The Role of Irrigation Policies in Expanding Irrigated Food Production in Mozambique

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ABSTRACT

In recognition of the crucial role irrigation plays in stabilizing agriculture production in the face of erratic rainfall that often affects Mozambique, the Government has, since national independence in 1975, implemented several policies regarding irrigation development. Yet, the country is still struggling to expand the area equipped for food crop irrigation. In particular, the formulation and implementation of irrigation policies has faced constraints in the expansion and effective use of irrigated land to ensure increased food production. Despite this, there has not been a systematic effort to consistently document and identify constraints and enablers of irrigation policies and development in to support evidence-based policy dialogue and interventions. This study intends to fill this gap. It does this through an analytical historical trajectory of the irrigation subsector, paying particular attention to critical factors affecting the effectiveness of irrigation policies in contributing to the expansion and effective use of irrigated land to enhance agriculture's contribution to food production and food security in Mozambique. A qualitative approach is employed in which a review of the existing literature and official documents, along with secondary data collection, is augmented with interviews of key informants and expert opinions.

The analysis posits that the ability of irrigation policies to effectively contribute to an expansion and improvement of irrigated production can be enhanced through addressing issues of policy weaknesses, limited investment resources to expand irrigated land, inadequate public institutional support to the irrigation subsector, especially at field level, limited involvement of the private sector in irrigation, weak farmers' organizations (FOs) and water users associations (WUAs) on irrigated land as well as weak information and knowledge generation and sharing among relevant stakeholders. These issues are particularly pertinent in light of the anticipated implementation of the 2010 Irrigation Strategy. The role, cooperation and partnerships among Government, private sector, FOs/WUAs and development partners need to be taken into account in the formulation and implementation of public irrigation policies. Overall, it is important to note that the success of irrigation depends critically on other agriculture sector-wide policies, suggesting that it is important to have a comprehensive agricultural development policy in place.

DECLARATION

I, Hélder R. Gêmo declare that:

- The research reported in this mini-dissertation, except where otherwise indicated, is my original work;
- This mini-dissertation has not been submitted for any degree or examination at any other university;
- This mini-dissertation does not contain other persons' data, pictures, graphs or other information, unless specifically acknowledged as being sourced from them;
- The mini-dissertation does not contain other authors' writing, unless specifically acknowledged as being sourced from them. Where other written sources have been quoted, then:
- Their words have been rewritten but the general information attributed to them has been referenced. Where their exact words have been used, their writing has been placed inside quotation marks and referenced; and
- This mini-dissertation does not contain text, graphics or tables that have been copied and pasted from the Internet, unless specifically acknowledged, and the source being detailed in the thesis and in the references sections.

Signed:..... Date: 08.03.2013

Hélder R. Gêmo

As supervisor, I agree to the submission of this mini-dissertation for examination.

Signed: .....Date.....

Professor Sheryl L. Hendriks

As co-supervisor, I agree to the submission of this mini-dissertation for examination.

Signed: .....Date.....

Professor G.F. Ortmann

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ABBREVIATIONS

AIM	Mozambique's Information Agency
AfDB	African Development Bank
ARA	Regional Water Administration Entities
BPD	Peoples' Development Bank
CAADP	Comprehensive Africa Agriculture Development Programme
CAIL	(State) Agro-Industrial Complex of Limpopo
CAP	Agriculture Census
CEPAGRI	Agriculture Promotion Centre
CMFF	Common Mechanism of Flux of Funds
CRA	Water Regulatory Council
CTA	Confederation of Economic Associations
DP	Development Partners
DPA	Provincial Directorates of Agriculture
DINA	National Directorate of Agriculture
DINAP	National Directorate of Livestock
DNA	Water National Directorate
DNHA	National Directorate of Agriculture Hydraulics
DNSA	National Directorate of Agricultural Services
DTA	Land and Water Department
DUAT	Land Use Right "Title"
EWS	Early Warning System
FIPAG	Water Supply Investment and Assets Fund
FMIS	Farmer Managed Irrigation Schemes
GCPI	Cabinet for Coordination of Integrated Projects
HICEP	Chókwè Public Management Board

IFAD	International Fund for Agriculture Development
IGF	General Inspectorate of Finance
IIAM	Mozambique's Agrarian Research Institute
INE	National Statistics Institute
INIA	National Institute for Agronomic Research
IWMI	International Water Management Institute
JICA	Japanese International Cooperating Agency
INIR	National Institute of Irrigation
MADER	Ministry of Agriculture and Rural Development
MAP	Ministry of Agriculture and Fisheries
MINAG	Ministry of Agriculture
MOPH	Ministry of Public Works and Housing
NEPAD	New Partnership for African Development
NIDMP	National Irrigation Development Master Plan
PAEI	Agriculture Policy and Implementation Strategy
PAPA	Action Plan for Food Production
PEDSA	Agricultural Sector Strategic Development Plan
PGARH	General Plan for Water Resources Use
PIDA	Integrated Agriculture Development Project
PPP	Public-private partnerships
PROAGRI	National Agriculture Development Program
PROIRRI	Mozambique's Sustainable Irrigation Development Project
RAE	Agro-ecological Regions
SADC/RISDP	Southern Africa Development Community/Regional Indicative Strategic Development Plan
SDAE	District Services for Economic Activities
SEHA	State Secretariat of Agriculture Hydraulics

SERLI	State Secretariat for Rehabilitation of Limpopo and Incomati
SETSAN	Technical Secretariat for Food and Nutritional Security
SPA	Provincial Agriculture Services
SPFS	Special Programmes for Food Security
SSIP	Small Scale Irrigation Project
TIA	Nationally Representative Agriculture Surveys
UEM/FAEF	Eduardo Mondlane University/ Faculty of Agronomy and Forestry Engineering
UNAC	Peasants National Union
UNICEF	International Children Emergency Fund
WUA	Water User Associations

CHAPTER 1: INTRODUCTION

1.1 Background Information

Mozambique's economy is agriculture-based (World Bank, 2008a) with agriculture contributing around 25% to the country's total GDP in 2010 (Chilonda *et al*., 2011). Administratively, the country is divided in 128 rural districts out of 140 districts including urban and peri-urban ones. Of Mozambique's 128 rural districts, 20 are "highly prone to drought"; 30 to flooding; and another 7 to both risks. Overall, 48.2% of the population is prone to one or both risks (FAO, 2007)

Of a total estimated Mozambique population of 23 million, about 69% lives in the rural areas and rely directly or indirectly on agriculture (National Statistics Institute (INE), 2010a from *Instituto Nacional de Estatísticas*). They comprise of a total of 3.8 million farmers, of whom 99.3% are smallholder farmers (INE/Agriculture Census (CAP), 2010b, from *Censo Agro-Pecuário*). Agriculture is the core activity in virtually all rural areas of the country.

The country is composed of 10 agro-ecological regions (RAE, from *Regiões Agro-Ecológicas),* each comprising several production systems. These regions are indicative of the agricultural potential based mainly on predominant soil types, and long growing period for rain-fed and irrigated agriculture. Figure 1.1 shows the distribution of the 10 RAEs in the country, from the one with the most potential (R1) to the one with the lowest potential (R10). The figure also illustrates the location of the main research stations across the country.

The different RAEs, particularly the high and moderate potential regions, are suitable for a wide range of annual and perennial crops and livestock. Main food crops include cassava and sweet potatoes, maize, rice, sorghum, millet and pulses. Cash crops are mainly cotton, tobacco, bananas and perennial crops such as cashew, coconut, citrus and mango. Livestock is another important part of agriculture in the different agro-ecological regions, comprising mainly cattle, goats, pigs and poultry (Ministry of Agriculture and Rural Development (MADER/ Agriculture Surveys (TIA), 2002; 2003 from *Trabalho de Inquérito Agrícola*; Ministry of Agriculture (MINAG)/ TIA, 2005-2008).

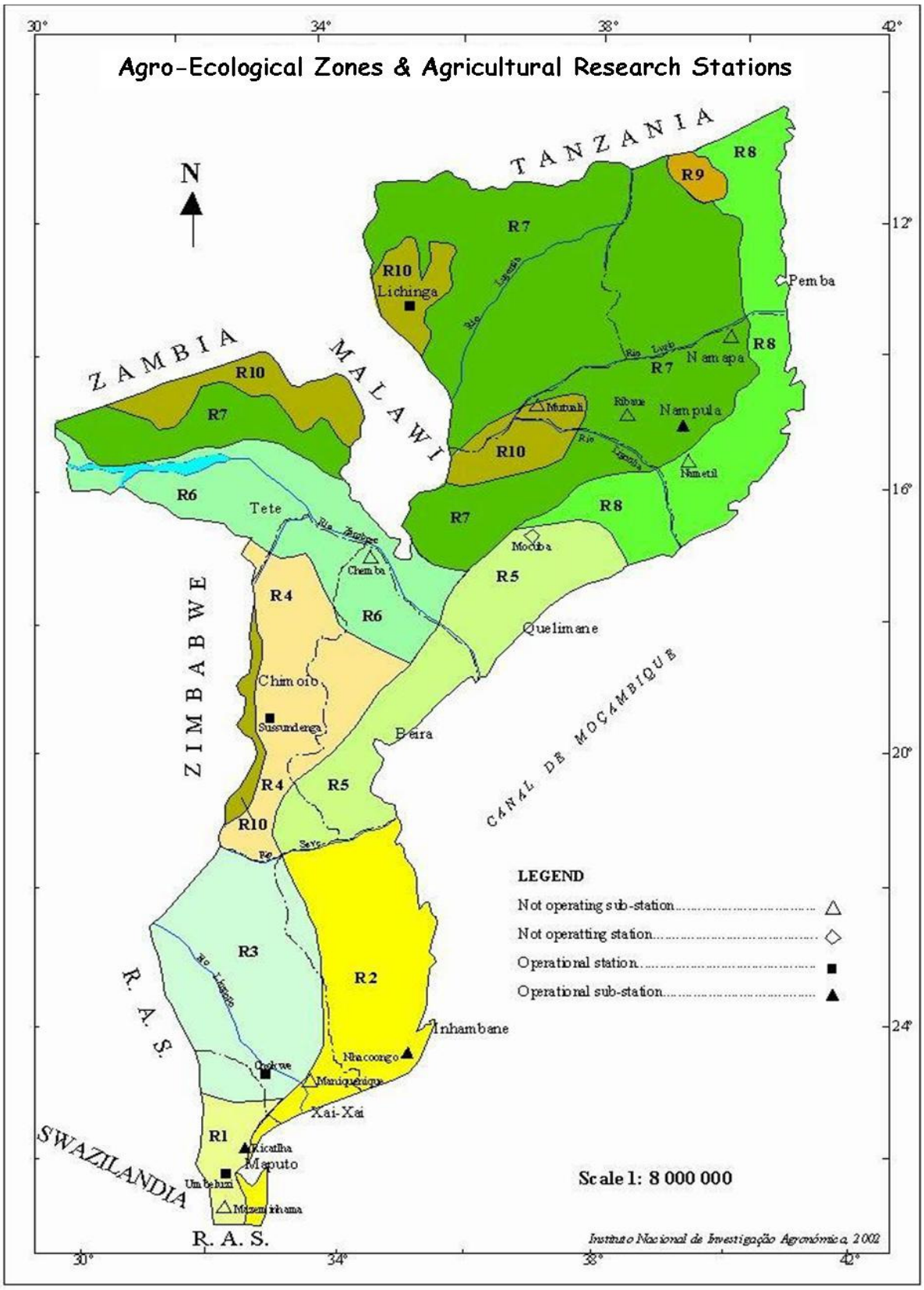


Figure 1.1: The 10 Agro-Ecological Regions (RAE) and main research stations and sub-stations in the Country

Source: Ministry of Agriculture and Rural Development (MADER)/ National Institute for Agronomic Research (INIA) (2002).

While people living in high potential regions can grow crops both for their own consumption and marketing, in marginal areas, agriculture (crop production) has been almost exclusively at subsistence level to support household food security. Harvests in marginal areas are often at higher risk of loss due to low and often erratic rainfall (Technical Secretariat for Food Security and Nutrition (SETSAN, 2011, from *Secretariado Técnico para Segurança Alimentar*).

The country's arable land is estimated at 36 million hectares (ha) (approximately 46% of total land), but less than 14% has been under cultivation over the past 10 years (MINAG/ Early Warning System (EWS), 2008; 2009; MADER/TIA, 2002; 2003; MINAG/TIA, 2005-2008; INE/CAP, 2010b). Agriculture is characterized by low levels of inputs such as improved seed varieties, commercial fertilizers and pesticides (MADER/TIA, 2002; 2003; MINAG/TIA, 2005-2008). Only about 10% of farmers cultivating maize used improved maize seed in the 2007-2008 agriculture season (MINAG/TIA, 2008). Maize and cassava have been the two most produced food crops in the country since 2000 (INE/CAP, 2000; MADER/TIA, 2002; 2003; MINAG/TIA, 2005-2008; INE/CAP, 2010b)

The rainy season lasts for about 5 to 6 months, starting in October/November and up to March/April (FAO, 2005; MINAG/ EWS, 2006-2010). However, rain can also be recurrently erratic and sometimes even scarce. Mozambique relies heavily on the "first or main planting season", which is officially launched by the Government on 16 October each year (MINAG, 2012; Mozambique's Information Agency (AIM, 2011a from *Agência de Informação de Moçambique*). The second planting season, which normally starts in early April during the dry or winter season, is chiefly for the areas with access to irrigation or land with a favourable micro-ecology. During the second season, the main crops that are cultivated are vegetables. Other food crops such as maize and pulses when cultivated in the second season need to be short vegetative cycle varieties often around 90 days.

In most countries, irrigation is most important for reliable agricultural production (FAO, 2009). In Mozambique, irrigation is viewed as important in enhancing crop production, improving performance of agriculture, and sustaining food security (Ataíde *et al*., 1976; Ministry of Agriculture and Fisheries (MAP, from Ministério da Agricultura e Pescas)/Agriculture Policy and Implementation Strategy (PAEI), 1995, from *Política Agrária e Estratégia de Implementação*; MAP/National Agriculture Development Program (PROAGRI I), 1998 from *Programa Nacional de Desenvolvimento Agrário*;

MADER/PROAGRI II, 2004; MINAG, 2010a). The PROAGRI was the first agriculture sector budget support program implemented in Mozambique by Government in collaboration of several development partners (DP). With eight investment components (research, extension, livestock, forestry, land management, irrigation, support to agriculture production and institutional development), its implementation was guided "basic principles" and strategic targets agreed between Government and DP. The first phase, with estimated cost of USD 202 million was implemented from 1999-2004/06 and the second from 2007 to 2011.

A total estimated area of 3 to 3.3 million ha of land is considered suitable for irrigation (FAO, 1997; FAO, 2005). Currently, only about 2.5 % of the total potentially irrigable area is under effective use as irrigated land (MINAG, 2010a). Irrigation is necessary to meet crop water requirements in areas of moderate production potential and crucial in the south and central regions that are characterized by low rainfall with erratic distribution (< 600 mm per year) (FAO, 2005).

In view of this, the government and DP have been paying attention to irrigation development since the country's independence in 1975. This dissertation reviews the key policies the country has taken since 1975 aimed at expanding irrigated land as a strategy to increase and sustain food production and food security, including relevant achievements and related critical factors. By doing so, the study intends to identify and analyse critical factors that have been constraining sustainable expansion of land under irrigation and identifies factors that need to be taken into account in future developmental irrigation programs in the country.

1.2 Motivation and Relevance of the Study

Irrigation plays an important role in stabilizing agriculture production by reducing variability of production associated with erratic rainfall patterns (Shanan, 1987). In general, irrigation is productivity enhancing, growth promoting, and poverty reducing (Hussain and Hanjra, 2004). In many of the development countries the expansion of irrigated agriculture is used as a major development tool for bringing about increases in agricultural output, rural economic growth and income distribution (Schramm, 1981). Since national independence in 1975, the Mozambique Government has implemented various policies and public institutional support approaches aimed at irrigation development to boost and sustain food production and security (MINAG, 2010a).

Over time, irrigation provision and support has faced different challenges, experiences and achievements, and many lessons have been learnt related to the expansion of irrigated land and its contribution to food production. However, despite important efforts made in the past three decades to strengthen irrigation in the country, limited attention has been paid to consistently documenting and sharing relevant information and knowledge to boost evidence-based policy dialogue and intervention design in the irrigation subsector. This study intends to address this gap through a historical analysis of policy developments in the irrigation subsector at national level - probably the first documented historical analysis of the irrigation subsector.

Documenting the history or evolution of irrigation policy helps to preserve the memory and enable the challenges, experiences and lessons learnt over time to be shared. This will provide a valuable source of information and knowledge for design of future actions and investments in the irrigation subsector, especially considering that, in recent years, irrigation has been increasingly emphasized as one of the key pillars to boost agricultural output and enhance food security at the national level (MAP/PROAGRI I, 1998; MADER/PROAGRI II, 2004; MINAG/Green Revolution Strategy (GRS), 2007a; MINAG/Action Plan for Food Production (PAPA), 2008, from *Plano de Acção de Produção de Alimentos*; MINAG/Strategic Plan for Development of the Agriculture Sector (PEDSA), 2011a; from *Plano Estratégico de Desenvolvimento do Sector Agrário*). At regional and continental levels respectively within the context of the Southern Africa Development Community's Regional Indicative Strategic Development Plan (SADC/RISDP) and the New Partnership for African Development's Comprehensive African Agriculture Development Program (NEPAD/CAADP), irrigation is also regarded as vital to increase and sustain food production as a contribution to enhance food security. For example, within SADC region member states are expected to expand irrigation to cover at least 7% of the national irrigation potential in each country by 2015 (SADC/RISDP, 2006), although some countries such as South Africa and Madagascar are already above this target (Chilonda, 2011).

1.3 Statement of the Problem

Since national independence in 1975, irrigation in Mozambique has been considered as crucial towards increasing agricultural production and productivity and contributing to food security (Ataíde *et al.*, 1976; MAP/PAEI, 1995; MAP/PROAGRI I, 1998; MADER/PROAGRI II, 2004; MINAG/PEDSA, 2011a). However, the country is still

struggling to expand the area equipped for irrigation (i.e., land area equipped with irrigation infrastructure) and irrigated production (i.e., the use of land for irrigation).

The overarching research question tackled in this study is: what factors affect the effectiveness of irrigation policies in contributing to the expansion and effective use of irrigated land in order to enhance irrigated agriculture's contribution to food production and food security in Mozambique? The following sub-questions were investigated to answer this overarching research question.

Sub-question 1: To what extent have the policies led to an expansion in irrigated food production?

Sub-question 2: To what extent have public resource mobilization approaches led to an expansion in irrigated food production?

Sub-question 3: What has been the role of public irrigation services towards the expansion of irrigated food production?

Sub-question 4: What role has Government played in enabling the private sector to contribute to irrigated production?

Sub-question 5: What has been the role of water users and water associations in irrigated food production?

Sub-question 6: What role has information and knowledge generation and sharing played in expansion of irrigated food production?

1.4 Organization of the Mini–Dissertation

This mini–dissertation is structured into seven chapters. Chapter I introduces the dissertation and provides background information, motivation and relevance of the report and specifies research questions tackled within the dissertation. Chapter II provides a brief overview of the country's water and irrigation profile, explaining the establishment of conventional irrigation and its trajectory in the country, outlining the main law and policy related issues and justifies irrigation as a priority in the agriculture sector. Chapter III summarises a review of the literature on the role of irrigation in food production and security thereby placing irrigation within the broader context of socio-economic development in Mozambique. Chapter IV

discusses the methodologies and materials used in the study. Chapter V is dedicated to an analytical and comprehensive overview of the irrigation subsector trajectory at national level. Chapter VI attempts to answer, based on findings from the analysis of the irrigation subsector trajectory, the overall research question and sub-questions, while Chapter VII incorporates conclusions, implications and the way forward.

CHAPTER 2: WATER AND IRRIGATION PROFILE IN MOZAMBIQUE

2.1 Brief Water and Irrigation Profile

2.1.1 Water profile

Mozambique is located on the eastern coast of southern Africa, along the Indian Ocean. The country has 104 identified river basins that drain from the central African highland plateau into the Indian Ocean (FAO, 2005). However, the aggregation of the 104 basins results in 13 main basins.

Most rivers have a highly seasonal, torrential flow regime, with high water flows during December through to March and low flows for the rest of the year. The climate varies from tropical and subtropical conditions in the north and central parts of the country to dry semi-steppe and dry arid climate in the south (Ataíde *et al*., 1976; FAO, 2005).

It is estimated that 97.3 km^3 of surface water and 17 km^3 of groundwater are generated annually within the country. Taking into account the 14 km^3 overlap between surface and groundwater, the total internal renewable water resource reaches about 100.3 km^3 per year. In addition, 116.8 km^3 of surface water enter the country annually, of which 66% is from the Zambezi River and, therefore, total actual renewable water resources becomes 217.1 km^3/yr (FAO, 2005).

Figure 2.1 shows the main river basins in the country. By far, Zambezi is the biggest basin offering, for example, the major potential area for rice production in the country.

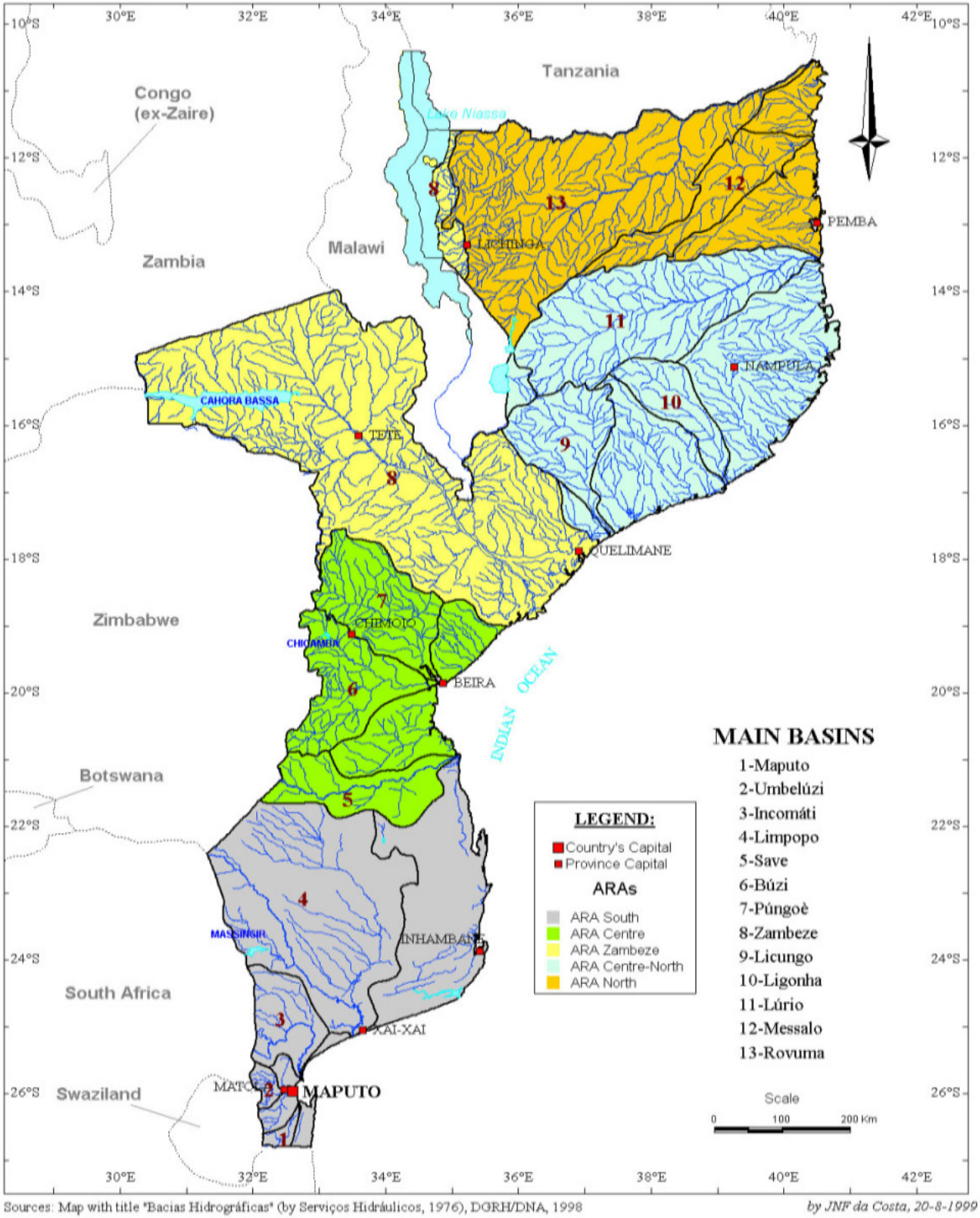


Figure 2.1: Main River Basins of Mozambique
Source: National Directorate of Water (DNA) (1999).

In terms of water resource storage infrastructure, the total capacity of the 27 dams (with heights of 10 m or more), is currently estimated at 64.5 km^3 - mostly as useful reservoir

capacity. The Cahora Bassa Dam on the Zambezi River is the largest in the country and in southern Africa, with a storage capacity of 39.2 km^3 (FAO, 2005).

Water use estimates for the years 1992 and 2000 indicate a total water withdrawal of 605 and 635 million m^3, respectively. As in many countries, the main consumer of water is agriculture, accounting for 540 in 1992 and 550 million m^3 (87%) in 2000 (FAO, 1997; FAO, 2005). The 2000 estimates also indicated that the municipality areas were then using an estimated quantity of 70 million m^3 (11%) and industry consuming an estimated volume of 15 million (2%) (FAO, 2005). It is important to note that since 2000 some new industries have emerged in the country, such as in the aluminium industry (MOZAL in Maputo province), alcoholic and beverages industries in Maputo, Manica and Nampula provinces; as well as in charcoal exploitation industries in Tete province; this may have increased total industry water consumption.

2.1.2 Irrigation profile

Mozambique's total arable land is estimated at 36 million ha - approximately 45% of the country's land area. However, annual cultivated land over the last 10 years has been limited (less than 14% of total land in 2010), although this is increasing slightly, mainly due to population growth. In terms of irrigation potential, FAO has estimated an area of 3,072,000 ha while other sources present an estimation of 3,300,000 ha, with most irrigation potential found in the central and northern regions (FAO, 2005). Given the relatively rich water and land resources, Mozambique has significantly greater potential for expanding agriculture and irrigation than some neighbouring countries such as South Africa (approximately 1.3 to 1.5 million ha) (Karar and Hollingworth, 2008; Wosseya *et al*., Undated) or Swaziland with a total irrigable potential land of 93,220 ha (FAO/ Water Profile Swaziland (WPS), 2008).

In terms of distribution of irrigation throughout the country, the Zambezia province in the central region of the country accounts for about 60% of the national irrigation potential (FAO, 2005). Although the southern region has the highest need for irrigation, only a small share of land is suitable. However, 68% of total area with some irrigation infrastructure in the country is located in the southern region (FAO, 2005). This includes some non-operational areas with problematic or degraded infrastructure.

Despite the considerable water resources, agricultural production is still predominantly rain-fed and the variations in quantity and distribution of rainfall influence the performance of

crop production (and of livestock by affecting the availability of natural pastures). Mozambique is periodically affected by floods and droughts, in some years with severe crop failure for thousands of smallholders and some large commercial farms, resulting in food shortages. For example, the severe droughts in 2004-2005 left about 801,000 rural people relying on food aid for several months. The coastal belt comprising most of the areas south of the Save River and the lower Zambezi area, which covers about 44% of the country, is usually hardest hit by floods (FAO, 2005).

Equipped and functioning irrigated land in the country has been very limited despite some impressive achievements immediately after independence in 1975. An extensive field survey conducted by then MADER in 2001-2003 at national level had estimated that there were about 118,120 ha with of irrigation infrastructure (MADER, 2003). Table 2.1 summarises the distribution of land equipped for irrigation as identified by the survey.

Table 2.1: Distribution of equipped land for irrigation by province, Mozambique

Country regions	Provinces	Area equipped for irrigation per Province (ha)
North region	Cabo-Delgado	1,764
	Nampula	980
	Niassa	608
Central region	Zambezia	10,848
	Tete	1,895
	Manica	2,067
	Sofala	24,220
South region	Inhambane	1,285
	Gaza	50,323
	Maputo	24,130
Total National		118,120

Source: MADER (2003)

However, the use of land equipped for irrigation has been limited by several factors which are discussed below. For example, the 2001-2003 survey showed that only about 40,000 ha were at that time irrigated. The survey also provided data and information on the typology of irrigation schemes based on their size, as shown in Table 2.2.

Table 2.2: Total equipped land and total land in use in 2002 per type (class) of irrigation systems, Mozambique

Description	North region		Central region		South region		Total	
	(ha)	(%)*	(ha)	(%)	(ha)	(%)	(ha)	(%)
Equipped land :								
Class A (<50 ha)	592	17	1,428	4	4,369	6	6,389	5
Class B (50-500 ha)	1,760	53	6,653	17	11,234	15	19,647	17
Class C (>500 ha)	1,000	30	30,949	79	60,135	79	92,084	78
Total	3,352	100	39,030	100	75,738	100	118,120	100
Equipped land in use in 2002								
Class A (<50 ha)	200	30	624	4	2,452	11	3,276	8
Class B (50-500 ha)	461	70	1,584	10	2,635	11	4,680	12
Class C (>500 ha)	0	0	14,049	86	18,058	78	32,107	80
Total	661	100	16,257	100	23,145	100	40,063	100

Source: MADER (2003)

Notes: (*) % of the total per region. Class A, irrigation schemes with less than 50 ha; Class B, between 50 to 500 ha; and Class C, with more than 500 ha.

Almost all irrigated land uses surface water. Groundwater used for irrigation is still minimal. Irrigation is mostly performed through gravity-fed systems. However, water pumping is common, often at a high cost because of the use of diesel rather than electricity. In medium to large scale irrigation schemes, water is distributed through networks of lined canals on a large scale comprising main, secondary and tertiary canals and furrows. In summary, surface irrigation is used for rice in basins and furrows for maize and some vegetables such as tomato, onions and cabbage. Sprinkler irrigation is mainly used in sugarcane and to a lesser extent in citrus and some other fruits and vegetables (FAO, 2005). Large sugarcane companies generate energy for pumping. In peri-urban agriculture, which involves mainly vegetable production, smallholders still use traditional methods and technologies such as watering cans.

The 2001-2003 survey also provided information on the types of irrigation (based on technologies and practices) as well as the main crops which were irrigated at the time. This is shown in Table 2.3.

Table 2.3: Types of irrigation and main irrigated crops country per region and at national level, Mozambique

Description	North region		Central region		South region		Total	
Type of irrigation	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Surface irrigation	656	99	4,200	26	12000	52	16,856	42
Sprinkler irrigation	0	0	11,530	71	8,330	36	19,860	50
Drip irrigation	5	1	527	3	2,815	12	3,347	8
Total	661	100	16,257	100	23,145	100	40,063	100
Main irrigated crops	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
Sugarcane	0	0	13,799	84.9	10,059	43.4	23,858	59.6
Horticulture	301	100	210	1.3	6,500	28.1	7,011	17.5
Rice	0	0	480	3.0	3,650	15.6	4,130	10.3
Tobacco	0	0	445	2.7	0	0	445	1.1
Citrus	0	0	370	2.3	0	0	370	0.9
Others	0	0	953	5.9	3,036	13.1	4,249	10.6
Total	301	100	16,257	100	23,145	100	40,063	100

Source: MADER (2003).

Currently, some crops are widening the scope of irrigated production as is happening with bananas and mangos grown mainly on commercial farms, although on a limited scale. In the 2009-2010 agriculture season, irrigated land with operational infrastructure was estimated at 61,407 ha with at least 50% belonging to sugar companies (MINAG, 2010a). In 2012 the figure is expected to reach 64,442 ha based on information from the ten Mozambique's provinces (MINAG, 2012).

In addition to conventional irrigation schemes, smallholder farmers also work in wetlands. Most of these areas do not have any infrastructure for water management. The use of wetlands without having appropriate infrastructure for water management (mainly for rice, vegetables and sweet potatoes production) allows for higher rates of water use, particularly by smallholder farmers. In 2008 it was estimated that 8.8% of the 3.72 million small and medium farms had access to some kind of water for irrigation (MINAG/ TIA 2008) while in 2010 the same figure was estimated at 5.3% of the 3.8 million small and medium farms (INE/ CAP, 2010b).

