

Introduction

This situation analysis covers all regions of Zambia and is based on secondary data, field observations, and household and key informant interviews. It examines farming systems in Zambia and the characteristics of existing agricultural water management (AWM) practices. It takes into account the natural, political and institutional environments that influence AWM and identifies the people and organizations that have a stake in smallholder AWM.

The results of the situation analysis are summarized here, concentrating on existing environmental, social and political conditions across Zambia, as well as on AWM solutions. These include AWM solutions currently in use and those that have potential to improve agricultural production and farmers' livelihoods. The AWM solutions described here were shared at the National Consultation Workshop and priority solutions were selected by participants. For more on this, please see the National Consultation Workshop Brief which is also available on the website.

The Context

Farming Systems and AWM

Approximately 48 million hectares (Mha) of land in Zambia are suitable for agricultural use. In most parts of the country, rainfall is sufficient for rearing livestock, wet-season crop production, and storage for irrigation during the dry season. Year-to-year variability in rainfall is an important determinant for crop output and household food security.

Agroecological Regions

The country is subdivided into 36 agroecological zones grouped into three agroecological regions. They are defined as:

Region I covers the country's major valleys; Gwembe, Lunsemfwa and Luangwa, and the southern parts of Western and Southern provinces. It is a drought-prone area characterized by low rainfall (< 800 mm/yr) and a short, hot growing season. However, there is potential for high-value vegetables, fruits and rice.

Region II is the medium rainfall area (800-1,000 mm/y) covering the Sandveld Plateau of Central and Eastern Lusaka and Southern Province; Kalahari Sand Plateau; and Zambezi Floodplains of Western Province. The region has a total area of 27.4 Mha of which 50% is available for agricultural use. Wetlands, *dambos*, rivers and lakes allow for AWM activities and, with good market infrastructure, support high-value crops.

Region III, with rainfall of 1,000-1,500 mm/yr and a growing season of 120-150 days, occupies 41% of the country including part of the Central African Plateau

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covering Northern, Luapula, Copperbelt and Northwestern provinces, and parts of Serenje and Mkushi districts. Due to soil conditions, only 53% of the land is suitable for cultivation. This, along with poor market access, limits the number of crop types that can be cultivated. There are large areas of wetlands, *dambos*, rivers and lakes, but low commercialization restricts irrigated production.



Water Resources

Zambia's total renewable water resources are estimated at 163.4 km³/yr. Of this, internal renewable water resources are estimated at 114.8 km³/yr of runoff and 49.6 km³/yr of groundwater. The renewable water resource per capita is estimated at 8,700 m³/yr. Water withdrawals for agriculture currently stand at 1.7 km³/yr. Zambia has an irrigation potential of 2.75 Mha but only 156,000 ha are currently being irrigated (MACO/FAO 2004).

Categories of Farmers

There are three major categories of farmers in Zambia.

Smallholder (traditional) farmers cultivate <5 ha each and consume most of their produce. Of Zambia's estimated 1.1 million farmers, 96% are smallholders cultivating 76% of the total cropped area. Most female farmers come within this category. **Medium-scale farmers** cultivate 5-20 ha each and sell most of their crop. **Large-scale and commercial farmers** cultivate >20 ha each and sell most of their produce. Around 67% of the Zambian labor force is employed in the agriculture sector.

Table 1: Current Estimate of Irrigated Land in Zambia

Land under AWM	ha
Irrigation potential	2,750,000
Surface irrigation	32,189
Sprinkler irrigation	17,570
Localized irrigation	5,628
Developed lowlands (equipped wetlands)	100,525
Total land under irrigation	155,912
Flood recession cropping area	100
Cultivated lowland	100,000
AWM area	255,912
Land under irrigation by source of water	ha
Groundwater	6,750
Surface water	149,162
Power irrigated area	38,630
Irrigation schemes by size	ha
Small irrigation schemes	111,525
Medium irrigation schemes	7,372
Large irrigation schemes	37,015

Source: MACO/FAO, 2004

Policy Environment for AWM

Agricultural Policies

The Fifth National Development Plan (FNDP 2006-2010) was designed to achieve:

- Food security for at least 90% of households.
- An increase in the contribution of agriculture to total foreign earnings up to 20%.
- An annual growth of 10% in the agriculture sector.
- An increase in the contribution of agricultural output to GDP (up to 25%).
- Increased incomes for those working in the sector.

While improvements are apparent, most of these targets have not yet been met. The main obstacles facing the agriculture sector in Zambia include:

- Lack of access to improved technology (especially for women farmers) and high irrigation costs.
- Limited capacity of farmers to access and utilize new technologies.
- Poor rural infrastructure for agriculture.
- Ineffective agricultural services.
- Lack of affordable credit.
- Poor market linkages for inputs and commodities.
- Unpredictable trade and pricing policies.
- Insecurity of land tenure for women in parts of Zambia.
- Unreliable data and insufficient drought early warning systems.
- Environmental degradation.
- Low and declining levels of investment in agriculture.

