Trends and Outlook: Agricultural Water Management in Southern Africa

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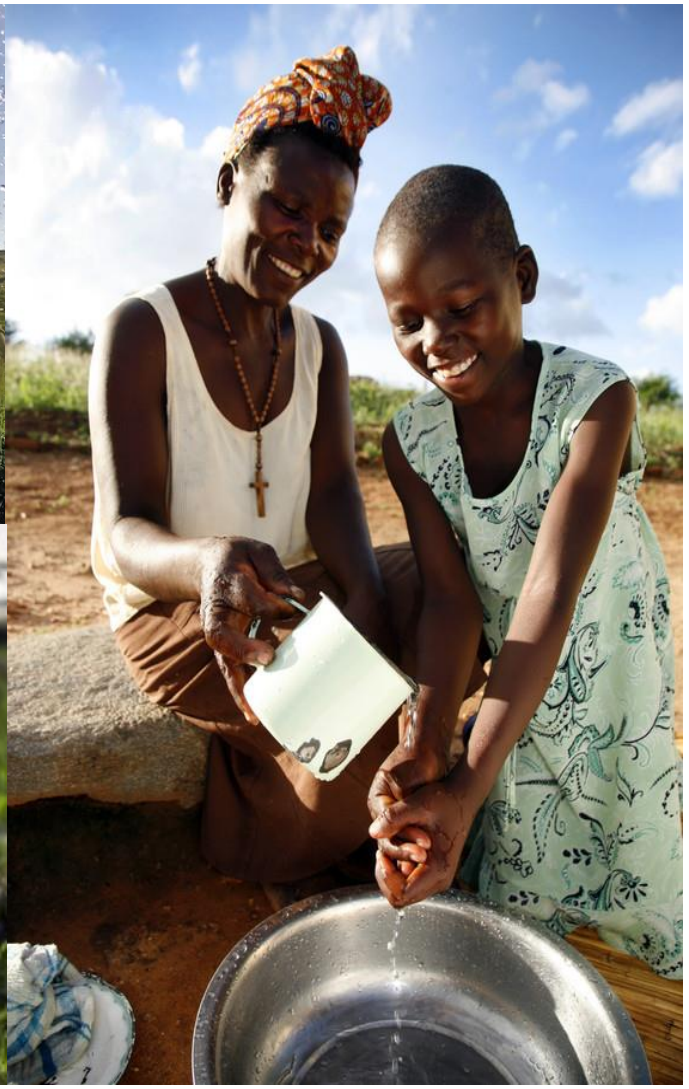

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Acronyms

AU	African Union
AFC	Agricultural Finance Corporation
ARDA	Agricultural and Rural Development Authority
CAADP	Comprehensive African Agricultural Development Program
DANIDA	Danish International Development Agency
DERUDE	Department for Rural Development
DWD	Department for Water Development
EEC	European Economic Community
ESAP	Economic Structural Adjustment Program
EU	European Union
FANR	Food, Agriculture and Natural Resources [Division}
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
ha	hectare
IFAD	International Fund for Agricultural Development
IMO	Irrigation Management Committee
IWMI	International Water Management Institute
KFW	Kreditanstalt für Wiederaufbau
LSCF	Large Scale Commercial Farmer
MM^3	$MillionM^3$
NEPAD	New Partnership for Africa's Development
NFIF	National Farm Irrigation Fund
NGO	non-governmental organization
NR	natural region
O&M	operation and maintenance
PSIP	Public Sector Investment Programme
RAP	Regional Agricultural Policy
RDC	Rural District Council
ReSAKSS – SA	Southern Africa Regional Strategic Analysis, Knowledge and Support Systems
RSAP IV	Regional Strategic Action Plan IV
SADC	Southern African Development Community
SISP	Smallholder Irrigation Support Programme
SSHIP	Support to Smallholder Irrigation Project
SSIP	Small Scale Irrigation Programme
UNDP	United Nations Development Program
UNHCR	United Nations High Commissioner for Refugees
USAID	United States Agency for International Development
ZAPF	Zimbabwe Agricultural Policy Framework (1995-2020)
ZASA	Zimbabwe Agricultural Sector Assisted Programme
ZINWA	Zimbabwe National Water Authority

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1 Introduction

1.1 Agricultural water management for poverty alleviation and sustainable growth

About 70 percent of citizens of the Southern African Development Community (SADC) depend on rainfed agriculture for their livelihoods (SADC 2003). Moreover, enhanced and sustainable development of this sector is the engine of improved economic growth, socio-human development, food and nutrition security and alleviation of poverty (SADC 2014a). Broad-based agricultural growth with agriculture-based industrialization can replace the extractive, capital-intensive and often 'jobless growth' path as currently persists in SADC's dual economies. Inclusive agricultural growth not only contributes to national food security at affordable prices, export and foreign currency; it also creates employment for the rapidly growing new generations, narrows the wealth gaps, and stabilizes SADC's young democracies.

However, rain fed agriculture is directly exposed to the hazards of climate. SADC's rainfall patterns are characterised by high and unpredictable variability over the seasons, years, and decades. Moreover, Southern Africa is predicted to warm up faster than the rest of the world (IPCC, 2014). It is one of the few regions in the world that will experience significantly drier conditions, more extreme and unpredictable dry spells, droughts, and floods, while sea levels will rise faster here than elsewhere. These increased temperatures and less predictable, more variable extreme events hold SADC's farmers and economy 'hostage to hydrology'. This is also true where average rainfall is abundant. These predictions of long-term climate-induced changes render the need for 'no regret' measures today even more urgent.

A key 'no regret' measure that turns these climate hazards into opportunities is improved agricultural water management, or 'agwater management'. Agwater management encompasses a broad menu of techniques ranging from improved on-field water harvesting and soil moisture retention to year-round water storage for year-round fully controlled irrigation of crops, trees and livestock feed; improved water supplies for livestock; and the development of fisheries and aquaculture. Agricultural water management was a vital component in Asia's Green Revolution to boost the 'trickle-up' growth path through poverty alleviation (Jazairy, 1992).

The CAADP of the African Union's (AU's) New Partnership for Africa's Development (NEPAD) recognized this unlocked potential throughout Africa by prioritizing the first of its four pillars, that of 'Sustainable Land and Water Management'. In pillar one, African states committed to the doubling of irrigated area from the 3.5 percent at the time to 7 percent by 2015 (CAADP 2009).

SADC's Regional Indicative Strategic Development Plan (2003, revised in 2007 and 2015) re-affirms CAADP goals, including pillar one. SADC operationalizes this through both its Water Division and the Food, Agriculture and Natural Resources (FANR) Division. The SADC Regional Agricultural Policy (RAP) (SADC 2014a) envisages the improvement of the management of water resources for agriculture (SADC 2014a, section 10.5). In the results framework, outcome 1.4 foresees that water infrastructure for agriculture is expanded and upgraded. The RAP commits to assess the effective utilisation of existing irrigation infrastructure and to promote new infrastructure development (SADC 2014a, section 16.1 (75)). In terms of monitoring, the RAP results framework signals the need to provide baseline data on the number of dams, irrigated area and irrigation management practiced in the SADC region (SADC 2014b).

The Regional Strategic Action Plan IV (RSAP IV) (SADC 2015), which is based on the SADC Water Policy (2006) and Strategy (2007) aims at 'An equitable and sustainable utilization of water for social and environmental justice, regional integration and economic benefit for present and future generations'. Noting that there is about 50 million hectares (ha) of irrigable land available within the SADC Region of which only 3.4 million ha (7 percent) is currently irrigated, the RSAP IV emphasizes the importance of infrastructure development and water resource management for food security in the water-food nexus, and the stronger urgency to take action in the view of climate variability and change. RSAP IV also highlights the benefits of multipurpose dams for both energy and irrigation. At local level, SADC Water commits to conduct action-research to develop and sustainably implement resilient water-related infrastructure; and to innovate affordable and appropriate technologies and innovative approaches and practices. Priority interventions are the demonstration and upscaling of community-based water for livelihoods projects (SADC 2015).

1.2 Trends in irrigated area

In spite of the major unlocked potentials and strong policy commitments, the average percentage of arable land in SADC has only slightly increased from 7.6 percent in 1990 to 8.4 percent in 2012 according to the Food and Agricultural Organization of the United Nations (FAO's) AQUASTAT (see Figure 1). A peak was reached a decade earlier. Moreover, the high average percentage of irrigated land is largely the result of irrigation by large-scale agribusiness in only four countries (Madagascar, Mauritius, South Africa and Swaziland). Moreover, both smallholder irrigation in South Africa and irrigated land area in Madagascar declined.

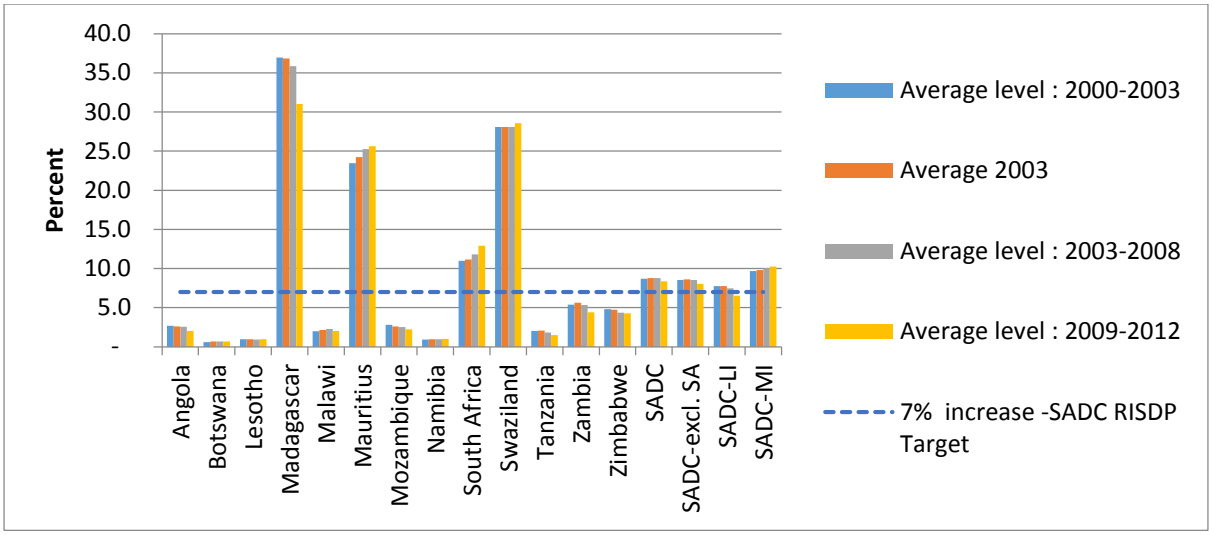


Figure 1: Irrigated area as proportion of arable area
Source: FAO AQUASTAT

This raises a pertinent question: why is irrigation expansion stagnating, and how can this be turned around? Unfortunately, there is no systematic regional body of knowledge to analyze these trends and provide answers. As the Regional Agricultural Policy observes, there is not even a base line on irrigation management practiced in the region, neither for the upgrading of existing infrastructure nor for new investments.

Moreover, in spite of the clearly related common goals of the Water and FANR divisions in SADC and in national states, forums to bring these sectors and other relevant stakeholders together are rare. Potential synergies between sectors that would allow each sector to better achieve its goals remain untapped.

The present study on 'Trends and Outlook: Agricultural Water Management in Southern Africa' seeks to fill these gaps. The project is part of the ReSAKSS – SA project, implemented by the Southern Africa Regional Program of the IWMI. It is supported by USAID's Feed the Future Program through USAID's Southern Africa Regional Program. At the interface of both water and agriculture, the IWMI is well placed to enable such dialogue and provide a robust knowledge base on inclusive agricultural growth in general, and agwater management in particular.

1.3 Study aim and method

In order to explain the current stagnation and find ways to overcome this, the following questions will be answered:

- What are the precise hydrological hazards of climate variability and change, and what is the meaning of 'water scarcity' for agriculture in SADC?

- What lessons can be learnt from past and current investments in agwater management in SADC, in particular from their strengths and weaknesses in sustainably contributing to poverty alleviation, food security and agricultural and economic growth?
- How can SADC and national government, non-governmental organizations (NGOs) and donors build on these strengths and overcome weaknesses?
- What are the untapped synergies between the public sector agencies with mandates in agriculture and those with mandates in water management, so that both sectors can achieve their goals more effectively?

The method to answer these generic questions consisted of both an extensive literature review and analysis of past performance (Mutiro and Lautze 2015), as well as interviews with key stakeholders at SADC and national levels. Further national studies with illustrative in-depth case studies were conducted in four selected countries: Malawi, South Africa, Zambia and Zimbabwe. This report is the Country Report for Zimbabwe.

The Synthesis Report and the four country reports of the Trends and Outlook: Agricultural Water Management in Southern Africa Project are available at www.iwmi.org - Southern Africa Regional Program.

1.4 Definitions and research approach

Agwater management encompasses a wide range of interrelated hard- and software measures to ensure that the right quantities of water of the right quality reaches the right sites of agricultural (and other) uses at the right time. Improved water control enables crop diversification, stabilizes and increases crop yields, and enables more cropping seasons, including the slack and hunger seasons. Storage in dams or in 'green infrastructure' (such as recharged aquifers or managed wetlands) attenuates floods. Hardware typically includes (combinations of) infrastructure to harvest and store precipitation and run-off water by recharging aquifers, to convey and apply water, and to drain excess water. This study focuses primarily on water supply to crops through infrastructure that extends beyond in-field soil and water conservation alone.

