took up the opportunities of private lift irrigation and half or more moved into mechanization (Figure 15). However, there was a gender gap. With smaller family size and rainfed and irrigated land sizes, FHHs were, overall, less often technology adopters than MHHs. Their technology choice was somewhat more biased to manual lifting. However, the differences were small and there were exceptions. On the one hand, the differences confirm the relevance of differentiation by household headship. On the other hand, these findings confirm that FHHs are also adopting irrigation at substantive levels.

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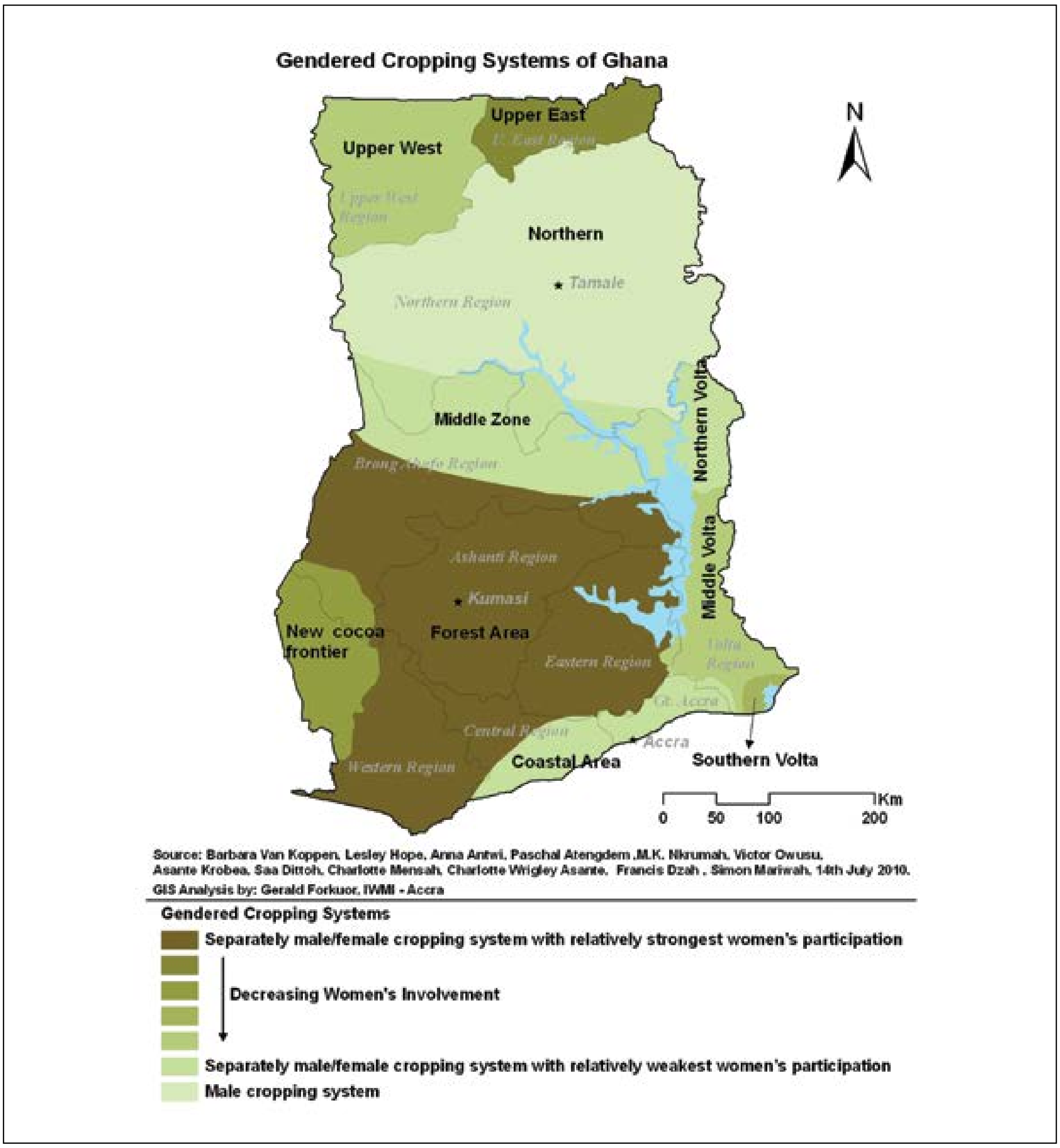
[9] Based on Meinzen-Dick et al. 2012; van Koppen et al. 2012.