2.2 Institutions and Governance of Water Resources

A comprehensive cross-sector framework is vital for managing water resources particularly at country level (Sun, 2000). In Mozambique, governance of public water resources involves different institutions operating at different levels in the country, and includes:

The Ministry of Public Works and Housing (MOPH - from *Ministério das Obras Públicas e Habitação*), through to the National Directorate of Water (DNA - from *Direcção Nacional de Águas*) play a major role in overall policy design and co-implementation, planning and management of water resources development and water use related issues. The DNA functions and responsibilities include policy formulation and planning for water resources, and provision of water supply and sanitation services; inventory and maintenance of adequate information on water services and water needs at national and regional level; establishment of water legislation and to monitor its application; and execution of public investments for relevant studies, development projects and capital works in both rural and urban areas (Government, 1995).

The Ministry for Coordination of Environmental Action's (MICOA – from *Ministério para Coordenação da Acção Ambiental*) also plays a role in ensuring that environment related Law and regulations issues are considered in relevant water use projects, including irrigation development projects.

The Water Supply Investment and Assets Fund (FIPAG - from *Fundo de Investimento e Património do Abastecimento de Água*) is a public entity established in December 1998 and its creation was related to the implementation of the 1995 National Water Policy which, among other relevant issues, started the privatization of water supply services in urban areas. FIPAG functions include acting as an asset holder, financial and investment manager in the water sector (rehabilitation and expansion of water supply assets); leasing out operations and management to private operators for determined periods; pursuing the maximum efficiency in the water sector; and monitoring and enforcing of contracts signed with private operators (Government, 1998a).

The Water Regulatory Council (CRA - from *Conselho de Regulação do Abastecimento de Água*) was created in December 1998. The CRA is an entity under public law with a legal personality, administrative and financial autonomy. It is an independent regulatory agency responsible for balancing the interests of consumers with commercial principles to ensure a viable and sustainable water sector. Thus, CRA is in charge of regulating the water supply service in order to ensure the financial sustainability of the operators and, at the same time,

guarantee that all Mozambicans have access to safe, affordable and good quality water (Government, 1998b).

Under the MOPH/ DNA umbrella there are the Regional Water Administrations (ARAs - from *Administração Regional de Águas*), which are basin authorities in charge of water development related issues and water management in defined country regions. The currently five ARAs are responsible for controlling water use in irrigation systems, including collection of water fees in their respective areas of jurisdiction. The five ARAs comprises South-ARA, Centre-ARA, Centre/North-ARA, North-ARA and Zambeze-ARA. Although under MOPH/ DNA and reporting directly to DNA, the ARAs benefit from administrative, organizational and financial autonomy. In summary, the ARAs are technically and financially oriented and have a strong relationship with water users, particularly in agriculture, through the irrigation systems (*Lei da Água* (Water Law), N. 16, Article 18, 1991).

MINAG has been responsible for promotion and coordination of irrigation and drainage development issues. Since 2006 to early 2012 such responsibility was ensured through DNSA/ Department of Irrigation. In the first half of 2011, MINAG started preparing the reform of the public irrigation services towards "more visible, competent and capable" services. The new organizational setup was approved in May 2012, constituting a national institute of irrigation with representation at provincial level. Called INIR (Portuguese acronym for *Instituto Nacional de Irrigação*), the Institute is expected to revitalize the role of MINAG in promoting irrigation development (Government, 2012). MINAG has been in charge of irrigation policy formulation, provision of irrigation public services as well as coordinating and co-implementing activities related to irrigation public investment. However, the development of large infrastructure such as large dams to be used for irrigation (among other uses) has been the responsibility of MOPH (MINAG, 2010a).

2.3 Early Stages of Conventional Irrigation

Irrigation development was a priority during the colonial period (particularly from the 1950s to 1975), as a strategic investment option to attract settlers and commercial farmers to rural areas, given the potential benefits from irrigated production in terms of productivity and mitigation of drought effects. This was done mainly in the southern and later in central regions of the country. Existing documents reveal that colonial efforts towards irrigation development started at least in the 1930s or even earlier. For example, it is documented that

important hydraulic studies were conducted at the Incomati Basin in 1936 by a team of Portuguese engineers (De Morais, 1951). It is also documented that comprehensive ideas for the establishment of irrigation (and electricity) infrastructure in the Limpopo and Incomati valleys were discussed at public events in Portugal in 1951 (De Morais, 1951). In addition, British private investors in sugarcane started to work on irrigation issues even before the 1930s. For example, they arrived at the Xinavane sugarcane area by 1914 where they established the first sugarcane mill, approximately 136 km north of Maputo, the national capital city (Tongaat Hulett, 2010).

Colonial organizations such as *Junta Provincial de Povoamento* and *Direcção Provincial dos Serviços Hidráulicos*, and other regional investment initiatives (COBA, 2003) held responsibility to coordinate basin development and irrigation expansion. In 1968 the irrigated land totalled 65,000 ha; of which 72% was located in today's Maputo and Gaza provinces is the southern region. In 1971, a total of 583 small dams (of which 90% were for irrigation or livestock watering) were registered, with a total volume of 60 million m^3. In 1973, irrigated land had increased to 100,000 ha mainly due to sugar companies and Limpopo settlers, and some in Manica province uplands (FAO, 2005). It is worth pointing out that irrigated land was primarily used by Portuguese and commercial famers rather than indigenous or smallholder farmers (Negrão, 2003).

Immediately after independence in 1975 the Government proclaimed agriculture as a basis for development, as the country embarked on a centralized economy. At that time, public investment in the agriculture sector was channelled mainly through state farms and agriculture parastatal service providers, and irrigation became one of the priority investment areas. Substantial expansion of irrigated land was achieved in the early 1980s compared with the total irrigated operational land inventoried immediately after national independence which was estimated at 91,500 ha in 1976 (Ataíde *et al.*, 1976).

The liberalization of the economy in the second half of the 1980s led to changes in macro and sectoral policies as well as in the organizational and institutional setup of various social and economic public sectors, including the agriculture sector. Policies and public institutional support setup for irrigation were also changed. In addition, the armed conflict that devastated the rural areas, especially in the 1980s, also affected irrigation and agriculture in general.

After some stagnation in terms of political commitment and public investments, particularly between the late 1980s and the late 1990s[1], the Government started to pay more attention to irrigation through the mobilization of public investment in collaboration with DP as well as by attracting foreign direct investment. Since then irrigation has been deemed as an important pillar towards agricultural sustainability, performance and growth and in contributing to food security (MADER/PROAGRI II, 2004; MINAG/GRS, 2007a; MINAG/PAPA, 2008; MINAG, 2010a; MINAG/PEDSA, 2011a). MINAG has been the Government's institution directly involved in promoting irrigation, namely through the channelling of public investments and through the facilitation of private investments.

2.4 The Main Post-Independence Related Water Law and Policies

The 1991 Water Law (*Lei da Água* N.16/91) was the first water law in the country. It provided a basis for water use principles, rights and subsequent regulations related to various economic purposes as well as peoples' consumption. Table 2.4 highlights some of the key law statements, principles and implementation approaches.

Table 2.4: Selected key statements, principles and implementation approaches of the 1991 Water Law, Mozambique

Summarized principal statements	Water is a public good to which Government has the primary responsibility of ensuring access to by people, in as much as possible in safe, equitable and easy conditions.
Government leading institutions in water issues:	The Ministry of Construction and Water (at that time) was responsible for water resources management, through the National Directorate of Water (DNA)
Inter-sectoral coordination	Involvement of the Ministries of Construction and Water, Agriculture, Foreign Affairs and Cooperation, Industry and Energy, Mineral Resources, Public Administration and Health; establishment of the National Council of Water (CNA) to advise the Council of Ministers on the implementation of the Water Law
Inter-sectoral Law harmonization issues	Harmonized Water Law implementation with general policies on territorial zoning and on environmental equilibrium conservation.
Water resources management approach	Coherence on the management of river basins in the country
Decentralization and participation issues	Establishment of regional administration entities (ARAs) for water resources focusing on river basins management. Government entities encouraging local level participation by key stakeholders, including private entities
Water resources control and use related issues	Encouraging/promoting water recycling and retention infrastructure and control of surface water flows. Better use of available water resources through rational and planned use in order to meet peoples' need and economic development goals.
Inter-sectoral regulatory actions	Regulation on water use for irrigation, industry and power generation, and other important uses.

Source: Mozambique's Water Law (*Lei da Água*) (1991).

[1] In part this can be related to the then devastating war that prevailed until October 1992 which meant that the Government concentrated in relief efforts following the Peace Agreements until around 1996.

The 1991 Water Law specifically addressed some agriculture related issues. For example, smallholder famers in rural areas throughout the country were authorized to use water for irrigation from sources close to or crossing their farms with no need for special authorization, but based on good practices, i.e., being using environmentally sustainable practices. Since land is state property, in case of transfer of land use rights from one person (or group) to another, the Law stipulates that in the case of irrigated land, water use rights are jointly transferred with land use rights (DUAT - from *Direito de Uso e Aproveitamento de Terra*). Article 46 of the 1991 Water Law was especially related to irrigation and comprised three specific issues:

- Water users should ensure intensive and maximum use of water resources
- The need to implement measures to reduce water losses through seepage, evaporation and other losses
- Regulation measures by the irrigation schemes' management teams to address local specifics as the basis for ensuring better water use, but taking into account the general principles and regulations of the 1991 Water Law.

In October 2009, an important regulation for design, construction, use, maintenance and measurement' observations in small dams was published (Government 2009). Small dams are defined as those with a maximum of 15 meters of height and water retention capacity below one million m^3. This is an important regulation which can be relevant to small and medium scale investments by private investors, especially for cash crops such as rice, bananas and some vegetable crops (onion, garlic, cabbage).

2.5 Should the Irrigation Subsector continue to be a Priority to the Government?

The fact that rain-fed agriculture remains dominant implies that irrigation is crucial in contributing to overall rural socio-economic development, both for smallholder farmers and medium to large scale commercial farmers. Starting with smallholder farmers, their consistent and cost-effective access to water for irrigation is crucial for more stable production and better prospects of increasing productivity and profitability. As stated by the World Bank (2008b), if smallholder farmers are indeed to up-scale to commercial farming, then they must have the same secure water rights, as this is fundamental for effective production planning and increased production.

Increasing the productivity of rain-fed agriculture combined with sustainable scaling up of irrigation for smallholder farmers can generate potential impacts on both food security and poverty reduction. For example, the 2008 World Bank led cross-country Zambezi river basin study estimates that 80% of the rural population is not benefiting from irrigation, directly or indirectly, particularly in the Zambezi river basin. The same study mentions that if irrigation expansion takes place as an integrated component of the comprehensive water for agriculture strategy to improve agriculture productivity (particularly for food production), then a wider beneficial impact on rural poverty and food security could be achieved.

In addition to the need to develop small scale irrigation, medium to large scale commercial irrigation is also very important. This is often better integrated into the financial, and input and output markets, and thus offers a significant contribution towards total irrigated land and overall production. It also provides rural employment, contributing positively to the rural economy. Figure 2.2 shows the total number of workers (both permanent and temporary) employed in the sugarcane industry in Mozambique between 2004 and 2009, from which the equivalent rate of effective jobs (permanent workers) is estimated. The number has been continuously increasing and most of the workers are involved in field activities such as planting, irrigation related activities, harvesting, etc.

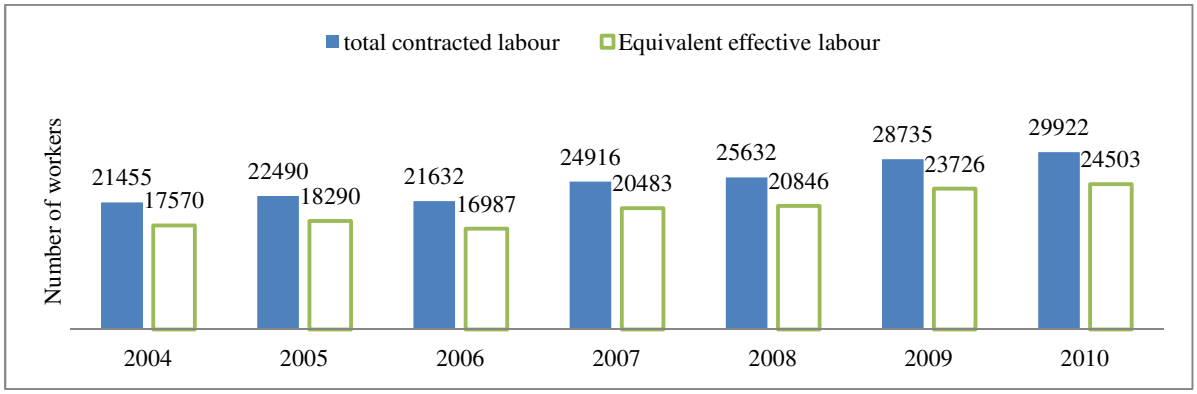


Figure 2.2: Total field workers in the sugarcane industry as a contribution of irrigated production, Mozambique
Source: MINAG/ Centre for the Promotion of Commercial Agriculture (CEPAGRI, from *Centro de Promoção de Agricultura*) (2011b).

The total number of field workers includes seasonal workers who on average have between six to eight months of employment per year. Although the current average rural agricultural wages are slightly below the equivalent of USD 100 per month (Mozambique's Information Agency (AIM), 2011b; Government, 2011), the current level of rural employment in

sugarcane production contributes greatly to the rural labour market. In 2012 the total number of field workers is estimated at 35,000, including seasonal workers (USDA, 2012).

In summary, the current agricultural production characteristics (largely rain-fed production and low productivity) and the contribution of irrigated agriculture to rural employment suggest that the irrigation subsector should continue to be a priority to the Government within the overall efforts aimed to strengthen the agriculture sector. This is expected to result in enhanced agricultural productivity, improved food security and poverty reduction.

CHAPTER 3: LITERATURE REVIEW

3.1 Defining Irrigation and its Role in Food Production and Food Security

Irrigation is an artificial application of water to the soil, and is used to assist in the growing of agricultural crops, maintenance of landscapes, and re-vegetation of disturbed soil in dry areas during periods of inadequate rainfall. Irrigation supplies dry lands with water by means of ditches, pipes, streams, sprinklers, drip kits, or with buckets with the main purposes of stabilizing or increasing growth of crops. Drainage is an important component of irrigation and is meant to reduce excess water when necessary (Penning de Vries *et al*., 2005).

In Africa, the high dependence on rain-fed agriculture, coupled with high rainfall variability, is one of the main causes of food insecurity across the continent (McCartney *et al*., 2007). Irrigation enhances food production through overcoming deficiencies in rainfall and stabilizing agricultural production especially in semi-arid and arid areas (Kinaga, undated; Stevens, 2007). Producing sufficient food, among other critical factors (for example, crop nutrients), is directly related to having sufficient water. Rain-fed agriculture (when crops are grown without any or little irrigation) generally produces far below its potential because rain is irregular, which makes investments in soil fertility too risky (Penning de Vries *et al*., 2005).

Irrigation can ensure adequate and reliable supply of water, increasing yields of most crops by 100 to 400%, particularly in developing countries (FAO, 1996). This means that increasing access to water for irrigation while limiting environmental damages through, for example, salinization or reduced soil fertility is important for food availability (Global Education, 2010). In fact, irrigation has been vital to meeting fast-rising food demand. Crops that are mostly irrigated, such as rice, wheat, and maize saw production increasing two to four fold since the early 1960s. Production increases in irrigated fresh fruits and vegetables were particularly rapid, estimated at 400 to 600% (World Bank, 2007a). New technologies and improved crop varieties have, over time, also played a significant role in increased crop production.

Irrigation has a multi-facetted role in contributing towards food production, self-sufficiency, food security and exports. In smallholder farms, irrigation assists with both food and cash crop production, enabling farmers to benefit from crops produced (FAO, 1996; Chiza, 2005;

World Bank, 2006). It is important to note that irrigation encompasses a wide range of interventions that enhance productivity and result in profitability for the rural farming population and the nation as a whole (Chiza, 2005). In large-scale commercial farms, irrigation enables crop production for local and export markets with significant impacts on the development of rural economies in particular and the overall economy in general (Baietti and Abdel-Dayen, 2008; Chiza, 2005).

In developing countries with a significant proportion of smallholder farmers, as is the case in Mozambique, access to irrigation becomes more critical within the scope of promoting sustainable intensification of their farming systems. For instance, in Mozambique, and neighbouring countries like Tanzania and Zimbabwe, the use of fertilizer for rain-fed crops by smallholder farmers has been threatened by climate factors, particularly taking into consideration that fertilizers are relatively expensive and in many cases farmers have to borrow to purchase this input (Gêmo, 2007; Chiza, 2005; Belder *et al.*, 2007). If rains fail, the farmers suffer from both reduced production as well as from cash losses or increased indebtedness. In this context, moderate investments in small scale water technologies (equipment, training and skills development) could enhance both stability and productivity of smallholder farmers even to levels where commercial production becomes possible (Penning de Vries *et al*., 2005). If farmers have both irrigated and rain-fed land, evidence indicates that they tend to make their investments in fertilizer for the irrigated rather than rain-fed land (Chiza, 2005).

3.2 Defining Food Security

Food security exists when all people, at all times, have physical and economic access to enough safe and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle (World Food Summit, 1996). To be food secure means that (Global Education, 2010):

- **Food is available**: the amount and quality of food available globally, nationally and locally can be affected temporarily or for long periods by different factors such as climatic conditions, natural disasters, armed conflicts, population size and growth rates, agriculture practices, environment, social status and trade.

- **Food is affordable**: when there is a shortage of food, prices increase and while richer people will likely still be able to feed themselves, poor people may experience difficulties in obtaining sufficient safe and nutritious food without assistance.
- **Food is utilized**: at household level, sufficient and varied food needs to be prepared safely so that people can grow and develop normally, meet their energy needs and avoid disease.

Like in many countries with predominantly rain-fed agricultural systems, the annual crop performance and harvests tend to influence the level of availability of domestic food production. Recurrent droughts, erratic rains and floods negatively affect food production performance with consequences on food availability and access particularly to subsistence farmers in rural areas. Agricultural seasons characterized by severe occurrence of adverse weather conditions result in poor harvests, often necessitating food aid interventions to assist the most affected people. Figure 3.1 shows the number of people that benefited from food aid in Mozambique following adverse weather conditions (mainly droughts).

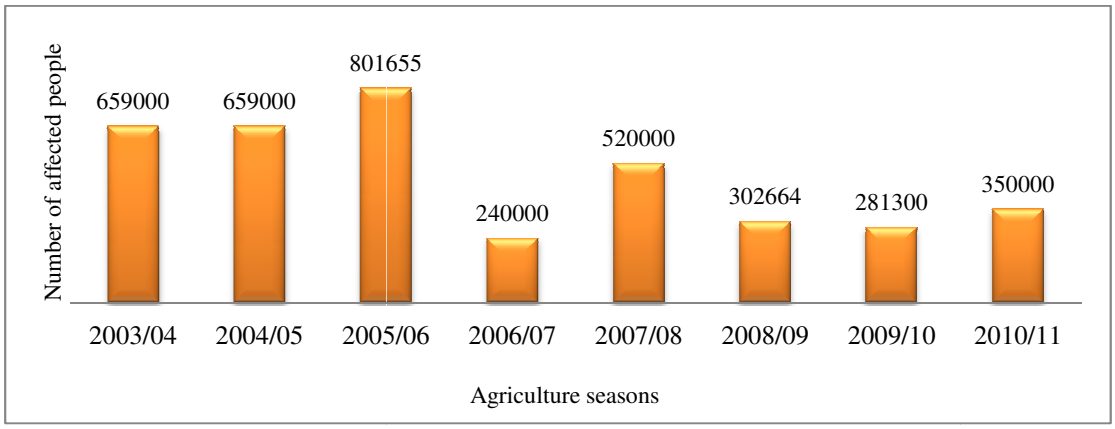


Figure 3.1: Annually estimated people facing food insecurity and relying on food aid for some periods of each year, Mozambique
Source: Technical Secretariat for Food Security and Nutrition (SETSAN) (2011).

Mitigation efforts against the effects of droughts include promoting the use of wetlands for sweet potato and vegetable production by smallholder farmers, distribution of cassava planting materials in agro-ecologically low potential areas, distribution of free or subsidized seeds in the subsequent agricultural season and diversification to livestock (small stock species) were applicable. In the long run, sustainable irrigation development is seen as vital to boost food production (MINAG, 2010a; World Bank/Mozambique Sustainable Irrigation Development Project (PROIRRI), 2011a). Irrigation investments (and development) act as

production and supply shifters, and have a strong positive effect on growth, benefiting the poor in the long run (Hussain and Hanjra, 2004).

3.3 The role of public policies and investment on irrigation development

Public policy is a purposive and consistent course of action produced as a response to a perceived problem of a constituency, formulated by a specific political process, and adopted, implemented, and enforced by a public agency (Hayes, 2009). The implementation of a public policy may, and often involves more than a single public agency. In agriculture, policies consist of government decisions that influence the level and stability of input and output prices, public investments affecting agricultural production, costs and revenues and allocation of resources (Alila and Atieno, 2006). Agriculture public policies are crucial in pursuing the expansion of irrigated land and production, particularly for food production. Water public policies in general, and in particular for the irrigation subsector, are important because they address critical issues such as (FAO, 1993; David, 1995; Ferguson and Mulwafu, 2004; IFAD, 2006; Lamptey *et al.*, 2011):

- Comprehensive water legislation, including water resources sustainable management, inter-sectoral demand and use (including agriculture), the right of access to water by people (equitable distribution, particularly for poor people), etc.
- Sectoral management policies and regulations (access, distribution, use, promotion and support of key stakeholders.), including water management for agriculture.
- Inter-sectoral and sectoral institutional support options (alternatives) for public support for water management, including in agriculture.
- Inter-sectoral, sectoral and spatial (geographical) public investments prioritization in water management (for example, for hydro-power generation, human consumption, and water management infrastructure for agriculture).
- Human capital development in water management disciplines, etc.
- People's participation in inter-sectoral and sectoral water policy dialogue and in the implementation and evaluation of policies at different levels of governance (national, provincial and district levels, as in the case of Mozambique).
- Policy incentives aimed to promote key stakeholders (private sector and for water users associations, for example, in the case of agriculture).

The Mozambique Government adopted two distinct approaches to public policies with regard to water management for agriculture, and more specifically for the irrigation subsector, since

national independence in 1975 up to the present (2012). The first was from national independence until the mid-1980s, and the second from the mid-1980s up to 2012.

Following national independence, an "interventionist" approach was adopted during the centralized economy era. Between 1975 and 1985, irrigation policies were mainly addressed towards developing public actors within the agricultural sector, namely through the creation and support of (Caballero, 1990):

- Parastatals for irrigation equipment supply and technical assistance
- Parastatals for agriculture input supply (commercial fertilizers and pesticides) and for domestic trade (food crops and livestock commercialization)
- Parastatals for construction and maintenance of public works, including irrigation schemes
- Agro-industrial complexes and state farms with emphasis on developing irrigation schemes, where possible
- Smallholder cooperatives farming in limited irrigated areas.

In the second half of the 1980s, the Government implemented profound economic reforms, shifting from a centralized to a liberalized economy. In agriculture in general, and in irrigation in particular, the Government reduced its direct intervention through the then existing parastatals and in the early 1990s public irrigation services were also downsized (Gêmo *et al*., 2005; Mosca 2011). This was a period of changing roles from the State being "interventionist" to being a "facilitator", thereby promoting participation of non-government stakeholders in the sub-sector. Government "facilitation roles" include training, demonstration, information provision, adequate legislation (including regulation), setting up institutions to empower farmers (including WUA in this case), quality control of agricultural inputs and produce, transfer of management of irrigation schemes to empowered farmers (often organized), facilitating credit initiatives (Penning de Vries *et al*., 2005).

Despite the fact that the irrigation subsector became pluralistic in the mid-1980s (Government, private sector and NGOs), and that some key processes such as decentralization of planning and transfer of some governance responsibilities of small scale irrigation schemes to the users had started being implemented under PROAGRI I, there was no documented comprehensive irrigation development policy as such until 2010. It is, however, important to note that between 2000 and 2002 there were several policy debates

initiated by MINAG involving some stakeholders aimed to develop an irrigation policy development. However, the process did not lead to the approval of the intended document by the Government and reasons for that are not clear.

The 2010 MINAG Irrigation Strategy (MINAG, 2010a) provides a comprehensive framework intended to pursue irrigated land and production, with an emphasis on food production in order to enhance food security at both household and national levels. In summary, the Irrigation Strategy establish the main objectives, goals and expected results for the next 10 years in the irrigation subsector, principles, the main implementation stakeholders, needed resources and strategy implementation and monitoring and evaluation (M&E) mechanisms. It focuses on intervention in the following pillars:

- Institutional development
- Irrigation infrastructure development
- Technology development and transfer
- Effective use of irrigated land (and increased irrigated productivity)
- Development of conducive environment for private sector and WUAs development
- Cross-cutting issues: water quality, health issues (e.g. HIV/AIDS), equity and gender issues.

With regard to public investments in Mozambique, available information shows that it has been contributing substantially to boosting irrigation in the country (Cabral, 2009; Ministry of Finance (MF)/General Inspectorate of Finance (IGF), 2010 from *Inspecção Geral de Finanças*). As in many developing countries, public investment is important in contributing to irrigated land and production. Public investments in irrigation were, for example, fundamental in supporting the Green Revolution in Asia (Turral, 1995). In Africa, the most visible agricultural water investments have been largely driven by national governments and international donors (Penning de Vries *et al*., 2005).

In Mozambique, public investment was a significant source of funding for irrigation between 1975-1985 during the stage of state farms and agro-industrial complexes and over PROAGRI I (1999-2004/06) and PROAGRI II (2007-2010/11) implementation. Public investment here includes irrigation projects implemented in collaboration with DPs. As in many developing countries (Shah *et al*., 2002), irrigation schemes in Mozambique have been rehabilitated or

established with financial contributions from international DPs, in particular through specific irrigation projects.

Since 2001, small scale irrigation has been a priority option within the scope of the implementation of some Government and DP funded projects as well as of PROAGRI. The option of prioritizing small scale schemes seems to be in line with the increasing need to rationalize the use of public funds for large, gravity irrigation systems (David, 1995). However, the rehabilitation of large schemes, which are managed by specific management boards nominated by the Government, has also been on the agenda, as happened with two large irrigation schemes in the southern regions of the country between 2000 and 2008.

The literature review, review of relevant official documents and interviews with key informants suggest that irrigation public investments implementation in Mozambique has been imposing four crucial challenges to the Government/ MINAG, namely (Ussivane, 2010; MINAG, 2010a; MF/ IGF, 2010):

- Resources mobilization, including from DPs and international financial institutions such as the African Development Bank (AfDB) and more recently the World Bank from 2007
- Timely execution and accomplishment of planned expansion of irrigated land (new or rehabilitated infrastructure) over time under the timeframes agreed within the scope of the different implemented projects
- Effective use of publicly funded irrigated land, from small, medium to large-scale schemes. Effective use here is mainly related to use of available equipped and operational irrigated land over time, i.e., in each and over subsequent agricultural seasons
- Effective linkages with input and output markets.

3.4 The role of public institutional support in boosting irrigation

In Mozambique, public institutional support to irrigation has mainly been channelled through Government agencies with a broad mandate on irrigation (and drainage) development at national level with operational services (kind of branches) at provincial level within the MINAG organizational structure. Set up with establishment of a State Secretariat, first at regional level (South region, the State Secretariat for the Accelerated Development of

Limpopo and Incomati (Basins) in 1979 and later (1983) with an expanded State Secretariat in terms of outreach at national level (the State Secretariat of Agriculture Hydraulic), those agencies had responsibilities that often characterized Government agencies, particularly at that time (MINAG, 2010a). Irrigation agencies typically have the national mandate for the development, management and monitoring of water resources for irrigation and drainage. In many countries emphasis has traditionally been on the planning and design of irrigation development and the responsibility for the management of the larger state operated irrigation schemes (Smith and Munoz, 2002).

By the mid-1990s, the public irrigation agency in Mozambique was formally downsized with the creation of a national directorate to respond to the irrigation mandate within MINAG, although also with the same branch services at provincial level. As in many countries, (FAO, 2001; Kamara *et al*., 2001; Smith and Munoz, 2002), the Government's direct intervention in developing, managing and controlling irrigation infrastructure has declined since the mid-1990s. Currently, the two large publicly funded irrigation schemes (Chókwè and *Baixo Limpopo*) in the southern region of the country are managed by specific management boards, with chief executives nominated by the Council of Ministers. Efforts have been addressed towards enhancing the role of WUAs in these schemes.

The Government focus, especially since 2000, has been expansion of small scale irrigation with a gradual transfer of its governance and management to beneficiaries or partners in the sense that water users collaborate with Government in using irrigated land. This led to "new" institutional challenges in accomplishing actual public roles, especially the need of supporting the development of farmers' organizations on irrigated land, and WUAs. The capacity of irrigation public services seems to be limited by several institutional reasons that include limitations on human capital, logistical means and financial resources. (MINAG, 2010a; MINAG/ ICENA, 2011c).

Other Government agencies (services) like extension, research and land management are expected to contribute to enhancing effective use of irrigated land, particularly in light of the Government's aim of increasing food production and productivity (MINAG, 2010a).

3.5 Private sector and water user's role in developing irrigation

The private sector involved in Mozambique's irrigation subsector comprises different actors, namely consulting enterprises providing services such as studies in various irrigation related

subjects, irrigation infrastructure design, supervision and quality control of irrigation construction, construction contractors, irrigation equipment suppliers, relevant commercial enterprises such as input suppliers and farming services providers on irrigated land (MINAG, 2010a; MINAG/ ICENA, 2011c).

The Government has been trying to promote participation of the private sector in the irrigation subsector mainly through four modalities:

- Attracting and facilitating foreign direct investments for medium and large scale irrigation schemes for industrial crops, including food crops (mainly fruits)
- Facilitating access to land for private small scale irrigation schemes (for example, five to ten ha, as is happening with some sugar-cane out-growers in Maputo province, Xinavane Sugarcane area (Gomes, F., Water Management Expert, MINAG, personal communication, 2011).
- Launching public bids mainly for small scale equipment supply through MINAG related institutions, including at provincial level through the Provincial Directorates of Agriculture (DPAs for distribution among selected farmers' organizations or private farmers, based on certain criteria with the aim to contribute to technology dissemination and boosting local-based initiatives on food production
- Launching public bids for establishment of small scale irrigation schemes, particularly in provinces in the south and central regions as well as for rehabilitation of large irrigated areas, as happened with different rehabilitation stages of Chókwè and *Baixo Limpopo* large irrigation schemes. These are public tenders that are funded by DP, and therefore, subject to agreements on procurement issues, although the country procurement rules have to be followed.

In many countries, public-private partnerships (PPP) offer different contractual options with the Government to promote private sector participation in irrigation. The PPP refers to a public entity entering into a contractual agreement with the private sector to take some or all of its essential services to the general public. The goal is to provide the service using suitable recent technologies at low cost as well as to allocate the risks of the venture in a balanced manner between the private and public entities (Attia, 2006). The PPP can be implemented through different modalities, in particular under the form of service contracts for operation and maintenance or financing schemes enabling farmers to invest in on-farm pumping equipment as has been the case in, for example, Egypt (Baietti and Abdel-Dayem, 2008).

Different modalities or forms of PPP comprises service contracts, management contracts, lease, build-operate-transfer, concession, etc. (Attia, 2006). Table 3.1 summarizes different modalities on PPP.

Table 3.1: Different modalities of public-private partnerships (PPP)

Modalities	Asset ownership	Operations & maintenance	Capital investment	Commercial risk	Duration (years)
Service contract	Public	Public and private	Public	Public	1 – 2
Management contract	Public	Private	Public	Public	3 – 5
Lease	Public	Private	Public	Shared	8 – 15
Build-operate-transfer	Private (bulk services)	Private	Private	Private	20 – 30
Concession	Public	Private	Private	Private	25 – 30
Divestiture	Private	Private	Private	Private	Indefinite

Source: Attia (2006)

In Mozambique, the PPP are not yet developed and experiences are few. However, in February 2010, the Government approved a decree which outlines different modalities of management contracts that can be established between related Government agencies and the private sector for operation and management of publicly funded irrigation schemes (MINAG/ *Modelos de Gestão de Regadios Construidos pelo Estado*(MGRCP) 2010b).