There are various classification systems of agwater management – and even more blends: by source (well, surface storage, stream, wetland, groundwater); by technology (which often determines the scale as well); by ownership and/or management either by individuals or communal groups; by plot size and/or scheme size; by goal of investment and type of beneficiaries (household food security; marketing); by formal or informal in terms of formalized, written and state-backed rules; whether privately invested in capital costs and/or operation and maintenance (O&M), and rehabilitation, or by government, NGOs or otherwise; etc.

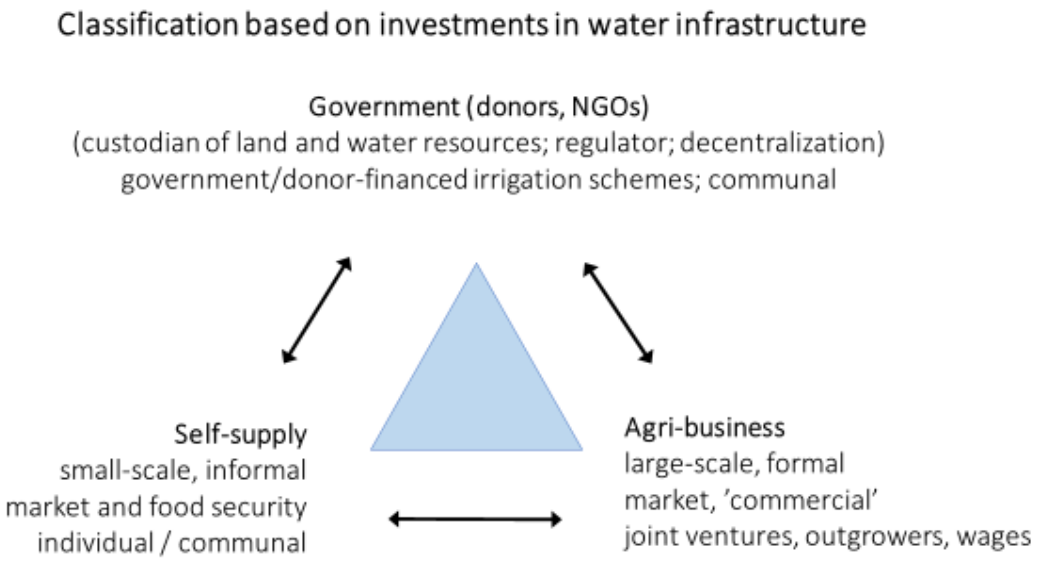


Figure 2: Classification of types of investments in irrigation based on types of investors

For the present purpose of learning lessons for investments, we build on the latter; so the main criterion to distinguish the different types of irrigation is: who is the main investor in the construction and installation of infrastructure? Capital costs are usually the most expensive part of irrigation. Moreover, claims to the water stored and conveyed tend to go together with investments in the infrastructure and subsequent maintenance ('hydraulic property rights creation') (Coward 1986). As we will see, although their performance varies widely, each type is quite specific in terms of the historical and political-economic context in which it emerged and continues to exist, and its strengths and weaknesses in contributing to poverty alleviation and socio-economic growth.

The first type of irrigation investments are by governments, both before and after independence. International donors and financers typically work through governments, while most NGOs also work in close collaboration. Government- or NGO-financed schemes are typically collective schemes. They may be accompanied by resettlement at local or wider scales. The involvement of government can range from very strong (in government-run schemes) to a role that is limited to design and financing of the infrastructure construction and sometimes rehabilitation, leaving all other tasks to communities. In addition to investing in infrastructure, governments also play unique roles as regulator and custodian of the nation's land and water resources in SADC's evolving resource tenure systems. Governments influence the next two types of irrigation in both capacities.

The second type of irrigation investments are by citizens – also known as self-supply – where citizens are the key investors in infrastructure for their own benefits. That is done by

individuals or groups, and often is seen as informal. Adaptation to climate variability through these investments has been at the heart of agrarian societies' survival since time immemorial. One strategy for people is move to and from water through their settlement patterns. Both farmers and pastoralists look for the better-watered areas with better rainfall and fertile soils throughout the seasons, also using receding floods and water that accumulates in valley bottoms or entire floodplains for dry season cropping and grazing. People's other age-old strategy is to make water move to them, which requires investments in infrastructure. Household wells provide groundwater for domestic uses, livestock, and small-scale production at and around homesteads. Free gravity energy has long been tapped in mountainous areas in river-diversions, sometimes with night storage. These are typically for domestic uses, irrigation, brick making and other uses. The availability of new appropriate technologies boosts innovation. Multi-purpose infrastructure is the rule; single uses are the rare exception, because rural (and peri-urban) people have multiple water needs, and multi-purpose infrastructure is more cost-effective. People also use and re-use the changing multiple water sources for greater environmental resilience.

The public sector plays a role in supporting technology development and uptake, for example by stimulating market-led equipment supply chains. The Regional Agriculture Policy (SADC 2014a) promotes the removal of import tariffs on equipment for that reason. Effective forward and backward linkages as a result of broader agricultural support for inputs, marketing and skills development are a key 'pull' factor to convince farmers to invest in infrastructure. Further, government's land and water policies, laws and regulations also affect investments for self-supply.

The third type of investments in infrastructure are those by agri-business. Colonial settlement and state formation was largely shaped around this type of investment, and it forms the basis for SADC's dual economy of highly mechanized, often export-oriented large-scale farming; alongside largely manual smallholder agriculture, lack of electricity, poverty and unemployment. The financial crisis of 2008 fuelled further foreign or national investments in SADC's abundant land and related water and mineral resources, also dubbed as 'land and water grabs' (Mehta, 2012). Governments play key roles in these investments through their national investment policies, public-private partnerships and, especially, their post-colonial custodianship of both land and water resources.

In the following presentation of findings we first give an overview of agricultural water management, in particular irrigation, in Zimbabwe. This places irrigation in an historical, political and economic context in the pre-independence era and three post-independence eras till the Fast Track Land Reform (rehabilitation, attempts at user participation and cost recovery (1981-1984); increased emphasis on user finance (1985-1990); and irrigation management turn-over by experiment and default (1990-1999)), as well as the broader policy environment. Section two ends with an estimate of the untapped irrigation potential and the

changes under the Fast Track Land Reform in terms of declining irrigated area and government investments on the one hand and NGO investments on the other. The in-depth case studies include one government-financed smallholder scheme (Chitora I) and one farmer (Mrs Gledys Chisano Chisanga) engaged in a widespread form of informal smallholder irrigation for self-supply: wetland cultivation.

2. Overview of irrigation in Zimbabwe

Zimbabwe has a total developed area of 206 000 ha and a potential irrigable area of 1 500 000 ha. The developed area consists of the following sub-sectors: Model A2 (i.e. farms larger than 6 ha resettled since 2000) irrigation (29.3 percent), large private company estates (30.7 percent), Agricultural and Rural Development Authority (ARDA) estates (8.3 percent), Model A1 (i.e. farms smaller than 6 ha resettled since 2000) irrigation schemes and old resettlement areas (14.7 percent), communal areas (8.3 percent) and wetland cultivation (9.7 percent). Seventy three percent (150 898 ha) of the developed land is operational while the rest needs rehabilitation. The total potential irrigable area of 1.5 million ha envisages the use of water resources from the Zambezi River and Lake Kariba. The unexploited internal renewable water resources of 3 600 MillionM^3 (MM^3) has a potential of irrigating 300 000 ha, of which 200 000 ha can be developed from existing under-utilised dams and dams under construction.

The country mainly relies on surface water resources given that groundwater resources are scarce. The major irrigation technologies utilized in the country are surface irrigation, sprinkler irrigation and micro-irrigation. In surface irrigation, furrow and border irrigation are predominant. The major types of sprinkler irrigation systems in the commercial farming sector are semi-portable, portable (normally used on tobacco) and centre pivot irrigation. In the smallholder sector, the drag-hose sprinkler irrigation system is dominant although small portable and semi-portable systems can also be found on individual schemes. Micro-irrigation is mainly practised in the commercial sector. In the smallholder sector, three conventional micro-irrigation projects were set up as pilot projects. In addition, many units of family drip irrigation systems were distributed to predominantly individual farmers as well as to some community gardens for garden irrigation. The program on family drip systems was evaluated as having failed owing to a number of constraints.

Irrigation is considered a major tool for economic development in Zimbabwe. There are many different crops that are irrigated including major crops such as tobacco, cotton, maize, wheat, tea, coffee and horticultural crops. Though currently difficult to quantify, irrigation is known to contribute considerably to the agricultural sector, which itself contributes about 20 percent of the GDP. The key objectives of irrigation development are to: (1) increase crop yields, (2) improve nutritional status of rural communities, (3) commercialize crop production, (4) improve household and national food security, (5) support industrial growth, (6) increase agricultural exports and foreign currency, (7) create employment, (8) effect

general rural development, (9) increase land and water resources utilization, and (10) efficiently utilize land and water resources.

2.1 Historical overview of irrigation in the country

In Zimbabwe, both pre-independence (pre-1980) and post-independence governments have been the key drivers of smallholder irrigation development, at strategic, planning, financing, implementation and management levels. The extent of government involvement was dictated by strategic objectives that differed, in particular before and after independence. Though none of the governments managed to produce a comprehensive irrigation policy document, strategic considerations that varied from time to time and from one government to the next had a profound impact on irrigation development, especially in terms of how projects were initiated, financed, the technologies selected, and implementation processes undertaken. The motivations driving smallholder irrigation development placed smallholder farmers at the epicentre of the strategies, allowing farmers to participate to the extent that was consistent with the strategic development objectives. For long, Zimbabwe has not had an irrigation policy to specifically guide irrigation development, but it has had development policies and legal instruments, most from other sectors of the economy, that have shaped the perception, implementation and management of irrigation in the country.

2.1.1 Pre-independence scenario

The policy of separate development of Black and White people adopted by pre-independence governments gave birth to two major groups of irrigators: (1) Large Scale Commercial Farmers (LSCFs) (private individuals or institutions) who had title to land and, on the strength of the National Water Law (1912), had a basis on which to obtain water rights; and (2) small-holders who had no title to land and, therefore, lacked a basis on which to apply for water rights. During the development of the first few irrigation schemes in Manicaland Province between 1912 and 1927, small-holder farmers became main actors when, of their own initiative and without government assistance, but with technical assistance from missionaries, they developed, operated and maintained schemes, that became the first formal farmer-managed schemes. By 1945 government had increased regulation and control of plot-holders thereby taking over the management of communal irrigation schemes. Farmers viewed the imposition of water rates and requirements for contributions to labour for maintenance, as well as the requirements of double cropping, as attempts by the government to control their fate.

In the 1950s government placed high priority on water development, in particular dam construction and the provision of concessionary loans for irrigation development in the LSCF sector. This initiative made the LSCF key beneficiary stakeholders of this policy. The amendment of the Land Apportionment Act of 1930 to the Land Apportionment Act of 1950 to remove Blacks from White areas and move them to Native Reserves, stimulated

compensatory construction of new dams and smallholder irrigation schemes by the government to accommodate those displaced. In the 1960s government became a major player in the small-holder irrigation sector as it financed and developed government-managed small-holder irrigation schemes based on a policy of stemming urban migration by rural communities. These schemes were exclusively surface irrigation schemes since Blacks were not expected to cope with the more sophisticated sprinkler irrigation. Although the target beneficiaries of this policy were rural communities, the nature of the policy militated against any meaningful farmer participation as it excluded farmers from both the choice of irrigation technology and the processes of project implementation. The result was that farmers viewed the schemes as government enterprises in which they were mere labourers and, therefore, passive stakeholders, forced to engage in irrigation so as to grow crops as prescribed by government agents.

Around 1975, at the height of the liberation war, government constructed irrigation schemes to provide for 'protected villages' for rural communities to deny liberation war fighters access to communities. These schemes were negatively viewed by the beneficiaries. Government enacted the Water Act (1976) and its amendments in 1978, consolidating permanent private ownership of water through private property ownership and priority dating of water rights. Priority rights militated against the entry of new irrigators (most of whom were communal farmers) into the irrigation sector. The top-down approach to smallholder irrigation development can be attributed to the governments of the time. Donors were not involved owing to sanctions against the country. Many schemes constructed during this period are still operational, and are expected to continue to function in a sustainable manner.

2.1.2 Post-independence scenario

Smallholder irrigation development in Zimbabwe post-independence happened in an *ad hoc* way. This *ad hoc* approach, it is argued, was a symptom of the absence of an appropriate policy to guide the process (Mfote 1994; Bolding et al. 2004). Many other commentators (Mupawose 1984; Magadzire 1994; Chabayanzara 1994 and Chitsiko 1995) echo these sentiments. Makadho[1] (1994) made it more explicit when he stated that “irrigation policy is not in black and white: it is only understood”. As a result some of the objectives of smallholder irrigation development in Zimbabwe have not differed in any meaningful way from the colonial era. The objectives have hovered around increased production per unit of land, introduction of new irrigation technology, decongestion of communal areas (Manzungu 1999) and bringing the marginalized communal farmers into the market economy (Mfote personal communication 2004). Some attempts were made by central government departments responsible for irrigation, aided by international and bilateral donor agencies, to come up with some policies. However, the attempts were not coordinated, and each attempt emphasized different or new agendas. This section shows how this scenario has led to the current status of smallholder irrigation schemes in Zimbabwe.