FIGURE 14. Cropping systems defined by gender roles in Ghana.



Source: This study; GIS analysis by Gerald Forkuor, formerly IWMI, Ghana.

Where to invest

Based on the research findings, the AgWater Solutions Project suggests that the demand for small private irrigation technologies among female-headed households appears larger than what the current market chain is able to supply. Opportunities exist to further support women's access to a broader set of AWM technologies:

- Targeting AWM interventions based on household head to improve access for female and male heads of households.
- In addition to the technology itself, ensuring women have equal access to public support

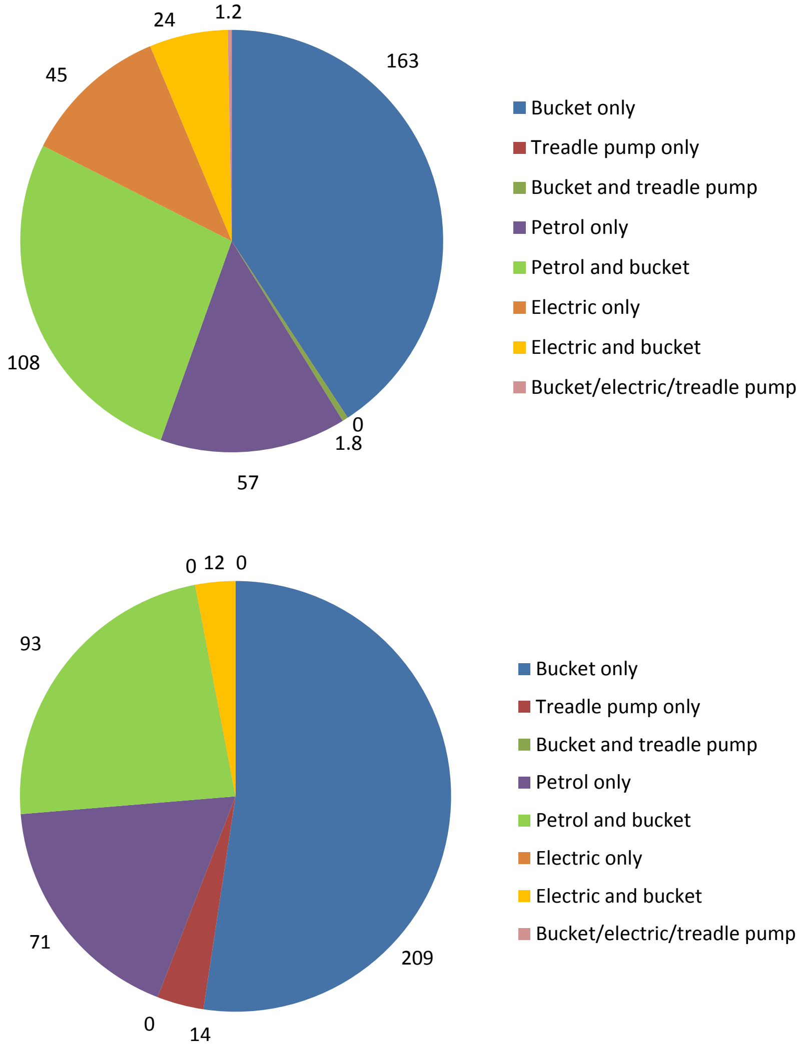
systems including training and extension services, agricultural inputs, electricity, financing and transport.

- Provide options that are less labor-intensive – this will benefit all households.

FIGURE 15. AWM technologies used by (a) male-headed households, and (b) female-headed households.

(a)

(b)



Source: van Koppen et al. 2012.