WUAs are vital stakeholders in irrigation and their role became more critical within the scope of decentralization of some governance and management responsibilities to the users. The underlying principle of this decentralization policy is to encourage farmers and local communities to take responsibility for the management of local resources, and thereby limit external interventions to the provision of information and institutional support services that enhance efficient resource allocation (Kamara *et al.*, 2001). The successful decentralization of governance and management of irrigation schemes and devolution of governance and ownership of the schemes to the users requires well-functioning producers' organizations (De Janvry and Sadoulet, 1997).

An increasing number of private sector groups, particularly WUAs, are taking over some public sector irrigation responsibilities. Their inclusion in irrigation governance, planning, management and development of sense of ownership is proving to be an effective method towards irrigation schemes efficiency in many cases (FAO, 1993). In this context, the provision of institutional support to the WUAs to help them in developing competencies and experience and performing their governance and management roles is of paramount importance (Smith and Munoz, 2002; IFAD, 2006). In Mozambique, public debate and

efforts aimed to develop WUAs in the irrigation subsector are relatively new, increasing mainly after 2000. In fact, although the concept is used in some irrigation schemes and among irrigation professionals, the broader concept of farmers' organizations is still substantially used mainly on irrigated land compared with WUAs, a stage that imposes a major level of autonomy, decision making capacity and competencies of the water users in participating on governance and management of the irrigation schemes.

3.6 The importance of developing and sharing information and knowledge in strengthening irrigation

Information and knowledge sharing contributes to strengthened irrigation, particularly to supporting decision making at different levels of intervention. Information systems to support distributed decisions need to serve a diverse set of potential users/stakeholders highlighted in Box 3.1.

Box 3.1: Potential users of irrigation information and knowledge

Direct potential information users	Other important potential users
• Individual farmers • Farmers' organizations and WUAs • WUAs leaders and managers of relevant NGOs on irrigated land • Irrigation agency field staff, including other staff from relevant support services such as extension workers • Irrigation agency and other government offices • Policy-makers and funding agencies, including DP • Government and politicians at higher level	• Input suppliers • Irrigation equipment suppliers and farming services providers • Output buyers and processors • Other support service providers

Source: Adapted from Bruns (1992).

Information and knowledge is considered here at three levels, namely at farmers' organization and WUAs level (i.e., at irrigation schemes level); Government agencies or services level (information management system); as well as at the subsector level in terms of sharing relevant information and knowledge among key stakeholders at national level.

Farmers in general, and in particular those on irrigated land, need information on new technologies (including varieties) and related knowledge on, for example, input and output prices, local and other domestic market opportunities, etc. If the productivity of irrigated land is to be maximized, the level and frequency in responding to demand-driven information and knowledge needs from the farmers (or WUAs) is likely to be higher compared with

information and knowledge in rain-fed subsistence farming. This also includes relevant information and knowledge on irrigated production good practices, especially for "new" farmers on irrigated land. For example, besides issues related to water access and its equitable distribution at a physical scheme level, it is fundamental that farmers know how much water to apply and when and that they are familiar with the practices of irrigated production (Brouwer and Heibloem, 1986).

Input suppliers in irrigated land often require information on estimated demands on the type of certified seeds (crops), inorganic fertilizers and pesticides in order to purchase quantities that can be with some certainty sold to the farmers. This minimises the risk of having surplus of inputs in the warehouse for the next plating season and also ensures that perishable inputs are sold timely and additional storage costs are avoided.

At Government level, it is of paramount importance to have information and knowledge on, for example, performance of large irrigation schemes in the country, the performance of small scale irrigation schemes in different provinces as well as the expansion and expenditures on irrigated land in each province, or at the various irrigation development projects. Information on private-led irrigation investments, expansion, land use and outcomes in terms of production, marketed production and rural employment is also important. This implies the development of a sound irrigation M&E system capable of assessing regularly performance and major developments in the irrigation subsector (MINAG, 2010a; Lamptey *et al*., 2011).

Government policies in many countries are increasingly recognizing and supporting farmer managed irrigation schemes (FMIS). This requires better information on FMIS schemes (Bruns, 1992; Smith and Munoz, 2002). Although still limited, this is also happening in Mozambique, meaning that major efforts are needed in monitoring and evaluation (M&E) on the performance of as well as in assessing the main constrains faced by FMIS, especially on food production and marketing issues. This includes information on critical technical issues in irrigation schemes, such as access to water and distribution, irrigation techniques, technologies used, crop patterns, farmers' needs for technical support from extension, etc. In Mozambique, the task of collecting data and information on FMIS, especially in small scale schemes, has been challenged by (Ussivane, 2010; MINAG, 2010a):

- Dispersion of many small scale irrigation schemes in each province which operate almost under isolation from each other
- Generally limited capacity at the provincial irrigation nuclei for monitoring periodically the performance of the farmers managed irrigation schemes and ensuring that relevant data at irrigation schemes is collected, organized and stored by the incumbent (extension workers or leading water users at the schemes level).

At the irrigation subsector level, issues such as irrigated land expansion and performance, especially in terms of irrigated production and productivity, as well as the expenditures in the subsector at provincial, regional and national levels are of importance. Information on opportunities for public-private, and WUAs partnerships, formulation/updating of relevant policies and regulations, are also issues of wider interest to key stakeholders of the irrigation subsector.

CHAPTER 4: METHODOLOGY AND MATERIALS

4.1 The nature of the study

This work is a qualitative study. The study involved the following research steps: conceptualization, literature review, collection of secondary data, interviews with key informants and experts, and writing up the report.

4.2 Research Process: Sampling and Data Collection

The conceptualization phase included informal consultations with key informants and irrigation experts to obtain relevant opinions on the preparation of the study among public and non-public stakeholders at central level. In addition, consultations with relevant public institutions were also held to assess the availability of data and information needed to complete this study.

The main objective of consulting key informants was to gather relevant opinions on policy and institutional issues and identify key issues that helped in re-defining the research questions of the study and the questions used for the interviews. The questions were discussed with top managers at MINAG/ former Department of Irrigation as well as with relevant lecturers at the University Eduardo Mondlane University/ Faculty of Agronomy and Forestry Engineering (UEM/FAFE), prior to the interviews. Key informants are expert sources of information who, due to their personal skills or position within a community/society, are able to provide more information and deeper insights into what is going on around them (Marshall, 1996). Interviews of key informants involve interviewing a select group of individuals who are likely to provide needed information, ideas, and insights on a particular subject (Kumar, 1989).

An extensive review of the available literature and official documents was conducted. This comprised travelling to irrigation schemes to interact with their respective management teams (such as Chókwè and *Baixo Limpopo* Schemes) and consulting unpublished but official documents, such as approved annual reports and various consultancy study reports.

Data collection was mainly conducted at the Ministry of Agriculture (MINAG) both at the central and local level, also with some private enterprises and at the Chòkwé and *Baixo Limpopo* Irrigation Schemes (which is the largest in the country). The data collected included:

- Main irrigation investment programs recently implemented (in the last 10 years)
- Human capital in irrigation public services at central and local levels
- Type and irrigation equipment sold by main suppliers (to the extent possible to obtain such data)
- The number of employees in private irrigation schemes
- Irrigated production outputs in both public and private schemes (to the extent possible to obtain such data)
- Level of membership of water users' organizations (to the extent possible to obtain such data).

Data collection involved field visits to some selected provinces, namely Maputo (Boane and Matutuíne districts), Inhambane (Morrumbene and Panda districts) and Gaza (Xai-Xai and Chókwè districts) in the southern region as well as Manica (Manica and Sussundenga districts) and Zambezia (Mopeia and Maganja da Costa districts) provinces in the central region of the country. The selection of these five provinces was deliberate, i.e., it was a targeted sampling. Three reasons behind this sampling option were:

- Irrigation is particularly crucial in the southern and central regions due to the unfavourable climatic conditions in vast areas of both regions
- The five provinces have been benefiting from public (and private) investment for irrigation virtually since national independence in 1975. Inhambane is the only exception in this case, although it has also benefitted from some investment mainly for small scale schemes, particularly since 2002, through relatively localized rural development projects, and also through PROAGRI funding which started in 2000-2001.
- In principle, all the five provinces as well as some of the visited districts will continue to benefit from irrigation public investments for years to come either through on-going investment programs or through new planned and approved investments. For example, approved projects such as the Government/World Bank Sustainable Irrigation Development Program (PROIRRI), the rehabilitation of 7,000 ha in Chókwè Irrigation Scheme probably from 2012, the expected next phase of

rehabilitation of 3,000 ha in *Baixo Limpopo* Irrigation Scheme in principle from 2013; are examples of new investments in the southern and central regions of the country.

Thus, the findings and recommendations of this study are of particular interest to these five provinces although they also have implications for other areas of the country.

Key informants and expert opinion interviews were conducted in targeted institutions, according to their roles and responsibilities within the irrigation subsector both at central and local level. The interviews in these institutions were conducted with their top managers or with senior and experienced staff. Interviews were also extended to independent consultants and some retired and independent knowledgeable people that had worked as decision-makers or technical professionals at MINAG's irrigation services, former state farms and former parastatals linked to the irrigation subsector (e.g., technical assistance and equipment supply). Key informants and expert opinion interviews focused on policy, institutional support (political commitment, governance issues and organizational setup) and relevant socio-economic issues. Despite the focus on these three dimensions, the interviews were kept as open as possible. Three objectives were pursued:

- To gather opinions on how the interviewees identify and characterize the main steps of the irrigation subsector over time, from far back as possible since national independence in 1975

- To gather opinions on how the main public policies and irrigation institutional support and broader social-economic issues have been influencing the irrigation subsector over time

- To gather perceptions on what have been the most critical factors that have been affecting irrigation and its capacity to contribute to food production and food security.

Targeted institutions and people were contacted on average one week prior to the interviews and were given explanations about the nature and objectives of the interviews and the overall objective of the study. Each interview lasted for about an hour to an hour and a half. In the visited districts and provinces some exceptional interviews took two to three hours because of the need to interview multi-disciplinary staff engaged in irrigation, namely planning and field technical staff, heads of related services such as agricultural extension as well as administration and finance staff.

4.3 Overall Research Framework

Figure 4.1 summarises the research framework used in this study. As illustrated, depending on the type of institutions interviewed, in some cases data collection and interviews with key informants and experts were carried out at the same time.

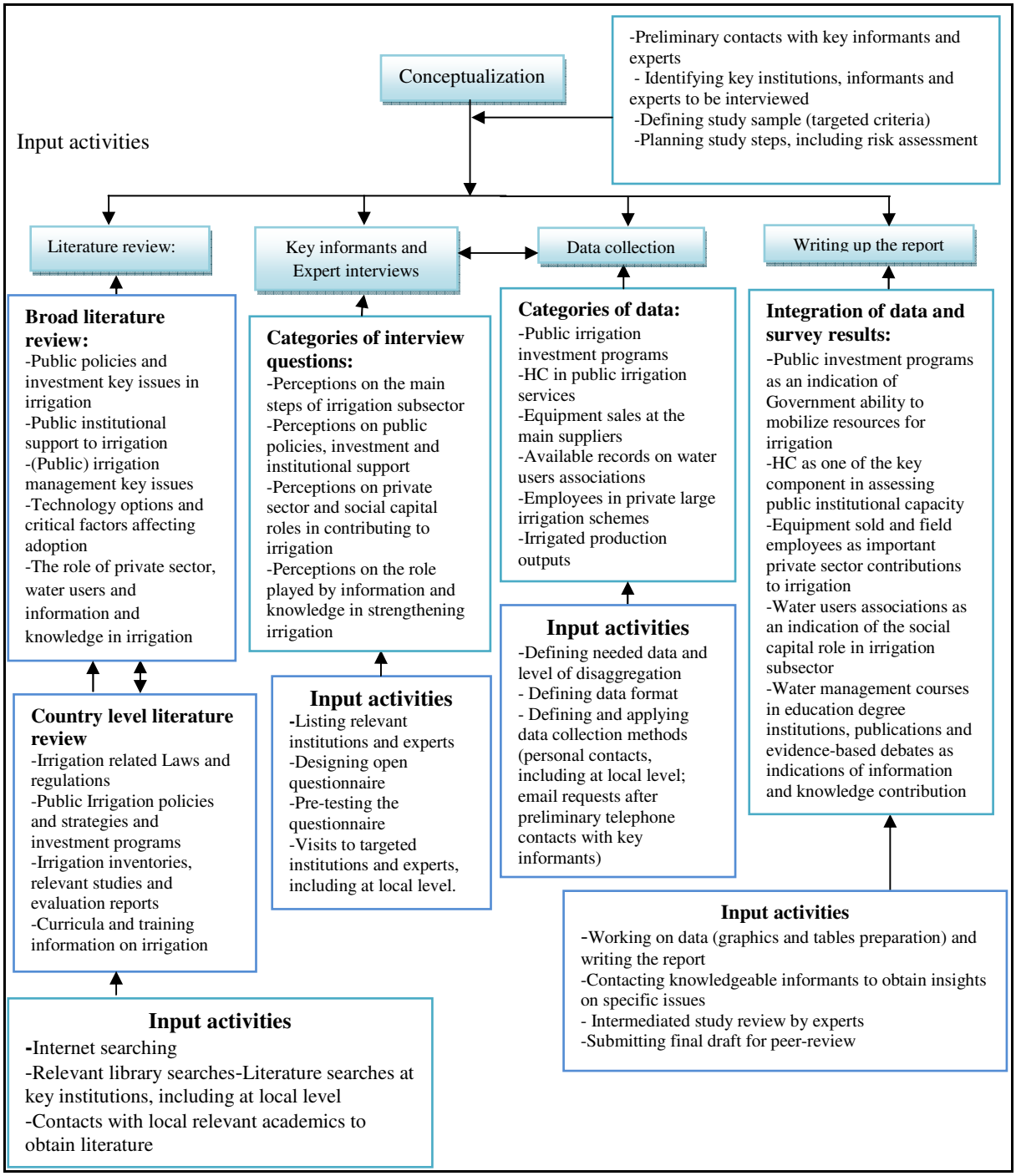


Figure 4.1: The main research steps followed in conducting the study
Source: Author's compilation.

This work did not include field surveys among water users and other field stakeholders such as extension staff and local leaders working on irrigated land mainly due to time constraints and resource limitations. However, the methods used were effective in terms of attaining expected study results. In addition, the methods used have made it possible to:

- Minimize study implementation costs by limiting the scope of key informants and expert opinion interviews and also through the use of secondary data
- Add value to the work of others (data providers) by using secondary data and also by recommending improvements on data collection
- Gather relevant information from knowledgeable people among key stakeholders.

4.4 Analytical Approach

Box 4.1 illustrates the analytical approach that was used. Of importance, data and information availability and access to them during the study have substantially influenced the extent to which different "key related development issues" are discussed over the "development stages" mentioned below. Data collection was a challenge as the key targeted public institutions at national and provincial levels often did not have organized and easily accessible data. In some cases, the required data was updated/ reviewed during or after the interviews.

Box 4.1: Analytical Approach

Main development stages of the irrigation subsector:	key related development issues (here discussed):
• 1975-1985:the centralized economy stage • 1986-1998: Irrigation development during the transition from centralized to liberalized economy under emergency situation • 1999-2010: Renewed policy developments in the Irrigation Subsector • 2011-2013: The turning point towards accelerated expansion and improved use of irrigated land?	• Irrigation policies (under the Water Policy/ Legislation framework) and irrigation investment • Public institutional support for the irrigation subsector (in terms of public services) • The role of the private sector and of the water users (including smallholders) in irrigated production • Irrigation subsector monitoring and evaluation (including periodical nationally representative surveys) • Irrigated production output • The role of development partners
Study specific research/ policy questions:	
• To what extent have the policies led to an expansion in irrigated food production? • To what extent have public resource mobilization approaches led to an expansion in irrigated food productivity? • What has been the role of public irrigation services towards the expansion of irrigated food production? • What role has Government played in enabling the private sector to contribute to irrigated production? • What has been the role of water users and water associations in irrigated food production?	

Source: Author's compilation

CHAPTER 5: REVIEW OF THE POST-INDEPENDENCE IRRIGATION SUBSECTOR TRAJECTORY IN MOZAMBIQUE

This chapter provides an overview of the irrigation trajectory in Mozambique since its national independence in 1975. Post-independence irrigation trajectory can be divided into four main stages:

- 1975-1985:the centralized economy stage
- 1986-1998: Irrigation development during the transition from centralized to liberalized economy under emergency situation
- 1999-2010: Renewed policy developments in the Irrigation Subsector
- 2011-2013: The turning point towards accelerated expansion and improved use of irrigated land?

5.1 1975-1985: Irrigation Development under a Centralized Economy

In discussing irrigation development between 1975 and 1985, three aspects are discussed, namely the immediate (following the national independence period) Government actions aimed to maintain and strengthen irrigation; the main steps followed to strengthen irrigation within this period; and the contribution of training and extension towards irrigation development.

5.1.1 Initial post-independence steps towards irrigation development

In June 1976, just one year after independence, the Ministry of Public Works and Housing (MOPH) requested the then Directorate of Hydraulics Services to prepare the first General Plan for Water Resources Use (PGARH, from *Plano Geral de Aproveitamento de Recursos Hídricos* for the 1977-2000 period, including water use for irrigation (Ataíde *et al*., 1976).

The post-independence pioneer PGARH envisaged:

- Assessment of water resources (surface and groundwater) for human consumption, irrigation, energy, industry and other uses

- Definition of priority irrigation studies and hydraulic works to be developed
- Assessment of relevant existing human and material resources, their rational use and enhancement needs
- Identification of small irrigation interventions, in terms of the level of investments and size, particularly for rural irrigation, specifically in Cabo-Delgado, Niassa and Tete provinces, and
- Identification of disaster mitigation measures (floods and droughts).

The preparation of the PGARH (an inter-sectoral plan) was completed in six months and special emphasis was put on irrigation issues. It should be noted that the PGARH was conducted at the time when the country was struggling with a critical shortage of human capital and data in almost every public institution. It highlighted "difficulties faced in conducting the work" namely (Ataíde *et al*., 1976):

- Lack of basic inputs such as comprehensive and updated statistics
- Lack of sectoral development plans in rural areas (communal villages) and in agriculture and industry in general, and
- Lack of qualified professionals in relevant areas and particularly agronomists, hydro-geologists and economists.

The PGARH estimated that at least 2.2 million ha were suitable for irrigation (less than the 3 million ha later estimated by other sources such as FAO, 1997), and specified potential areas for irrigation development on some of the main rivers of the country, as shown in Figure 5.1.

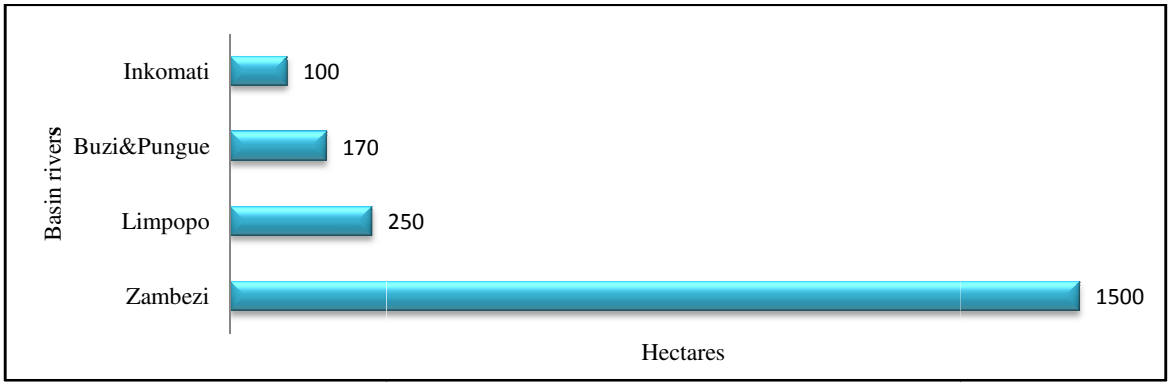


Figure 5.1: Potential irrigable land related to main rivers (000 ha), Mozambique
Source: Ataíde *et al*. (1976)

The estimates were based on water resources availability and soil quality. In addition, the PGARH identified a total of about 91,500 ha of equipped and operational irrigated land. But it was emphasized that not all of the total area was being effectively used. Interventions were needed to rehabilitate some infrastructure and strengthen water users' knowledge and competence in order for them to work more efficiently on irrigated farms. A field assessment was recommended to characterize constraining factors and identify alternative solutions for more effective use of the 91,500 ha. Thus, although referring to the need to expand irrigated land, the PGARH highlighted the need for more effective use of the then available irrigated land as a priority.

The PGARH offered two possible options to expand irrigated land during the 1977-2000 period (Ataíde *et al*., 1976). The first and second options targeted an additional portion of equipped irrigated land area of 146,000 ha (with 108,000 effectively operational) and 271,000 ha (with 226,000 effectively used), respectively by 1986, i.e. within a period of 10 years. As the PGARH was prepared under a centralized economy, characterized by a strong Government interventionist role in services provision, the expansion of irrigated land and its respective use were planned to be almost wholly implemented through Government related entities such as public enterprises and parastatals involved in civil construction with some "adaptable technical capacity for irrigation".

Heavy machinery and field equipment were also to be acquired to accelerate irrigated production through the establishment of new schemes. Human capital needs to expand irrigated land were also identified as an important factor to be taken into account to the materialization of the planned expansion. Figure 5.2 shows, for example, the identified human capital needs for the implementation of the first expansion option.

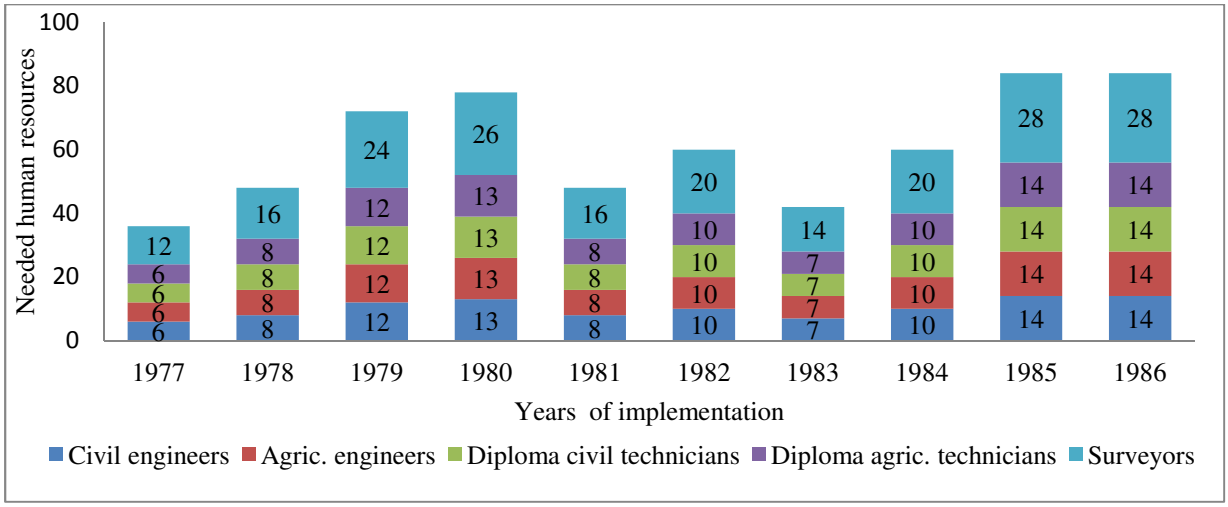


Figure 5.2: Human capital needs for expansion of irrigated land to 146,000 ha by 1986 through Government entities, parastatals and state farms (1977-1986), Mozambique.
Source: Ataíde *et al.* (1976)

Human capital was to be distributed among Government hydraulics and irrigation services and the participating parastatals and state farms. The staff was mainly expected to be involved in establishment of small and medium scale schemes; while the large scale would involve other approaches and mechanisms (particularly for studies and projection) to secure the needed expertise. The main issue here is to note that, immediately after independence, there was a clear understanding of the importance of qualified human capital within the efforts aimed to build the irrigation subsector.

In addition, the PGARH argued that small scale irrigation was the best option taking into account that "100 irrigation schemes of 200 ha each are potentially more beneficial than one large system of 20,000 ha, often with complex operational, maintenance and technical implications" . In summary, the PGARH proposed that irrigation development actions should take into consideration (Ataíde *et al.*, 1976):

- The available irrigation schemes and their effective use
- Emphasis on small scale irrigation (that was not the case, as between the second half of 1970s and first of 1980s, the Government prioritized investments in medium and large scale irrigation schemes particularly through the state farms)
- The existing hydraulic works
- Reduction of construction costs on dams and other costly hydraulic works, and
- The available relevant studies and/or irrigation projects.

The following issues from the PGARH need to be highlighted due to their relevance to the research questions of the present study, particularly because they are related to policy issues and the role of WUAs, information and knowledge in expanding irrigated food production:

- Awareness of critical limitations related to human resources and lack of critical information on, for example, irrigation schemes technical maps in some cases, some relevant studies related to establishment, or planned establishment of new irrigation schemes

- Ineffective (although not quantified) use of the then existing irrigated land and the need to improve such use, including the need to strengthen water users' knowledge and competence

- The recommendation to promote small scale irrigation rather than large scale systems which generally tend to be more expensive to establish, operate and maintain, and

- The recommendation to use available information and evidence in the development of irrigation activities.

5.1.2 Great emphasis on public investments and publicly managed irrigation schemes

Public investment and institutional support for irrigation development was particularly prevalent in late 1970s and first half of the 1980s, mainly through agricultural state farms. From 1978 to 1982, about 90% of public investment was allocated to state farms (Caballero, 1990) and irrigation was one of the key investment areas, along with mechanization. Over this period, various public and parastatal actors and some private companies supported agricultural irrigation development.

Government's efforts during this period enabled the country to cover approximately 120,000 ha with irrigation in the early 1980s (FAO, 2005). In the late 1970s and during the 1980s, many suitably situated state farms played an important role in crop production, particularly for supplying rice, citrus and vegetables. In addition, between the middle 1970s through to the 1980s, some thousands of smallholder farmers were organized in production cooperatives and associations. These cooperatives were supported by the Government within the political campaign of "socialization of rural areas" (Mosca, 2011). Data and information on state

farms' contribution to total food crop production are scarce. Table 5.1 illustrates the area and production of state farms and other actors per crop registered in the 1978-1979 agricultural season from available data.

The suitability for irrigation of some areas in the southern region of the country led to the creation of the State Secretariat for the Rehabilitation of the Limpopo and Incomati basins (SERLI, from *Secretaria de Estado para Reabilitação do Limpopo e Incomati*) in the late 1970s (Government, 1979) . The main mandate of SERLI was to ensure the development of medium- to large-scale irrigation schemes in those areas, including the required studies, establishment and operationalization of the needed infrastructure and technology. In 1983, the scope of intervention of SERLI was expanded, resulting in the closing down of this Secretariat and the creation of the State Secretariat for Agriculture Hydraulics (SEHA, from *Secretaria de Estado de Hidráulica Agrícola*). The new SEHA had a broader goal of "promoting the maximum use of water resources to serve agriculture" (Government, 1983). The late 1970s and early 1980s was characterized by comprehensive support for irrigation, as part of state farms' production system, particularly in the southern and central regions of the country, as shown in Figure 5.3.

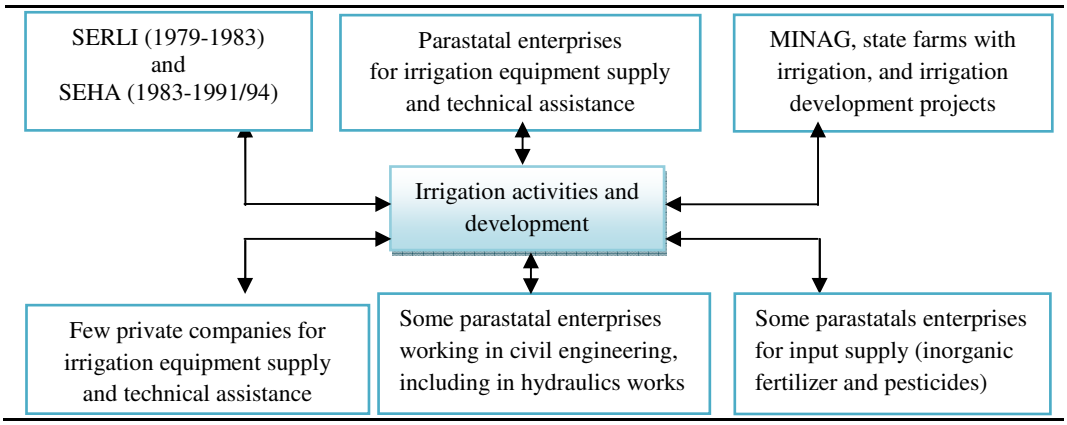


Figure 5.3: Different actors involved in or supporting irrigation in late 1970s and 1980s
Source: The author, based on interviews with key informants and review of literature.

As referred to above, during the centralized economy (until the mid-1980s), public investments in irrigation were mainly allocated to medium to large scale schemes through state farms (Caballero, 1990; FAO, 1995; Valá, 2006). SERLI and principally SEHA played an important role in channelling public investment to medium to large-scale irrigation schemes, particularly in the southern region of the country.

It was between the second half of the 1970s and 1986 that the Government embarked upon major actions to (re)establish and operate medium- to large-scale irrigation systems such as Chipembe Dam and Nguri Irrigation system (Cabo-Delgado province, northern region); Corumana Dam (Sabié-Incomati irrigation scheme), *Pequenos Libombos* Dam and irrigation development project (Maputo province, southern region), *Massingir-Chinhangane* and *Macia* irrigation projects (Gaza province, southern region); *Chindjinguire* irrigation project (Inhambane province, southern region), among others. (Pijnenburg and Simbine, 1996; COBA, 2003; FAO, 2005).

It is estimated that the state farms and agro-industrial complexes reached the maximum cultivated land of 140,000 ha by the early 1980s. The public Chókwè Irrigation Scheme played an important role in rice production as the largest scheme in the country having rice as one of the main crops grown over time. However, there are very few estimates available of the contribution of irrigated production to total crop output in this period. Table 5.1 shows cultivated areas, yields and production by category of producers in 1978-1979 agriculture season. Many of the state farms had irrigated land, fully or partially, in terms of total area under production. Private commercial farmers had also access to irrigated land particularly for rice production.

Table 5.1: Cultivated areas, yields and production by category of producers (1978-1979 agricultural season), Mozambique

	Category of producers	Maize	Rice	Sorghum	Cassava	Groundnuts	Beans
Cultivated area (1000 ha)	State farms	25.2	26.6	5.8	n.a	1.5	9.9
	Smallholders cooperatives	7.1	5.6	0.7	n.a	0.7	2.5
	Private sector	9.8	3.7	0.6	n.a	0.02	2.8
	Family producers	578.5	26.6	257.0	602.0	80.5	107.2
Average yields (tons/ha)	State farms	3.7	2.7	1.3	n.a	1.0	0.7
	Smallholders cooperatives	1.1	1.5	0.8	n.a	0.4	0.6
	Private sector	1.6	1.6	0.6	n.a	0.5	0.5
	Family producers	0.5	0.6	0.5	3.6	0.3	0.3
Production (1000 tons)	State farms	93.7	72.8	7.8	n.a	1.6	7.3
	Smallholders cooperatives	8.1	8.5	0.6	n.a	0.3	1.6
	Private sector	16.1	5.8	0.4	n.a	0.01	1.5
	Family producers	318.5	17.4	135.6	2.195,0	23.8	40.5
	Total production (1000 tons)	**436.4**	**104.5**	**144.4**	**2.195,0**	**25.7**	**50.9**

Source: MINAG (1979) in SEHA/ SOGREAH (1987)

Data on marketed agricultural output by the different category of producers (State farms, private sector and family producers) in the second half of 1970s and first of 1980s was difficult to encounter during the study at relevant institutions such as MINAG, and the Ministry of Industry and Trade (MIC), the later in charge of agriculture marketing at national

level. Table 5.2 presents the estimated marketed volume of seven food and oil crops in 1985 (SEHA/ National Irrigation Development Master Plan (NIDMP), 1993).