Supportive Policies for AWM Solutions

The Zambia Development Agency (ZDA) has announced packages of incentives for investors. Several of these plans, including the National Irrigation Plan, National Long Term Vision 2030¹ and the FNDP, highlight irrigation as a key investment activity.

The National Irrigation Plan (2004), for example, outlines development paths for the different categories of farmers in Zambia, and established the Irrigation Development Fund.²

The government has included an irrigation-related performance assessment indicator under the Poverty Reduction Budget Support (PRBS), which measures the number of hectares brought under irrigation each year. The purpose is to raise the level of irrigation and recognize the role of AWM in poverty reduction.

Institutional Setting for AWM

There are two key government agencies in the sector:

- The **Ministry of Agriculture and Cooperatives (MACO)**, whose role is to promote sustainable agricultural productivity, to ensure food security, income generation, creation of employment opportunities and poverty reduction. There are 10 departments in MACO including Agribusiness and Marketing, Agriculture, and Cooperatives.
- The **Ministry of Energy and Water Development**, under which is the Department of Water Affairs. The Department is divided into: Ground Water Resources; Surface Water Resources; and Water Resources Management.

Several other organizations are critical to agriculture and AWM in Zambia, some of which are:

- The **Ministry of Lands** and the **Office of the Vice President (Department of Resettlement)**, which are responsible for new farm blocks and agricultural lands.
- The **Ministry of Tourism, Environment and Natural Resources**, which, through the Environmental Council of Zambia, supervises all new investments to ensure the mitigation of environmental effects.
- The **private sector** plays an important role through: "outgrower" arrangements for cotton, sugar and other products, which offer farmers access to water, inputs and markets; the supply of irrigation equipment; and extension services. Prominent players include the Coffee Growers' Association of Zambia (ZGCA), the Zambia Export Growers' Association and the Conservation Farming Unit (CFU).
- The **Zambian National Farmers Union (ZNFU)** represents both large- and small-scale farmers.
- **Statutory commodity-based boards** established by Parliament to regulate aspects of the sector.
- **Public-private partnerships**, such as the Golden Valley Research Trust, the Cotton Development Trust and Lyambai Agricultural Development Trust.

- **NGOs and Civil Society Organizations** through the promotion of irrigation and AWM technologies at farm level, for example, International Development Enterprises (IDE) which runs the Rural Prosperity Initiative (RPI), a value chain-based project promoting profitable use of irrigation technologies.
- **Micro-finance institutions**, including Micro-Bankers Trust and CETZAM.

AWM Solutions

There are large numbers of methods for capturing water and directing it either on to crops or into storage facilities in Zambia, suiting different categories of farmers in different agroecological regions. Several of these were reviewed and suggested for further analysis under the project. They are summarized here.

In-situ Seepage Systems – Wetlands, Dambos and Recession Systems

These AWM systems rely on the simple natural flow of underground or subsurface water seeping towards the crop. Zambia is noted for its inland wetlands that cover 29,559 km³. The six main wetlands and flood plain systems include Kafue, Zambezi, Bangweulu, Mweru-wantipa, Luapula-Mweru and Lukanga swamps. Specific examples are given below.

The Barotse Floodplain includes a wetland of 9,000 km² in the Western Province. The key factors affecting utilization of the wetland are the timing and extent of the annual flooding of the Zambezi River, and the timing and consistency of the rains. Cropping is undertaken in line with this natural pattern. Various crops including maize, sorghum, pumpkin, mango, rice, cashew and vegetables are currently grown, and cattle are also grazed. However, agriculture in the plains is vulnerable to drought.

Within the plains, there are many scattered shallow circular pans varying from <1 km to 5 km in circumference. A number of these are connected by natural spillway channels and some artificial canals. The area is also characterized by scattered zones of perched water tables that are used for winter cropping, utilizing subsurface soil moisture.

An opportunity exists to utilize the plains outside the rainy season through low-cost water-lifting and application technologies. Bucket irrigation is used to supplement natural seepage.

Gwembe Valley has a network of rivers flowing into the Zambezi and Lake Kariba, and agriculture relies on a recession system. The annual flooding of the banks leaves behind rich wet alluvial soils that provide an environment conducive to crop growth. The two basic flood recession systems are Nchelela (lakeshore) and Zilili (riverine). The main crops planted are maize, vegetables, rape and squash.

Northern Upper Plateau comprises *dambos*, which are grassland areas that seasonally flood or have high water tables. The benefits from *dambos* include domestic water supply, grass for thatching, wild plants, grazing, dry-season

supplementary cultivation and planting of perennial crops. A wide range of crops can be grown in up to three crops per year, including vegetables, maize, rice, bean and sweet potato. On average, 70% of households in the region are reported to have a *dambo* or wetland field averaging 0.2-1.25 ha.

Conservation Agriculture

This AWM solution is an improved in situ water and soil management practice recently developed and promoted on the central plateau areas of Lusaka, and Central, Eastern and Southern provinces. Conservation farming was officially incorporated into the National Agriculture Policy in 1999. Since then, extension manuals have been produced by the CFU of the ZNFU. The key principle is to restore and maintain the fertility of the land in the crop root zone. The main crops are cash crops and pulses. The key elements include:

- Retention of crop residues.
- Restriction of tillage to the precise area where the crop is to be grown.
- Completion of land preparation in the dry season.
- Establishment of a grid of planting basins, or rip lines, which capture moisture from the early rains.
- Measured and targeted application of fertilizers.
- Early and continuous weeding or use of herbicides.
- The use of nitrogen-fixing legumes in strip crop rotations, fallows or intercrops.