[1] Makadho was the director of AGRITEX at the time this remark was made.

Rehabilitation, attempts at user participation and cost recovery (1981-1984)

The government introduced 'Scientific Socialism' leading to attempts to establish state-assisted irrigation-based agricultural co-operatives. During the period there was very little development of new irrigation schemes. Efforts were centred on the rehabilitation of the irrigation schemes destroyed during the fifteen years of liberation struggle. The United Nations High Commissioner for Refugees (UNHCR) and the USAID funded the rehabilitation and reconstruction program. The main policy initiative during this period was the Department of Rural Development (DERUDE) policy paper on smallholder irrigation schemes of April 1983[2]. It advocated for: (i) increased smallholder farmer participation in financing the establishment, O&M of smallholder irrigation schemes, (ii) introduction of Irrigation Management Committees (IMCs with the hope of achieving user management (Bolding 2004 196), and (iii) enhancement of cost recovery so as to reduce government spending on smallholder irrigation schemes. Successive government irrigation agencies have subsequentlydepended heavily on the DERUDE document described by Meinzen-Dick (1993 35) as 'the most definitive smallholder irrigation policy statement in Zimbabwe'. This document was, however, never formally adopted by the government as policy.

Increased emphasis on user finance (1985-1990)

Government policy during this period emphasized the reduction of government subsidies and increased farmer participation in the design, financing and management of smallholder irrigation schemes. The mandate to design, construct, and operate small holder irrigation was wholly put under one department, AGRITEX. However the development of the water source and the subsequent delivery of the water to the irrigation schemes remained the responsibility of the Department of Water Development (DWD) (Makwarimba, et al 2004). It is during the period that government introduced the National Farm Irrigation Fund (NFIF), which was set up in 1985. The NFIF was a loan facility through which a group of smallholder farmers could borrow money for the purchase of irrigation in-field equipment at low interest rates. Government retained the responsibility for financing the main system to field edge. Overall the policy was ineffective becuase smallholders hardly made use of the loan facility (Rukuni and Makadho 1994). Electoral promises by various politicians to provide each district with a dam and smallholder irrigation scheme free of charge, as well as the availability of donor support to smallholder irrigation development at no cost to the ultimate users, severely undermined the policy (Bolding 2004; Zawe 2006).

[2] It is not clear who formulated this policy paper. Most probably it was formulated at directorate and provincial levels by officers of DERUDE, who were themselves a mixture of officers that originated from the then defunct extension departments for communal and white commercial farmers of the colonial era. Note that the director and deputy director of DERUDE later moved to become successive directors of AGRITEX in 1985 and 1988 respectively.

Irrigation management turn-over by experiment and default (1990-1999)

As a consequence of the Economic Structural Adjustment Program (ESAP) adopted by the government in 1990, the economy of the country was opened to market forces. The government's capacity to provide finance for O&M for the smallholder irrigation schemes was eroded as it struggled with economic reforms. The Irrigation Division of AGRITEX began to experiment with irrigation management turnover policies. In some cases farmers were forced to contribute resources for O&M as government and farmers experimented in some kind of joint irrigation management while in others irrigation schemes were turned over to the farmers by default when government failed to provide O&M funds (Bolding et al 2004). The following experiments were initiated to test policy models for future use by AGRITEX: (i) Farmesa initiative (1996); (ii) the Musikavanhu Small Scale Irrigation Programme (SSIP, 1995); (iii) SISP, 1999; (iv) the Negomo Irrigation Scheme (Zawe, 2006); (v) AGRITEX's participatory irrigation design and construction of wholly farmer managed smallholder schemes (Zawe 2006); and (vi) AGRITEX's commercialization of irrigation services through the Agricultural Research Fund (Chidenga 2003). AGRITEX's participatory design and construction of irrigation schemes survived up to 2000. The Farmesa approach and AGRITEX's commercialization proposals are still to be implemented. The SSIP and Negomo attempts were never completed having been abandoned at the commencement of the agrarian reform (locally known as 'Third Chimurenga') in 2000.

2.2 Types of irrigation schemes

2.2.1 Zimbabwe's irrigation subsector

The proposed Zimbabwe Government Draft Irrigation Master Plan document of 2010 streamlined Zimbabwe's irrigation sector into six subsectors (A2, Large Private Estates, ARDA Estates, A1 and Old resettlement, Communal area, and Wetland cultivation) based on the farming sectors of the country.

Table 1 summarizes the equipped but not necessarily operational area based on the six subsectors. Two of these six subsectors, the Communal and Old resettlement (i.e. areas resettled using the willing-buyer-willing-seller approach), and Wetland cultivation are classified as smallholder irrigation schemes. There are suggestions that A1 should also belong to this category. However the A1 farming subsector is on land that donors and NGOs have termed "contested land" because of the disputed fast track land reform process of the past decade. The classification of this subsector has not yet been adequately debated by stakeholders, and is therefore not concluded.

Table 1: Area equipped with irrigation infrastructure by subsector in Zimbabwe

Subsector	Area equipped (ha)
A2	60 560
Large private company estates	63 470
ARDA estates	17 100
A1	30 460
Communal area and Old resettlement	15 000
Wetland cultivation	20 000
Total	**206 590**

2.2.2 Defining smallholder irrigation in Zimbabwe

In Zimbabwe smallholder irrigation schemes generally have the following attributes: (i) irrigated plot-holding ranging from 0.1 – 1.5 ha according to commonly agreed classification prior to the land redistribution program (pre-2000) and 0.1 – 5 ha according to new suggestions that include A1 farmers in the smallholder sector; (ii) shared infrastructure, in some cases including plot level infield infrastructure; (iii) self-management, joint management between farmers and government, or predominantly government management; (iv) communal land tenure; and (v) a community elected IMC.

Therefore a smallholder irrigation scheme can be defined as an irrigation scheme in which a group of farmers irrigate together, sharing the same water source and delivery line, with individual or joint control of irrigation and farming activities on their plot(s). The fact that the schemes are communally owned and operated has significant implications on the performance of the subsector, precipitating opportunities and challenges for the development and sustainability of the sector. However, in the case of wetland cultivation, irrigation schemes are normally individually owned and managed. In these schemes there is virtually no government support to farmers. As a result wetland irrigation is sometimes referred to as informal irrigation. It is not surprising, therefore, that these irrigation schemes are sometimes referred to as unofficial, and are often off the government record. As a result not much is known or recorded about these schemes.

2.3 Irrigation investments

Since before independence, successive Rhodesian and later Zimbabwean governments deliberately invested public funds in irrigation in general, and smallholder irrigation development in particular. Financing of irrigation development in Zimbabwe was supported by government and numerous other financing institutions. However, with respect to smallholder irrigation development, financing occurred within the context of a policy discourse that was guided by the DERUDE Paper (1983) and the Irrigation Policy Paper of 1994, even though these papers were never officially adopted as government policy.

Stakeholders interpreted and in most cases implemented the discourse according to their own interpretations.

Table 2 presents major sources of financing for irrigation development in Zimbabwe after 1980.

Table 3 illustrates the different financing positions (e.g. grant, loans and soft loans) taken by the different financiers in accordance with their interpretations of government objectives for irrigation development. On receiving loans from some of the financiers, government was supposed to extend the loans to farmers so as to be able to repay their loans. However, to date, no recovery strategies have been put in place. This brought about contradictions in implementation strategies even where smallholder schemes were adjacent to each other. Chitora smallholder irrigation scheme is a case in point, where one part of the scheme was developed as a grant and the other part required contributions from farmers.

Table 2: Sources of financing for irrigation development

Investments	Purpose	Time (Period)
PUBLIC SECTOR INVESTMENTS		
Public Sector Investment Programme	To rehabilitate and develop new smallholder irrigation schemes. Prior to 2009, government informed and expected beneficiary farmers to compulsorily grow maize and wheat for food security.	Annually
NFIF administered by the government-owned Agricultural Finance Corporation	Large-scale commercial schemes for individuals (allocated 85 percent of funds) and smallholder irrigation schemes for communal groups of irrigators (allocated 15 percent of funds). Primary conditions for smallholders to access funds were to form groups, be viable and grow wheat and maize among other crops.	From 1985 to the 1990s
Ministry of Finance funded Irrigation Rehabilitation Programme (PSIP)	Rehabilitation of mainly A2 and A1 irrigation schemes following destruction of infrastructure during land reform program. Growing maize and wheat was a key stated, but not always enforceable, condition to access funds.	2001 -2003
Reserve Bank funded Zimbabwe "Accelerated Irrigation Rehabilitation and Development Programme"	Rehabilitation of mainly A2 and A1 irrigation schemes following destruction of infrastructure during land reform program and incapacity of Ministry of Finance to fund program. Growing maize and wheat was a condition to access funds.	2004 to 2007
Zimbabwe Agricultrual Sector Assisted Programme (ZASA)	Smallholder irrigation rehabilitation of Nyanyadzi and Tawona irrigation scheme.	1983 - 1986
DONOR FUNDING		
Dutch Government	New smallholder irrigation schemes providing all irrigation infrastructure, including dam construction. Farmers contributed labour during construction. Funds for O&M were provided for first two years.	Late 1980s
Danish Internaatianl Development Agency (DANIDA)	New construction or resuscitation of smallholder irrigation schemes in pre-2000 resettlement areas. Focus was to create farmer-managed schemes. Provided O&M funds for first two years of	1987-1995

Investments	Purpose	Time (Period)
	operation.	
Kreditanstalt für Wiederaufbau (KFW)	Rehabilitation and construction of new smallholder irrigation schemes. Promoted farmer-managed schemes and experimented with new private-sector based management institutions (neither IMC nor government) and semi-on-demand irrigation technologies.	1985-2003
European Union (EU) (then European Economic Community (EEC))	New smallholder schemes with strong capacity building component for both farmers and irrigation staff through training. The program demanded farmer contributions up to 25 percent of the costs.	1985-2011
International Fund for Agricultural Development (IFAD) and DANIDA funded Smallholder Irrigation Support Programme (SISP)	Rehabilitation and development of smallholder irrigation schemes. Government expected farmers to grow food security crops, maize and wheat among other crops of their choice (though not a condition of donors).	Around 1998-2003
Australian government	Smallholder irrigation development for Deure irrigation scheme.	Late 1980s
FAO water management program	Introduction of treadle pump, micro-irrigation and training for smallholder farmer groups and individual farmers.	2001-2004
United Nations Development Program (UNDP)	Introduction of treadle pump, micro-irrigation and training for smallholder farmer groups and individuals.	2005-2007
Lead Trust	Introduction of treadle pump, micro-irrigation and training for smallholder farmer groups and individuals.	
Chinese Program	Agricultural equipment as well as irrigation equipment for rehabilitating A1 and A2 irrigation schemes. (about US$ 20 million)	2006-2008
Brazilian Program	About US$ 50 million out of US$ 98 million assistance program targeting smallholder and A1 farmers.	2011-on-wards
NGO SUPPORT		
Oxfam	Small irrigated gardens for individual farmers and farmer groups. In some cases small holder irrigation schemes.	Ongoing
Mvuramanzi Trust		
USAID		
World Vision		
Care International		
Christian care		
Catholic Relief Services		
Others		

2.3.1 Public Sector Investment Programme (PSIP) financing

The National Farm Irrigation Fund (1985 to 1993)

The NFIF was a credit facility created by the government in 1985 to assist farmers to purchase infield irrigation equipment as a complement to government's own investment in water supply installations. This was a revolving fund administered by the Agricultural Finance Corporation (AFC). In principle it was one of the most suitable programs to ensure easy turnover of irrigation management to smallholder farmers. The idea was that by providing funding to farmers in the form of a loan, the farmers would regard the irrigation infrastructure as their own and would be more willing to operate and maintain it. This reasoning failed to recognize the weakness of lending to groups. A single defaulter in a group

rendered all members of the group defaulters. Under this program AGRITEX had, by October 1989, developed 10 smallholder irrigation schemes throughout the country (Makadho 1994). However the program was abandoned in 1993 and only continued to exist on paper. Makadho (1994) hinted at the following problems with the program: (i) The condition of group borrowing was not popular since most farmers found it difficult to trust each other. Group borrowing could badly affect family relations in the event of death; (ii) The majority of smallholder irrigation schemes were fully funded by government including more than 80 percent payment for the O&M costs. The introduction of NFIF was therefore in contradiction to prevalent practices of government subsidies; (iii) The lack of a grace period in loan repayment and the insistence on centrally marketed crops made the program even less attractive and; (iv) The availability of a number of donor finance agreements in the irrigation sector that worked with grants at no cost to the beneficiaries made it unreasonable to push the NFIF program.