Table 5.2: Estimated marketed volume for seven major food and oil crops in 1985 (1000 tons), Mozambique

Crops/ Categories of producers	State farms	Smallholders Coops	Private sector	Family Producers	Total
Maize	21.9 (22.2)	1.3 (1.4)	5.7 (8.0)	29.7 (33.4)	58.6 (65.0)
Rice	12.6 (22.0)	0.3 (0.8)	1.1 (3.6)	3.9 (2.6)	17.9 (29.0)
Sorghum	0.2 (0.2)	0.01 (0)	0.02 (0.1)	1.4 (1.1)	1.6 (1.4)
Cassava	n.a	n.a	n.a	n.a	6.3*
Groundnuts	n.a	n.a	n.a	n.a	2.0*
Beans	n.a	n.a	n.a	n.a	3.6*
Sunflower	n.a	n.a	n.a	n.a	5.7*

Source: SEHA/ NIDMP (1993)
Note: (*) Non-disaggregated marketed output; numbers in brackets are the estimated output for 1986.

It should be noted that in 1985, the performance of the agricultural sector was adversely affected by war, which affected rural areas, while many of the state farms and state agro-industrial complexes had started to face technical and managerial sustainability related problems. Despite such problems, the state farms and state agro-industrial complexes offered at that time about 70% of total commercialized rice and about 40% of maize (SEHA/ NIDMP, 1993) –the two most cultivated cereals in the country to date.

Based on the documented 1985 figures, the contribution of state farms and state agricultural complexes to commercialization of outputs was substantial, increasing food availability in the market, although throughout the country supply remained weak, particularly in towns. In this period, domestic food production, food availability and commercialization were extremely constrained by war and recurrent calamities which made the country highly dependent on international food aid (Abrahamson and Nilsson, 1995). Data on national food demand at the time was not available at MIC.

Although not included in the table, it should be highlighted that state farms, and particularly the State Agro-Industrial Complex of Limpopo (CAIL from *Complexo Agro-industrial do Limpopo*), played a significant role in contributing to total marketed vegetables (mainly cabbages and tomato) to markets in the southern region in the 1980s, especially to Maputo, the national capital.

In 1987, it was estimated that approximately 34,000 smallholder farmers were organized in 371 production cooperatives. However, this included less than three percent of total farmers and many cooperatives were not necessarily located in areas with irrigation infrastructure or

in areas with access to water for irrigation. This means that smallholder farmers' role in irrigation was very limited at the time.

5.1.3 Training and extension contribution

The contribution of agricultural education to the irrigation subsector from the late 1970s to the mid-1980s was limited, but important. An important aspect is that irrigation subjects or knowledge was not extensively offered to agriculture diploma students (Chimoio and later Boane Diploma Institutes) although included in the curricula of BSc degree students at the Faculty of Agronomy and Forestry Engineering (FAEF, from *Faculdade de Agronomia e Engenharia Florestal*) of *Eduardo Mondlane* University (UEM), by then the only faculty of agronomy. However, diploma and BSc agronomists who were at the time available and working on state farms (almost all farming in irrigated land) have certainly contributed with their knowledge and skills to the management of irrigation, in particular, and to farming activities, in general (Zandamela, C., Senior Agronomist, former technical staff in Nguri Irrigation Scheme, Cabo Delgado Province, in the early 1980s; personal communication, September 2011). This is despite the fact that at that time many of the state farms were not necessarily managed by agriculture diploma holding technicians or by the then limited BSc agronomists.

From 1985 to 1990, the FAEF implemented "rural engineering" as one of the three options of the 5-year agronomy degree course offered at the time, with technical assistance from Wageningen University. The rural engineering option included subjects such as soil science and fertility, agriculture hydraulics, hydrology, irrigation and drainage and agriculture mechanization. Graduates from this course option were trained to support mainly irrigation management besides extension and soil fertility issues. In addition, UEM/Faculty of Engineering was also offering graduates in civil engineering to the job market, a BSc course that includes hydraulics and construction related disciplines. Some of these graduates are equipped to be involved in rehabilitation and construction agriculture hydraulics works, especially through the then civil construction and hydraulics works parastatals.

The contribution of extension to irrigation development was also limited during this period. Although MINAG had conducted some rural extension related activities, particularly during the first half of the 1980s, the formal creation of extension services only occurred in March 1987 (Gêmo, 2001; Gêmo *et al*., 2005). Until March 1987 there were no formal and

structured public extension services at MINAG or at any other Government entity. In summary, extension activities were at an early stage of development, with a limited contribution to offer to irrigation development. It is also important to note that irrigated land was almost all within state farms and state agriculture complexes and the role of public extension services, even if the services were at that time stronger, was of lower importance, because state farms and agricultural complexes relied on their own staff (although many times with limitations, especially in terms of qualifications) for technical field tasks.

5.1.4 Was the PGARH used as a guiding plan for the irrigation subsector by the Government?

Historical facts show that the irrigation development trajectory until the late 1980s was not related to PGARH expected targets and recommendations, despite the fact that some rural areas identified within the PGARH as priorities for public investment had actually benefited from such investments. For example, Government support to irrigation from the second half of the 1970s to the first half of the 1980s was more focused on medium and large scale irrigation schemes, mainly through state farms and state agricultural complexes rather than through small scale schemes as recommended in the PGARH (Ataíde *et al*., 1976).

Evidence based interventions in the irrigation subsector also seem to have been a challenge, perhaps due to weaknesses in terms of human capital and lack of critical information and knowledge at irrigation public services as well as among state farms and state agricultural complexes. Various sources refer to managerial and technical problems faced by these actors at farm level, including in managing irrigated production (Caballero, 1990; Valá, 2006; Mosca, 2011). In fact, technical and economic inefficiencies faced by many of the capital intensive state farms (including irrigation investments and operational costs) contributed to their collapse.

Exogenous factors have also contributed to keeping expansion of irrigated land far below the PGARH 1977-1986 targets. The war that ravaged the rural areas until 1992 seriously constrained irrigation development. The challenge of mobilizing significant public funding to invest in the irrigation subsector (to meet PGARH targets) might also have played a constraining role in expanding irrigated land, especially taking into account that the Government was dealing with a devastating war across the country.

Despite the apparent failure to implement the PGARH within the scope of the irrigation subsector, the increase in land area equipped for irrigation from 91,500 ha in 1976 (Ataíde *et al*., 1976) to about 120,000 by 1982 (FAO, 2005; MADER, 2003) was impressive. It was in the early 1980s that the country reached its highest level of land equipped for irrigation compared with approximately 100,000 ha in 1973 (FAO, 2005).

5.2 1986–1998: Irrigation Development during the Transition from Centralised to Liberalised Economy

During the second half of the 1980s, the Government started to shift from a centralized to a liberalized economy. This macro-economic policy shift caused significant changes in public institutional support to irrigation as discussed below.

5.2.1 Changes in the structure of public institutional support for irrigation

Linked to the fact that the Government's direct intervention in economic activities had been declining since the late 1980s, in 1991 the Government decided to transfer the coordination and investment roles from SEHA to the new Cabinet for Coordination of Integrated Projects (GCPI, from *Gabinete de Coordenação de Projectos Integrados*). All logistics and significant portions of SEHA's resources were then transferred to this office (Melo, N., Former Director of DNHA, personnel communication, September 2011). Scarce documentation on GCPI activities, particularly with regard to its institutional performance, makes it difficult to assess the extent to which this entity has contributed to boosting irrigation. It was unclear as to how public support for irrigation should have been rendered at the time. This is because, although the SEHA was discontinued and the position of Secretary of State of Agriculture Hydraulics was abolished from the Government system, at least one of the technical SEHA directorates continued to work until 1995, out of GCPI's organizational structure, and under the leadership of the Minister of Agriculture. Daily interaction between the former SEHA directorates and MINAG between 1991 and 1995 was conducted mainly through the then Directorate of Hydraulic Technology, which was one of the three directorates of the former SEHA.

Despite the weak institutional capacity of SEHA's directorates after 1991, the old Secretariat did coordinate the preparation of the National Irrigation Development Master Plan (NIDMP, 1993), a process carried out between 1991 and 1993. At that time the country started planning and implementing a number of actions to re-launch the agricultural sector (and the irrigation

subsector) following the Peace Agreement (October 1992).The National Irrigation Development Master Plan (SEHA/ NIDMP, 1993) was to focus investments on:

- Five catchment areas (river basins) namely Umbeluzi, Inkomati, Limpopo, Buzi and Púngoè
- Five provinces (Maputo, Gaza, Inhambane, Sofala and Manica) through selected areas in 33 districts, mainly rural ones
- Two towns specifically Xai-Xai and Chimoio, which are respectively Gaza and Manica provincial capitals.

The 1993 NIDMP included figures related to the irrigation situation at the time as summarized in Table 5.3.

Table 5.3: Irrigation area planned to be rehabilitated within the scope of the NIDMP (1993), Mozambique

Equipped area	**Hectares**
Small irrigation systems (≤ 100 hectares)	46,000
Large systems (> 100 hectares)	11,000
Chókwè large system	25,000
Sugar estates	36,000
Total targeted equipped land for irrigation	108,000

Source: SEHA/ NIDMP (1993)

The document highlighted that from 1975 until 1991-1992, about 35,000 ha of "new" land was equipped for irrigation, but effective use of this land was very limited. For example, from the total 36,000 ha of land equipped for sugarcane irrigation only about 5,400 ha was estimated to have being used. It was estimated that only 40,000 to 55,000 ha of total equipped land for irrigation was being used. The estimated gap on the effective use of irrigated land in 1993 (40,000 to 55,000 ha) was argued to result from inaccurate figures related to the use of the Chókwè and *Baixo Limpopo* Irrigation Schemes in 1991-1992, when the field assessment was conducted within the scope of preparation of the 1993 NIDMP. Security problems, degradation of the infrastructure and equipment, and a general lack of maintenance were then pointed out as the main reasons for the extremely low levels of use of land equipped for irrigation. Collapse of state farms in the second half of the 1980s, by then the major irrigation actors in the country, resulted in a major reduction in the use of land equipped for irrigation,

particularly because they were not replaced by new actors capable of using the available land equipped for irrigation.

Following the first general elections held in 1994, the Government created the Ministry of Agriculture and Fisheries in 1995 (MAP, 1995-1999 from *Ministério da Agricultura e Pescas*). As part of the MAP, a new National Directorate of Agriculture Hydraulics (DNHA - from *Direcção Nacional de Hidráulica Agrícola*), was established (Government, 1995). This process also comprised the formal abolition of the former "Secretariat of State" (SEHA).

5.2.2 Privatization of state farms and irrigation development

In the early 1990s, the state farms started being privatized as part of the Government's actions towards a liberalized economy. Most state farms collapsed by the second half of 1980s because of the devastating war that affected mainly the rural areas until 1992 as well as technical and managerial problems that were affecting many state farms (Caballero, 1990; Valá, 2006; Mosca, 2011). An assessment conducted in 1986 concluded that state farms and state agricultural complexes had accumulated loans to the value of USD 200 million (Caballero, 1990), particularly with the Peoples' Development Bank (BPD - from *Banco Popular de Desenvolvimento*). In fact, one of the "shifting policies" from centralized to a new economic era was the control of credit expansion, particularly by limiting credit to government or public institutions (SEHA/NIDMP, 1993), including state farms and state agro-industrial complexes, as part of the efforts to control public expenditure.

The collapse and privatization of state farms marked the end of an important group of traditional irrigation operators that had existed from the late 1970s to the late 1980s. By the mid-1990s, about 200 small to large state farms had been privatized (Gêmo *et al*., 2005). But most privatised state farms did not perform well, and some were abandoned and subsequently occupied by smallholder farmers.

Consequently, the privatization of state farms and the end of some of the development irrigation projects (for example Sabié-Incomati and Chingjinguire), brought new sustainability challenges to the few parastatal enterprises that were at the time involved in irrigation equipment supply and provision of technical assistance. Under the new market circumstances, without state farms as their main clients and with little or no Government direct support, these enterprises needed to become more commercially efficient and competitive. The collapse of parastatal enterprises followed during the first half of the 1990s.

It should be highlighted that the contribution to irrigation development of the majority of the scarce human capital that used to work in the state farms and parastatal enterprises was lost in the subsequent years, along with the practical experiences and knowledge developed among public and parastatal actors.

The macroeconomic policy changes had substantial consequences on the irrigation subsector, which was highly dependent on public support mainly through:

- The State Secretariat for Rehabilitation of Limpopo and Incomati (SERLI), from 1979 to 1983 and the State Secretariat for Agriculture Hydraulics (SEHA), from 1983 to 1991/94, although with lower capacity of intervention since 1991. As mentioned above, SEHA was not formally abolished in 1991 despite the transfer of its substantial roles and resources to the Cabinet for Coordination of Integrated Projects (GCPI) created in that year.

- State farms and state agro-industrial complexes (large state enterprises often comprising farming, transport and even processing services, as it was the case with the Limpopo Agro-industrial Complex during the second half of the 1970s and first half of the 1980s)

- Irrigation development projects

- Some parastatal enterprises involved in irrigation equipment supply and provision of technical assistance, and

- Some parastatal enterprises involved in input supply (fertilizer and pesticides).

The problems that affected the irrigation subsector occurred at a time when MINAG and other agricultural sector stakeholders were involved in revitalising agriculture as from 1993, after the Peace Agreement was signed in October 1992. This means that the contribution of irrigation in revitalising agriculture was very limited. In fact, with the limited contribution of conventional irrigated production, the impressive recovery of agricultural production between 1993 and 1998 was mainly due to the favourable combination of three factors. First, thousands of rural people were returning to their places of origin and resuming farming activities. Second, Government, donors and NGOs support and commitment in revitalising agriculture and the rural economy, particularly through free or substantially subsidized

agricultural inputs (thousands of tons of seeds and millions of hand tools) and through strengthened technical assistance and extension services provision by public, NGOs and private (cash crops) actors (MINAG/ Seed and Hand Tools Emergency Program (PESU), 1994; from *Programa de Emergência de Sementes e Utensílios*); MAP/ PESU, 1995; 1996;1997; MAP/National Directorate of Rural Extension (DNER), 1996; 1997; 1998). Third reasonable to favourable climatic conditions were also critical in Mozambique's predominantly rain-fed agriculture (MAP/EWS, 1996-1998). Table 5.4 shows production levels of main food crops produced in the country between 1993 and 1998, which is the period in which agriculture underwent a notable recovery following the Peace Agreement in 1992 (Gêmo *et al*., 2005).

Table 5.4: Food crop production (tons) at national level, Mozambique

Crops/ Agricultural seasons	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99
Maize	526,361	733,803	947,225	1,042,025	1,123,658	1,246,078
Sorghum	163,710	243,291	249,306	262,491	317,145	326,250
Millet	28,803	35,414	41,560	44,171	53,332	61,278
Beans	95,331	134,172	140,551	152,805	191,067	188,590
Groundnut	73,654	102,081	117,476	126,214	142,836	147,001
Cassava	3,294,441	4,727,535	5,336,742	5,638,963	5,552,928	5,361,974

Source: MINAG-Early Warning System (EWS) (1994), MAP/EWS (1995-1999)
Note: Despite current discussions on the need to harmonize MINAG/ EWS and MINAG/ TIA on crop production estimations (Kieregyera, 2007), MINAG/ EWS was the main source for food crop production levels between 1993 and 1999, as the first nationally representative Agriculture Survey (TIA) was only conducted in 1996 and the first Agriculture Census in 1999-2000.

Some small scale irrigation initiatives aimed to boost smallholder farmers' food security were implemented during this period by Government, some donors (Italy, in particular) and some UN development agencies, such as UNDP, FAO, UNICEF and IFAD, and by some NGOs, particularly in the green belts of Maputo city and Beira city and, to a lesser degree, in the peri-urban areas of other provincial capitals, or in selected districts of Gaza, Inhambane, Nampula and Cabo-Delgado provinces, mainly for the production of horticultural crops such as cabbage, tomato, lettuce and onion. Apart from peri-urban areas of Maputo, Xai-Xai and the Beira green belt that have some irrigation infrastructure, small scale irrigation initiatives generally consisted (and still consist) of informal use of water in small wetland areas without irrigation infrastructure *per se*.

In Maputo province, small scale pumped and gravity fed systems were promoted in the Boane, Marracuene and Manhiça districts. Public extension services were involved in the early stages of development in some of these initiatives. However, technical and economic

sustainability issues have led to the partial collapse or discontinuation of many of such initiatives. For example, by the late 1990s, sustainability issues led to the reduction of the size of irrigated land in Massaca and Mafuiane rural areas of Boane district (35 km from Maputo city) in favour of rural housing, that kept home gardens for horticulture, but production was not at the same level as before the construction of houses.

At the same time, Public and NGO extension started to encourage smallholder farmers to farm in the wetlands (*machongos*), as an important alternative to increasing productivity and mitigate the effects of the potential occurrence of droughts. Horticulture and rice crops have been a priority in such areas.

Once again, documented and official sources related to the contribution of irrigated production to total production during the period from 1987 to 1998 are scarce, if at all available. Most small scale irrigation schemes that were operating in peri-urban areas of the provincial capitals and the scattered and small rural wetlands used for irrigated production with some sort of support by NGOs, were not necessarily supported by M&E systems responsible for recording production outputs and productivity issues. In fact, MINAG itself started to build its first post-war production output information system in 1993-1994, with focus on annual forecasts of rain-fed production for the basic food staples at provincial and national level (MINAG/ EWS, 1994). The national agriculture surveys (TIA) that have been implemented since 1996 (with the first attempts in 1993 and 1994) over periods of one to two years as well as the agriculture census (CAP) conducted in 1999-2000 and 2009-2010 have also been aimed to assess the overall production output (almost all rain-fed), rather than addressing particular efforts to assess irrigated production.

5.3 1999-2010: Renewed policy developments in the Irrigation Subsector

Three factors are briefly discussed here, namely changes in irrigation policy, restructuring of MINAG's institutional support, and government mobilization of new and old DP to support irrigation.

5.3.1 Policy changes and new expectations towards irrigation development

An important policy change, especially during PROAGRI I implementation (1999-2004/06), was the shift towards small scale irrigation support instead of the previous approach of

prioritizing large- and medium-size systems during the late 1970s and the 1980s. PROAGRI I had three main objectives:

- Institutional development focused on MINAG
- Support to production efforts, and
- Improved natural resources management (land and water).

Irrigation was within PROAGRI I priorities. When PROAGRI I was approved in 1998 there was no written irrigation policy document approved by Government and shared with potential stakeholders. However, discussions held during PROAGRI I preparation (1996-1998) within MINAG and between MINAG and the potential PROAGRI I DPs resulted in consensus at two levels:

- Prioritize MINAG´s interventions mainly in small scale irrigation, and
- Decentralize decision-making related to irrigation investments allocated through the MINAG system to Provincial Directorates of Agriculture (DPAs) and to promote the participation of water users in the management and ownership of small scale irrigation systems. In May 2011, the Government and development partners (DPs) directly involved in funding MINAG/ agricultural sector, agreed to formalize and operationalize the common mechanism of flux of funds (CMFF). The CMFF was a joint account created to operationalize direct funding to MINAG budget (central and provincial levels) by several DPs and by Government within the context of PROAGRI implementation (MINAG/ PROAGRI, 2007b; Cabral, 2009)

Three reasons were highlighted for having small scale schemes as a priority, namely the need to:

- Contribute to the continuation of revitalisation of smallholder agriculture following the Peace Agreement (October 1992)
- Contribute to smallholder farmers' food security through better use of local resources (especially land and water),and

- Contribute to poverty alleviation, including in the green belts surrounding the major towns in the country. Peri-urban green belts have been viewed as an important source of smallholder farmers' income as well as the supply of horticultural products to towns.

Despite the political emphasis on small scale irrigation, the Government continued to support existing large systems like the Chókwè Irrigation Scheme, where at least USD 20 million were spent from the late 1990s to date for the rehabilitation of the main irrigation canals and related infrastructure and equipment, and in rehabilitating approximately 7,000 ha of the scheme in terms of water distribution canals. MINAG also continued to provide support to some other large scale schemes, such as the gradual rehabilitation of the *Baixo Limpopo* with a total area of about 9,000 ha with the support from the African Development Bank (AfDB).

In addition to public investment, the Government also made efforts to attract foreign direct investment into agriculture, particularly since the second half of the 1990s. The sugarcane industry is a good example of successful foreign direct investment in irrigation, accounting for at least 35,000 ha of mainly rehabilitated irrigated land (MINAG, 2010a). Most of the original canals, drains and pumps were repaired, re-designed or replaced to the present flood (inundation), floppy and pivot irrigation systems (Tongaat Hulett, 2010). Banana production has also benefited from foreign direct investment, particularly in Nampula province with a projected 3,000 ha of irrigated land; and in Maputo province, where private companies are working on about 720 ha of irrigated banana farmland in Boane district (District Services for Economic Activities (SDAE)–Boane, 2010; from *Serviços Distritais de Actividades Económicas*). Sugar and banana production have been for both domestic and export markets.

In December 2010 the Council of Ministers approved the Irrigation Strategy (MINAG, 2010a) for the next ten years. The formulation process started in 2000 when MINAG was initiating the implementation of PROAGRI I, building on a draft irrigation policy (*Política de Irrigação*) (MADER/DNHA, 2002) that was prepared by the then DNHA. However, such document never reached the approval stage at Government level (Melo N., former Director, MINAG/ National Directorate of Hydraulics Services (DNHA) and Nhabetse, A., Head, MINAG/ Irrigation Department, personal communication, September 2011). Nonetheless, some of the principles of the unapproved irrigation policy have been implemented, namely the emphasis on small scale irrigation schemes through public investment; public budget

decentralization as much as possible; promotion of water users' participation in the construction and management, particularly in small scale irrigation schemes.

It was only in 2006-2007 that MINAG resumed discussions on the Irrigation Strategy, with assistance from different stakeholders, especially FAO. The resumption of the formulation of the Irrigation Strategy included consultations at central and local levels, notably in the provinces from the southern and central regions of the country where irrigation needs are higher (MINAG, 2010a). In 2010, more effort was placed on renewing consultations among key public and non-public stakeholders and writing up the final document towards the approval of the Strategy, at this stage in close collaboration with the International Water Management Institute (IWMI- Southern Africa). In June 2010, IWMI collaborated with MINAG in conducting a public consultation in Maputo on the then draft Strategy with key stakeholders from the irrigation subsector among public professionals, private sector, farmers' organizations, academia and some DPs linked to irrigation (MINAG, 2010a). The extent to which the new Irrigation Strategy will respond to the major and most critical irrigation factors will be vital to expanding irrigated land in a consistent and sustainable manner in the future.

5.3.2 Restructuring of irrigation public institutional support and the role played by DNHA

As stated earlier, the DNHA was established at the then MAP in 1995 (Government, 1995). The Directorate had a mandate to lead policy and strategies formulation and to coordinate, implement and monitor MINAG's irrigation interventions. The structural organization of DNHA comprised representations in six provinces, through what was termed as Provincial Nuclei of Agriculture Hydraulics (*Núcleos Provinciais de Hidráulica Agrícola*); while at central level it comprised three departments, namely Economics, Technology and Regulation, and the Hydraulics Department.

The "irrigation provincial nuclei" were established during the SEHA period and they had been conceptualized to be semi-autonomous entities in relation to the Provincial Directorates of Agriculture (DPAs). With some construction and irrigation equipment, the "irrigation provincial nuclei" were aimed to provide maintenance, rehabilitation and construction services. They also assisted in public funded irrigation schemes. However, the "irrigation provincial nuclei" were never institutionally developed into strong technical and operational irrigation entities as initially envisaged. In the late 1980s, the provinces of Zambezia, Sofala

and Cabo-Delgado had some of the relatively stronger "provincial nuclei". These nuclei also existed in Nampula, Manica and Inhambane, but with limited institutional capacity and intervention roles in irrigation. In Gaza province, which currently hosts the most important irrigation schemes in terms of size and potential for rice and vegetables, notably Chókwè, *Baixo Limpopo* and Macia, irrigation works used to be conducted by parastatal enterprises or by public funded management bodies.

Late in 2005, DNHA was abolished and irrigation was integrated into a new directorate formed early in 2006 and called the National Directorate of Agriculture Services (DNSA), which resulted from the merger of the former DNHA, the National Directorate of Agriculture (DINA) and the National Directorate of Livestock (DINAP). Thus, public institutional support to irrigation was downgraded from a national directorate (DNHA) to a department within DNSA early in 2006. This organizational change was implemented within the scope of the 2005 and 2006 MINAG broad institutional reforms, which consisted of the elimination of various national directorates and research institutes in order to establish a reduced number of new directorates and to integrate all research institutes (crops, livestock, veterinary, and natural resources) into the current Mozambique's Agrarian Research Institute (IIAM). Such reforms were conducted primarily to render MINAG's performance more effective and efficient in responding to the agricultural sector's major goals and challenges (MINAG/ PROAGRI, 2005).

Until its abolishment in 2005, DNHA was responsible for the following key activities:

- Assuming a leadership role in policy discussions during the preparation of PROAGRI I (1996-1998)

- Assuming a coordination role in the preparation of the annual plans of activities and budget (PAAO) for the PROAGRI I irrigation component in collaboration with DPAs (1999-2005), where the "Provincial Nuclei of Hydraulics" used to be hosted, especially since DNHA's establishment in 1995

- Hosting or implementing roles with regard to public investments in irrigation through specific projects with partners such as the AfDB and the Italian Government

- Representing MINAG's in discussions on water policy issues with relevant institutions such as the Ministry of Public Works and Housing (MOPH), particularly through the National Directorate of Water (DNA).

- Responsible for ensuring direct technical dialogue between MINAG and public management bodies that are in charge of large irrigation schemes, such as the Hydraulics of Chókwè Public Management Board (HICEP, *Hidráulica do Chókwè Empresa Pública*), when appropriate.

Documented sources on DNHA's (1995-2005) performance evaluation are scarce and available sources are not clearly focused on MINAG/DNHA institutional issues, but wider irrigation issues, although including some considerations of MINAG's/DNHA activities and relationship issues with other key stakeholders (MINAG/ PROAGRI, 2007b). However, it seems that DNHA's role in contributing to effectively strengthening the irrigation subsector was constrained by both internal and external factors. Interviews with key informants at central and mainly at district level and review of available documents at visited Provincial Directorates of Agriculture and direct observations in the field, suggest that internal factors included:

- Limited representation at national level in terms of qualified human resources, allocated annual financial resources and logistical means, such as means of transport for monitoring and technical supervision field visits in publicly funded small- and medium-scale irrigation schemes, and

- Limited structural capital. This is related to a functional and effective monitoring and evaluation sub-system; updated database on irrigation schemes and effective use of available land at district, provincial and national level; relevant analytical reports and case studies.; that could allow DNSA to be more knowledgeable on the developments, key constraints in different regions/provinces, opportunities, and potentially success cases that could eventually be replicated in suitable areas of the country.

Similarly, critical external factors included:

Difficulties in balancing immediate "social and political" oriented demands for establishing or rehabilitating irrigation schemes (often small scale schemes) by local authorities in responding to farmers' needs, and needed technical procedures and economic considerations

by the public irrigation services. In some cases, these difficulties resulted in problems in the management and effective use of irrigation schemes (re)established without necessarily taking into consideration the required technical steps and procedures due to the urgency in establishing them. The success or failure of irrigation technology depends to a large extent on careful selection, thorough planning, "accurate" design and effective management (Muguambe and Chilundo, 2010).

Dispersion of publicly funded irrigation schemes at provincial level make it difficult for the "irrigation provincial nuclei" to ensure an effective monitoring of the governance and management and needed technical support (or helping in conflict resolution, when needed) of new or rehabilitated irrigation schemes, particularly those under the responsibility of farmers' organizations, which are expected to develop to water users associations. This is particularly serious taking into consideration the limited logistical capacity of the "irrigation provincial nuclei" during the DNSA period in regularly reaching y the rural areas with public irrigation investments (in fact this is a prevailing problem), as well as the weaknesses that often characterize the initial stages of local-based governance and operations of the recently (less than two years) rehabilitated or established (small scale) irrigation schemes in rural areas (Ussivane, 2010).

Limited services providers for construction and rehabilitation of irrigation schemes, particularly in rural areas out of Maputo province. This is a problem because alternative options in terms of qualified services providers are limited and often the construction or rehabilitation works face temporary interruptions, resulting in delays. This makes it difficult for "the provincial nuclei" to follow the processes of construction or rehabilitation as needed, because of resource implications in extending field working visits for certain irrigation schemes where construction has been delayed.

It should be pointed out that MINAG also has a Land and Water Department (*DTA, from Departamento de Terra e Água*) within Mozambique's Agriculture Research Institute (IIAM). Some of its activities include land and water inventory and evaluation; soil fertility issues; geographic information systems; and water and soil laboratory analysis. DTA has also the mandate to evaluate the efficiency of water management in irrigation systems and to produce technical recommendations. However, the institutional capacity of IIAM/ DTA has been limited, including in terms of human capital. For example, in September 2010 DTA had a

total of three MSc and five BSc staff members to respond to all the Department's service demands at the national level.

5.3.3 Increase in funding partners and other stakeholders

Since the late 1990s, new DPs emerged, while existing ones expanded their contribution to the irrigation subsector (MINAG, 2010a). The AfDB has been one of the most important agencies providing support to the irrigation subsector since late 1970s, in particular through MINAG and MOPH. Indeed, from 1977 to March 2008 the agricultural sector received the largest proportion of the AfDB portfolio in Mozambique. Agriculture's proportion is estimated at 303.5 million "Units of Account" (UA), equivalent to about 29% of the total 1045.7 million UA, which corresponded to USD 1.6 billion in April 2008 (AfDB and Mozambique, 2008). A portion of these resources was allocated to the irrigation subsector.

Recently, the AfDB funded two important irrigation projects, namely the Massingir Dam Rehabilitation Project (Smallholder's Agriculture Rehabilitation Component which consisted of rehabilitation of the *Baixo Limpopo* Irrigation Scheme, Gaza province) and the Small Scale Irrigation Project, approved in 1993 and 1998, respectively, but with their implementation starting in 2002. In fact, the *Baixo Limpopo* rehabilitation field work started almost two years later, after completion of related procurement process by the project management team in collaboration with Government and AfDB. The *Baixo Limpopo* rehabilitation was aimed to rehabilitate about 9,000 ha out of a total area of 11,207 ha (COBA, 2003). The rehabilitation was planned to be implemented in two phases, with the first implemented until 2009 and the second from around 2013 (Ussivane, A., CEO of the *Baixo Limpopo* Public Irrigation Enterprise, personal communication, November 2011). In turn, for the later project, the aim was to establish and rehabilitate a total irrigated land of about 2,500 ha in selected areas in Maputo, Sofala and Zambézia provinces. Both projects prioritized smallholder farmers' access to irrigated land. In addition to the AfDB, other DPs have joined the national efforts to boost public support for irrigation through the implementation of PROAGRI I (1999-2004/06) and PROAGRI II (2007-2011) funding small scale irrigation scheme through MINAG/ DNHA until 2005 and through MINAG/ DNSA from 2006 to 2011. PROAGRI I and PROAGRI II were funded initially by a total of 15 and 8 DPs, respectively, using the common flow and funding mechanism (CFFM) between 2001 and 2011. At least three of the 15 DPs involved with PROAGRI I later decided to contribute through other mechanisms, as general budget support (GBS) rather than the CFFM.

From 2004 to 2007, the Government of Italy provided support for the implementation of an Integrated Agriculture Development Project (PIDA) in selected districts of Maputo, Sofala and Manica provinces (Bohor, 2006). Although not specified in terms of the final expenditure, a portion of the total budget of € 9.2 million was earmarked for supporting the rehabilitation or establishment of new small scale irrigation systems. Italy also funded two pilot irrigation systems in Maputo (Boane district) and Sofala (Gorongosa district) provinces between 2000 and 2002 (both with 8 to 12 ha each) within the scope of FAO's special programs for food security (PAN, from *Plano de Acção Nacional*), phase I, implemented since 1998 to 2002 (FAO, 2010).

In 2006-2007 the European Commission (EC) provided about € 10 million to support small scale irrigation in selected districts of Gaza and Inhambane provinces. The initiative was aimed at contributing to MINAG's efforts to expand irrigated land and to rehabilitate obsolete irrigation infrastructure. Other DPs, such as the Irish Government and Japanese International Cooperating Agency (JICA), have also provided limited support to irrigation in Inhambane and Gaza Provinces, respectively. The JICA has been specifically supporting irrigation within Chókwè's larger scheme. Figure 5.4 shows the main irrigation stakeholders in the country over the 1996-2010 period.