AWM SUPPORT MEASURES

Many of the AWM techniques and technologies reviewed require support measures to ensure that they address the challenges identified by the project. These were identified in the case studies and discussed extensively with local stakeholders. In Ghana, the stakeholders highlighted: improving access to rural finance, improving the business capacity of farmers and better irrigation planning (Table 5).

TABLE 5. Stakeholder recommendations for AWM support measures.

Access to finance in rural areas for agriculture and irrigation	• Promote capacity building and mutual understanding between financial managers and AWM experts. • Farmers' demand for financial products and services is large, but farmers are hard to reach and have little power to negotiate terms in their favor; the supply of financial products and services is centrally organized and limited in availability. • Rural credit from official sources is rare. The current micro-finance institutions and products need to be reviewed and packages tailored to AWM-related needs (e.g., lending to groups, repayment schedules adjusted for farmers' needs, etc.). • Micro-finance institutions lack a policy framework that would enable them to source external funds from donors and other forms of external investments and partnerships. They do not have insurance deposits with the Reserve Bank; hence, the farmers are always at risk. • A regulating framework is needed for the micro-finance sector to protect users. • Poorer farmers need to be informed about grant funding options.
Improving agribusiness capacity and marketing	• Financial institutions lack confidence that farmers will succeed. Therefore, building farmer's capacity to manage agribusinesses is important. Technical assistance is required along the value chain in: agronomy, water productivity, soil conservation, crop diversification, input use, produce storage, marketing and crop insurance. • Training is needed on the selection, efficient use and maintenance of irrigation equipment. • Improve input supply chains to break the monopoly of some companies. • Set up farmers' markets; regulate broker networks; formulate policies to encourage consumption of local produce; and invest in storage and processing facilities. • Provide basic infrastructure like roads and electricity for potential irrigation areas.
Irrigation planning	• Identify ecological zones to determine what to irrigate, where to irrigate and what type of scheme to use. The economics of crops to be irrigated should be considered before irrigating, and research should be carried out on how high-value crops that are grown in other countries can be irrigated in Ghana.

Source: FAO 2012b.

CONCLUSIONS[10]

Both surface water and groundwater use can be enhanced to benefit millions of farmers. By employing a strategy that combines options, farmers throughout the country can achieve better access to water for irrigation. Key elements to enhance the spread of AWM options could encompass some or all of the following:

Inland valleys could benefit up to 377,000 households irrigating 3% of the total land area. Developing inland valleys would contribute to the country's commitment to become self-sufficient in rice. The total investment could be up to USD 339 million, and would involve not only physical interventions to capture and utilize rainwater but also improved extension services. This combination would result in higher yields.

Small reservoirs are another important way of capturing and storing water for agricultural use. They are a costly investment at around USD 750,000/m^3 of stored water, but they can be used for more than just irrigation and their costs should be balanced against these many benefits. Critically, they provide protection in drought years. Costs can also be brought down through

[10] All figures provided in this section assume that 50% of the total potential users adopt the AWM option. All figures are taken from FAO 2012a.

better management at all stages of planning, construction and rehabilitation. In Ghana, small reservoirs could benefit some 163,000 households at a total cost of USD 962 million.

Motor pumps are an important element for accessing both surface water and groundwater. They are predominantly used to irrigate high-value dry-season crops such as vegetables. For motor pumps to be a viable option, farmers must have access to markets to sell their produce. Although many farmers have already adopted motor pumps, others find it hard to do so. The areas of support that could increase adoption are appropriate finance, points of sale close to agricultural areas, information about pump specifications, costs and operation, and after-sales service. If these areas are addressed, motor pumps could benefit some 730,000 farming households irrigating 3% of the total agricultural land. The total investment cost would be USD 292 million. An alternative, which could reach even more farmers, would be to support irrigation service providers.

Out-grower schemes could also benefit farming households, if regulated and supported. At present, they tend to favor better-off farmers who live nearer urban areas. However, there are good examples of out-grower schemes that could be replicated in more remote areas if incentives are provided.

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