Table 3: Irrigation projects and sources of funding as at July 1990 (Zim$'000) [3]

Scheme / Program	Donor	Cost estimate	Gov input	Donor input	Type of funds	Area (ha)	Start date
Nyanyadzi	ZASA	7 200	4 948	2 251	Grant	150	1983
Masvingo rehabilitation	KFW	9 454	3 110	6 343	Soft loan		1985
Nyamaropa	NFIF	564	564	0	Loan	198	1985
Irrigation Support Fund	PSIP	19 800	19 800	0	Grant	3 000	1985
Tawona extension	ZASA	360	0	360	Grant	71	1986
National rehabilitation	KFW	6 132	17 66	4 366	Soft loan	98	1986
SSHI	DANIDA	6 370	0	6 370	Grant	2 500	1985
Musikavanhu	EEC	10 375	0	10 375	Soft loan	700	1989
Biri / Hama	Dutch Gov	1 120	0	1 120	Grant	92	1988
Devure Block C	Australia Gov	2 297	0	2 297	Grant	45	1989
Ngezi	KFW	2 050	0	2 050	Soft loan	216	1989
Siwaze / Kalope	KFW	1 366	0	1 366	Grant	50	1989
Bonde	Dutch Gov	15 420	5 820	9 600	Grant	600	1989
Total all projects		**82 508**	**36 008**	**46 498**		**9 504**	

Source: FAO (1990)

The strategy of the NFIF (of offering loans to smallholder farmers) contradicted heavily with both PSIP (a sister government program) and most of the donor strategies of providing full grants – a clear problem that can be attributed to the of lack of an irrigation policy.

[3] The exchange rate in July 1990 was US $1.00 to Zimbabwe $2.45.

The PSIP

Since before independence, successive governments deliberately invested PSIP funds in smallholder irrigation development annually due to the importance of irrigation in Zimbabwe. Prior to the 2000, this fund was used to: (1) develop all irrigation infrastructure from head-works to infield works as a grant to famers; (2) develop head-works infrastructure from the water source to field edge as a grant to farmers in combination with the NFIF that was used to develop infield infrastructure as a loan to farmers; and (3) meet part of the O&M costs of government-managed irrigation projects. Before independence in 1980, and after donor fatigue set in around 1996, the PSIP fund increasingly became the single largest facility through which government channelled funds for smallholder irrigation development as illustrated in Figure 3.

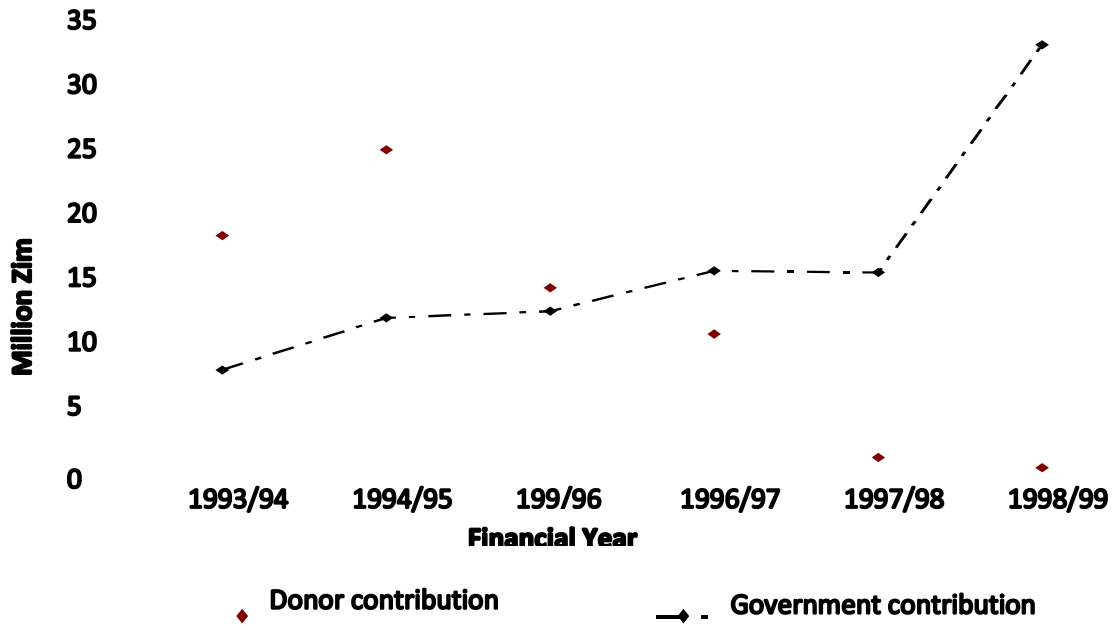


Figure 3: Investments in smallholder irrigation

From 2000 to date, the PSIP fund has been used to develop and rehabilitate all smallholder irrigation infrastructures as a grant. However, in addition to being inadequate with respect to demand, the PSIP fund is no longer used for O&M costs which farmers now have to meet. These realities are not policy *per se*, but are ad-hoc measures that the Department of Irrigation has had to implement. By default, neither is the government collecting irrigation fees that it used collect, thereby leaving all smallholder irrigation schemes to manage themselves. From 2000, the decline in donor funding triggered spirited attempts to increase PSIP funding by the then government against a backdrop of a declining economy as government made irrigation development the central part of its strategy to maintain food security. Around 2005 the government launched the Accelerated Irrigation Rehabilitation and

Development Programme that principally targeted rehabilitating infrastructure in former commercial farms through financing from the Reserve Bank of Zimbabwe.

The responsibility for O&M at government managed smallholder irrigation schemes lay with government. Over time, AGRITEX, the Department responsible for O&M, received increasingly limited funding towards O&M. From 1995 onwards it became clear that the government could no longer continue to pay for O&M of irrigation schemes for farmers as donor fatigue and the effects of the ESAP set in. Most of the donor funded irrigation development programs ended around 1995.[4] This resulted in a serious shortage of O&M funds for government which in turn triggered a process of irrigation management turn-over by default and, in some cases, irrigation management turn-over by experiment (Bolding et al 2004). This demonstrated that government faces too many responsibilities and constraints to be able to provide O&M.

2.3.2 Donor financing

As indicated above, prior to 1996, Zimbabwe got a lot of assistance from donors for smallholder irrigation development. The general trend was to finance farmer managed irrigation schemes in order to reverse the effects of top-down approaches used by earlier governments and promote sustainability. Notable approaches by some donors were that: (i) Some donors such as Dutch Government, FAO, UNDP and DANIDA provided starter packs and O&M funds for two seasons to reduce the financial burden on new farmers; (ii) Most donor financing was in the form of grants to farmers at the same time that efforts were underway to inculcate a culture of borrowing and cost recovery in smallholder irrigation development. DANIDA, in particular, bailed out farmers who had borrowed for infield equipment under NFIF, thereby unintentionally undermining the principle of NFIF. Similarly, government continued to provide PSIP grants. This scenario may have undermined the spirit of cost recovery amongst irrigators; (iii) KFW used lessons learnt from previous projects to positively vary their development strategies. They introduced semi-on-demand schemes as an improvement on existing designs. They also put together a new type of scheme management system the effectiveness of which has not yet been studied for possible adoption by other schemes; (iv) The conditions of abundant financial resources from donors and government did not continue after the introduction of liberalisation polices that accompanied the ESAP.

2.4 Economic contribution of irrigated agriculture

Agriculture has over the years contributed around 20 percent of the Growth Domestic Product (GDP). It has also provided raw materials for the industrial sector. The contribution of irrigation to GDP is difficult to establish because not much is known about production within the former commercial areas. Zimbabwe's real GDP was contracting at a negative rate of 14.4

[4] For example the Dutch fund and the Support to Smallholder Irrigation Project (SSHIP) ended in 1995 and were not renewed.

percent in 2008, but has improved, with the 2011 projections estimating that the real GDP in Zimbabwe will increase by 9.3 percent during 2011. The Ministry of Finance is still struggling to determine the exchange rate to use in settling Zimbabwean dollar account balances that were frozen when government decided to dollarize the economy in February 2009. Treasury is facing a dilemma in trying to come up with a formula to use in determining payment since there were four exchange rates in use during the Zimbabwe dollar era – the official exchange rate, the cash rate, the Real Time Gross Settlement rate and the parallel market rate. The official rate was too low and, if adopted, would result in too many people becoming millionaires in US dollar terms. On the other hand, parallel market rates were high and attractive, but were outside formal rates, and government would be breaking its own laws if it recognized these.

2.5 Policy environment

After independence government spearheaded some major and fundamental changes to policy and practice in all sectors of the economy, including agriculture. The overriding principle was to facilitate inclusion of previously disadvantaged groups into the mainstream economy. The major policies and practices impacting on the irrigation sector and smallholder irrigation sector, in particular, are summarised below.

2.5.1 Entry-exit and re-entry of donors into smallholder irrigated agriculture

As indicated earlier, there was a spike in donor investments in smallholder irrigation that peaked around 1994, but declined drastically to negligible levels around 2000 due to differences in policy between donors and government. Between 2000 and 2008 the few donors who remained in Zimbabwe concentrated efforts on the provision of food to communities and promoting community gardens. Following the formation of the Government of National Unity in 2009, donors have started trickling back and have initiated limited engagement with government but full engagement with communities. This is the current scenario.

2.5.2 Discourse on irrigation policy and strategy

Following earlier policy efforts that included the Policy Paper on Small Scale Irrigation Schemes by DERUDE (1983) and the FAO funded Irrigation Policy Paper 1994, further attempts have been made by Department of Irrigation in 2005, as well as in 2010 and 2011, to compile an irrigation policy and strategy. These attempts are still to bear fruit.

2.5.3 Agricultural policy

The most significant agricultural policy to smallholder irrigation was the Zimbabwe Agricultural Policy Framework (ZAPF) (1995-2020). The document set out the national agricultural policies and objectives within the agricultural sector, with particular focus on raising the incomes and standard of living of small-holder families and increased investment

by private sector participation. The ZAPF reiterated the 1994 National Irrigation Policy and Strategy, with respect to irrigation development, with the following major strategies for small-holder irrigation development: (i) giving priority to farmer-managed and operated schemes, with government continuing to fund development while communities operated and maintained the schemes; (ii) continuing responsibility of government to develop major irrigation infrastructure on state land while the private sector would be encouraged to invest in irrigation; (iii) promotion of more efficient and equitable use of water; and (iv) strengthening of water users' associations.

This policy marked the first recognition at policy level of the private sector as a major player. The private sector became involved in construction of irrigation schemes as contractors but did not participate in funding smallholder irrigation development, mainly due to the lack of collateral. However the private sector, mainly finance houses, funded commercial irrigation due to the fact that the sector had (prior to the fast-track land redistribution program) title deeds for their properties, and hence collateral.

2.5.4 Water policy

The National Water Act of 1976 was repealed to allow entry of previously disadvantaged groups into the irrigated sector and to improve the nation's water management practices. The strategies of the National Water Act (1998) with regard to irrigation development are: (1) that the basis for financing of management of water resources under the Zimbabwe National Water Authority (ZINWA) would be full cost recovery from users with targeted subsidies for vulnerable groups, such as small-holder farmers; (2) the removal of priority dates of water rights and their replacement with 20-year renewable water permits and (3) replacement of River Boards, which hitherto excluded communal area stakeholders, by Catchment Councils, which on paper are representative of all stakeholders, including small farmers. Notable inconsistencies in the implementation of the new water policy with respect to smallholder irrigation are that: (1) most farmers feel that they are not being consulted in arriving at water charges; (2) farmers are not meaningfully represented at sub-catchment level as envisaged by the Act or are not accorded an appropriate status and voice as ZINWA appears to dominate the Councils; (3) farmers in some schemes pay for water while others do not; (4) blend water charges, instead of catchment level determined charges are still being applied; (5) in most cases there are no water measuring devices against which to validate the water charges; and (6) even where measuring devices are available ZINWA is not always able to read the devices hence it is forced to estimate water consumption.

2.5.5 Land policy

Since 2000 tenure on all land was vested in the state although the law to effect this, Constitutional Amendment 17, was enacted later. While the laws had a profound effect (e.g. lack of collateral as viewed by financing institutions and many other stakeholders) on commercial farms they had no effect on smallholder irrigation since the land already

belonged to the state. Local government, through Rural District Councils (RDCs), is the superintendent of local governance. Therefore it has always been a major stakeholder in irrigation development, particularly as regards issues pertaining to land ownership and use. Matters relating to custodianship of land, water rights/permits, and resettlement/ compensation have always been dealt with within the realm of governance through the structures of local government, in particular the RDCs under which smallholder irrigation custodianship falls. Government structures like the provincial and district administration offices, local leadership structures like the IMCs, chieftainship and headmanship, and political structures, have played a role in irrigation development. The RDC Act (1988) empowers RDCs not only to levy charges from large scale farmers but also from rural communities.

2.6 Water availability

Table 4 summarizes water availability based on internal renewable sources, according to estimates from the Ministry of Water Resources and Management. The amount of water to be exploited (3 600 MM^3) is estimated to command 300 000 ha. Over and above this, Zimbabwe has a further potential to utilize water from shared water courses, in particular the Zambezi River and Kariba Dam. Zimbabwe is a semi-arid country that receives less than 450 mm/year to over 1 000 mm/year of rainfall in one season (November to March). The country has been divided into five broad agro-ecological regions (natural regions (NRs)) in which the dominant partitioning factor is rainfall (Table 5 and Figure 4). Agricultural production patterns depend on these natural regions. Rainfall generally decreases from North to South and East to West. Mid-season droughts are frequent, and they occur around January and February each year.