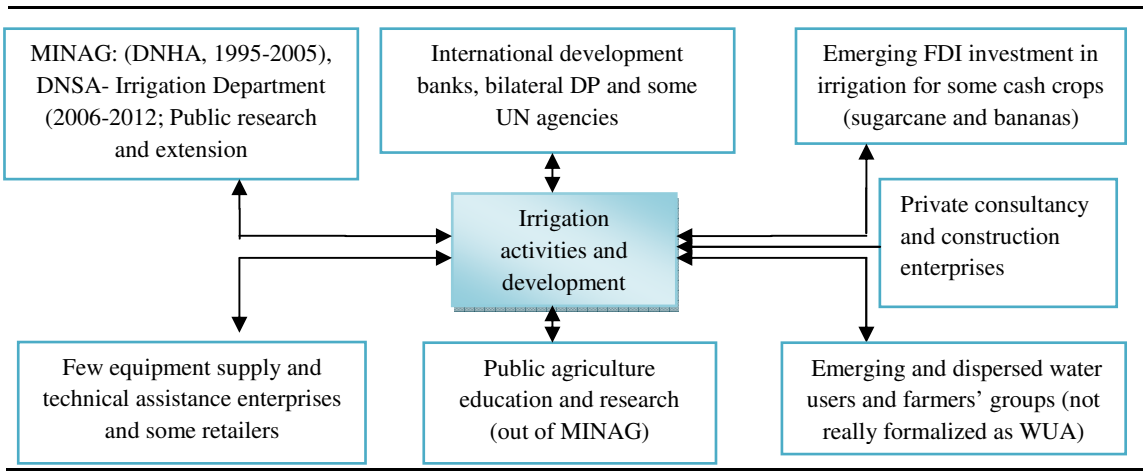


Figure 5.4: Main irrigation stakeholders in Mozambique over the 1999-2010 period.
Source: The author, based on literature and documents review, interviews with informants and field observations.

Foreign Direct Investment started to contribute to irrigated agriculture particularly from the second half of the 1990s, notably for sugarcane and later banana crops. Private companies involved in irrigation equipment supply and provision of technical assistance are still limited

in quantity and distribution throughout the country (at least at provincial capitals) and with regard to their consistency in terms of capacity to supply demanded equipment and technical assistance to the water users. Private consultancy and construction enterprises working and specialized in irrigation are important for the development of the sub-sector, but they are also still limited in number.

Private consultancy enterprises have highly qualified national professionals (experienced staff with PhDs and MSc, mostly working in public degree education institutions, mainly in the civil engineering and agronomy fields). Depending on the scope of public tender for contracting consultancy services on irrigation matters, partnerships between local and foreign consultancy enterprises make it possible to increase the level of competition and options for the contractor, mainly MINAG, or publicly funded irrigation projects.

Construction enterprises specialized in irrigation infrastructure are few and those involved in general civil engineering works are often involved in irrigation infrastructure development. Construction enterprises involved in irrigation infrastructure development range from small to large. The small are often located at provincial level, with limited capacity in terms of related construction equipment, qualified staff and often limited technical background based on practical experience. These enterprises have been involved with small scale irrigation schemes. The large enterprises are focused on large irrigation works which have been limited to two main large schemes in Southern region: the Baixo Limpopo and Chókwè irrigation schemes.

Many publicly funded irrigation schemes are small scale schemes, often dispersed in rural areas and implemented within the scope of specific projects that depends on long negotiation processes between Government and DPs, including international financial institutions or banks; or through MINAG's annual investment funding for irrigation, which has been limited. Interviewed key informants in large civil engineering construction companies suggested that until recently, irrigation has not necessarily been an attractive business that can justify developmental investments by private enterprises aimed to secure permanent expertise, equipment and knowhow due to unpredictable demand over time. Many construction enterprises that gain public tenders for establishing new, or to rehabilitate, small scale irrigation schemes are small scale enterprises located at provincial level.

Public extension started to collaborate with public irrigation services mainly in the late 1990s, principally through specific projects (Gêmo, 2001; Bohor, 2006; FAO, 2010) but in limited rural areas and interventions like, for example, selected irrigated areas of:

- Matutuíne and Boane districts in Maputo province and some peri-urban areas of Maputo city
- Chókwè Irrigation Scheme and Xai-Xai Valley Irrigation Scheme and some rural irrigated areas of Chibuto district in Gaza province
- Morrumbene, Massinga and Panda districts in Inhambane province; in the southern region of the country.

In the central region, extension also intervenes in some irrigated land as is the case, for example:

- Peri-urban areas in Beira City and some rural areas of Dondo, Nhamatanda and Gorongosa districts in Sofala province
- Rural areas of Nicoadala, Namacurra and Maganja da Costa districts in Zambezia province
- Parts of Manica and Sussundenga districts in Manica province.

In the northern region, there are also some public extension interventions, though to a lesser degree, in areas of irrigated land.

In general, the collaboration between public extension and irrigation is still weak. Public extension became unified in the 1998-1999 agricultural season to comprise crop production (mainly annual food crops), livestock (mainly chicken, goats and fish farming), agro-forestry activities (related to smallholders), thus excluding irrigation. In summary, Public extension has been working with smallholders in some wetlands in the districts where it has been operating since its establishment in 1987 (Gêmo, 2001). However, as above mentioned, the formal collaboration between public extension and public irrigation services started mainly in the late 1990S, particularly with the implementation of FAO's Special Programmes for Food Security (SPFS) (MADER/ DNER, 2000; FAO, 2010). DNEA also collaborated with Government/Italy funded irrigation investments as the Integrated Agriculture Development

Project (PIDA) (Bohor, 2006) and with Government/AfDB irrigation project, namely the Integrated Agriculture Development Project and the *Baixo Limpopo* Irrigation Scheme Rehabilitation Project, as part of the Massingir Dam Rehabilitation Project, particularly since 2004-2005 agriculture season.

The research contribution to irrigation was also been limited over the 1999-2010 period. As mentioned above, the IIAM structural organization comprises the DTA within the technical directorate of Agronomy and Natural Resources. However, the role of IIAM in pursuing consistent and useful irrigation research throughout the country, particularly with regard to socio-economic studies, has been modest.

The role of public degree education (and research) in 1999-2010, particularly civil engineering and agronomy, was important in terms of providing knowledge to the graduates on water management related disciplines. The Faculty of Agronomy of the University Eduardo Mondlane (UEM), since the cancelation of the rural development course in 2001, did not introduce a new option at BSC level with emphasis on agriculture hydraulics, agro-hydrology and irrigation and drainage, as was the case with the former Agronomy BSc course/ Rural Engineering option. However, the Production and Plant Protection BSc course that has been offered comprises some semester courses on agro-hydrology and hydraulics. In 2011 the same Faculty introduced an MSc course on soil and water management. However, the course was postponed to the 2012 academic year due to a limited number of candidates in 2011. The Faculty of Engineering of UEM BSc Civil Engineering course continued offering modules on water resources and water management knowledge fields like hydraulics and agro-hydrology. In 2010 the Faculty of Engineering introduced the first MSc course on water resources management to be completed in one year plus the mini-dissertation. The first group of students comprised 25 candidates. In November 2011 the same Faculty announced the second MSc course on “hydraulics and water resources” for the year 2012, with 25 vacancies (Notícias, 2011).

The water users associations and informal farmers’ groups are still few, dispersed across the country and at an early stage of development. Many of these emerging organizations rely on public extension and NGOs institutional support. This occurs especially through specific projects aimed at improving household food security on irrigated land (small scale schemes) or to mitigate the effects of persistent droughts in the country by working in wetlands with some sort of water management for crop production. Chókwè Irrigation Scheme has some

data on water associations while the former Small Scale Irrigation Project (SSIP) had addressed efforts in monitoring and recording similar data then across its selected areas of intervention until 2010. Some medium scale irrigation schemes such as in Nante rural area, Maganja da Costa district (which has consistent support from extension), have some organized records on membership and production (of rice in this case). However, in general, monitoring and studying the emerging water user associations at provincial, regional and national is still a challenge.

5.3.4 MINAG interventions in rehabilitating and expanding irrigated land

As indicated above, DNHA was responsible for the implementation of MINAG's irrigation activities between 1995 and 2005 and this responsibility falls under DNSA, through its Irrigation Department between 2006 up to early 2012. Decision-making on annual irrigation priorities and resource allocation at provincial level (DPAs) has been decentralized since 2001-2002, as one of the goals of PROAGRI for all the eight program components. The Provincial Nuclei of Agriculture Hydraulics have, as their primary task, to help the Provincial Directorates of Agriculture identify irrigation investment priorities. At the DPAs without irrigation nuclei, such responsibility rests with the Provincial Agriculture Services (SPA, from *Serviços Provinciais de Agricultura*). Some consultation with the central level still occurs, particularly with regard to investments supported through projects based at the central level.

In particular, since the 2001-2002 agricultural season many of the ten DPAs started to import or to buy locally adapted treadle pumps. From 2001-2002 to 2005-2006 agriculture seasons at least 2500 treadle pumps were supplied to Provincial Directorates of Agriculture (MADER/ DE, 2003; 2004; MINAG/DE, 2005; 2006). Treadle pumps were acquired from national suppliers (importing prototypes and adapting locally) but also from traders importing final products. Sofala, Zambezia and Manica are the three provinces that have invested more than others in this type of technology, and PROAGRI I was the major source of funding. Despite the strong enthusiasm of the Provincial Agriculture Directorates in acquiring and distributing these pumps, evidence-based studies on outcomes and impacts of treadle pumps on, for example, production, income or improvement of beneficiary households' food security, are scarce, if any. Rural primary and some secondary schools, farmers' associations or group of farmers in selected areas, and innovative smallholders have been the beneficiaries. Interviews with key informants revealed that:

- In areas with easy access to water, treadle pumps were useful in increasing food production and, in some cases, household income, especially with respect to vegetables, and

- Most of the pumps were too stiff to operate, and many had worn out (one or two farming seasons) as the beneficiaries faced problems in obtaining spare parts.

An evaluation of FAO's emergency irrigation projects using treadle pumps revealed that there was a general technical deficiency to furnish technical specifications that would provide efficient and durable equipment and that the specifications were determined by what was available on the market (Dzvurumi, Undated).

In addition to treadle pumps, MINAG has also been pursuing the expansion of irrigated land through the establishment of small scale schemes, particularly in the southern and central regions. However, the annual rates of new or rehabilitated irrigated land have been somehow limited, particularly when compared with expected southern Africa regional targets of doubling irrigated land from 3.5% to 7% of total potential irrigable land at country level by 2015 (SADC/RISDP, 2006). In fact, Mozambique has never exceeded 4% of irrigated land as a proportion of total irrigable land. Therefore, the accomplishment of the SADC/RISDP target seems to be extremely difficult for the country that presently has approximately 2.5% of land equipped for irrigation under use (MINAG, 2010a; MINAG/ DNSA, 2011d; MINAG, 2012).

Irrigation expansion is crucial towards sustainable agriculture, especially in vast rural areas of the south and central regions of Mozambique with higher vulnerability to harvest losses due to scarce or erratic rains but, at the same time, with some areas suitable for supplementary irrigation. However, in long term, expansion of irrigation only contributes to sustainable agriculture if implemented in a productive and sustainable manner (technical, socio-economic and environmental issues). Figure 5.5 shows the annual progress in new or rehabilitated irrigated land throughout the country.

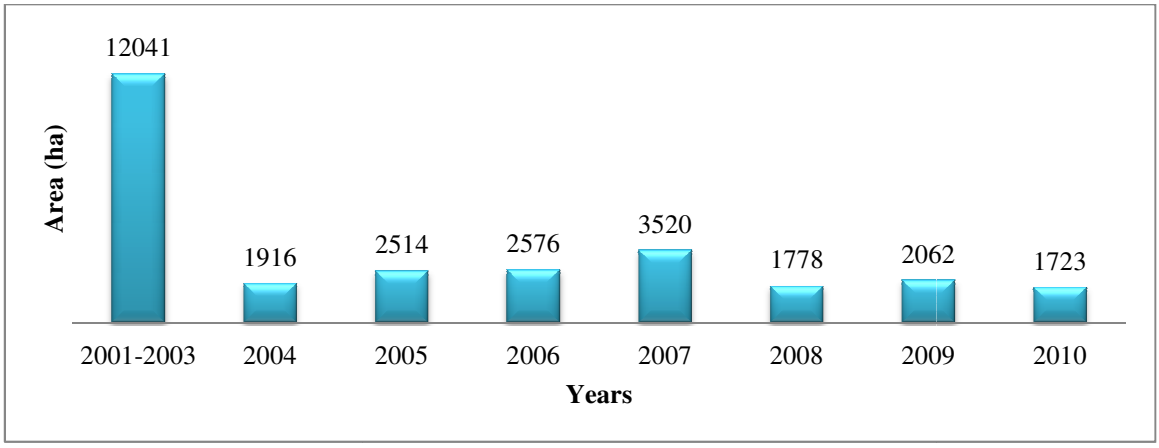


Figure 5.5: New annual irrigated land (ha) per year through public investment, Mozambique.
Source: MINAG/ DNSA (2011d).

From 2001 to 2010, the 2001-2003 period recorded what seems to be the best performance in terms of the annual expansion of irrigated land with an annual arithmetic average of 4,000 ha. The years 2006 and 2007, with respectively 2,576 and 3,520 ha represented the major annual achievements in expanding irrigated land. The 2004-2005 and 2006-2007 periods represented the major year to year growth in increasing irrigated land in the country through MINAG channelled resources. This was due to completion of several irrigation schemes in 2005 and 2007 that had been delayed. The PROAGRI I implementation (1999-2004/06), the MINAG/ AfDB Small Scale Irrigation Project (2002-2010), the MINAG/ Italy Integrated Agriculture Development Project (PIDA) (2004-2007) and the rehabilitation of *Baixo Limpopo* Irrigation Scheme (particularly between 2005 and 2009), had a significant contribution in increasing irrigated land.

Some of the new areas of irrigated land have not been fully used and this is a challenge that needs to be addressed in future within the scope of the Irrigation Strategy (MINAG, 2010a; MF/ IGF, 2010, from *Inspecção Geral de Finanças*). In addition, some of the medium size irrigation schemes established or rehabilitated in the late 1970s and 1980s have not being used fully, as is the case in Sabié-Incomati. In some cases, the infrastructure is virtually obsolete, such as in Nguri irrigation scheme in Cabo-Delgado province. Even in the Chòkwé irrigation system, less than 35% of its total area (25,000 ha) has been used in the last 10 years.

In 2010, MINAG estimated the effective use of new and rehabilitated irrigated land at 60% while the total area under use was estimated at 61,407 ha (MINAG, 2010a). However, a recent study commissioned by the Government (MF/IGF, 2010) revealed that effective use of land equipped for irrigation can be lower than 60%, suggesting that merely 40% is being used.

But, this estimate is also based on sampled rapid field visits across the country. Clearly, as the last was conducted ten years ago there is a need to conduct a comprehensive field inventory on the effective use of irrigated land as a basis for more accurate and updated data.

A particular problem related to the effective use of land equipped for irrigation is the huge variation in land sizes under use by the various water users, particularly in medium and large scale irrigation schemes. This problem is important because it brings to the fore technical and managerial issues related to water distribution and use in the schemes. Chòkwé irrigation scheme may be the extreme example with smallholder farmers "holding" areas ranging from one to five ha, and commercial farmers holding dozens or even some hundreds of ha, particularly for rice and vegetable production. Depending on the crops grown (e. g. crop value and related production costs, duration of crop vegetative cycles and rotation implications), small plots of land constrain sustainable generation of income. Crops grown on irrigated land are sometimes of relatively low value (e.g. sweet potatoes and maize), and combined with the prevailing low productivity and market access constraints this means that small areas on irrigated land (<1 ha) generate limited income.

Due to social and political considerations it is difficult for the Government to address the issue of land (re)distribution in publicly funded and managed irrigation schemes. A more effective use of small areas (less than one ha) by many smallholders is a particular challenge for the public services involved in supporting irrigation. In summary, ensuring effective use of existing (and new) irrigated areas for irrigated production has been a major challenge for the irrigation public services, and related services such as extension. In general, there is a need for improved performance of irrigation carried out at any and all scales and hence improved production per unit of area (ha). Strengthening dissemination and use of good agriculture (irrigation) practices in irrigated land is of paramount importance.

5.4 2011-2013: The Turning Point towards Accelerated Expansion and Improved Use of Irrigated Land?

The agricultural sector in general has been on top of the Government's agenda, and the political support for this sector appears to be strong at the moment. Within the scope of the Green Revolution Strategy (MINAG/GRS, 2007a) and of the Action Plan for Food Production (MINAG/PAPA, 2008), the Government has been emphasizing the key role of irrigation for the success of both GRS and PAPA. In 2010, the Government, through the

Council of Ministers, approved the Irrigation Strategy for the 2011-2020 period and, as mentioned above, launched the CAADP process which comprises land and water management as one of the four implementation pillars. Thus, if the CAADP framework is to be consistently implemented, the role of irrigation is likely to be more emphasized in the future, particularly through reinforced public investment and also through the mobilization of private funding sources.

In preparing the implementation of the Irrigation Strategy, two key activities must be accomplished prior to the implementation of the strategy, namely:

- The establishment of reinforced irrigation public services by 2012, and
- The design and approval of a detailed national irrigation (development) program for the next 10 years, by 2012.

In 2011, MINAG/DNSA (through the then Department of Irrigation) initiated actions towards the accomplishment of both activities. Relevant documentation related to the proposal of the "new" irrigation public services were prepared and discussed, particularly at MINAG. As mentioned, the new public irrigation institution (INIR) was approved by the Council of Ministers in May2012, although the establishment and operationalization will take some time.

Public tenders for the selection of an enterprise or organization that will be responsible for designing the expected national irrigation (development) program (NIP) were launched by mid-2011. However, due to various institutional and procurement related reasons, the process was interrupted and only resumed in second semester of 2012. This means that the NIP will be hopefully designed and approved in 2013. Thus, despite the delay in developing the NIP, if these two key activities are to be fully accomplished by 2013, then the years 2011-2013 can mark a turning point towards a new stage for irrigation development, which is likely to be characterized by improved irrigation public services, increased public investments, accelerated expansion of land equipped for irrigation as well as increased irrigated food production, and major interaction among key stakeholders.

Of paramount importance will be to ensure the capacity to operationalize the INIR as well as to implement the NIP. One of the key challenges in operationalizing the INIR and in implementing the NIP on a consistent manner is the Government's ability to mobilize resources. The next five to ten years will reveal the extent to which the political intentions to

expand irrigated land and to boost irrigated crop production as a contribution for food security will be materialized.

The Irrigation Strategy (MINAG, 2010a) intends to be the framework for establishing shared principles, goals, priorities and targets among key stakeholders. It should also be a basis for developing important synergies and platforms for knowledge development and sharing towards evidence-based debate on how to strengthen irrigation's role in the country's crop production and food security. With an estimated budget of USD 600 million, this is the first comprehensive Strategy in the country in the last 20 years.

Ongoing and future investments are of paramount importance to expanding irrigated land as well as to developing human and social capital in the irrigation subsector. For example, the on-going Government and World Bank investment program on irrigation (PROIRRI)(formally launched in December 2011 with an estimated budget of USD 70 million) is an important contribution to expanding irrigated land and boosting the role of key stakeholders in the subsector through their effective participation in the program. It is planned to operate in selected rural areas of Manica, Sofala and Zambezia provinces over the next eight years. The Japanese International Cooperation Agency (JICA) may contribute with an additional amount of approximately USD 15 million for the implementation of PROIRRI.

Although in a limited manner, new private investments are starting to emerge, from small to large scale irrigation schemes. For example, the Matutuíne District rice investment project (Lap-Ubuntu) in Maputo province is expected to progressively operate in a maximum land area of about 5,000 ha mainly for rice production, including the processing infrastructure (Mozambique's Information Agency, 2011c; Coalition for African Rice Development (CARD), Undated). A few private small scale irrigation schemes are also emerging for sugarcane production, as the sugar out-growers in Xinavane Sugarcane Company, which is part of the Tongaat Hulett investments (Jelsma *et al*., 2010). In Baixo Limpopo large Irrigation Scheme (Gaza province), a Chinese private investment might reach approximately 8,000 ha of new land equipped for irrigation, mainly for rice in the next two years with the possibility to expand significantly in the next five years. In Mopeia district (Zambézia province), Singapore private investment are expected to state soon for irrigated rice production in an available area of approximately 9,000 ha (Valá, R., Senior Agronomist, National Director for Agriculture Services, personal communication, September 2012). Therefore, if all favourable signals that are now emerging really materialize in the near future,

and the sustainability issues are adequately addressed, then 2011-2013 can become a turning-point towards an enhanced irrigation subsector.

Unfortunately there have been examples of large private investments, through foreign direct investments, that did not perform as expected in terms of planned investments. A substantial part of private investment initiatives in irrigation has been through foreign direct investment and this comprises some uncertainties in terms of their continuation over time. For example, one large private investment project called PROCANA that was expected to be implemented through foreign direct investment for irrigated sugarcane in Massingir district (Gaza province) in approximately 30,000 ha, was cancelled in 2010 by the Government after two years following the authorization of PROCANA implementation. The cancelation was arguably related to limited PROCANA progress implementation based on scheduled activities (Suárez *et al*., 2010). Currently the same area is allocated to a new Joint Venture composed by South-Africans and Mozambican's investors (Massingir Agro-Industrial), for the same purposes, i.e., irrigated sugar cane production (Hanlon, 2012).

In summary, having 2011-2013 as turning point will depend on the ability of the Government and private sector to expand irrigated land and to ensure its effective use. This is also related to how input and output markets and access to credit will be improved in the future, especially aimed at sustaining irrigation investments by increasing the productivity and profitability of irrigated production (MINAG, 2010a).

CHAPTER 6: DISCUSSION

The discussion in this chapter attempts to answer the overarching study question, namely: what factors affect the effectiveness of irrigation policies in contributing to the expansion and effective use of irrigated land in order to enhance irrigated agriculture's contribution to food production and food security in Mozambique? The discussion is organized along seven research sub-questions which were investigated to answer this overarching research question and includes:

- To what extent have the policies led to an expansion in irrigated food production?
- To what extent have public resource mobilization approaches led to an expansion in irrigated food productivity?
- What has been the role of public irrigation services towards the expansion of irrigated food production?
- What role has Government played in enabling the private sector to contribute to irrigated production?
- What has been the role of water users and water associations in irrigated food production?

6.1 To what extent have the policies led to an expansion in irrigated food production?

Pragmatic and conducive policies and regulations are important to developing irrigation. The main steps, achievements and constrains with regard to the adopted policies are summarized below.

6.1.1 The impressive post-independence accomplishments in irrigation expansion and subsequent reversal

After independence, the Government invested substantially in irrigation mainly through state farms, agro-industrial complexes and irrigation development projects, including the construction or rehabilitation of dams to also provide water for irrigation, like in the case of

the *Pequenos Libombos* Dam, which was built in the early 1980s as well as the attempt to build *Chipembe* dam in Cabo-Delgado province. The Chipembe Dam was built under North Korean technical support between late 1970s and early 1980s but its construction was never finished, in part due to the war that affected the country since the late 1970s until 1992. This was a period when the Government attempted to provide comprehensive support for irrigation through relevant parastatals meant to provide irrigation related services. The linkages with markets were also assured to a certain degree by a network of state and some private agro-processing industries such as the large rice processing facilities at Chókwè's Irrigation Scheme and in Manhiça district, Palmeiras Administrative Post, belonging to Inácio de Sousa Enterprise. Parastatals were also involved in provision of input supply (import and distribution) and many of the state farms had access to credit for investment and recurrent expenses through a Government owned bank, the then *Banco Popular de Desenvolvimento*. It is important to note that most state farms had their own means of transport to support input and output flows.

Evidence shows that irrigation was one of the key pillars within the entire production and marketing system of the state farms and agro-industrial complexes with irrigation infrastructure. This fact was evidenced by the existence of about 120,000 ha of land equipped for irrigation in the early 1980s, probably with the highest levels of use of irrigated land at post-independence time until presently, which had occurred at the most active phase for state farms and agro-industrial complexes. The policy of prioritizing public irrigation schemes within the agriculture public investment, under comprehensive support, was maintained by the Government until the early 1980s. However, by the mid-1980s almost all state farms had collapsed and, consequently, public support to the irrigation subsector substantially declined.

The collapse of state farms and agro-industrial complexes had direct consequences on the use and maintenance of irrigated land. Of policy interest is, if the Government directed almost the entire public agricultural budget to the state farms (and parastatals providing supportive services) from the late 1970s to the early 1980s, what determined their collapse by the mid-1980s? Interviews with key informants and existing literature (Caballero, 1990; Valá, 2006) underscored the contribution of the following issues to the collapse of state farms:

- Weak technical and managerial capacity on many state farms, which were unable to ensure an efficient and sustainable irrigated production. Efficiency is related to productivity in irrigated land, including water productivity, while

sustainability refers to operations and maintenance costs, in particular those resulting from poor water and soil management.

- Widespread insecurity in rural areas, which affected the performance of state farms in general and irrigation in particular, especially during the late 1980s

- The profitability of state farms was not necessarily a determining factor in annual production planning decisions. This contributed to financial unsustainability of most of state farms, thereby reducing the ability to maintain general farming operations, including irrigation (maintenance and operations). For example, an assessment conducted by MINAG in 1986 to assess the financial situation of state farms estimated at USD 200 million the bank loans not paid by the state farms (Caballero, 1990)

- Underutilization of some of the irrigated land for various reasons, including the excessive size of some of the schemes in relation to the operational capacity of the state farms and cooperatives that were using such schemes

- Inadequate maintenance in some of the medium to large irrigation scheme infrastructure, and

- Irrigated land degradation, particularly soil salinity in some schemes, including some areas of Chókwè Irrigation Scheme.

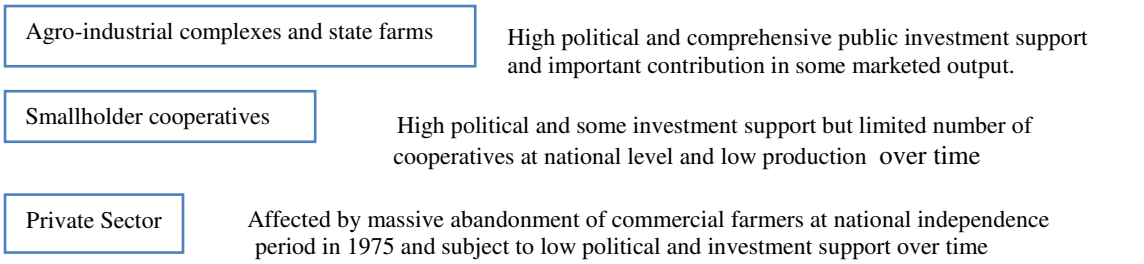
Given the above-mentioned problems, the prevailing policy of prioritizing public irrigation through state farms could hardly be a successful option in the long run. The lack of a critical mass of qualified human capital in the irrigation subsector, coupled with overall management limitations at the state farms, and the influence of macroeconomic policies (central planning and control of price and marketing systems) and the political situation that was characterized by ever-increasing insecurity in rural areas, contributed decisively to the collapse of the state farms and, by consequence, a substantial reduction in the use of irrigation schemes then under the state farms and agro-industrial complexes.

In summary, the Government was able to expand irrigated land within the state farms, but the odds of failure of state farms were extremely high, as was later evident in their collapse by the mid-1980s. In order to highlight the main policy developments from 1975 to 1985, Box

6.1 outlines Government support options provided to the three different actors in the irrigation subsector over this period.

Box 6.1: Government support to the three different irrigation actors from 1975 to 1985, Mozambique

Government support to the three category of stakeholders :



Source: The author, based on study findings.

As mentioned earlier, both smallholder cooperatives and the private sector had little influence on the overall irrigated landscape. Despite the political and investment support provided to smallholder cooperatives, they did not perform well and had very few members, affecting the proportion of irrigated land in actual use and productivity levels (Caballero, 1990). Under these circumstances, it would be very difficult especially to smallholders' cooperatives to make a meaningful impact on the overall irrigation subsector. Conversely, and despite the Government's limited support provided to the few private sector actors, the private sector played an important role in some irrigated rural areas. For example, some private commercial farmers in the Chókwè Irrigation Scheme contributed significantly to vegetable production during the first half of the 1980s (particularly in 1983-1985), at a time when the country in general, and particularly the urban food markets of southern Mozambique, (including the capital city Maputo), were severely affected by devastating food shortages. Private commercial farmers contributed by supplying mainly cabbages, tomato and onions, which were some of the few fresh products that could be found in the markets at the time.

6.1.2 Privatization of state farms and subsequent discontinuation of integrated support for irrigation

The adoption of a liberalized economy in the second half of the 1980s resulted in the privatization of state farms, including the agro-industrial complexes. In practical terms, this stage marked the discontinuation of the Government policy of ensuring integrated or

comprehensive support to the irrigation subsector through state farms and a number of related parastatals. From the late 1980s to the late 1990s, the country did not have a clear policy to promote and expand irrigation, making this perhaps the weakest period for the irrigation subsector since Mozambique's independence in 1975.

It should be noted that between 1993 and 1998 the country was engaged in emergency activities, especially those aimed at revitalizing agriculture and rural life, at a time when thousands of displaced rural people and refugees were returning to their places of origin following the 1992 Peace Agreement. Therefore, although some irrigation development projects were still operational (for example, Chindginguire Irrigation Project in Inhambane Province) and some United Nations agencies were also investing in small scale irrigation schemes as United Nations International Children Emergency Fund (UNICEF) did in Inhambane Province (Panda and Massinga districts) and in Zambezia Province (Namacurra district), such investments were not necessarily part of a comprehensive support framework.

Isolated investments without key support services such as field technical assistance, financial support, mechanization, and links to input and output markets are prone to failure. The Chókwè Irrigation Scheme has probably been the only case where integrated support has been maintained over time, but often without the needed commitment from different stakeholders to fulfil their roles and responsibilities throughout the agricultural seasons.

One remarkable Government policy action over this period was its decision to attract foreign investors to invest in the irrigation subsector, especially in irrigated sugarcane production, an industry that had been beset with low use of irrigated land and low productivity.

6.1.3 Renewed interest in irrigation public policy in the late 1990s with spells of discontinuation until 2010

It was only in the late 1990s that irrigation policy issues started to be substantially discussed at MINAG within the scope of PROAGRI I preparation process (1996-1998). Indeed, it was in 2000 that MINAG started to look into the formulation of an irrigation development policy, a process that was over time discontinued until it moved into its final preparation stages and approval in December 2010. Some literature mentions the existence of the 2002 national irrigation policy. However, this document, although discussed at the then Ministry of Agriculture and Rural Development (MADER), was not officially approved by Government.

Since 2000, small scale irrigation schemes have been a priority investment option, particularly through PROAGRI I and PROAGRI II funding. But, as referred to above, public investments in new small scale irrigation schemes have not been realized within the framework of a comprehensive support strategy that would contribute to irrigation sustainability.

It should be noted that the MINAG/AfDB's projects have tried to pursue an integrated support to irrigation, especially in the *Baixo Limpopo* and in Macuvolane Irrigation (the last funded under the Small Scale Irrigation Project) schemes, in Gaza and Maputo provinces respectively. But, these initiatives were implemented under strong project management support, including resource provision to operationalize commercial agreements aimed at boosting water users' access to input and output markets. However, in general, public investments in small and medium scale irrigation schemes have in essence been confined to the mere establishment of the schemes, i.e. without necessarily taking into account the crucial role of complementary services such as input supply and output commercialization.

Despite the priority attached to small scale irrigation, the Government has also made limited effort to support medium to large scale irrigation schemes. Chókwè and *Baixo Limpopo* Irrigation Schemes constitute two examples of Government support for large schemes.

6.1.4 Irrigation costs and regulation issues

High irrigation costs can hamper the efforts to expand irrigated land in a sustainable manner. In Mozambique, the low emphasis on pursuing pragmatic policies aimed to reduce costs (infrastructure development and operations costs) has been critical. For example, electricity costs for pumping have been referred as being very high by emerging commercial farmers through Confederation of Economic Associations (CTA, from *Confederação das Associações Económicas*) and by smallholder farmers through the Peasants National Union (UNAC, from *União Nacional de Camponeses*) (MINAG/DE, 2007). In February 2010 that the Government decided to reduce water pumping costs "in order to promote the use of power for irrigation and contribute to the competitiveness of agricultural outputs". Electricity irrigation-related costs for pumping under "medium tension electricity" (*electricidade em média tensão*) are now expected to drop by 10% per Kilowatt per hour. This is to benefit especially water users involved in food production within the scope of implementation of the Green Revolution Strategy approved in 2008 (Government, 2010). The challenge will be to actually implement

this decision. If effectively implemented will contribute to sustainable irrigation in economic terms but also potentially in environmental terms if, in the future, irrigation expands substantially and new commercial irrigators use electricity rather than fuel for pumping water for irrigation.