Basic Water Application Models

Buckets constitute the most common system used throughout Zambia wherever an appropriate water source exists. It is particularly common near markets and in gardens.

Plastic container drip kits are especially suitable where water and labor are scarce. They have been tested with peri-urban farmers in Chongwe by Kasisi Agriculture Training College but wider promotion has been limited. The 5 or 20 liter containers are filled with water and the tiny holes in the bottom gradually allow the water to drip onto the crop. The kits are suited to horticultural crops and gardens, and can be made from recycled materials, such as old plastic containers.

Clay pot drip kit solutions are similar to the above but can be created wherever clay is available. They have been tested by the Zambia Agriculture Research Institute at Nanga National Irrigation Station, which found that irrigation intervals of 7-14 days are possible and water savings of 50-70% can be achieved, with yield increases of 30-45% over flood and furrow.

Low-Cost Water-Lifting Devices

The treadle pump is a manually operated device for capturing water from rivers, lakes and shallow groundwater and conveying it to crops. FAO has distributed over 3,000 in Eastern, Southern, Western and Luapula provinces since 1999. IDE has also sold 3,500 treadle pumps and drip kits, and established maintenance and retail markets. The MACO has been promoting the technology with vegetable growers, and Kickstart has also started operating in Zambia. Incomes can reach US\$ 4,000/ha, but the capital cost of up to US\$200 is

prohibitive for many smallholder farmers.

The rope and washer pump is a similar concept to the treadle pump but is operated by hand and can lift water from deeper wells. It has been promoted by Development Aid from People to People (DAPP) for 5 years. DAPP has set up systems for production, promotion and sale, but these pumps are still relatively new to Zambia and not well known by farmers.

Motorized Water-Lifting Pumps

Diesel and petrol pumps require a higher investment of around US\$400-500 and tend to be used by medium-scale farmers rather than by smallholders, or where farmers have access to markets and can justify the investment. Pumps are sold by private companies, and various models are available. Pumps can lift water 6-8 m and convey it over several times that distance, making them efficient and effective.

Small Dams and Micro-Irrigation

Small dams are widespread across Zambia. Recently, the government has constructed six dams and irrigation schemes through the Rural Investment Fund (RIF), which was established to respond to community demand for infrastructure. Schemes are operated by water user committees that distribute the water to their irrigators. Dams are especially beneficial in Region I where rainfall is low and where dams are fed by streams, so the farmers are buffered from variations in rainfall.

Diversion Weirs

Transitional river diversion weir schemes involve the blocking of streams with a temporary weir that cannot withstand floods and must be reconstructed every year. This traditional technology is being promoted by the Technical Services Branch of the Northern Province, Department of Agriculture, supported by the Japanese International Cooperation Agency (JICA). Region III has a high potential for such schemes. Farmer groups have been trained to identify potential sites and build or rehabilitate schemes. Each scheme involves 5-20 farmers with about 0.10-0.25 ha each.

Permanent river diversion weirs – earth and lined canal schemes are the improved, more permanent version of the transitional weir. They are commonly promoted by MACO. In most cases the community is helped to form a water user

association because of the commitment, financial resources and skills required. JICA found that many of the existing weir schemes were underutilized and is therefore supporting their use.

Electric Water Pumping Systems

Submersible pumps are suitable for farmers with access to a borehole and electricity. Good links to market are usually required to warrant the investment of around US\$5,000. They are most common in Region II and around urban areas.

Electrical pumps for surface water have similar requirements and, due to the need for market access, also tend to be found in Region II. At the price of US\$2,000 they are still not viable for smallholders. In commercial agriculture, schemes exist in which water is pumped to small reservoirs from where it flows to fields by gravity. This has been successfully adapted for smallholders in Kaleya and Manyonyo. Connections to sprinklers have also been tried in outgrower schemes and joint ventures, but the investment cost is US\$10,000/farmer/ha.

Next Steps

Since the situation analysis was conducted, several case studies have been undertaken on AWM solutions across Zambia. The results of these studies will be published as briefs on the project website as soon as they are completed, and stakeholder consultations on the proposed AWM solutions will be conducted to share findings and receive comments.

References

MACO/FAO. 2004. Irrigation Policy and Strategy. Zambia.

¹ This is Zambia's first National Long-Term Vision, which articulates possible long-term alternative development policy scenarios at different points that would contribute to the attainment of desirable socioeconomic indicators by the year 2030.

² The National Irrigation Plan became operational following its merger with the Citizen Economic Empowerment Commission (CEEC), which was created under the Citizens Economic Empowerment Act (2006).

This briefing note is based on a report by The Farming Systems Association of Zambia (FASAZ).
The report is internal but if you would like a electronic copy, please contact the Project Secretariat (awmsolutions@cgiar.org)

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