Table 4: Water availability based on internal water resources

Surface water	Groundwater
Mean annual total run-off : 19 900 MM^3	Scarce and not yet fully investigated
Potential yield : 11 260 M M^3	Provides potable water to 70 percent of population
Exploitable yield (75 percent) : 8 500 M M^3	Provides water to 20 000 ha of small gardens
Committed water 4 900 M M^3	
To be exploited : 3 600 M M^3	

Table 5: Rainfall patterns of Zimbabwe's five natural regions

Natural region	Area ($km^{2)}$	Percent of total	Rainfall characteristics	Comments
I	7 000	2	More than 1 050 mm rainfall per year with some rain in all months.	Specialized and diversified farming region.
II	58 600	15	700 - 1 050 mm rainfall per year confined to summer.	All types of crops and animal husbandry practices are carried out. Supplementary irrigation is done for winter wheat

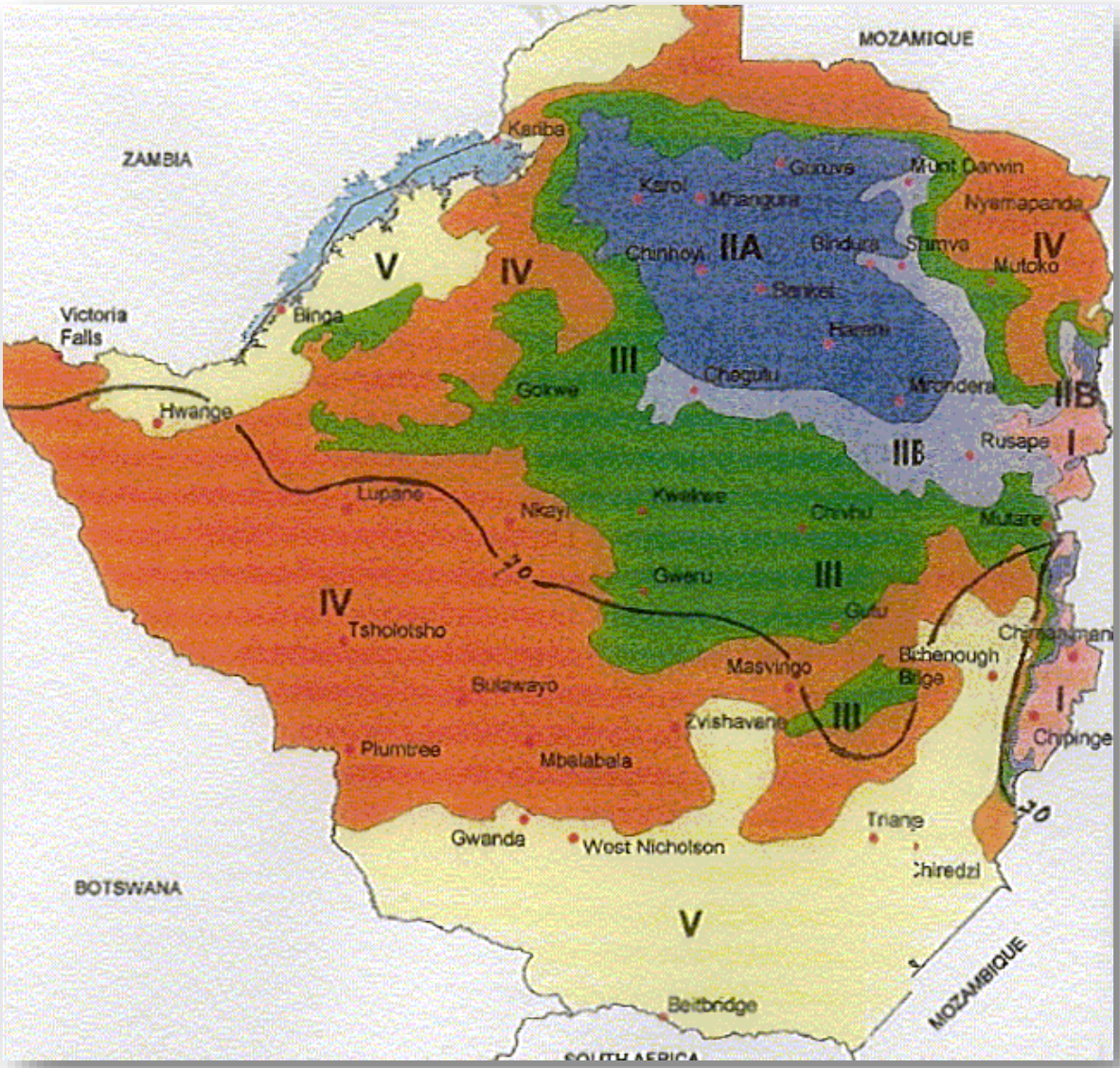
Natural region	Area ($km^{2)}$	Percent of total	Rainfall characteristics	Comments
III	72 900	18	500 – 700cmm rainfall per year. Infrequent heavy rainfall. Subject to seasonal droughts.	Semi-intensive farming region with periodic seasonal droughts, prolonged mid-season dry spells and unreliable starts of the rainy season. Irrigation vital for sustaining crop production.
IV	147 800	38	450 – 600 mm rainfall per year. Subject to frequent seasonal droughts.	Too dry for successful crop production without irrigation
V	104 400	27	Normally less than 500 mm rainfall per year, very erratic and unreliable. Northern Lowveld may have more rain but topography and soils are poorer.	Too dry for successful crop production without irrigation
Total	**390 700**	**100**		

Source: Rukuni and Eicher 1994

Only 37 percent of the country receives rainfall considered adequate for agriculture. In the remaining 63 percent, no meaningful crop production can be carried out without harnessing water for irrigation. This scenario has seen Zimbabwe develop over 10 000 dams to harvest water for domestic, industrial, mining and agricultural use, making it one of the countries with the highest number of dams in Southern Africa. Eighty (80 percent) of harvested water is used for agricultural purposes.

2.7 Irrigation potential

Prior to the start of the agrarian reform (locally known as 'Third Chimurenga') in 2000, the entire equipped irrigation sector comprised a total equipped of 206 000 ha, as shown in Table 1 and re-classified as presented in Table 6. Internal renewable water resources, excluding Zambezi river water and Limpopo River water can command a potential 300 000 ha. Of this area, about 200 000 ha can be immediately constructed to use under-utilized water in existing dams and those under construction. Preliminary identification of further irrigation potential by the Department of Irrigation, taking into account the Zambezi River flow, Kariba Dam, and Limpopo River indicate a total potential of about 1 500 000 ha, inclusive of the internal potential. The Third Chimurenga re-configured the whole irrigation sector. The new irrigation thrust centred on the rehabilitation of vandalized former white commercial farmer irrigation schemes. There was very minimal development of new irrigation schemes owing to the rapid decline in the economy, lack of funds by government, and the flight of donors.



LEGEND: Natural regions: I Specialized and Diversified Farming Region; IIA Intensive Farming Region, IIB Intensive Farming Region; III Semi-Intensive Farming Region; V Extensive Farming Region. 70 percent probability of receiving more than 500 mm rainfall during the period October-April. The 70 percent probability isoline is based on information from the Meteorological Department as compiled by the early warning Unit for Food Security.

Figure 4: Natural regions of Zimbabwe

In fact, there was a decline in the irrigated area from 206 590 ha to the present 150 900 ha presented in Table 6. It is important to note that the situation is still very fluid as land reoccupation is still on-going. Also, rehabilitation centred on replacing whatever was missing of the original infrastructure that the single user (former commercial farmer) had put up. Funding for rehabilitation was pre-dominantly provided by government through the Reserve Bank of Zimbabwe, although the Chinese government did assist from 2006 to 2008. There was no redesigning of the irrigation scheme to suit the incoming group. During this period there was very little government investment in the smallholder sector as all its efforts were directed towards rehabilitating former commercial farms. While government was pre-

occupied with the rehabilitation of A1 and A2 irrigation schemes, donors and NGOs (such as EU's SISP, Oxfam and World vision) were involved in the development of nutritional gardens and rehabilitation and development of smallholder irrigation schemes in the communal areas under the limited-engagement-with-government approach to support to Zimbabwe. This helped the smallholder sector survive the vagaries of a nearly collapsed economy, thereby maintaining the equipped area around the present 151 000 ha. Following the formation of the Government of National Unity in 2009, smallholder irrigation has gained prominence beyond A1 and A2 schemes in terms of priority funding with the sector getting US$ 12 million dollars from PSIP in 2011 in addition to re-invigorated efforts of donors and NGOs.

Table 6: Irrigation subsector the situation after land reform process

Subsector		Prior to agrarian reform	During agrarian reform	Status 2011
Commercial	White LSCF	66 770	8 140	91 101
	Black LSCF	9 250	9 250	
	ARDA estates	13 500	13 500	
	Private Plantations	63 470	63 470	
	A2	-	12 450	
	Total	152 990	94 360	
Smallholder	Estates out growers	3 600	3 600	59 797
	Formal Communal and Old resettlement	10 000	10 000	
	Informal Communal and Old resettlement	20 000	20 000	
	A1	-	7 620	
	Wetland cultivation	20 000	20 000	
	Total	53 600	61 220	
Total		**206 590**	**155 580**	**150 898**

3. Case study schemes

3.1 Selection criteria

This study focuses on two irrigation schemes, Chitora I and Gledys Chisango (see Map: Figure 5 below). The major attributes and justification for this combination of schemes is summarized below: (i) The irrigation schemes selected do not have water supply problems; (ii) The schemes are amongst some of the shining examples of successful smallholder irrigation schemes in Zimbabwe; (iii) The two schemes represent two of the four types of farmers that constitute smallholder sector. Chitora I represents a conventional (i.e. formal) smallholder irrigation scheme in the old (pre-2000) resettlement areas while the Gledys Chisango scheme represents an informal individually owned irrigation scheme under wetland irrigation; (iv) Chitora I is a self-managed community scheme while the Gledys Chisango

scheme is individually managed. This offers an opportunity to study the two models of management; (v) Being a community scheme, Chitora offers opportunities for studying community dynamics while at the same time offering opportunities for studying individuals within the schemes and comparing their decision-making and response to the individual irrigator; (6) The two irrigation schemes did not stop operating even during the height of economic meltdown in 2007/8.

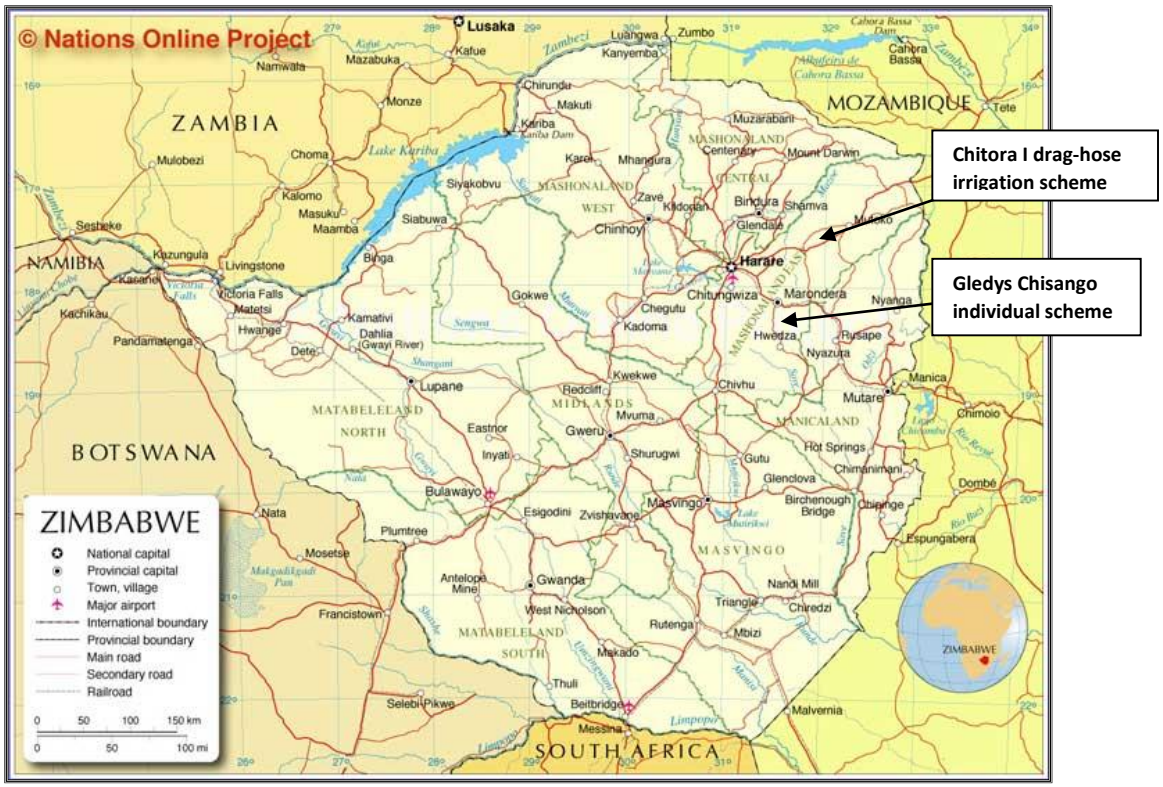


Figure 5: Map Locations of Chitora and Gledys Chisango irrigation schemes
Source: Nations Online Project

3.2 Description of schemes

3.2.1 Chitora I drag-hose sprinkler irrigation scheme

The Chitora I irrigation scheme is the oldest of four small farmer managed irrigation schemes collectively called Chitora irrigation scheme. Chitora irrigation scheme is located 104 km (of which 100 km is along the Harare-Nyamapanda highway and four km is gravel road) north east of Harare in Mutoko District of the Mashonaland East Province. Chitora I drag-hose irrigation scheme (9 ha) was constructed in 1994, followed by Chitora II drag-hose (6 ha) and Chitora II surface irrigation scheme (9 ha) constructed in 2007, and Chitora II extension (11.5 ha) drag-hose irrigation scheme in 2011. The focus of this study was Chitora I irrigation scheme because it has operated for a long enough time to allow elements of success or failure to become evident. In the study, reference is made to the other Chitora irrigation schemes, as necessary.