Regulation can also influence the distribution patterns, performance and sustainability of irrigated land. Land access and use in most of the public irrigation schemes have not necessarily been based on technical and economic criteria. As mentioned above, while before independence irrigation was principally for settlers and other commercial farmers, after independence access to irrigated land was also expanded to smallholders, although with priority to state farms and agro-industrial complexes until the first half of the 1980s. The collapse of state farms contributed to wider smallholders' access to irrigated and equipped land, which had been previously occupied by state farms as was the case, for example, in the Chókwè Irrigation Scheme.

Smallholder farmers' access to irrigated land seems to be a politically and socially delicate issue. But, the current weak or even outright absence of technical and economic criteria to guide access to and use of irrigated land influences the level of investment, productivity and long term sustainability of farming on irrigated land (Marques *et al*., 2006) in part due to high variability of individual land sizes, different patterns of farming, heterogenic farmers' knowledge and skills in water management, different levels and frequency of access to water, etc. For example, inequality in water access in the same schemes can occur between canal upstream and downstream users, and also between influential farmers and other farmers (Sun, 2000).

6.1.5 The current situation and influential factors that have affected adopted policies

The current situation is still far from the relatively vibrant irrigation subsector of the late 1970s and early 1980s with regard to the post-independence period. Figure 6.1 shows progress on operational equipped land for irrigation from 1968 to 2009.

Even with the contribution from the private sector, especially through Foreign Direct Investment, total irrigated land with operational infrastructure was estimated in 2009 at 61,407 ha (MINAG, 2010a), which was substantially far from that reached before independence (about 100,000 ha in 1973) and even in relation to the level registered in 1968

(65,000 ha of conventional irrigation). However, there is a need to consider that sugarcane irrigation has been slightly increasing and such information may not necessarily taken into account by MINAG/DNSA, as discussed below. For example, while sugar cane area is estimated at 35,000 ha (MINAG, 2010a; MINAG, 2012), other sources suggest that such area is currently close to 50,000 ha (USDA, 2012), although it is not clear if the whole area is under irrigation. In addition, publicly funded new schemes also expanded and the 2012 preliminary figures reveal a total irrigated land of 64, 244 ha at national level (MINAG, 2012).

The early 1980s experienced the highest expansion of land equipped for irrigation since national independence in 1975 up to the present (FAO, 2005). However, it is not clear to what extent such capacity was effectively used and for how long.

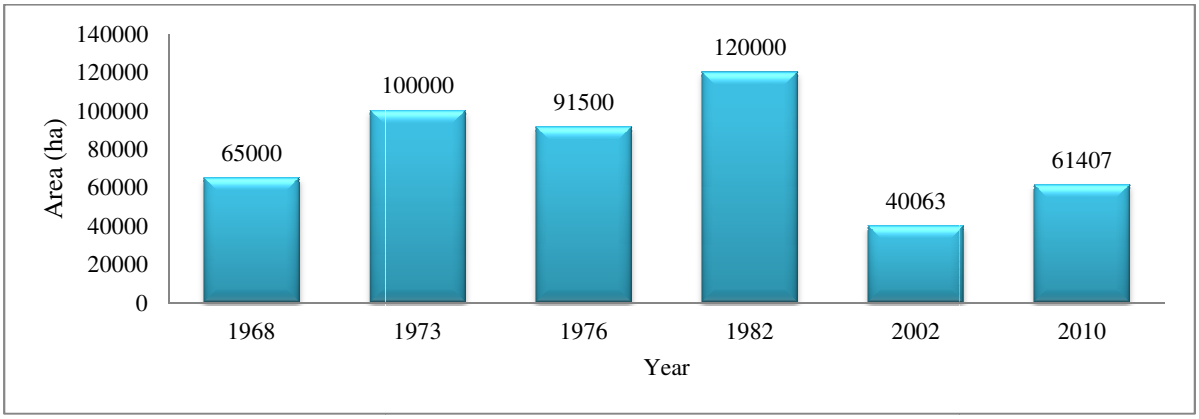


Figure 6.1: Total equipped and operational irrigated land from the year 1968 to 2009 (ha), Mozambique.
Sources: Ataíde *et al*. (1976); FAO (2005); MADER (2003); MINAG (2010a).

Although increasingly important in some peri-urban and rural areas with regard to emerging commercially grown crops such as banana, Irish potato and tomato, the actual contribution of irrigated production to the national output has not been properly assessed over time and, consequently, is not known. Moniting and evaluating irrigated prduction in the country seems to be one of important actions that must be pursued in the future in order to assess the contribution of irrigated production to total agricutural production.

However, some of the provinces have recently started to collect data on irrigated production as, for example, the Maputo province (Figure 6.2).

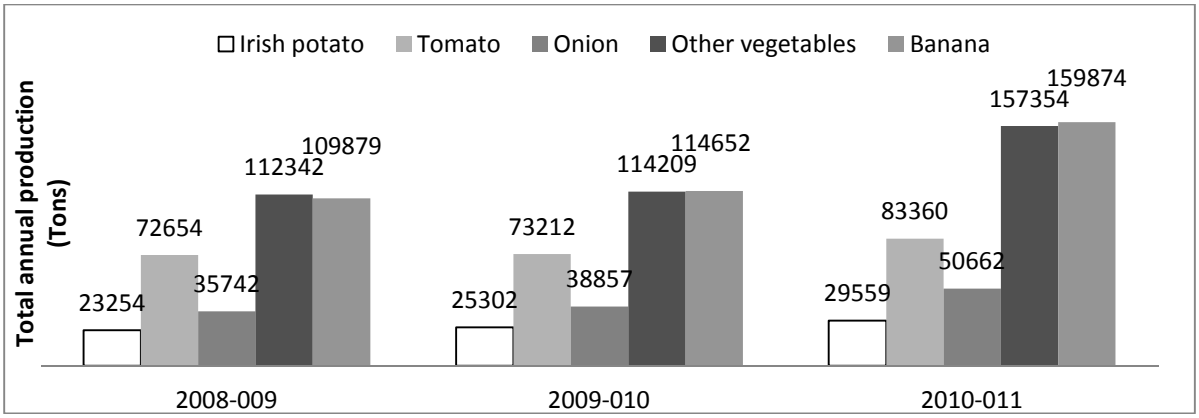


Figure 6.2: Total irrigated production in Maputo province, Mozambique.
Source: MINAG/ Maputo Provincial Directorate of Agriculture (2011e).

The above figures are collected through the Provincial Services of Agriculture (SPA) at Provincial Directorate of Agriculture (DPA). Key informants at DPA Maputo affirmed that tracking irrigated data is an important effort in monitoring the contribution of irrigated production to total agricultural production. However, data collection methods and procedures are challenging in terms of ensuring their validation at district and provincial levels, thus subject to some questions on their accuracy. For example, production estimates at district level are done through field measurements of production in parcels of seven by seven meters ($49m^2$) on selected farms per crop. The number of parcels in each sampled farm can vary according to the size of the farm. The average yield per crop in each district is estimated based on the yields obtained in the $49m^2$ measurement parcels. Field measurements of production are conducted by extension workers in collaboration with SPA staff members on a random manner comprising different producers (and farms) per crop at district level.

However, it is not clear how the size of samples related to each crop (or group of crops such as "other vegetables") is defined. The extension and Provincial Services of Agriculture staff often faces logistical constraints (transport means and per diems) to conduct production field measurements in various districts. In these cases, measurements can only be conducted on farms close to district capitals, which may not represent the reality in each district. In addition, data collected in each district does not pass through a validation process either at district or at provincial level. In summary, the way in which data is collected suggests that the above figures may be unreliable. Key informants in Maputo suggested that, in general, annual production estimates per crop tend to be overestimated.

Inhambane is another province which has been tracking some data on irrigated production, as shown in Figure 6.3.

Many concerns over how data is collected and used in the Maputo province are also relevant in the case of Inhambane province, which in terms of geographical size is much bigger than Maputo, requiring major efforts on data collection at field level, particularly in ensuring quality control on collected data. In the case of Inhambane, some irrigated production data are provided by local associations in charge of some small scale irrigation schemes based on sales.

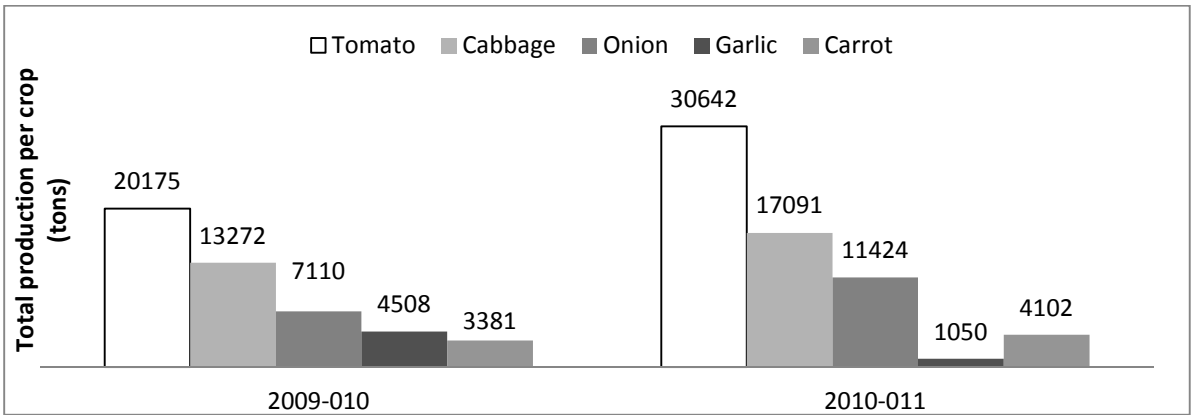


Figure 6.3: Estimated irrigated production in Inhambane Province, Mozambique.
Source: MINAG/ Inhambane Provincial Directorate of Agriculture (2011f)
Notes: Fresh weight of onion and garlic.

In both provinces, irrigated horticultural production comprises both private commercial farmers, mainly emerging farmers and operating in small areas (with a maximum of five ha), as well as smallholder farmers with areas less than one ha. Apart from the regional irrigation projects managed at central level, irrigated production, particularly in two provinces, and others in South and Central regions has been promoted within the scope of local-based initiatives aimed at contributing to household food security and income generation.

In addition to existing data in some provinces, some data are available for large irrigation schemes. For example, figures from the Chókwè Irrigation Scheme comprises production of rice, the main cereal grown within the scheme, and horticultural crops such as tomatoesand onions, with the involvement of the private sector and thousands of smallholder farmers (Figure 6.4).

Rice production in Chókwè Irrigation Scheme had dropped significantly from the 80,000 tons of paddy rice in the 1974-1975 agricultural season to 40,000 tons in 1979-1980. This could be attributed to, for example, decreasing irrigated land use due to degradation of some areas of the scheme as well as limited use of commercial fertilizer by smallholders farmers;

staganant yields in some cases due to, for example, late land preparation and seeding, rains at harvesting time, among other reasons.

Chókwè Irrigation Scheme production estimates are based on field estimations by extension staff and principally on harvested and sold production to the processors (as, for example, on rice) and to other markets, as Maputo Province for tomatoes. Recorded production comprises both commercial farms and smallholder farms. The private sector is particularly active on Chókwè Irrigation Scheme, especially in rice and horticultural production.

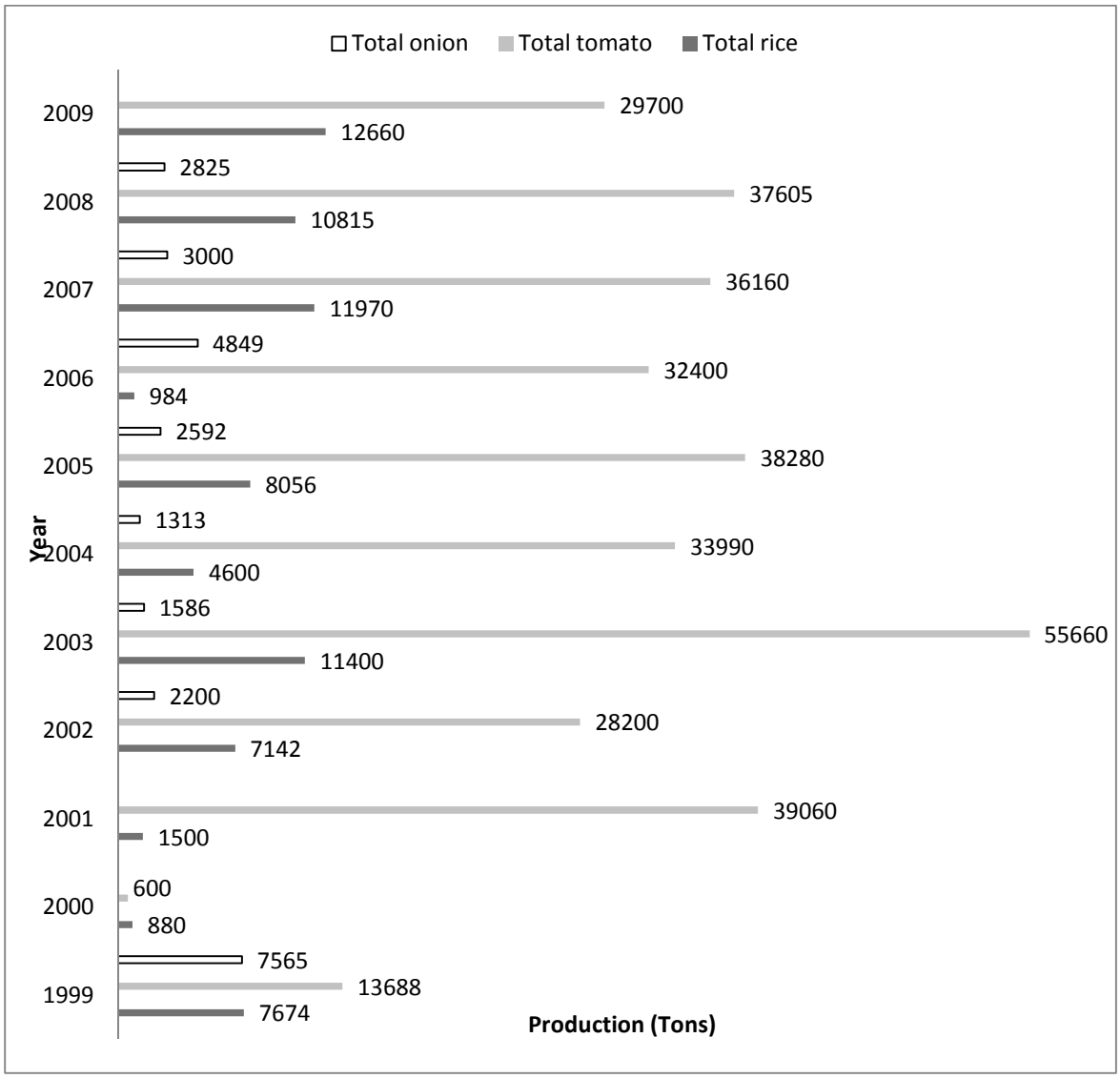


Figure 6.4: Chokwe irrigated production for selected crops (tons) from 1999 to 2009, Mozambique

Source: Chókwè District Services for Economic Activities (SDAE) (2010).

Notes: Total onion production refers to the production of fresh onions. Rice production refers to paddy rice.

It is worth noting that, in the case of rice production across the suitable areas in the country, almost all production is undertaken under rainfed conditions, with partial water management, mainly in low altitute wetlands with moderate to high rainfall levels (above 1000 mm per year). Figure 6.5 shows total rice production in the country from 2002 to 2008. Clearly, the contribution of conventional irrigation to rice production has been limited.

In summary, government policies have had a limited impact on expanding irrigated land and in terms of increasing the contribution of irrigated production to total production, particularly with respect to food crops. Some of the main constraints that have hampered irrigation development include the following three elements:

First, although prioritization of state farms and agro-industrial complexes led to an increase in irrigated area by more than 20,000 ha between the second half of the 1970s and the early 1980s, various internal (irrigation subsector) and external (overall agricultural sector) influential factors hampered such progress

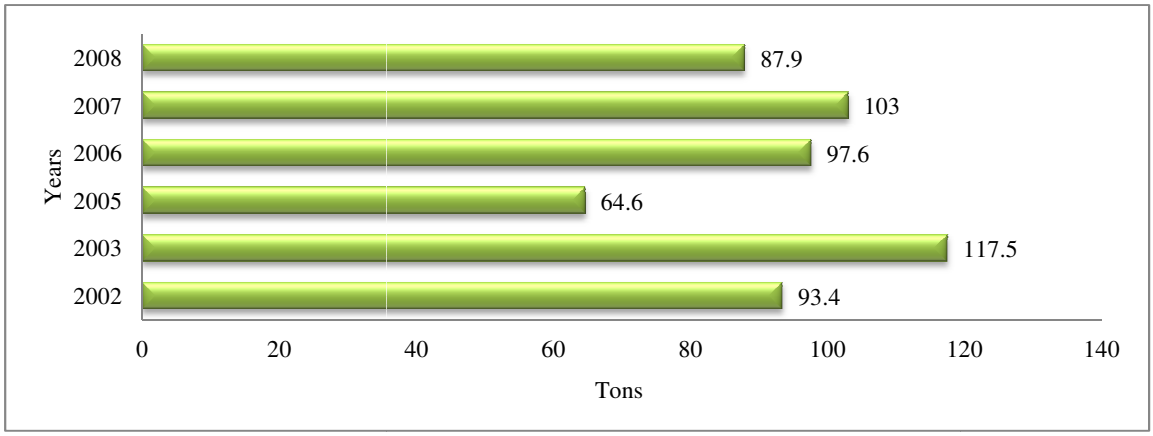


Figure 6.5: Total domestic rice production (milled rice, tons* 1000), Mozambique
Source: MADER /TIA (2002; 2003); MINAG/ TIA (2005-2008).
Note: On average, milled rice is estimated at 0.6 of paddy rice production.

Second, the political support rendered to smallholder farmers' cooperatives until the mid-1980s had a limited impact mainly because of their limited scale of intervention

Third, adopted public policies over time failed to contribute in a meaningful way to the irrigation subsector development through the private sector intervention. It should be recalled that shortly after independence there was a massive exodus of commercial farmers from the country. The lack of strong policy support to the private sector after independence further constrained the role that could possibly be played by these actors. By the mid-1980s private

sector participation was still negligible and confined to a few rural areas mainly in Gaza and Maputo provinces. The shift to economic liberalization in the second half of the 1980s alongside the political openness towards the private sector did not bring the immediate boom and development of the private sector operating in the irrigation subsector.

The end of the war in October 1992 opened new prospects for investment demand in rural areas, including in irrigation. But, by then the country was faced with a serious emergency situation with thousands of displaced rural people and refugees in neighbour countries such as Swaziland, Malawi and Zimbabwe (Barnes, Undated). In addition the country was also affected by a severe drought in 1991-1992 (Aragón *et al*., 1998). As the Government was involved in the provision of basic items (seeds and tools and some clothes) to smallholders returning to their rural origins, irrigation was not necessarily a priority issue. Despite the political openness towards the private sector since the middle of the 1980s, little progress has been made until recently to effectively strengthen the local private sector operating in the irrigation subsector. An exception has been the private Foreign Direct Investment in sugar cane, as discussed below.

6.2 To what extent have public resource mobilization approaches led to an expansion in irrigated food productivity?

Mozambique's poverty is closely linked to its dependence on rain-fed subsistence agriculture in the context of highly variable rainfall and frequent droughts and recurrent floods (World Bank, 2007b). Thus, increasing water management infrastructure especially for agriculture through evidence-based criteria seems to be of paramount importance. This sub-section discusses how public investment in the irrigation subsector has impacted the expansion of irrigated land and contributed to food security. It also discusses some issues related to the access and procedures for use of financial resources raised during interviews with key informants as well as issues related to the ineffective use of irrigated land.

6.2.1 Limited expansion due to limited public resources mobilization

Comprehensive (Government, private and NGOs), accurate and available information on resources used in the irrigation subsector over the last five to 10 years is scarce, and most probably unavailable in many cases. Field visits, interviews with key informants and direct observation on how irrigation projects have been implemented over time have enabled the

identification of some of the factors that seem to have hampered the comprehensive and updated tracking of irrigation investments, namely:

- Scattered development and implementation of irrigation schemes without an effective system for relevant investment data collection, compilation and analysis in the subsector (Government, private and NGOs, when applicable). This could be, for example, a role to be played by the irrigation public services, in collaboration with other key stakeholders (local private sector, foreign investors and relevant DP)

- Limited or lack of information sharing on irrigation expenditure among different irrigation projects and programs implementers throughout the country

- Limited disaggregation of spending data with respect to some agricultural multi-disciplinary programs, which included irrigation and related activities

- Delays in establishing and operating new schemes, all too often resulting in changes in the initial estimated unit costs over the two to three years it took to establish and operationalize some irrigation schemes, thus making it difficult to track, on an annual basis, the irrigation costs at provincial level (DPAs), for example

- Financial information has been, to a considerable extent, treated as internally managed information available only for some project implementers, who therefore were reluctant to share such information.

In the same token, total accurate public investment over the last five to 10 years in the irrigation subsector has been difficult to determine, at least from 2002 onwards (World Bank, 2011b; Chilonda *et al*., 2011). It is worth noting that the Government has been involved in the mobilization of public resources through six main modalities:

First, prioritization of irrigation when negotiating new investment portfolios with multi-lateral cooperating partners or international financial institutions such as the AfDB and, more recently, the World Bank (WB). This modality occurs at the central government level involving MINAG and other key ministries such as the Ministry of Planning and Development and the Ministry of Finance at different stages of negotiation, approval and implementation. Irrigation projects funded through this resources mobilization modality have been implemented by specific management and coordination teams, but in close relationship

with MINAG. Often, the implementation process is subjected to regular performance assessment by the funding agency, which also in many cases plays a role in defining some implementation principles, particularly with respect to transparency and spending issues.

Second, agreeing with bilateral DP at central level to prioritize, or to also include irrigation investments in their agricultural sector and rural development portfolios. The "PIDA" funded by Italy and implemented between 2004-2007 was an example of multi-disciplinary project, namely in areas of agricultural market development, support for extension, forestry inventory as well as substantial support for rehabilitation of some small scale irrigation schemes in selected districts where the project operated. MINAG's role in emphasizing irrigation as a priority within the agricultural sector and rural development DP's portfolios is crucial. Projects funded under this modality have also been implemented through specific management teams that collaborate directly with the Irrigation Department (and sometimes with public extension) within MINAG at the central level and with related Provincial agriculture services, at provincial level.

Third, central level negotiations with specific international banks or development agencies to rehabilitate specific irrigation schemes, as in the case of Chókwè Irrigation Scheme, since the late 1990s involving the OPEC Fund (OPEC, 1999), JICA (rehabilitation of the main water distribution canal), as well as the Islamic Development Bank (IDB) for the rehabilitation in the near future of about 7,000 ha.

Fourth, central level tripartite collaboration agreements involving MINAG, specific DPs and FAO to establish and operationalize small scale irrigation schemes as it happened between the late 1990s and 2002 within the scope of the implementation of the "Special Programs for Food Security" in selected districts of Maputo and Sofala provinces.

Fifth, provincial negotiations by Government by the Provincial Directorates of Agriculture with bilateral DP involved in agriculture and rural development at this level to also support irrigation. Projects under this modality have been limited in terms of size (ha) and amount of funds involved, and in some cases the Provincial Directorates of Agriculture took full responsibility for the implementation (design, development and operationalization), in collaboration with the DP concerned.

Sixth, political support to Government District Administrators in using "annual district investment funds"[2] to boost food production, which may include investments in small scale irrigation schemes in rural areas.

Despite all the above modalities for mobilizing public resources, the level of expansion of irrigated land achieved since 2003 has been limited. This suggests that annual public allocated resources may have been limited in terms of volume and consistency (Simone, 2009). As stated above, only three main cooperating partners, namely AfDB, the Italian Government and European Commission have been supporting irrigation directly, especially since 2000. Some other partners, notably the Irish Government and FAO, have been providing support to some local and small scale initiatives in selected districts. JICA and OPEC have provided substantial support, but targeted principally to Chókwè's large scale scheme. PROAGRI I (1999-2004/06) funding for irrigation was also limited (MINAG/ PROAGRI I, 2007b).

Recent achievements at national level in expanding irrigated land show limited progress even in provinces with high potential for surface-water based irrigation, such as Zambezia, Tete and Sofala provinces. Table 6.1 illustrates the annual progress made on the rehabilitation and establishment of irrigated land per province based on public investments mainly through small and medium size irrigation schemes.

Table 6.1: New and rehabilitated annual irrigated land through public/MINAG investments, Mozambique

Provinces	Progress on new or rehabilitated irrigated land (ha) per province per year						
	2001-03	2004	2005	2006	2007	2008	2009
Maputo	908	876	324	980	60	517	82
Gaza	7,867	930	1,520	598	2,300	500	1,432
Ì`mbane	247	90	420	452	821	143	201
Tete	373	n.a	n.a	n.a	20	10	13
Sofala	112	n.a	40	75	110	133	39
Manica	1,126	n.a	192	283	n.a	70	n.a
Zambezia	965		18	54	45	45	200
Nampula	352	20	n.a	119	70	1	57
Niassa	7	n.a	n.a	15	94	359	15
C.Delgado	84	n.a	n.a	n.a	n.a	n.a	23
Total (ha)	12,041	1,916	2,514	2,576	3,520	1,778	2,062

Source: MINAG (2010c).
Key: n.a: non-available

[2] Public investment funds allocated annually to all rural districts since 2006-2007, being initially the same amount to all such districts (about USD 300,000), is currently to be extended to urban districts with the annual allocated volume of funds now following some criteria, including existing population and performance of each district.

Gaza province shows higher annual rates of new or rehabilitated irrigated land due to investments supported by AfDB (*Baixo Limpopo* Rehabilitation Project, 2002-2009), PROAGRI I and, more recently, to a lesser extent, by the European Commission since 2008. It should be noted that after the devastating floods in 2000, which destroyed most irrigation schemes in the lowlands of the province, the Government has focused its efforts on rebuilding such schemes.

Maputo province has also been benefiting from different investment sources, such as FAO's "Special Programs for Food Security" (SPFS) during the late 1990s; the Italian Government through PIDA (2004-2007); AfDB through SSIP (2002-2010) and PROAGRI I, among other sources. Maputo has been promoting horticultural production, especially in districts near Maputo city such as Boane, Manhiça and Moamba with easy market access. Initiatives aimed at re-introducing Irish potato production, especially in Moamba, Magude and Boane districts as well as some emphasis on rice production in Matutuine district, are increasing demand for irrigated land in this province.

Inhambane has been prioritizing the use of small wet land areas with enough water for irrigation to establish small scale irrigation schemes (Monteiro, B., Former Inhambane Provincial Director of Agriculture, personal communication, November 2011). Small scale rice and horticultural based farming systems have been promoted particularly since 2000 and 2008, respectively, through public investment. Irrigation initiatives include semi-arid rural areas in the northern region of the province (Vilacunlos, Govuro, Mabote districts, for example) mainly to contribute to household food security, particularly for poor rural families (Sahale, A., Head, Inhambane Provincial Services of Agriculture, personal communication, November, 2011).

Sofala province has been benefiting from funding from the Government of Italy through PIDA, SSIP project as well as PROAGRI I funding. Irrigation investments have been prioritized for Gorongosa, Buzi, Nhamatanda and Dondo districts mainly for horticultural production and rice. However, the results achieved in Sofala have been relatively poor compared to other provinces. In summary, and as shown in Table 6.1, the current levels of annual expansion of irrigated land are still limited and characterized by high annual variations at provincial and national level due to reasons such as availability of financial resources as well as the duration of key processes in establishing new or rehabilitating irrigation schemes, namely water availability (re)assessment, impact assessment (when

applicable), the need to follow bureaucratic and administrative procedures for public works that are often time consuming.

Based on the achieved expansion of irrigated land at national level, much greater effort to mobilize resources will be needed, at least over the next two decades, if irrigation is to play its crucial role in mitigating adverse weather conditions and increasing agriculture production and productivity. It should be pointed out that Zambezia and Nampula provinces account for at least 40% of the total farms in the country (MINAG/TIA, 2008), and Zambezia in particular is endowed with the most substantial water resources in the country (FAO, 2005). However, irrigation expansion in both provinces has been very slow, compared to some areas in the central and southern regions.

The current underdevelopment and deterioration of water management infrastructure (FAO, 1995; MADER, 2003a; World Bank, 2007; MINAG, 2010a) suggests that the Government will still be required to play a pivotal role in mobilizing resources to (re)build irrigation and related infrastructure; to expand electrical power to irrigable rural areas with potential to succeed throughout the country; to build large infrastructure for water storage and distribution; to establish strategic rural market facilities and access infrastructure, and even to address joint public-private irrigation initiatives. These interventions are crucial for future sustainable growth of the irrigation subsector.

6.2.2 Some procedural issues concerning mobilized funding

In relation to public resources mobilization (and use), some important issues were raised during interviews with key informants at MINAG both at the central and local levels, namely:

Besides the need for transparency, there is a need for more flexibility regarding compliance with administrative procedures or rules while implementing irrigation programs. More often than not procurement and payment processes are very bureaucratic and time consuming causing delays or even the need to update some procurement procedures during the design or development of the schemes

Procurement principles and guidelines used by some funding sources are not necessarily contributing to building local capacity for provision of quality services. Targeted eligibility criteria or preferences for some services providers for building or rehabilitating large to

medium scale irrigation schemes may not necessarily favour local private sector competitiveness and efficiency in terms of resources use

The time between official approval and implementation of new irrigation projects should be minimized. Currently, this can be too protracted (exceeding 3 to 4 years), as it happened with two major AfDB irrigation projects (*Baixo Limpopo* Irrigation Rehabilitation Project and SSIP).

For analytical purposes, information on public and private investment in irrigation should be made easily available by relevant institutions, public irrigation projects, and large farm enterprises. Easy access to information related to public and private expenditure on irrigation is important for the annual irrigation subsector performance assessment and to conduct other relevant socio-economic analysis. As mentioned above, public spending data on irrigation has been scattered through the coordination units of the different programs and projects making it difficult to access such data in a comprehensive manner.

6.2.3 Effective use of irrigated land

In addition to the limited progress in expanding irrigated land, its ineffective use has also been a problem. As pointed out earlier, the effective use of irrigated land at national level is estimated at about 60% (MINAG, 2010a), although other studies suggest that that figure may currently be overestimated. The main causes identified through field observations, interviews with key informants and review of available documents hampering the more effective use of irrigated land include:

- The tendency for Government and some DP to view the scheme (infrastructure) development as the end goal, and not necessarily its sustainable operationalization and productivity issues, especially in the case of small scale schemes

- Lack of or weak prior assessment (gender and relevant socio-economic issues) of potential water users that could allow timely identification of risks, including potential conflicts among them, or among different categories of water users

- Lack of a clear definition of shared responsibilities among water users in pursuing good governance and operationalization of the schemes, when such responsibilities are under community associations or farmers' organizations

- Technical assistance from irrigation public services (technical water management issues) and from extension (production issues) is not necessarily adequately addressed by MINAG or other relevant stakeholders (NGOs, for example)

- Limited market access resulting often in lower producer selling prices or even in some harvest losses in the case of perishable products (tomato, for example). In addition, agricultural input supply has also been problematic in most of the scattered small scale schemes across rural areas

- The practice of subsistence farming in irrigated land (small sizes of land, low use of improved seeds and of fertilizer and pesticides, if any) by many smallholders, especially on small scale schemes

- Lack of or limited access to appropriate land preparation technologies and to resources to invest during the crop planting seasons, particularly for smallholder farmers' market oriented production

- Inadequate water management in some irrigation schemes, in some cases due to degraded infrastructure as is the case in Chókwè Large irrigation scheme with many of the tertiary channels damaged.

The above identified problems suggest that public investment in irrigation has been mainly addressing infrastructure development (rehabilitation and new establishments) and less in key factors such as support for maintenance and operation (when needed as a public support), production (mainly extension and research), irrigation schemes governance and market related issues (input and output). Farmers' organizations have a role to play in contributing to good governance of irrigation schemes. In the same tone, the private sector has a role in contributing to the development of market networks in irrigated land. However, in practice this has been difficult, in particular for irrigated land located far from the markets.

Ussivane (2010) advocates that initial operationalization support to water users in a new or rehabilitated scheme is of utmost importance. Initial support during the first two consecutive years of operation through the provision of basic knowledge in agro-business planning, field technical assistance and market linkages facilitation is undoubtedly crucial for the sustainability of irrigation schemes.

Public resource mobilization has contributed to an expansion of irrigated land, albeit on a limited scale. Public resources have been particularly focused on increasing access to irrigated land to smallholder farmers through building or rehabilitating small scale schemes. However, the effective use of irrigated land still remains a challenge. This is a critical issue to be addressed by MINAG and other relevant stakeholders aimed at maximizing the returns from public irrigation investments.

6.3 What has been the role of public irrigation services towards the expansion of irrigated food production?

The institutional capacity to provide effective public services mainly in rural areas, among other critical factors, is closely related to the type of institutional setup, particularly the need of functional institutional setup representation at local level and effective links, including the development of synergies and partnerships with other relevant institutions at local level. This sub-section discusses how the institutional developments in public irrigation services contributed to expansion in irrigated area.

6.3.1 Downsizing irrigation public services since the 1990s

Evidence reveals that public institutional support to the irrigation subsector has been dwindling, particularly since 1991. The creation of a Coordination Office for Integrated Projects (GCPI) (i.e., irrigation development projects) in 1991 implied the transfer of coordination and investment roles from the then SEHA to GCPI. Although SEHA did not cease to exist formally until 1995, its role in the irrigation subsector became increasingly weaker. Between 1991 and 1994, the Directorate of Hydraulic Technology of the SEHA became the institution interacting with MINAG on a day to day basis on irrigation institutional and field support issues, especially for small scale irrigation.

The GCPI was practically only in charge of medium to large scale development projects that had been under SEHA during the 1983-1991 period. This unclear institutional setup of having the GCPI concurrently with a weakened SEHA (i.e., without any real formal importance to the irrigation subsector) occurred between 1991 and 1995, ant it was only resolved in 1995 with the creation of the then DNHA. As mentioned above, 11 years later, in 2005, DNHA was also formally abolished and subsequently transformed into two departments within the DNSA since early 2006. However, only one irrigation department was developed instead of the two initially planned. It is worth noting that no clear reasons were given for the current

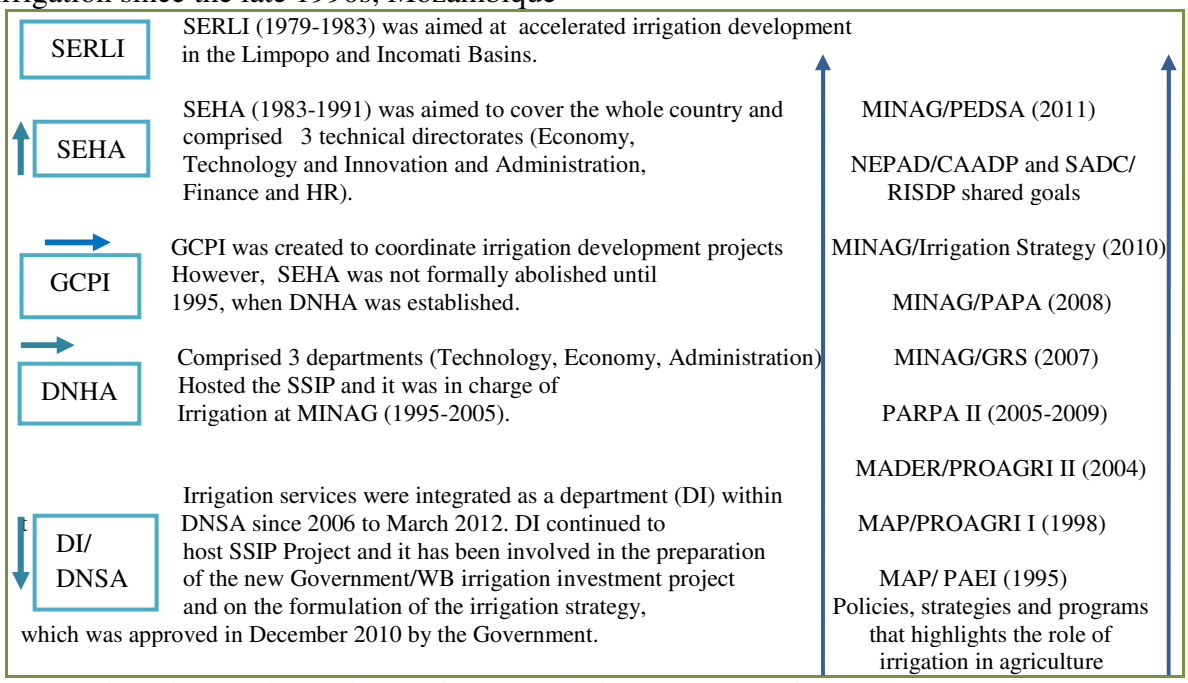
institutional setup by the key informants interviewed at MINAG/DNSA and at the Irrigation Department. The 2006 public irrigation services reforms were carried out within the scope of MINAG's overall institutional reforms implemented during such period.

It seems, however, that the problem is not so much the institutional size or level of organizational complexity of the public institution in charge of the irrigation subsector in terms of being a state secretariat, national directorate or a small department within a national directorate, as it has been from early 2006 to presently. Rather, the problem is related to the need to come up with a public institutional setup that allows for appropriate visibility, capacity (human and structural capital, and other key resources, including financial), competence and credibility of the public irrigation services to really drive irrigation in the country, particularly in ensuring effective delivery of public services. The reality reveals that although irrigation has been referred to as being important to the agricultural sector (MAP/PAEI, 1995; MAP/PROAGRI I, 1998; MADER/PROAGRI II, 2004; MINAG/GRS, 2007a), public institutional support to contribute to irrigation development seems to have been on the decline over time. This is particularly true for the representation of public irrigation services at central level.

At provincial level, irrigation services have also been weak compared with other agricultural services such as agriculture (support for crop production), extension, livestock, etc; within the Provincial Directorates of Agriculture. Large irrigation development projects have been providing some operational capacity to public irrigation services both at central and provincial level, for example, with the Government/AfDB SSIP project (2002-2010), and even at district level as in the case of the Government/AfDB *Baixo Limpopo* Irrigation Rehabilitation Project (2002-2008) in Xai-Xai district. This is notably in terms of some means of transport, some recurrent funds and field technical assistance (through project contracted staff), contributing to meaningful institutional capacity reinforcement, albeit on a temporary basis and only to assist with project implementation.

The major steps in the public irrigation services lifespan in terms of institutional setups are summarized in Box 6.2.

Box 6.2: Institutional setup of the public irrigation services and political demands from irrigation since the late 1990s, Mozambique



Source: The author based on available references and relevant documentation

Key: NEPAD (New Partnership for Africa's Development); CAADP (Comprehensive Africa Agriculture Development Program); SADC (Southern Africa Development Community); RISDP (Regional Indicative Strategic Development Plan). (Arrows: ↑ upgraded institutional importance; → almost the same; ↓ diminished importance).

The apparent dilution of the institutional importance of public irrigation services seems to be at odds with growing political demands from this subsector, as shown in Box 6.2. The downsizing of public irrigation services from the periods of the State Secretariats (late 1970s and 1980s) to a period of some unclear institutional setup in the first half of the 1990s (co-existing GCPI and mainly one directorate of the then SEHA) followed by the creation of a national directorate in 1995 (DNSA) can be, in part, explained within the context of the overall institutional/ administration reform due to the then changes in the role of Government in supporting production of goods and services, from an interventionist role to a less interventionist role under a liberalized economy implemented since the second half of the 1980s.

However, the downsizing of public irrigation from a national directorate (former DNHA) in 2005 to create a small department within a national directorate (DNSA), with limited financial and human resources, constrained the institutional capacity of public services to ensure the effective implementation of its role. In effect, strong public irrigation services are fundamental not only to deal with complex policy and public investment issues, but also to interact with other key players in a subsector that remains underdeveloped, at a time when the

Government still faces enormous challenges that need to be addressed, particularly in terms of increasing food and cash crops, as well as livestock production and productivity in a consistent manner.

6.3.2 Human capital and competency issues in irrigation and other related public services

In addition to the downgraded institutional setup of public irrigation services since the 1990s, and more drastically in 2005-2006, these services are not adequately equipped in terms of qualified human capital. Table 6.2 illustrates available human capital at central and provincial levels in 2010.

Most BSc staff members were agronomists who are not necessarily trained in irrigation or related subjects such as agriculture hydraulics or hydrology. In general, they are still in the process of acquiring critical professional experience due to their limited years of work after completing their respective formal academic training. At least half the diploma staff members possess qualifications in irrigation, while others are trained in hydraulics and sanitation or in some cases mechanics.

Table 6.2: Existing human capital in Irrigation Public Services (MINAG/DNSA, December 2010), Mozambique

Locations/ HC	HQ	Maputo Province	Gaza	Inhambane	Sofala	Manica	Tete	Zambezia	Nampula	C.D	Sub-Total
MSc Staff	1(a)			1 (e)							2
BSc	5(b)	2 (c)	3 (d)	1	3 (f)		2 (g)	1(h)	1		18
Diploma	2	2	1	4	2	1	1	1	1	1	17
Total staff											37

Source: MINAG/ Department of Irrigation (2010)

Key: (a) joined central department in 2010; (b) 2 agronomists, 2 architects and 1 civil engineer (c) 1 is moving soon to HQ; (d) 1 joined the team in late 2009; (e) expatriate hired by EC project; (f) 2 of the 3 will join the team soon hired through PROIRRI/WB ; (g) to be hired and integrated as civil servants by MINAG; (h) hired by AfDB and to be integrated as civil servant at MINAG; HC stands for human capital and HQ stands for headquarters.

Notes: The above table on human capital is slightly different with that in MINAG/ ICENA (2010b) (with a total of 45 staff members). The difference can be explained by the different periods in which data was collected or on provided data from the source.

A data updated conducted in June 2012 found that new staff had (re) joined the services at HQ, one economist holding MSc degree (before working to the Government/AfDB SSIP) and one MSc agronomist that returned from the studies.

As mentioned above, lack of qualified human capital in the irrigation subsector was highlighted as one of key constraints immediately after national independence in 1975

(Ataíde *et al*., 1976). Almost 20 years later, the NIDMP (1993) also referred to a lack of qualified human capital within the irrigation public services as a constraint, including at MINAG's water management research subsystem, which used to be under the responsibility of the former National Institute for Agronomic Research (INIA). To illustrate how qualified human capital has been scarce, it suffices to mention that of the 70 employees working at SEHA in 1991, only 27 were able to conduct supervisory work, and of these only 17 were managerial and technical (engineers) staff (26% of the total) and a significant portion of qualified staff were foreign professionals. Thus, although the total staff number at SEHA was considerable, it is clear that qualified human capital was limited, taking into account SEHA's driving role within the irrigation subsector. With regard to research, the Agro-hydrology division at INIA had only one MSc staff and two medium level technicians (SEHA/NIDMP, 1993).

Considering the human capital working at MINAG/ public irrigation institutions countrywide (2010) – two MSc, 18 BSc and 17 diploma staff – it seems that institutional capacity building has not been a priority objective aimed at building a critical mass of qualified staff in key areas in order to ensure a strong multi-disciplinary team of professionals within this subsector, as a MINAG contribution. Based on the interviews with key informants and a review of available documentation, different factors appear to have affected the development of qualified human capital, namely:

- Under circumstances of limited local qualified staff in water management in general, SERLI and particularly SEHA considerably relied on foreign staff, especially during the 1980s and early 1990s

- The institutional changes implemented in the public irrigation services during the 1990s did not necessarily imply the transfer of all the qualified human capital from the old to the new institutions. Therefore, some of the qualified or experienced professionals working in irrigation services opted to pursue other job opportunities

- The project-based approach, which has characterized public irrigation services since the late 1990s, may have contributed to the current weaknesses in human (and structural) capital both at central and local level. The main irrigation projects implemented over the last five to 10 years through MINAG were controlled by specific management teams agreed by both MINAG and the funding agencies, with

inputs from external technical assistance. This modality may have developed a misperception of an apparent adequacy of human capital.

- There is no evidence, for example, that there had been human and structural capital development plans over the last 10 years, and this fact can be one of the major limitations in developing institutional capacity. Although public irrigation services did comprise a human resources management unit, human capital development has not been viewed as a critical issue. Some irrigation projects incorporated budgets for in-service training, including formal training, like in the case of the SSIP, but such opportunities have not necessarily been used fully.

The implementation of the Irrigation Strategy (MINAG, 2010a) will certainly reinforce on-going discussions on how to strengthen public irrigation services (INIR) in the near future. Discussed options include the recruitment of qualified staff and even the possibility of offering post-graduate training for existing and new staff members as an action to be implemented in the short term (MINAG, 2010a). However, consistent efforts on both human and structural capital development will depend on how MINAG will deal with INIR in the future. As mentioned above, the apparently increasing political support towards irrigation development, the adoption of CAADP framework as well as PEDSA implementation, under which water management for agriculture becomes more important, can be conducive factors in developing critical mass of qualified professionals in the irrigation subsector in general, and particularly in public services.

In addition to the need to develop human capital at INIR, the collaboration between INIR and public extension is important. Such collaboration is aimed at improving water users' knowledge and skills in managing irrigated crop production, addressing governance issues at the scheme level and in interacting with markets. Additional efforts are needed towards effective collaboration between these entities, including the need to address knowledge and skills gaps among extension staff working in irrigated land. For example, irrigation knowledge in extension services seems to be a continuing limitation. In a national survey conducted in 2004-2005 using a sample of about 35% of the then total civil servants, less than 30% of extension workers interviewed knew about basic irrigation matters (Gêmo, 2006). From that period up to 2010 little effort was made to improve extension staff knowledge about irrigation issues. In order to perform core tasks, extensionists should retain trust from the farmers, and to gain trust and help farmers with informed decisions, extension

staff need a defined body of technical and extension knowledge skills (Stevens and Ntai, 2011). To be noted, few, if any, irrigation subject matter specialists (SMS) have been consistently integrated within the Mozambique's extension services as it was the case, for instance, with livestock particularly from late 1990s up to 2005 (Gêmo, 2007).

Informants interviewed at district (SDAEs) and provincial (DPAs) levels stated that there is a need to strengthen extension agents' knowledge on water management and use, particularly for those that deal with rice, vegetables, Irish potato and even irrigated maize production. It was further mentioned that there is a need to strengthen technical backstopping on irrigation issues from MINAG's central level to DPAs and from the DPAs to the districts. However, stronger technical backstopping from central to district level, among other factors, implies reinforced human capital at central and provincial levels in terms of both quality and quantity. Human capital is particularly relevant to the provinces with major irrigation schemes or with new planned investments to expand irrigated land.

Research is also fundamental in contributing to more effective public support to the irrigation subsector. But once again, the current situation on water management research capacity at the Mozambique's Agrarian Research Institute (IIAM) seems to fall below the needs. As referred above, water management research falls under the responsibility of Department of Land and Water (DTA) within the Directorate of Agronomy and Natural Resources of IIAM. Water research activities are mainly conducted through the hydrology unit, which in terms of human capital in 2010 employed two researchers, one with an MSc in Hydrology and another with an MSc in Hydraulics. One PhD researcher (re)joined the DTA team in the second semester of 2011. In view of the limited qualified human capital, in addition to budget and other resource constraints to conduct field research activities, complementary efforts are needed towards a more capable and responsive water management research at MINAG/IIAM, one of the most important public agricultural research organizations in the country, if not the most important.

Analysing the path of irrigation public services indicates that they had been particularly strong in the 1980s. The institutional reforms implemented in 1991 and the kind of "by-pass" that occurred with the former SEHA technical directorates until 1995 (i.e., partially functioning of SEHA after transfer of part of resources and projects to GCPI) seems to have caused public institutional weakness in addressing the issues of the irrigation subsector in a comprehensive manner, at national level. The creation of the DNHA in 1995 was important

in terms of having a specific national directorate in charge of irrigation. However, the abolishment of DNHA in late 2005 and the downgrading of the irrigation services to be a Department within DNSA, since 2006, the lowest institutional level of the irrigation public services since the national independence in 1975, suggest that MINAG was not positioning the irrigation services at its rightful hierarchical level, as the national directorates are within the general Government organizational system for public services.

As mentioned above, the 2005-2006 MINAG overall institutional reforms were aimed to increase effectiveness and efficiency in the Ministry's functioning and core services provision (MAP/ PROAGRI I, 1998). However, with regard to the irrigation services, no evidence of increased performance had been documented until the end of 2011. On the contrary, key informants suggested that:

- Fewer financial resources have been allocated to the irrigation services since 2006, in terms of annual nominal investment and recurrent budget, compared with the period before the reforms, affecting supervisory field activities throughout the country.

- The irrigation services lost visibility and direct interaction with key stakeholders such as management teams of large irrigation schemes (Chókwè and *Baixo Limpopo* Irrigation Schemes), provincial services, other relevant institutions within and out of MINAG, the ARAs that are in charge of the main river basins management throughout the country.

- Irrigation services became somehow diluted within the complex organizational structure of DNSA, although projects like the Government/ AfDB Small Scale Irrigation Project and the Government/ World Bank Sustainable Irrigation Development Program (PROIRRI) (whose management team started to operate in 2009) have been contributing to major visibility of the irrigation services.

It can be argued that strong irrigation public services alone cannot resolve the various challenges related to the irrigation subsector. However, the significant potential that irrigation plays in contributing to increased production and productivity, and the important role to be played by the Government in strengthening irrigation, suggests that the institutional setup, human capital and the logistics of the public services have been characterized by limited capacity to address effectively key challenges in the subsector. Inadequate institutional setup

of the irrigation services was mentioned as a constraint by more than 70% of key informants at MINAG both at the central and local level, and from other targeted institutions.This is particularly valid from the 1990s to 2011.

6.4 What role has Government played in enabling the private sector to contribute to irrigated production?

The role of the private sector has to be analysed within the context of the main political and economic circumstances that characterized irrigation history in the country. In this context, it is important to contextualize the private sector role over the different realized stages of irrigation. As mentioned above, the private sector includes commercial farmers, input and equipment suppliers, irrigation consultancy and construction enterprises, and also irrigated production buyers and processors.

6.4.1 Political changes and the role of the private sector in irrigation development

As mentioned above, over the 1975-1985 period, the Government's support to the irrigation subsector was almost all aimed towards state agro-industrial complexes, state farms and parastatals for equipment supply. Private sector and smallholder farmers received little support, almost marginal (Caballero, 1990; Mosca, 2011). With no specific incentives on issues such as access to credit, fiscal incentives, etc., and without a clear overall political support, the role of the private sector for both private farmers and equipment suppliers was potentially constrained between 1975–1985. In addition, private farmers were operating under administrative controlled circumstances, for example, with regard to price and marketing systems (Mosca, 2011), at least for basic food crops, including some vegetables. With no strong political support to the private sector, especially taking into account its substantial collapse following national independence, its role in the irrigation subsector in particular and in the agricultural sector as a whole was very limited over the 1975-1985 period.

It should be emphasized that an estimated 2,400 commercial farmers, most of them Portuguese and almost all of them farming on irrigated land, had abandoned the country by independence time in 1975 (Caballero, 1990). This means that the rebuilding of a "new" private sector should have received strong political support immediately after the national independence, if the development of a private sector in irrigated agriculture was intended.

However, at that time the Government's main support to the agricultural sector, including irrigation was through state agro-industrial complexes and state farms as well as through parastatals for provision of supportive services. Private farmers were then few and confined to selected small areas.

With regard to 1986-1998 period, which was characterized by formal political openness towards the private sector, it comprised two important sub-periods namely:

- The shift from the centralized to liberalized economy in the country since the second half of the 1980s, with implications for the agricultural sector and, consequently, irrigation policies, and

- The re-launching of agriculture particularly between 1993 and 1998 following the Peace Agreement in October 1992.

The adoption of a liberalized economy since the second half of the 1980s led to the end of direct Government support to agro-industrial complexes and state farms as well as to their consequent privatization, particularly in the first half of the 1990s. However, such new economic measures did not necessarily imply more Government support to the private sector involved in the irrigation subsector. The country was at that time emerging from a long civil war (about 16 years) and many of the then available resources were allocated to emergency purposes aimed to rebuild social life, including the return of thousands of displaced people and refugees to rural areas. Thus, although the political environment had become more open to the private sector, no substantial changes have occurred in terms of promoting the establishment and strengthening of commercial emerging farmers on irrigated land, their access to credit as well as in increasing demand for irrigation services for both equipment suppliers and technical assistance.

As referred to above, Chókwè large irrigation scheme seems to be a rare example in which annual credit opportunities for private rice producers have been offered, often with intermediation or support of MINAG, especially through CEPAGRI. However, although with little impact in promoting local private farmers and equipment suppliers, the Government had accomplished notable progress in attracting foreign direct investment (FDI) to form some joint ventures for irrigated and processing of sugar cane production.

The 1999-2009 period was characterized by substantial changes in the role of the private sector in irrigated production. The Government policy of attracting foreign direct investment (FDI) accomplished some success in bringing new investors and initiating of field investments for rehabilitation of sugar cane irrigation schemes. As mentioned above, private investment has been strong in sugar cane especially since the late 1990s. Since then, sugar cane irrigation schemes have been contributing substantially to total irrigated land. In 2010 sugar cane irrigated land was estimated at 35,000 ha (MINAG, 2010a) which corresponded to about 55% of the current total irrigated land with operational infrastructure. Most recent data suggest that total sugar cane cultivated land may reach 38,000 ha, including some rain-fed area at Marromeu sugarcane mill (MINAG/ CEPAGRI, 2011g).

The sugarcane industry comprises four large enterprises and the respective irrigated areas, namely Xinavane and Maragra in the southern region, and Mafambisse and Marromeu in the central region of the country. Almost all were directly and/or indirectly constrained by the war until 1992 and also claiming for technology update and rehabilitation of the irrigation schemes. The sugar-cane industry has been showing an impressive recovery and progress even from the record historical sugar production in 1972 (325,000 tons). Figure 6.6 shows progress on total irrigated sugar cane planted area per annum as well as total produced sugar per annum.

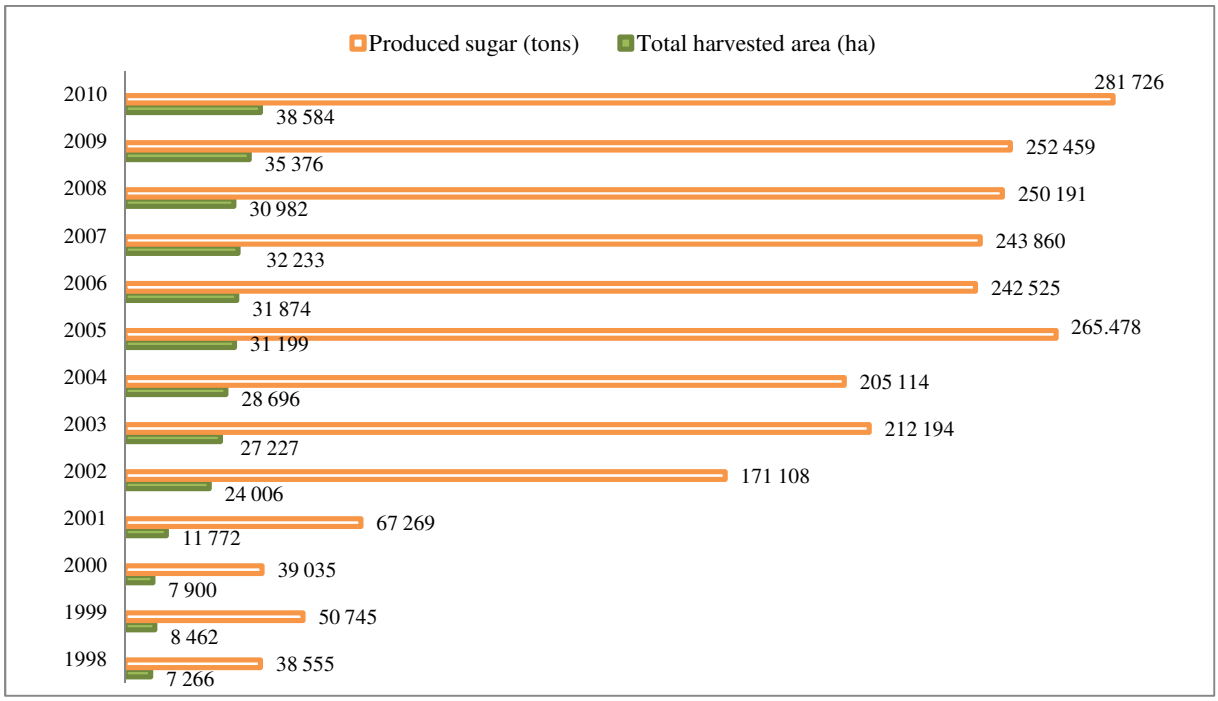


Figure 6.6: Total sugarcane irrigated harvested area per annum and sugarcane produced per annum, Mozambique.
Source: MINAG/ CEPAGRI (2011g)

Irrigated banana production also seems to be a new potential investment area in the future. Two provinces are especially benefiting from emerging FDI on irrigated banana production, namely Nampula and Maputo. Figure 6.7 shows commercial irrigated areas and banana production in Boane district in Maputo province. Boane district accounts for the major private investments in Maputo province on irrigated banana production (including through FDI) for both domestic and export markets, particularly since 2006. In 2009/10 and 2010/11 banana production in Boane district was estimated at 38,486 and 56,402 tons, respectively (MINAG/ DPA Maputo, 2011e).

The 1999-2009 period, especially from 2002, was also characterized by the implementation of irrigation public projects and programs with support from AfDB, Government of Italy, European Commission (EC), JICA and Irish aid in some cases. These initiatives have been contributing towards the creation of some demand for irrigation support services, namely in irrigation related studies, irrigation infrastructure construction and irrigation equipment supply by the private sector. This occurred particularly in some districts in selected provinces benefiting from such irrigation projects and programs, namely Maputo, Gaza, Sofala, Manica, Zambezia and Inhambane. PROAGRI I contributed to expanding such demand for irrigation services, especially to the establishment of small scale systems and acquisition of low cost technologies such as small diesel and treadle pumps.

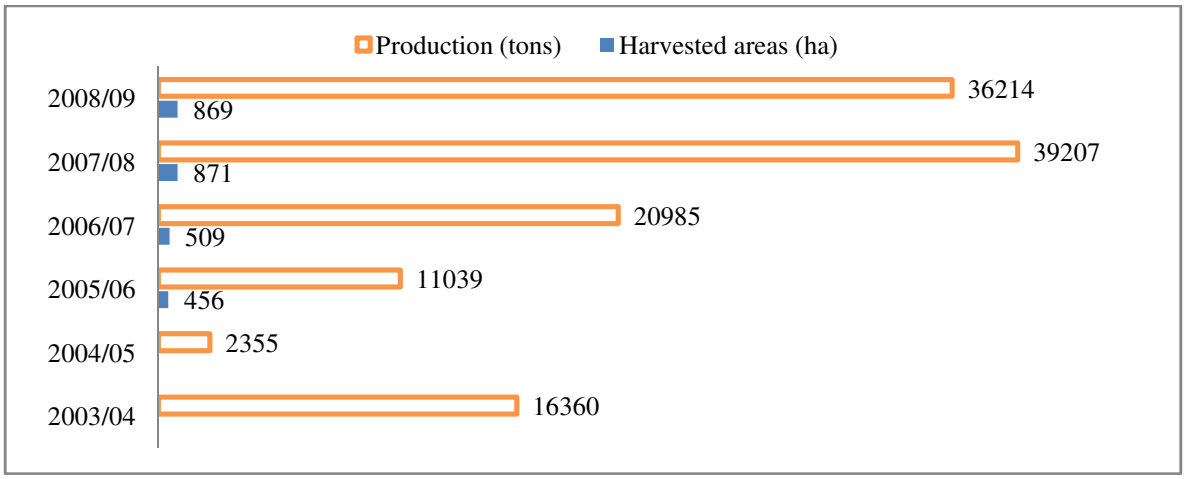


Figure 6.7: Commercial irrigated banana planted area and annual production in Boane District, Maputo Province, Mozambique.
Source: SDAE–Boane District (2010).

For example, in 2010 there were identified 12 enterprises working on equipment supply which are mainly based in Maputo, but there could be many more that were not identified (MINAG/ICENA, 2011c). However, the geographical coverage is focused on the southern

region with limited outreach to the central and northern regions; most of them were established after year 2000; and only an estimated 200-350 irrigation units consisting of pumps with piping systems, sprinkler and drip systems, are sold annually. The major sales of pumps are for the Chinese and Japanese manufactured small gasoline pumps with a capacity of 10-20l/ seconds sold at a price varying between an equivalent of USD 300-450 (MINAG/ ICENA, 2011c).

Pumps for small scale irrigation schemes seem to be playing an increasing role and some DPAs are involved in distributing these. For example, Inhambane Provincial Directorate of Agriculture has been buying diesel and electro-pumps for the establishment of small scale irrigation in targeted rural areas to benefit farmers' groups or associations as well as emerging private farmers with "proven interest in producing food crops, in particular vegetable crops such as onions, cabbages and tomatoes" at district level.

Distribution of pumps for small scale irrigation schemes started in 2008 and it aimed to mitigate the effects of droughts, particularly across the sub-arid areas of the Province, contributing to boosting food production and food security at household level. The beneficiaries are selected in collaboration with district authorities and relevant local-based organizations. The Inhambane Provincial Directorate of Agriculture/Irrigation unit (Hydraulic nuclei) conduct some technical work to assess water availability, soil physical conditions and topography issues at the proposed locations for the establishment of small scale irrigation schemes; the level of knowledge of the proposed beneficiaries in irrigated production; and linkages with markets. Most small scale schemes operated by smallholder farmers comprise water pumping, elevation and storage components to allow gravity fed irrigation using furrows, mainly for horticultural crops. In particular, paying for pumping costs has been a challenge for smallholder farmers operated irrigation schemes, while commercial farmers that benefited from this initiative tend to have financial resources that make them more capable of managing production costs. Table 6.3 shows the figures on land equipped for irrigation and the role played by pumps for small scale irrigation in the various districts.

Table 6.3: Inhambane equipped land for irrigation and the contribution of pumps used in small scale irrigation schemes, Mozambique

Districts	Equipped land for irrigation (ha)	Operational equipped land (ha)	Equipped land under use (ha)	Number of diesel pumps (DP)	Number of electro-pumps (EP)	DP and EP irrigated land
Funhalouro	8.2	7.2	0	3	0	7.2
Govuro	90	90	55	11	1	90
Homoine	194	94	77	3	0	34
Inhambane	1	1	1	1	0	1
Inharrime	91	76.5	22.5	5	0	31.5
Inhassoro	102	52	42	4	2	52
Jangamo	296	142	103	5	0	14
Mabote	18	13	8	2	1	13
Massinga	1,018	376	157	2	0	16
Maxixe	360	110	110	0	0	0
Morrumbene	307	185	70	0	4	5
Panda	324	109	64	3	0	29
Vilankulo	6	0	0	1	0	0
Zavala	5.5	3.5	2.5	1	0	3
Total	2,820.7	1,259.2	712	41	8	295.7

Source: MINAG/ DPA Inhambane (2011f).

The enterprises involved in supplying irrigation equipment are reported as providing mainly in-shop technical assistance rather than on-farm assistance. This is a serious constraint to farming in rural areas. Additional constraints that affect the market interaction between equipment suppliers and buyers are (MINAG/ICENA, 2011c):

- The buyers are not often informed on what capacity of pumps they need and tend to invest in pumps with higher capacity than required
- Weak maintenance capacity of the buyers/users
- Often difficult access to distant rural areas for installation of the equipment
- Often weak quality of specifications in case of Government tenders, and
- Occurrence of payment delays in the Government entities.

Dissemination of treadle pumps was substantially supported over PROAGRI I implementation at MINAG. Figure 6.8 shows treadle pumps locally produced and sold by a national company called Agro-Alfa, one of the two major enterprises then involved in producing (using mainly imported parts) and selling treadle pumps.