3.2.2 Mrs Gladys Chisango wetland irrigation scheme

"*Wetlands are moisture rich environments both during the rainy and dry season. As a result wetlands are viewed as key resources for agricultural development and community livelihoods in many Southern African countries. This is particularly so in situations where communities have no access to irrigation infrastructure. In response to challenges of food shortages, many people turn to wetlands as a source of land and water for agriculture. They are particularly useful during the dry season when most surrounding areas are dry and they are the only available source of water*" (FAO 2011). This is an extract from the foreword of a 2011 FAO publication 'Guidelines for the management of inland wetlands in Southern Africa'. Mrs Gledys Chisango is one famer who has turned to wetlands as a source of not only food but her entire livelihood. This study set out to investigate how Mrs Chisango has developed a thriving 1 ha irrigation scheme or "garden" as she calls it. Mrs Chisango's scheme is one of the numerous smallholder irrigation schemes that constitute the 20 000 ha wetland smallholder irrigation subsector discussed earlier. This subsector is sometimes referred to in the irrigation nomenclature in Zimbabwe as "informal irrigation" thereby blocking any meaningful outside support to it. Her irrigation scheme is located in the Chisango village of the Chihota communal areas of the Marondera District of Mashonaland East Province. The scheme is 72 km southeast of the capital city Harare.

4. Case study findings

4.1 Experiences at both schemes

Table 7 summarizes experiences from the two irrigation schemes.

Annex 1 provides guideline themes for filed evaluations and assessments at these two irrigation schemes; photographs taken at the schemes, and examples of standard tables used to calculate gross margins for revenue and costs.

Table 7: Experiences at Gledys Chisango and Chitora Schemes

Aspect	Individual scheme (Gledys Chisango scheme)	Chitora I irrigation scheme (community)
Implementation approaches **Original objectives**	The owner, 59 old Mrs Gledys Chisango, wanted to utilise the wetland plot that was allocated to the family to ensure sustained and profitable income generation from agriculture following her husband's death. She found life unbearable as an unemployed widow living in Harare. She decided to stay in the communal areas where she joined others who were growing vegetables for sale	To develop a self-managing irrigation scheme for young unemployed farmers to engage in irrigated agriculture, with particular emphasis on horticultural production. Objectives of self management were in line with the ZAPF (1995-2020), the DERUDE Paper (1983), the Draft Irrigation Policy (1994), and the government's wish to

Aspect	Individual scheme (Gledys Chisango scheme)	Chitora I irrigation scheme (community)
	to the Mbare market in Harare.	empower farmers.
Irrigation scheme initiators	The irrigation scheme was initiated in 1998 by Mrs Chisango's husband. They were living in Harare where her husband worked. They started off by following her father-in-law's cropping program (maize, rice and sweet potatoes) as rain fed crops. Mrs Chisango, whose parents were growing vegetables, rice and tsenza in the wetlands of Makoni district took over the scheme in 2000 when she started the irrigating vegetables following the death of her husband.	The Resettlement Officer of District Development Fund and retired officer for the Agricultural Finance Corporation initiated the idea of a banana plantation for resettled farmers. They allocated 6 ha each for dry land crop production in villages 10, 12 and 13. The idea was to allocate patches of land not resettled. Farmers agreed and suggested their unemployed young children be involved in the banana project. They approached AGRITEX District and Provincial offices with idea. AGRITEX Irrigation Branch was keen to develop a self-managed scheme for young farmers and took advantage of the idea to develop the first project dedicated to unemployed youth so as to evaluate how they would perform, compared to other schemes.
Stakeholder interests	Mr Chisango bought the fencing materials and fenced the plot using his own savings. Fencing is very important for cropping in the wetlands because these were originally designated grazing land. Mrs Chisango says one of the standing rules in the village is that if your neighbours' cattle strayed into your garden during the day, you cannot claim compensation from them. However compensation can be claimed if the cattle strayed into your garden at night. At night all livestock must be kraaled. Other players include the AGRITEX officers who provide agronomic advice, the vegetable transporter who provide transport, and the vegetable market brokers who buy the vegetables in Mbare, Harare. The farmer, the vegetable transporters and the market brokers mutually depend on each other for their survival, and their relationship is the guarantor of the viability of the scheme.	There was no contradiction in the interests of stakeholders. Major stakeholders involved were: (1) farmers resettled on 6 ha plots from villages 10, 12 and 13, (2) their children who became irrigators, (3) AFC, (4) government departments e.g. AGRITEX and local government, (5) ZESA, (6) ZINWA, and (7) DANIDA. Resettled farmers sought economic activities for their unemployed children. Government sought to empower previously disadvantaged rural communities as well as provide means for food production, especially maize and wheat. AGRITEX sought to set up farmer-managed schemes that are viable. AFC sought to increase its revenue base by providing loans to farmers from the National Farm Irrigation Fund. ZINWA's interest was to add users to the electricity grid. DANIDA's interests were to clear farmers' loans (they paid for all infrastructure development) owed to AFC to allow them to start from a clean slate.
Scheme appraisal	There was no feasibility report prepared by any organisation. According to Mrs	Standards such as irrigation efficiency (75 percent), sprinkler operating pressures of 3

Aspect	Individual scheme (Gledys Chisango scheme)	Chitora I irrigation scheme (community)
	Chisango, "I went into this project out of desperation. I had to at least feed my children. At least I was aware that most people in Chisango village were crafting their survival from the wetlands. In 2000 the world was coming down upon us in Zimbabwe".	bars for 3 mm nozzle sprinklers, pump capacity and pressure, classes of pipes used at planning were acceptable. Financial analysis parameters such as cost/benefit ratio, internal rate of return, and net present worth were acceptable for funding by AFC. The procedure of AGRITEX preparing feasibility reports according to AFC's funding criteria was followed, and the project showed viability at planning stage.
Infrastructure for irrigation schemes **Technical design irrigation infrastructure**	The scheme was designed by the farmer. The scheme is irrigated from wells using an array of channels that were initially fed by buckets. Water was then applied onto the beds where the crops are planted using buckets. However since February 2011, the farmer uses a small petrol pump and poly-pipes for water application to the crops.	The technical design of the irrigation infrastructure was adequate despite farmers' claims that the 20 HP pump does not provide enough pressure in 4 of the 18 plots. The problem of pressure is because farmers: (1) fully opened twin valves (that were installed and set to achieve the right sprinkler operating pressure and uniform water application for across all plots, and (2) all of them replaced the designed 3 mm nozzle sprinklers with higher discharge 4 mm nozzle sprinklers after some had done so without the knowledge of others. This allowed the problem to persist.
Adequacy of infrastructure	The farmer and local AGRITEX extension officer claim that the farmer's wells are reliable except when the season experiences poor rainfall. As a result the farmer is able to meet her irrigation cycles. The farmer's daughter claims with the petrol pump they easily meet their cycles. Mrs Chisango's 10-year grandson has observed that the pump sometimes empties one of the wells in less than an hour. The farmer and her family are content with the irrigation setup. One of the grand children is contemplating use of sprinklers. The farmer has no wetland cultivation permit.	All the components of the infrastructure are in satisfactory working order. Farmers are content with the sprinkler irrigation technology to the extent that those who will benefit from Chitora II extension categorically refused to adopt surface irrigation used at Chitora II surface irrigation scheme. They insisted on the drag-hose sprinkler system.
O&M expenses	Before they bought the pump, Mrs Chisango, her daughter, her daughter-in-law, a neighbouring young man, and two of Mrs Chisango's grandsons were involved in water application. Two of the four elders would scoop water from the well into a stilling box from which the other two elders would scoop the arriving water into the main canal from which it would be directed into a field canal. From there the two young ones would scoop it onto the bed of crops. Four items require maintenance. 1) The Fence: Labour and poles are required. Mrs Chisango hires people to fix the fence	All farmers pay their electricity bills through the IMC within a week of receiving the monthly bill. Failure invites penalties where the defaulter pays several other charges in addition to their contribution to the bill. Beyond that a farmer is barred from irrigating. For breakdowns farmers contribute immediately without excuses, surprisingly according to the farmers even an excuse like 'being broke due to recent funeral expenses' is not given. In October 2011 farmers paid US$ 320 for the scheme. Farmers do not pay for water. They contributed funds and bought a standby

Aspect	Individual scheme (Gledys Chisango scheme)	Chitora I irrigation scheme (community)
	annually. She has a gum plantation from which poles are cut every year. If there are not enough, she augments by buying from the nearby school or from neighbours at a total cost of +/- US$ 40.00 annually. 2) Canals: Mrs Chisango, her daughter and the young man reform canals every season using a cattle drawn plough. The young man is not paid in cash. Because he has no cattle of his own, he has free access to Mrs Chisango's cattle as payment. 3) Wells: Mrs Chisango hires people to clean and/or deepen the wells every six years for +/- US$ 15.00. 4) The Pump: She and her daughter do daily checks. There has been no major problem to date.	electric motor on their own and are talking of contributing funds to buy a diesel engine for use during power blackouts. All farmers from Chitora schemes carry out seasonal maintenance of the dam in January every year. Each scheme maintains its shared scheme infrastructure. Each farmer maintains his/her own field equipment. The Production Sub-Committee inspects equipment used by each farmer. Farmers reported that O&M costs had minimal impacts on income.
Support services **Micro-financing facility**	No micro-financing facilities or any credit facilities are in place.	There is no micro-financing facility. Farmers use their own funds for agro-inputs. They contribute towards funeral expenses through the Funeral Sub-Committee.
Contract farming	Mrs Chisango says of contract farming: "I have not tried it. My feeling is it is like what we do to our goats here. We tie them on to a tree. So their grazing area is restricted to the radius allowed by the length of the rope. They have no choice, even when the grazing is soiled by their dung. I would not want to be a tethered goat".	Farmers do not want contract farming following experiences where they were paid using cooking oil instead of money by a contractor called EXHORT in 2008. They claim contractors formulate contracts to their advantage and also change the goal posts.
Post harvest marketing structures	Mrs Chisango says that she grows vegetables for the open market in Harare. As for maize, she grows it for home consumption and her pigs. For vegetables the market decides the price. Every two weeks she delivers vegetables to Mbare. For transport, the arrangement is that she phones the transporter who stays in Harare. The transporter comes specifically for her produce. She uses the same transporter to bring her inputs from Harare. The transporter claims that the arrangement is based on mutual understanding. He already knows what the price of produce is in the market before he comes to collect the produce. The transport cost therefore is not fixed but negotiated based on market price of the produce. The prices fluctuate heavily but, in the process, everyone must benefit because their livelihoods depends on the	There are no post-harvest structures at the scheme. Farmers either deliver their produce as individuals or groups to Mbare market in Harare or sell to buyers at the scheme. Prior to selling, farmers (through the Marketing Sub-Committee) confirm prices at Mbare using cell phones. The Sub-Committee also negotiates prices for bulk purchases on behalf of farmers, but each farmer still sells as an individual in the bulk selling arrangement. They can also sell in Murehwa or Mutoko towns. Direct selling or through the Committee is preferred by all due to transparency. Farmers procure inputs directly from Harare, Mutoko and Murehwa as individuals. Where necessary the Marketing Sub-Committee organizes procurements and transport.

Aspect	Individual scheme (Gledys Chisango scheme)	Chitora I irrigation scheme (community)
Training	success of the crop production process. "AGRITEX officers train on crop husbandry. They come regularly or if I have a problem I phone him. I have his cell phone number. As for watering methods, it is my own initiative. I do not expect the AGRITEX officer to have anything to do with my pump and engine that I bought without his advice. If I have problems, I hire a mechanic to assist me," says Mrs Chisango.	The quality of extension service is good. One extension worker and one irrigation technician are dedicated to the Chitora irrigation schemes as advisors. The extension worker's house is located in the same area where the farmers live, and the irrigation technician lives 3 km away. They both communicate with farmers every day as there are short distances to walk to all schemes. The extension worker received training on how to develop a Constitution on three occasions. The level of training of farmers was sufficient to contribute positively to the farmers' performance. **On-scheme training**: The 18 farmers (16 men and 2 women) attended these courses: leadership training, agronomy, O&M, budgeting, water management, pump maintenance (at Zimbabwe Irrigation Technology Centre in Harare) etc. Men participated in the scheme installation as part of training by the contracting company, H.E. Jackson, that installed the scheme. **Training study tours**: Farmers visited other schemes such as Musengezi and Mahusekwa as part of their training. **Awards**: It was awareded the Best Scheme in Zimbabwe in 1997 and 1999, and the 2nd best in 2001. **Training other irrigators**: Farmers from other parts of the country have visited on training tours. **Formal training:** Farmers confirmed that they are satisfied with the content of the formal courses they attended. Currently, limited funds limit formal courses to 1 or 2 *ad hoc* courses per year, but extension support is continuous.
Effect of policies	Zimbabwe is a signatory of the Ramsar Convention and thus subscribes to the principle of wise use of wetlands. The country has no specific legislation for wetlands. The protection of wetlands is therefore effected through the	**Agricultural policy** is mostly supportive. Removal of the requirement to grow maize and wheat since 2009 has allowed farmers to concentrate on horticultural crops. Key supportive policies exist for agricultural, water, economic, energy and land (local

Aspect	Individual scheme (Gledys Chisango scheme)	Chitora I irrigation scheme (community)
	implementation of two policies: **The Environment Management Act of 2003:** The Act makes it mandatory to protect wetlands, giving a legal basis for prosecutions relating to stream bank cultivation and unsustainable use of wetlands. It prohibits the drainage of wetlands, the disturbance of wetlands in a manner that is likely to have an adverse impact on animal or plant life and the introduction of alien plant and animal life in wetlands. The Act has a provision for obtaining a permit for specific use of wetlands, including cultivation. Asked if she had a permit for her irrigation scheme, Mrs Chisango replied, "This garden was pegged by an AGRITEX officer together with the headman in 1998 so yes I have a permit". **The National Water Act of 1998:** Stipulates the requirements of permits to conduct activities that interfere with the banks, bed or course of a public stream, or mashes, springs or vlei's (wetlands) forming the source of a public stream. It restricts wetland contamination and provides for water quality control and environmental protection. Asked if she was aware of this Act and its implications, Mrs Chisango replied "I have heard of it but I do not see why ZINWA would want to charge us for water when they do not help with development of wells and their maintenance. No one in Chisango village is paying for water use." This was echoed by the headman and other farmers in the village.	government) exist. Though the agricultural policy is supportive, there is no irrigation policy. **Economic policy:** Dollarization of the economy and the free market economy have allowed inputs to be available and inflation to decrease, permitting farmers to plan their activities. The business environment has radically improved. Since 2009, most policies became predictable unlike abrupt changes before 2009. **Energy policy** and erratic supply pose a risk to irrigation. The energy policy promotes higher electricity charges that may affect irrigation negatively. Shortages of electricity pose risks to irrigation. Farmers suggested contributing to purchase a diesel engine to use during power blackouts. **Water policy**: Failure of ZINWA to levy charges for water has benefited farmers. The effect of the removal of fixed charges on electricity bills is still to be felt. **Land policy:** All land in Zimbabwe belongs to the government. Debate on merits of 99-year leases and title deeds is underway.

Aspect	Individual scheme (Gledys Chisango scheme)	Chitora I irrigation scheme (community)
Capacity of grassroots institutions for self-management	Local level by-laws are centred on the protection of crops from damage by domestic animals where during the day it is the owner of the field who keeps livestock away from the field while at night the owner of the livestock must keep his/her livestock kraaled. Also important is strict adherence to no working in the field on Wednesdays and Fridays, two days of the week that are traditional resting days. Mrs Chisango says that farmers in Chisango village have no problems with these by-laws. This is echoed by the headman who said that he has not witnessed any problems from farmers.	The IMC and Constitution are very strong and are key to success. The Scheme IMC has 4 fully functioning Sub-Committees with 7 members each: Production, Marketing, Maintenance and Funeral Sub-Committees. The well prepared Constitution has been amended three times. It is available and all farmers are compelled to have their own copies. Among other theings, the Constitution provides the vision, mission, objectives, eligibility for membership, inheritance, leadership, roles and functions, meetings, disciplinary issues, penalties and expulsion. Farmers dissolved the Disciplinary Committee and replaced it with availability of the Constitution to every member. Strict compliance with the Constitution is practiced. Organization for O&M is spelt out in the Constitution, especially measures adopted for default. Farmers are given one week to pay electricity bills, failure of which they will pay all interest charges, sales tax, monthly fixed charge and their contribution to the bill. The Maintenance Sub-Committee organizes farmers for common maintenance activities, including the dam. Each farmer maintains his/her own infrastructure. The IMC monitoring system appears effective. The scheme maintains records of meetings, resolutions and other activities e.g. they have records of the expulsion of one member in 2008 by the IMC. Every member is responsible for reporting any action noticed against the Constitution. The Production Sub-Committee inspects inputs (esp. herbicides, pesticides) used by members regularly. Production sub-Committee ensures farmers select horticultural crops to grow from a calendar of crops that were agreed to a few years ago. The scheme employs a guard who maintains security under the Maintenance Sub-Committee.

NB: According to the government extension staff and IMC at Chitora 1

I, neighbouring Nyaitenga irrigation scheme, with a similar set-up to Chitora I, is struggling mainly due to a weak Constitution and weak implementation of the Constitution.

4.2 Outcomes/impacts on social and economic objectives

4.2.1 Impact on crop yields

Diversification and intensification of crop production

At Chitora I irrigation scheme, development processes have led to diversification and intensification of crop production accompanied with maximization of use of land and water resources. Yields under irrigation have also increased compared to dryland agriculture. From three crops (maize, groundnuts and cotton) grown in one season under dryland farming, Chitora farmers have intensified to an average of 9 crops and a maximum of 12 crops grown under irrigation per annum. Chitora I irrigators have three broad cropping seasons per year, January to April, May to August, and September to December. The period for which data was obtained during the survey (May to August) generally has the least area of crops compared to the others due to low temperatures. Given that the average planted area during this period was 0.31 ha per farmer, the minimum cropping intensity is at least three times this area i.e. 0.92 ha/year or 184 percent. The average areas grown by neighbouring dryland farmers are maize (0.4 ha), cotton (0.5 ha) and groundnuts (0.2 ha). Chitora I irrigators do not have dryland plots.

Increase in crop yield

There is a general increase in yield of crops per unit area. Using groundnuts as a typical example at Chitora 1 irrigation scheme there is a seven-fold increase in yield (Table 8). Table 8 shows a shift from production of traditional low value crops such as grain maize grown by neighbouring dryland farmers to higher value horticultural crops at Chitora I.

Table 8: Yields of crops based on sampled farmers

Scheme	Crops	Average or typical yield (t/ha)
Chitora I	**Irrigated crops**	
	Butternut	29.5
	Groundnuts	7.4
	Carrots	40
	Beans	9
	Cucumber	41
	Watermelon	40
	Covo	32
	Dry land crops	
	Grain maize	1
	Groundnuts	0.8
	Cotton	1

Scheme	Crops	Average or typical yield (t/ha)
Gledys Chisango scheme	Maize	5
	Tomatoes	-
	Groundnuts (unshelled)	2
	Potatoes	-
	Covo	10 800 bundles
	Rape	31 200 bundles

4.2.2 Impact on incomes (direct and indirect)

Gross margins were computed using the formula gross margin = gross income – (agro-input costs + hired labour + electricity charges), as presented in Annex 1. The gross margins from irrigation (Table 9) increased 8-fold and 6.6-fold over margins from dryland crop production (Table 10) at Chitora I and Gledys Chisango irrigation schemes respectively. The average seasonal margin of $ 1 872.64 translates to a minimum of $ 5 617.91 per farmer for the 3 seasons in a year at Chitora I. This translates to $ 11 235.83/ha/year and $ 4 276.47/ha/year at Chitora I and Gledys Chisango irrigation schemes, respectively. The average annual gross margin of $ 5 617.91 ($468.16/month) at Chitora I and $ 3 635 ($ 302.93/month) at Gledys Chisango scheme are higher than the average salary of about $ 250/month earned by Zimbabwe's civil servants, making irrigation more worthwhile.

Auxiliary benefits

The development of Chitora I irrigation scheme brought with it general rural development. Motivated by the performance of this scheme, neighbouring youths requested for the development of Chitora II drag-hose (6 ha) and Chitora II surface (9 ha) irrigation schemes as well as the construction of Chitora II extension (11.5 ha). The improved livelihood indicators of Chitora I irrigation scheme are also being enjoyed by the farmers in Chitora II sprinkler and surface irrigation schemes with the latter having four farmers who have also purchased cars from the proceeds of irrigation. The electricity that was brought to Chitora I for the pump has now been extended to other areas, including the local business centre, Corner Store. Corner Store was upgraded from a small tuck-shop without electricity in the late 1980s and early 1990s to a vibrant electrified shopping and business centre. The maintenance of the gravel road to Chitora has improved given the brisk business in and around the scheme, as well as other schemes such as Nyaitenga and Hoyuyu in the surrounding area.

Table 9: Estimated seasonal gross margins from irrigation at Chitora I and Gledys Chisango

Scheme	Area (ha) planted per season	Actual gross margins per season ($)
CHITORA I IRRIGATION SCHEME		
Farmer's name		
Lilya Tapfumanei	0.25	928.5
Betty Muchemwa	0.25	1 248.25
Nimrod Chomere	0.5	3699

Scheme	Area (ha) planted per season	Actual gross margins per season ($)
Douglas Nyawasha	0.38	3 119.8
Maxwell Samanyanga	0.25	397
Kingstone Kagoyo	0.25	1 447
Seasonal average	**0.31**	**1 872.64**
GLEDYS CHISANGO SCHEME		
Maize	0.4	285
Groundnuts	0.1	200
Covo	0.3	2 040
Rape	0.05	1 110
Total	0.85	3 635

NB: Outputs of gross margin analysis for each crop for each farmer. Different farmers used different agro-inputs even for the same crop or the same inputs purchased at different prices depending on where farmer purchased from, hence they incurred different costs. O&M costs were negligible and own labor costs were not estimated during the survey period. Farmers did not accurately recall the transport and marketing costs for the period, and some said these were negligible; hence the costs were not factored into the analysis.

Table 10: Estimated annual gross margins from dry land at Chitora and Gledys Chisango

Scheme	Crop	Area grown (ha)	Average yield (t/ha)	Unit price ($)	Total net income ($)/ha
Chitora dry land	Grain maize	0.4	1	285	285
	Cotton	0.5	1	900	900
	Groundnuts	0.2	0.8	300	240
	Total				**1 425**
Gledys Chisango dry land	Grain maize		0.6	285	178
	Rice		0.3	1 250	375
	Sweet potatoes		NA		
	Total				**553**

Mrs Chisango's farming project has helped other farmers in the area. She can now offer drought power to a neighbor in exchange for strenuous work. Also she and 10 others have formed a working group that assists one another at harvesting. They have encouraged each other to produce more by learning from one another. Mrs Chisango also hires out her newly acquired petrol engine to members of her working group thereby making the art of crop watering less strenuous. She also claims that her business relationship with the produce transporters and the vegetable Mbare market operators is a win-win situation that is helpful to many families both in the rural and urban areas.

4.2.3 Impact on food security (national level and household level)

The farmers at Chitora I irrigation scheme are food secure, and they do not bother to grow grain maize or wheat, given that they make adequate money to purchase food. The data presented in Table 8 suggests that on average, Chitora I irrigation scheme contributes approximately 1 697 tonnes of predominantly vegetables. Most of this produce is marketed at Harare's Mbare market. As for Mrs Chisango, her neighbours claim that she is more than

food secure. She sums it up "I do not regard myself as a struggling widow. I eat whatever I want to eat. Good food is what I eat". Her grandchildren claim that they are food secure, and that they carry food to school every morning – something not very many children are able to do.

4.2.4 Impact on poverty (individual and community scales)

Improved rural livelihoods

Chitora I and Gledys Chisango's irrigation schemes provide evidence of positive improvement in the livelihoods of beneficiary farmers. Table 11 summarizes some of the key indicators of achievements of the farmers since project inception. The pre-project scenario is that at the inception of Chitora I in 1994, all plot holders, being youth, had no assets of their own. They did not have cattle, hence their parents provided draught power. They built and lived in pole and dagga huts. For the Gledys Chisango irrigation scheme, the period before irrigation is considered as the pre-project scenario.

Table 11: Wealth indicators amongst irrigators

Indicator	Number and percentage ownership among irrigators	
Chitora I irrigation scheme	Pre-project scenario	Post-project (October 2011)
Individual vehicles bought	0	4 (22 percent)
Urban stands and houses purchased	0	2 (11 percent)
Families with *'decent'* accommodation	0	14 (78 percent)
Cattle ownership	0	15 (83 percent)
Families with children at boarding school	0	7 (39 percent)
Homes with satellite dishes	0	8 (44 percent)
Farmers with generators for lighting homes	0	8 (44 percent)
Gledys Chisango irrigation scheme		
Scotch cut bought	1	1 (renovated)
Cattle bought	4	14
Pigs bought	0	20
Petrol powered irrigation water pump bought	0	1
Brick under asbestos house	0	2
Children in school fees paid from project	0	3
Solar electricity installed	0	Installed by son who is in South Africa
Satellite dish installed	0	Installed by son who is in South Africa

'*Decent*' means brick under asbestos. Chitora I farmers do not have dryland plots so they attribute their success to irrigation only.

Up-scaling of irrigation development and community institutional models

The construction of the three other schemes has led to the locally driven up-scaling and replication of the Chitora I irrigation development model and the evolution of organized and possibly sustainable local community institutions modelled along the IMC at Chitora I.

4.2.5 Decision making by men and women

The inclusion of women in committees at Chitora I irrigation scheme represents a recognition of the importance of gender in decision-making. The make-up of the IMC and its Sub-Committees gives an insight into the decision-making responsibilities from a gender point of view. The Scheme IMC comprises 7 men; the Production Sub-committee 1 woman and 6 men; the Marketing Sub-committee 5 women and 2 men; the Maintenance Sub-Committee 7 men; and the Funeral Sub-committee 5 women (1 of whom is the chair) and 2 men. From the roles of the committees, the mosst important decisions are made in the Scheme IMC and the Production Sub-Committee. Infrastructure maintenance is regarded as involving muscles. These roles are predominantly taken by men, while general house-keeping responsibilities appear to be allocated to predominantly women.

4.3 Lessons

4.3.1 Most critical factors that contribute to the success of the schemes

1) A strong Constitution spelling out clearly the objectives of the scheme, roles of all players, do's and don'ts with penalties implemented without fear or favour by a strong elected committee is essential for enhancing scheme cohesion and success. According to Chitora I farmers, when they distributed the Constitution to everybody, they dissolved the disciplinary committee after observing that the Constitution was adequate.
2) Diversification into horticultural crop production and intensification of crop production, coupled with up-to-date market information and understanding of trends in prices at the market, enhance profits, and hence the capacity of farmers to operate and sustain the irrigation schemes. Markets should dictate what crops farmers grow and not impositions from government or other players like contract-farming companies.
3) Self-management (as opposed to government management) in which farmers make their own decisions as a scheme and as individuals at plot level, together with clear responsibilities for O&M promote scheme success. State agents should be regarded by farmers as advisors and not supervisors.
4) An enabling policy environment, including agricultural and macro-economic policies, is essential. Policies must not seek nor promote undue state interference in smallholder irrigation. Among others, the objectives of development of the schemes should emphasise commercialisation of irrigation, and these should be captured in the farmers' Constitution as is the case at Chitora I. Self-management and the absence of government control, including prescriptions of crops to grow, have benefited both Chitora I and Gledys Chisango schemes.

5) The promotion of market economy conditions allows farmers to draw deep into their competitive instincts, innovate around problems, and be able to plan and negotiate with service providers, as evidenced by the positive mutual inter-dependence of Gledys Chisango and her transporter. However, farmers still need assistance, in particular to strengthen IMCs, so that they become legal entities recognised in law. The new irrigation policy should address this issue. However, the authors' opinion is that some irrigation schemes developed historically for government management or social purposes may not be able to withstand market forces. There is a need to study how such schemes may have to be assisted through targeted subsidies.

4.3.2 Most critical factors that contribute to failure of schemes

1) Poor farmer organisation at local level, such as a lack of or weak scheme Constitution, ineffective implementation of IMC by-laws, and a lack of trust among scheme members. This was confirmed by extension staff at Chitora I and IMC members.
2) Excessive government interference and control, including government operation of schemes, coupled with a requirement for farmers to pay O&M fees to government. Often government fails to maintain schemes as and when the break down occurs because of other pressing needs, and farmers become disillusioned and lose sense of ownership. The history of Zimbabwe's irrigation development attests to this.
3) Dis-enabling policy environment, such as controlled crops and prices, and laws that are unfriendly, as evidenced by some of Zimbabwe's past policies.
4) Inconsistent policy implementation by government and development partners. If one policy is promoting financial contributions for irrigation development all other policies, including those of donors, should fit into that framework. Providing grants alongside loans sends contradictory messages to farmers, and may create a dependency that militates against sustainability.
5) Self-serving service providers that include contract farming companies who fashion contracts to their advantage and move goal posts are a threat to scheme success. Once farmers are cheated and lose money, it becomes almost impossible to re-start crop production.
6) Poor training of farmers denies them the vital knowledge required for sustainable crop production under irrigation. Similarly, a lack of up-to-date knowledge of market dynamics leads to growing the wrong crops at the wrong times leading to depressed prices, low income, and an inability to maintain irrigation infrastructure.

5. Conclusions and implications for policy

Considering the above strengths and weaknesses of (uncontested) government-supported smallholder irrigation and self-supply, Zimbabwe has a definite need to create an irrigation policy that provides enabling conditions for smallholder irrigation. The policy should empower local individuals and institutions, such as IMCs, by legalizing them and providing

legal mechanisms for redress when irrigators are short-changed by the numerous service providers and stakeholders. Other existing policies need to be revised to loosen the grip on both organized and individual smallholder farmers. The payment of energy and water bills is scheduled monthly, yet crops take time to mature and revenues to flow, especially on irrigation schemes that grow traditional low value crops such as maize and wheat. The Zimbabwe Electricity Supply Authority cuts of electricity from farmers without any regard to the losses that may be incurred by farmers. This often leads to huge losses from which farmers are normally unable to recover. Some schemes have stopped operating and have had to be rehabilitated by government at great cost because of this policy. The policy should be changed to: (1) synchronize electricity payments with revenue flows, (2) develop a win-win mechanism where farmers can use their crops as payment even if they have not yet marketed, and (3) provide mechanisms for recourse to farmers if a service provider is deemed to have caused unnecessary loss of production.

Some schemes were developed with government management or subsidies in mind, or for social purposes. Therefore, the designs for such schemes were not tailored to minimize operating costs to the extent that farmers may not, on their own, be able to operate such schemes. There is therefore a need to develop a policy that either promotes incomes at such schemes (e.g. growing higher value crops with an assured market) or targeted subsidies. This market could be targeted at known buyers such as NGOs or Department of Social Services who provide food relief to stressed communities. However, proper studies should be carried out to determine the levels of this support. Other policies have to be revised to promote smallholder irrigation. The combined effect of land policy and financing and banking policies on loans to individual farmers and farmer groups and interest rates to agriculture make financing to agriculture unattractive. Current interest rates on borrowed funds are too high due to perceived risk in agriculture, and do not promote investments in the sector, yet they are the bedrock of Zimbabwe and SADC's economies.

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ANNEX 1: Additional information on the two case studies

1. Guideline themes for field evaluations and assessments of Chitora and Gledys Chisango irrigation schemes

The following themes (areas of investigation) provided guidelines for field investigations and questions to ask irrigators, dryland farmers as well as other stakeholders such as local community leaders and extension staff at the two schemes. The questions relevant to group irrigators that were used at Chitora community scheme were modified for the single irrigator at Gledys Chisango irrigation scheme.

Physical Infrastructure literature review and field checklist

The checklist was developed to ensure that as much data as possible can be collected about the physical condition of the irrigation scheme hardware. The collected data will on analysis help to inform on the adequacy of the irrigation scheme hardware in terms of the following:

- The water source (capacity, reliability, condition and any threats);
- Technical specifications of the installed irrigation system (technical designs, adequacy of structures, condition and any modifications required;
- Water delivery, distribution and application losses (efficiencies); and
- The farmers' capacity and innovations to cope with the installed irrigation system (O&M arrangements and strategies) to qualify the scheme physical condition and water losses observed.

Table: The Water Source

Aspect	Data	Source
Adequacy	Dam capacities	ZINWA =Dam feasibility report Agritex / DoI = Scheme feasibility report
Reliability	Annual drawdown levels Climate changes	ZINWA staff, Agritex staff, DoI staff and farmers' view about the water source
Condition	Dam wall, outlets, spillway protection fences	Inspection walks and Agritex staff, ZINWA staff, DoI staff and farmers' opinions
Threats	Siltation levels	Basin surveillance walks and Agritex Staff, ZINWA, DoI farmers' and upstream cultivators
Other uses	Livestock numbers, gardens, brick moulding etc activities	Basin surveillance walks and Agritex Staff, ZINWA, DoI farmers' and upstream cultivators
Pollution	Sediment load	Water samples

Table: Technical specifications of the installed irrigation system

Aspect	Data	Source
Adequacy	Scheme designs capacities, versus crop water requirements	Agritex / DoI = Scheme feasibility report and farmers' comments
Reliability	Irrigation cycles versus irrigation schedules	Agritex staff, DoI staff, farmers' view and crop condition
Condition	Pumps, pipeline, canals, structures, siphons, sprinklers, pipes	Inspection walks and Agritex staff, DoI staff and farmers' opinions
Modifications	Discrepancies between design and reality	Inspection walks and Agritex staff, DoI staff and farmers' opinions

Table: Water deliveries, distribution and loses

Aspect	Data	Source
Delivery	Delivery losses	Following the water, measurements, Agritex, DoI staff and farmers' comments
Distribution	Distribution losses	Following the water, measurements, Agritex, DoI staff and farmers' comments
Application	Application losses, Stream flows	Following the water, measurements, Agritex, DoI staff and farmers' comments
Modifications	Discrepancies between design and reality	Measurements, Agritex, DoI staff and farmers' opinions

Guiding themes for field investigations

- History of scheme development, when scheme built, who initiated, development process, involvement of farmers
- Total area of scheme developed
- Total area under irrigation and reason
- Total potential irrigable area
- Number of beneficiaries and gender representation
- Presence/absence of IMC and its Constitution, roles, viz-a-vis infrastructure management and overall scheme
- IMC, roles, responsibilities, gender
- Types of crops grown and reasons
- Types of inputs and costs for each crop
- Revenues from crops, markets, marketing systems
- Wealth indicators, houses, cattle, fees for children etc.
- Farmer training and skills acquired
- Adequacy of water to scheme
- Uses of dam and allocation of water to different users
- Responsibility for water management at dam (ZINWA, farmers etc.)

- Responsibility for water management at scheme
- Responsibility for maintenance (ZINWA, farmers etc.)
- Presence/absence of extension agent and role(s)
- Frequency of infrastructure breakdown and responsibility for maintenance
- Frequency of maintenance and costs
- How farmers organise themselves to carry out O&M, breakdowns etc
- Water measurement structures
    - Presence and state of water measurement structure(s)
    - water charges and payment schedule
    - Responsibility for water measurement (ZINWA, farmers etc.)
- Infield water management system eg block irrigation or individual plot irrigation
- State of dam (scale: 1-5) *example of scale*
    - 1 = poor: poorly maintained, leaking, has bushes and shrubs growing on wall, waterlogging downward areas, does not meet users' requirements due to poor design, designed well but insufficient to meet requirements due to poor maintenance
    - 5 = excellent: regularly maintained, no leaking problems, designed well and meets requirements of waters users
- State of main canal (1-5 with 1 = poor and 5 = excellent) including description and photos
- State of infield canals, pumps, pipes, sprinklers etc (scale: 1-5 with 1 = poor and 5 = excellent) including description and photos
- Other infrastructure e.g.
    - roads, including distances and costs to markets and input procurement centres
    - storage/processing infrastructure at scheme

2. Pictures of Chitora 1 and Gledys Chisango Irrigation schemes

Picture 1: Infield area with crops at Chitota I irrigation schemes. Left to right: Mr Madyira, Acting Chief Irrigation Engineer (Mashonaland Esat Province), Mr Mapurisa-Irrigation technician, Dr Madyiwa (Consultant), M. Kugombo (Chairman-Chitora I IMC), Mr Nyawasha (Chairman, Production Committee).

Picture 2: Water supply canal to Chitora II drag-hose and Chitora II surface irrigation schemes.

Picture 3: Chitora II irrigation scheme: Farmers purchased hoses shown to deliver water to the irrigated area from the canal after the Department of irrigation ran out of funds to build canals.

Picture 4:Other than the ISUZU twin cab, and the white truck, the rest of the cars are those purchased by farmers from proceeds of irrigation.

Picture 5: Pump and engine at Gledys Chisango.

Picture 6: Land preparation at Gledys Chisango

Picture 7: Fence at Gledys Chisango

Picture 8: Infield equipment at Gledys Chisango

3. Examples of standard tables used to calculate gross margins

NB: Standard tables for determining gross margins were filled in to assess revenues and costs (such as agro-inputs, water and energy charges, labour costs).

Table: Gross margin for butternut grown by farmer Felix Muchemwa (0.15 ha)

Crop butternut (0.15ha)	Quantity	Unit	Unit price (US$)	Total (US$)
Yield	4.5	tonne	300	1 350
Gross income				
Seed	1	kg	65	**65**
Variable costs				
Manure	1	tonne		**0**
Compound D	1	50 kg bag	28	**28**
Ammonium nitrate	1	50 kg bag	28	**28**
Fenverate	100	ml	0.01	**1**
Dimethoate	1	litre	6	**6**
Cabaryl	1	kg	12	**12**
Labour	1	Lump	30	**30**
Subtotal				170
Gross margin per crop				**1 180**

Table: Gross margin for butternut grown by farmer Douglas Nyawasha (0.125ha)

Crop Butternut (0.125 ha)	Quantity	Unit	Unit price (US$)	Total (US$)
Gross income				
Yield	3 875	tonne	300	**1 162.5**
Variable costs				
Seed	0.5	kg	65	32.5
Compound D	1	50 kg bag	22	22
Ammonium nitrate	0.5	50 kg bag	25	12.5
Manure	1	tonne	-	-
Karate	0.1	litre	50	5
Mancozeb	1	kg	8	8
Actara	40	g	0.225	9
Labour	1	Lump	30	30
Subtotal				**119**
Gross margin per crop				1 043.5

NB: Gross margin per farmer per season = sum of gross margins of all crops grown by farmer per season – energy costs per season