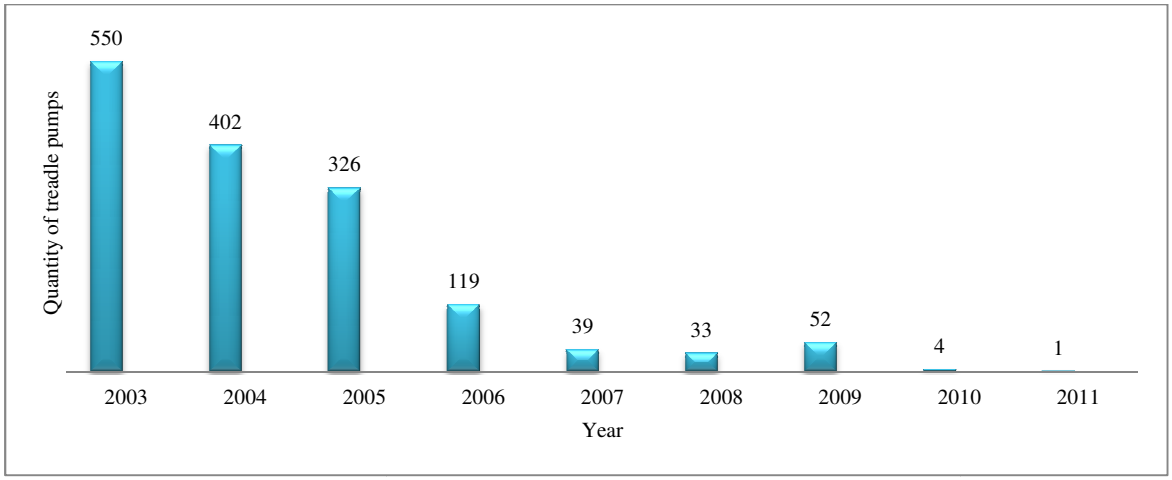


Figure 6.8: Treadle pumps locally produced and sold by Agro-Alfa, Mozambique.
Source: Agro-Alfa/Commercial Department (2011).

As shown, the end of PROAGRI I in 2006 seems to have influenced the level of acquisition of this type of technology, particularly through the Provincial Directorates of Agriculture which have supported the introduction of treadle pumps in rural areas, and even in some peri-urban areas aiming to promote low cost technologies in order to expand access to water for irrigation among smallholder farmers. During PROAGRI I (1999-2004/06) some Provincial Directorates of Agriculture have also acquired diesel pumps to install on small scale irrigation schemes in selected rural areas. However, data availability since 2000 on acquired diesel pumps at Provincial Directorates of Agriculture is limited due to weak procurement and patrimonial documentation over time in the visited Directorates.

Within the implementation of PAPA (MINAG/PAPA, 2008), in 2010 MINAG acquired at least 100 diesel pumps from private suppliers to be allocated to selected farmers' organizations and private farmers through subsidized mechanisms of payment (MINAG/DNSA, 2010). No information on technical specifications of the pumps was available at the time. In addition, in the southern region of the country there are few private sugarcane out-growers (Xinavane Sugarcane Industry) and few private farmers investing in small scale horticultural production. Private farmers also play an important role in rice and vegetable production in Chókwè Irrigation Scheme.

However, despite the above initiatives that may to a certain extent boost the role of the private sector in irrigation, its role in contributing towards irrigated production, particularly in food production is still limited in general. Very few local commercial farmers invest in irrigated production with little or no influence on national and provincial agricultural outputs.

The private sector is also still weak in providing key support services like engineering and specialized construction services throughout the country (MINAG, 2010a). Only Maputo city offers options for this type of service. Equipment supply and technical assistance is also still limited and often irregular, time consuming and with high variability of costs throughout the country (Ussivane, 2010; MINAG, 2010a). As with the agricultural sector as a whole, the irrigation subsector still faces market constraints that make it less attractive to potential investors, despite the agro-ecological potential in some of the rural areas throughout the country.

6.4.2 Summarizing the evolution of the role of the private sector in the irrigation subsector

The role of the private sector in the irrigation subsector, since immediately after national independence, was affected by different factors over time. The massive abandonment of commercial farmers on irrigated land following independence in 1975 constrained their role in contributing to irrigated production. The post-independence policy option of prioritizing Government support to state farms until mid-1980s also limited the ability of the private sector to rebuild. The overall political openness towards the private sector that resulted from the shift from a centralized to a free market economy in the mid-1980s was not accompanied by pragmatic policies and strategies to boost the role of the private sector in irrigation subsector development until the late 1990s. An exception has been the sugar cane industry which was revived from the late 1990s mainly through foreign direct investment in collaboration with the Government.

The implementation of PROAGRI I since 1999 and, particularly of some irrigation projects and development programs since 2002, has boosted the role of the private sector in irrigation in selected rural areas of some provinces mainly in the southern and central regions of the country. Although recently implemented and on a limited scale from 2008-2011 the Action Plan for Food Production (MINAG/PAPA, 2008) may also contribute to an enhanced private sector participation in irrigation. However, the impact of all these initiatives in strengthening the role of the private sector is still limited and not necessarily consistent. The main constraints to an enhanced role in irrigation as perceived by the private sector include (MINAG/ICENA, 2011c):

- The low and intermittent demand for services contributing to low interest of the irrigation related enterprises in investing continuously in strengthening and expanding their capacities in providing services

- Temporary demand which surfaces only when project funds are available

- Services (for example, rehabilitation or establishment of new irrigation schemes, including equipment supply),which are often tendered out on a large scale for which the private enterprises' capacity is often too low to complete it within the given timeframe, and

- The often poor quality of Terms of Reference for services provision, in particular with regard to defined timeframes for services provision.

The recently approved Irrigation Strategy (MINAG, 2010a) emphasizes the critical need of promoting and strengthening the private sector role in the irrigation subsector. It is of paramount importance to implement pragmatic policies, including incentives, to reinforce and expand the private sector's role in various activities within irrigation related value chains, i.e., in consultancy studies, construction, equipment supply, agriculture input supply and output buyers and processors and credit supply.

In summary, the private sector has played a limited role in expanding irrigated production and overall irrigation development. Low political and policy support until the mid-1980s, prevailing weaknesses in rural infrastructure (roads, market oriented facilities, etc.) and in crucial support services (limited access to credit as well as to input and output markets), limited demand for irrigation services over time and in general low self-capacity to invest in irrigated production by commercial farmers, have been the main factors affecting the role of the private sector in the irrigation subsector.

The sugar cane industry seems to be an exception whereby there is strong private sector participation in irrigated production. Among other reasons, the supportive policies implemented for the rehabilitation of the sugar industry such as equipment exemptions at early stages of the process, taxes for imported sugar at the beginning of the revival of the industry as well as access to internal and external markets were vital in sustaining the rehabilitation and expansion of irrigated sugar production. Mozambique exports sugar to only two main markets, the European Union (EU), under the new Economic Partnership

Agreements (EPA) introduced in 2009, and the United States under the Tariff Rate Quota and both agreements allow preferential access (USDA, 2012).

Banana irrigated production is also a promising industry, but to a lesser extent. In summary, the need for increasing irrigated production of rice, vegetables and tropical fruits with access to markets (especially banana, mango and citrus) suggest that the role of the private sector may be stronger in the future, if the prevailing major constraints are to be consistently addressed.

6.5 What has been the role of water users and water associations in irrigated food production?

Farmers' organizations and WUAs are key stakeholders in irrigation. They are crucial within the irrigation value chain in their role as producers. This is particularly important with regard to small scale irrigation schemes, which involve thousands of smallholder farmers throughout the country who are engaged mainly in subsistence farming.

6.5.1 Dispersed farmers' organizations and WUA and inability to developing national level databases

Presently there is no updated database on WUAs at national level, at least at MINAG/Department of Irrigation, which has since worked towards developing such a database in collaboration with various irrigation projects and programs implemented over time. At provincial level, it is also difficult to obtain comprehensive and updated data on WUAs. In fact, most of the provinces do not necessarily differentiate between existing farmers' organizations (FOs) in each province, thus including those working in rain-fed conditions, with FOs operating in irrigated land, which have water access and management as an important issue within their organizations.

It should be mentioned that the concept of WUA seems not to be yet widely accepted at Provincial Directorates of Agriculture and District Services for Economic Activities level, at least in visited provinces and districts, respectively. However, it is known that there are some dispersed farmers organizations working on irrigated land in rural and peri-urban areas which can be considered as water users associations , as access to water for irrigation is part of their dialogue agenda with relevant stakeholders such as District Services for Economic Activities, Provincial Directorates of Agriculture, managers of irrigation schemes such as

Baixo Limpopo and Chókwè Schemes as well as with the Regional Water Administrations Agencies (ARAs). This depends on the size and socio-economic importance (for example, number of beneficiaries, contribution to household food security and income generation) of the various schemes in each district and province.

WUAs are here considered as groups of smallholder farmers or of emerging private farmers working on irrigated land who share common interests and agree on belonging to specific local-based interest groups with specific organizational, functioning and representative rules aiming to accomplish shared objectives and goals, in particular those related to water management for crop and livestock production.

In general, most of the few and dispersed WUA are not yet registered, although some have already started actions towards their formalization and others have already been formalized as is happening mostly on Maputo peri-urban irrigated land (MINAG/ Small Scale Irrigation Project (SSIP), 2010) and, for example, within the large Chókwè Irrigation Scheme (*Hidráulica do Chókwè, Empresa Pública* (HICEP), 2010). Usually the process of formalization is facilitated by NGOs working in agricultural extension or in advocacy for agriculture and rural development activities or through irrigation development projects committed in promoting FOs, in general, and the emerging WUAs in particular.

The MINAG/AfDB SSIP implemented from 2002-2010 have developed a water users associations (WUAs) database related to rural and peri-urban areas where the project was implemented. A total of 31 WUAs were recorded under this project until March 2010 in Maputo, Zambezia and Sofala provinces, comprising 4,291 members, including 2,766 women. As mentioned above, these numbers include Maputo peri-urban irrigated land which comprised about 55% of the total WUAs registered by the project (MINAG/ SSIP, 2010d).

Chókwè large irrigation scheme has the highest number of registered WUAs (*associações de regantes*) in the country with about 24 WUAs having a total number of 12,422 members, comprising 9,398 men and 3,044 women water users. The WUAs are distributed from the north to the south areas of the irrigation scheme over a total area of 18,769 ha, thus with an average area of 1.51 ha per member of the combined WUAs. However the size of land per member is quite variable with members holding from 0.5 to 5.0 ha or even more. The WUAs are mainly organized according to the location of the secondary water distribution canals,

demarking different "block areas" with different sizes. Chókwè also comprises about 200 private commercial farmers (*Hidráulica do Chókwè, Empresa Pública* (HICEP), 2010).

However, despite the considerable number of water users, the level of land utilization in each "block area" has been variable, with some WUAs using very low levels of available land (estimated at 30-40%) due to various reasons such as limited investment capacity and lack or limited access to credit by most of the WUAs, deterioration of tertiary water distribution canals and drainage problems (particularly during the rainy seasons) affecting many WUAs "block areas"; as well as temporary abandonment of farming by some water users as well as some salinity problems in identified parts of the irrigation scheme (HICEP, 2010; SDAE/ Chókwè, 2010).

The *Baixo Limpopo* Irrigation Scheme also comprises some farmer's organizations and WUAs records, particularly with regard to smallholder farmers who occupy almost half of the irrigation scheme. Smallholders are mainly located in an area of about 4,500 ha (out of the total of 9,000 ha) in which drainage is particularly important within the scheme.The farmers' organizations (which are expected to develop towards WUAs) are organized in "Agrarian Houses" (*Casas Agrárias*) as shown in Table 6.4. "Agrarian houses" are houses where farmers meet among themselves and also with extension workers. The houses comprise gardens for demonstrations, small warehouses to keep some agriculture equipment and small shops of agricultural inputs.

Table 6.4: Organizational structure of water users associations in *Baixo Limpopo* Irrigation Scheme, Mozambique

Organizational structure of WUAs	**Quantity**
"Agrarian houses"	7
Number of WUA per "Agrarian house"	4
Total members (households) per WUA	209
Average area per "Agrarian house"	441
Average irrigated land per "WUA"	110
Average land per member (household)	0.5

Source: Adapted from Santos (2007)

Although the above figures are from 2007, they are still applicable to the current situation since the managers of the *Baixo Limpopo* Irrigation Scheme indicated that the number of households in the 28 WUAs did not change substantially since then. If some families decide eventually to leave associations, they may be replaced quickly as there is a demand for irrigated land, especially by farmers working in rain-fed conditions around the irrigation scheme. It is important to note that despite the demand for irrigated land by new water users,

those with access to land do not use it fully, as observed during the field visits and according to key informants at the *Baixo-Limpopo* Irrigation Scheme.

WUA in *Baixo Limpopo* Irrigation Scheme perform shared roles among themselves. For example, the associations have periodic meetings at the "Agrarian houses" mainly to discuss issues related to annual performance of crop production and market issues as well as some maintenance issues (for example, participatory cleaning of drainage canals). As the "Agrarian houses" possess some land preparation equipment, the water users can also rent the equipment for land preparation. Selected members of the associations are also involved in "agriculture commissions" (*comissões agrárias*) which, among other tasks, also address the issue of utilization of irrigated land. Thus, if determined family members abandon their plots for more than one agricultural season, the "agriculture commissions" are responsible for calling such family members, assess the reasons and take appropriate decisions/actions. However, it was mentioned that the experience with "agriculture commissions" in dealing with land management issues is recent and is still a "learning by doing" process.

Many of the *Baixo Limpopo* Irrigation Scheme received training on farmers' organizations matters and on notions of agri-business by 2007 then through the Government/AfDB Massingir Dam Rehabilitation Project (*Baixo Limpopo* irrigation project component). The role of extension in assisting technically the water users associations on production issues was mentioned as important.

Despite some progress made with regard to participation of WUAs on governance issues related to utilization of irrigated land, the effective use of irrigated land still remains a challenge. Table 6.4 shows the situation related to use of irrigated land identified in 2007.

Table 6.5: Irrigated land use by water users associations in the *Baixo Limpopo* Irrigation Scheme, Mozambique

Different sizes of parcels of irrigated land	WUA (family) members		Total area under effective use (ha)
	Quantity	(%) of (family) members	
– 0.25	3,350	72.0	824
> 0.25 – 0.50	761	16.4	380
> 0.50 – 0.75	76	1.6	56
> 0.75 – 1,0	322	6.9	322
> 1.0 – 1.25	24	0.5	28
> 1.25	120	2.6	295
Total	4,653	100	1905

Source: Santos ((2007).

The total number of smallholder water users effectively using irrigated land was below the total number registered in "Agrarian houses" and the area that was effectively occupied was less than half of the total available land of 4,500 ha belonging to the category "area one", which is a drainage managed area. Although no detailed field assessment had been conducted since 2007, key informants suggested that ensuring effective use of irrigated land is still a challenge. Field observation in the irrigation scheme also confirmed it as a challenge.

The Zambézia province, in the centre region of the country, also has WUAs, which were not included in the MINAG/AfDB SSIP as, for example, in Maganja da Costa (Nante irrigated area). In Nante irrigated area, for example, about 1,700 smallholder farmers were registered in the 2009-2010 agricultural season practicing irrigated production, mainly on rice, using a total land area of about 1,565 ha from the potential area of 5,000 ha. The 1,700 smallholder farmers are organized along 12 "managing councils" which deals with different relevant matters related to land preparation, water access, rice processing and marketing. From the 1,700 smallholder farmers, 300 belong to "Nante irrigated area WUA", including 210 women members. The average cultivated land per member of the Nante WUA is about 0.5 ha with the average rice yields of three tons, in good agricultural seasons, i.e., characterized by timely land preparation, planting, adequate water access for irrigation as well as adequate crop management (MINAG/DPA- Zambezia, 2010e).

Manica, Sofala and Inhambane provinces also had farmers' organizations on irrigated land, many not necessarily legalized yet, particularly in small scale schemes. However, additional efforts are needed to gather updated data on those local-based organizations at district level in order to start establishing updated databases at provincial level.

6.5.2 Challenges and constraints affecting FOs and WUAs

Field visits, interviews with key informants and consultation of available bibliography and relevant documentation revealed that:

- Most FOs in irrigated land and WUAs are still at an early stage of development
- Most FOs, including the emerging WUAs, often need initial support in developing capacity in agro-business related issues, including facilitation of linkages with relevant markets (financial, agriculture input and equipment as well as output markets)

- Most members of these organizations have been farming for a long time but they do not necessarily adopt and use good agricultural practices and agricultural inputs such as inorganic fertilizer, pesticides and even water for irrigation

- If not properly assisted, particularly in the first years of establishment through public or through NGOs working in extension or agriculture advocacy, and if not linked with relevant markets, many of these organizations face the risk of underperformance or even stagnation over time.

In summary, FOs in the irrigation subsector, including WUAs, are still few, most at their early stages of development throughout the country. The increase in number, technical and managerial strengthening of FOs and WUAs are needed towards more effective contribution to sustainable expansion of irrigation and to develop social capital in the subsector. This suggests that Government, public-private and even private support (for example, through sub-contracting mechanisms for specific irrigated crop production) will be fundamental to strengthening FOs and WUAs.

For example, the need for providing on-farm training to farmers (or water users) in irrigated land was highlighted immediately after national independence (Ataíde *et al.*, 1976). The NIDMP (SEHA/NIDMP, 1993) also stated that, in general, farmers had no experience of irrigation and had never received any consistent training. It is worth to mention that the MINAG/AfDB Small Scale Irrigation Project (SSIP) has addressed training efforts for FOs and WUAs in targeted rural and peri-urban areas (MINAG/ SSIP, 2010d). However, as the project was only implemented in selected areas of three provinces (Zambezia, Sofala and Maputo), the scope of intervention was very limited at national level. In addition, MINAG capacity in providing extension services, particularly for smallholder irrigated production, has been limited (Gêmo, 2006). Interviews with key informants and field visits also revealed that NGOs' contribution to provision of extension services to irrigated production has also been limited. The majority of NGOs concentrate their efforts on rain-fed agriculture, although there are some that assist famers using wetlands mainly for vegetables and rice production.

The current scenario suggests that FOs and WUAs promotion and support through the Government, public-private partnerships, private FOs and WUAs arrangements (especially sub-contracting agreements), and through available NGOs, will continue to be a critical

challenge for the next ten years, the implementation period of the Irrigation Strategy (MINAG, 2010a).

6.6 What role has information and knowledge generation and sharing played in the expansion of irrigated food production?

The development of a national information and knowledge development network is important because it contributes to building a comprehensive irrigation database as well as to document good practices, relevant experiences and lessons. This is a crucial challenge towards a more evidence-based intervention in the irrigation subsector.

However, the findings in this study suggest that particularly MINAG, MOPH, relevant agriculture and civil engineering education institutions as well as the DPs involved in the irrigation subsector (e.g. AfDB, Italian Government and European Commission) have been putting limited efforts towards contributing to building information and knowledge development network in the country.

First, the last comprehensive and nationally representative field inventory of the irrigation schemes was conducted in 2001-2003 and the current M&E system of MINAG/ INIR does not necessarily ensure adequate coverage in terms of including key irrigation related issues at different levels as well as needed update of information, for example, on categorization of the new irrigation schemes throughout the country. Categorization means the type of irrigation systems (for example, water distribution and application technologies), involved costs, new beneficiaries and main crops or to be grown. A stronger irrigation M&E system is needed to assess and update on irrigation performance. Assessing performance is vital to achieve efficient, productive and effective irrigation and drainage systems by providing relevant feedback to management and at all levels, including policy makers (Bos et al., 2005)

Second, there are very few documented events aimed at initiating public debate on irrigation subsector related issues, involving key stakeholders either at central or provincial level. MINAG interaction with key stakeholders was somehow activated in 2008 through a targeted consultative process within the scope of preparation of the Irrigation Strategy (MINAG, 2010a), including in seven provinces, mainly in the south and central regions. In 2010 the consultative process was resumed and MINAG conducted a large public debate event on the draft of the Irrigation Strategy in June 2010 in collaboration with the IWMI. The first public

event aimed to disseminate and debate the 2010 Irrigation Strategy implementation was held in December 2011, one year after its approval (MINAG/ DNSA, 2011h).

Third, there is limited evidence and literature on irrigation subsector particularly taking into account the importance and potential role of irrigation in the agricultural sector. Few DPs such as FAO, World Bank as well as some agricultural and civil engineering education institutions have been contributing some information and knowledge (particularly irrigation related field assessments and academic studies for completion of related BSc courses in the case of education institutions). MINAG research, through the Mozambique's Agrarian Research Institute (IIAM), has also been contributing to this process but in a limited manner, in part due to constraints in qualified staff on water management matters and on financial resources to conduct consistent field research activities on water management.

Fourth, the main stakeholders in the subsector have not been working necessarily on a collaborative manner, when applicable, particularly in sharing information and knowledge. The main irrigation stakeholders comprise:

- MINAG through public irrigation services, at central and provincial levels
- Management teams of public irrigation projects
- Private farmers and FOs (including WUAs) located on irrigated land
- Construction and consultancy enterprises
- Equipment and services providers
- Large irrigation schemes management boards (such as Chókwè Irrigation Scheme)
- Agricultural and civil engineer education institutions, and
- DP involved in supporting irrigation.

MINAG, particularly in collaboration with DPs, could play a catalytic role in this process, taking into account that public funding has been crucial within the irrigation subsector, even after the shifting from a centralized to a liberalized economy. For example, since PROAGRI I implementation (1999-2004/06) the MINAG core public services such as livestock, extension, research, forest and land management have been addressing efforts to implement annual

national meetings in which different stakeholders (e.g. NGOs, private sector, farmers organization, and DP) are invited to attend.

The level of participation in such annual meetings by the stakeholders in different agricultural subsectors varies depending on their level of interest, availability of time and financial resources. However, participation in such meetings has been fairly representative, involving Government officials at central and provincial levels, NGOs, farmer's organizations and some private sector representatives. These meetings offer an opportunity to share and disseminate relevant sub-sectoral information among key stakeholders.

However, the above meetings have not been implemented for irrigation, at least since 2000, although different public projects have been implemented over time, some of them hosted at MINAG central and provincial levels and with resources for capacity building, including in knowledge sharing. One of the reasons for this can be the isolated manner in which different projects tend to be implemented. Another reason can be the institutional weaknesses at MINAG/Department of Irrigation in bringing together all key stakeholders, particularly irrigation project implementers, to attend periodic public events aimed to disseminate and share relevant information and knowledge on irrigation.

The 2010 Irrigation Strategy emphasizes the need for using information and evidence in order to maximize the results and benefits from interventions in the irrigation subsector. However, the current stage suggests that more efforts are needed from different stakeholders, particularly by MINAG, aimed at enhanced interaction among stakeholders in order to build information and knowledge networks.

Weaknesses in implementing a functioning irrigation monitoring and evaluation (M&E) system comprising a set of hierarchical indicators (input, output and outcomes) at a national level, and centralized at MINAG/Department of Irrigation, could also be contributing to weak information and knowledge sharing. As mentioned above, implemented projects tended to work in an isolated manner, with their own M&E subsystems which were not necessarily inter-linked, and most importantly, supplying the MINAG/ Department of Irrigation with comprehensive data and information. The principal data and information channelled by different projects to MINAG/ Department of Irrigation have been on physical progress in terms of newly established or rehabilitated irrigation schemes and not necessarily on field developments and processes related to the progress of a project, the experiences and lessons

learned over time. This is an important issue that needs to be taken into consideration, especially in view of the implementation of the 2010 Irrigation Strategy as part of the Strategic Plan for Development of the Agriculture Sector (PEDSA) implementation under the CAADP framework.

CHAPTER 7: CONCLUSIONS AND WAY FORWARD

Agriculture has been prioritised by the Government as the basis for national development. Mozambique, however, often suffers from erratic rainfall which leads to fluctuations in agricultural production and poses a significant threat to the capacity of agriculture to steer national socioeconomic development. In light of this, irrigation has been viewed as an important area of Government development intervention to boost and stabilise agricultural output and subsequently enhance food security. However, despite the efforts made in the past 37 years following national independence to strengthen the role of irrigation in agricultural production, the country is still struggling to expand the area equipped for irrigation (i.e., land area equipped with irrigation infrastructure) and irrigated production (i.e., the use of land equipped for irrigation both in terms of area and productivity).

The formulation and implementation of irrigation policies has faced a number of challenges (including the war that devastated the country until 1992) that have constrained their impact on the expansion and effective use of irrigated land to ensure increased food production. This is further compounded by the fact that limited attention has been paid to consistently documenting and identifying key constraints and/or enablers of irrigation development in order to facilitate sharing of relevant information and knowledge on the role of irrigation policies in facilitating expansion and effective pursuit of irrigated production. This would boost evidence-based policy dialogue and intervention in the irrigation subsector. This study intends to contribute to filling this gap.

It did this through an historical analysis of policy and institutional developments in the irrigation subsector at national level (i.e., an analytical historical trajectory of the irrigation subsector), paying particular attention to critical factors affecting the effectiveness of irrigation policies in contributing to the expansion and effective use of irrigated land in order to enhance irrigated agriculture's contribution to food production and food security in Mozambique. This is probably one of the few, if any, documented analytical trajectories of the irrigation subsector in Mozambique. A qualitative approach was employed in which a review of the existing literature and official documents, along with secondary data collection, was augmented with interviews of key informants and experts opinion.

Documenting the historical trajectory of irrigation is important in efforts to preserve the memory and enable the challenges, experiences and lessons learnt over time to be shared, as a

valuable source of information and knowledge for all relevant stakeholders (e.g., irrigation professionals, agricultural sector decision makers (particularly those working in irrigation), academics and students, farmers' organizations and relevant private sector stakeholders) as well as for future actions and investments in the irrigation subsector.

Since national independence in 1975, the Government implemented different policies and institutional support approaches to pursue the expansion of irrigated land and irrigated (food) production towards irrigation development. The trajectory of the irrigation subsector is shown to be characterized by four distinct phases.

First, the 1975-1985 period characterized by high direct Government intervention through agro-industrial complexes, state farms, related agriculture parastatals and smallholder farmer cooperatives, with marginal public support to the private sector. Second, the 1986-1998 period characterized by a significant reduction in Government's direct intervention in the irrigation subsector and increased openness towards a pluralistic environment (Government, private sector and NGOs), with particular attention to addressing major efforts to emergency activities following the Peace Agreement accomplished in 1992 after a devastating war. Third, the 1999-2010 period characterized by some public investment mainly with support of development partners to expand irrigated land and production with a particular focus on small scale schemes (without necessarily neglecting large schemes) as well as significant private investment through foreign direct investment (FDI) with some other emerging private investments in micro and small scale irrigation. And, fourth the 2011-2012 period which might present a turning point towards an enhanced irrigation subsector if the expected implementation of the 2010 Irrigation Strategy (for the next 10 years) materializes.

7.1 Conclusions

The study shows that Government efforts to expand irrigated production and to develop the irrigation subsector, particularly since 1990s up to date, have been negatively affected by six policy and institutional critical factors:

- Policy weaknesses in addressing irrigated production in a comprehensive manner
- Limited resources mobilization to accelerate expansion of irrigated land and production
- Inadequate public institutional support to contribute to strengthen the subsector
- Limited role of private sector as farmers and services providers in irrigated production

- Weak farmers organizations on irrigated land (and particularly water users associations)
- Weak information and knowledge development and sharing among key stakeholders

7.2 Recommendations

The study illustrates that the ability of irrigation policies to effectively contribute to an expansion and improvement of irrigated production could be enhanced by addressing issues related to policy weaknesses in addressing key sustainability issues (for example, access to credit and improved inputs), limited investment resources towards expanding irrigated land and production, inadequate public institutional support to the irrigation subsector especially at field level, limited engagement of the private sector in irrigation, weak farmers' organizations (FOs) on irrigated land (and particularly of water users associations (WUAs) in terms of assuming their role in governance, management and use of irrigated land), as well as weak information and knowledge generation and sharing among stakeholders which is necessary to strengthen interventions in the subsector.

To ensure sustainability of the irrigation subsector, the analysis suggests that the implementation of the 2010 Irrigation Strategy, through the national irrigation program (to be hopefully finalized in 2013), should pay attention to issues such as:

Strengthening inter-sectoral collaboration on water management for agriculture

Key Ministries comprises Agriculture (MINAG), Public Works and Housing (MOPH), Coordination of Environmental Actions (MICOA), Industry and Trade (MIC), Energy (ME), Planning and Development (MPD), and Finance (MF). Collaborative actions can be in legislation and regulation development and implementation; inter-sectorial policy development, implementation and evaluation; inter-sectorial (complementary) public investments in the irrigation subsector, and other cross cutting issues, including health related ones.

Prioritizing public support according to the typology of the irrigation schemes

Prioritization of public investments in irrigation schemes in terms of infrastructural development and/or rehabilitation and public services support should be guided by criteria which could include for example: differentiation of goals, objectives, level of investments,

and their socio-economic importance in terms of their contribution to household food security, local/domestic food market supply, and regional market supply. This approach can contribute to more effective use of equipped land for irrigation. Of importance, it is difficult to justify the need for expanding irrigated land if a significant proportion of the available equipped land is not fully used (40% in 2010 at national level).

Strengthening public support and services delivery

This is related to development and implementation of conducive policies and regulations, promotion of functional public-private and WUAs partnerships, delivery of relevant services at field level, monitoring and evaluating performance of the irrigation subsector, including the contribution of irrigated (food) production in total agricultural production. To accomplish these responsibilities, MINAG should:

First, invest more in capacity building of irrigation services to develop a critical mass of human capital specialized in irrigation matters and boost irrigation information and knowledge generation and sharing among key stakeholders. Capacity building is needed at central and provincial levels, especially in provinces with huge opportunities but also facing challenges in expanding irrigated land for food production.

Second, strengthen contributions from research, education and extension (public and non-public) aimed at:

- enhancing irrigated land expansion and use
- increasing of productivity especially for food crops; and
- Enhancing analytical focus to inform actions aiming at addressing socio-economic and environmental issues at different levels such as irrigation schemes, district, provincial and national level. For example, while environmental issues can be physically addressed at irrigation scheme level, relevant environmental policies and regulations can be approved and implemented at regional and national levels.

MINAG/IIAM research on water management must be strengthened particularly in the view of the anticipated implementation of the 2010 Irrigation Strategy. Research and related education institutions can play a major role in irrigation by undertaking water management and water use efficiency studies; water-logging, salinity and drainage problems in irrigation

schemes; conducting policy analysis studies and promoting information and knowledge sharing

Third, empower farmers' organizations (or WUAs) to boost their participation in the governance, and where applicable, operations and maintenance of publicly funded irrigation schemes which is expected to ensure more effective use of irrigated land.

Enhancing access to investment and production incentives by the private sector

Promotion of private sector participation in the expansion of land equipped for irrigation and in irrigated (food) production thorough their effective access to existing incentives (for example, reduced of electricity costs in water pumping for food production) and through public-private initiatives, where applicable, is of paramount importance. Private sector participation in irrigated land expansion and irrigated food production have to be viewed in a comprehensive manner; i.e., including in the provision of financial services (credit), farming services (e.g., land preparation and harvesting, as in the case of rice), input and equipment supply and output trade and processing.

Facilitating collaboration with research institutions and relevant development partners

Relevant CGIAR organizations established or with activities in the country, particularly International Water Management Institute (IWMI), and others, can contribute to the research efforts to strengthen irrigation by generating relevant knowledge, including for policy and institutional development, and technologies. Some DP directly involved in the development of the irrigation subsector such as FAO, World Bank and the AfDB can also contribute to information and knowledge generation. Regional exchange of relevant experiences and lessons on irrigation, particularly on small scale irrigation involving smallholder farmers, should be encouraged and emphasized in the future, especially within the scope of CAADP framework implementation. This could be facilitated by regional organizations such as IWMI-Southern Africa and other relevant organizations.

Boosting policy dialogue in irrigation subsector

The development of an evidence-based policy dialogue platform on irrigation issues involving key stakeholders is needed. Such a dialogue can contribute to improved policies,

investment plans and relevant regulations in the subsector, especially to enhance irrigated food production. Policy dialogue could address issues on, for example:

- Irrigation policy including cross cutting regulation issues such as water charges and access to energy and costs for pumping water for irrigation.
- Management and governance issues in irrigated production, i.e., in irrigated schemes
- Public (and private) investments at provincial, regional and national level
- Access and use of agricultural inputs in irrigated production at provincial, regional and national
- Effective use of irrigated land, outputs (quantity and quality) and productivity issues; total *versus* covered WUAs by extension services; at provincial, regional and national levels.
- Irrigation marketed output (particularly food crops)
- Irrigation impact on food security, rural employment, income generation, poverty reduction at different levels (irrigation schemes, provincial and national)
- Environmental sustainability issues in irrigation schemes (natural disasters risk assessment/monitoring and copping strategies at community level/social assistance networks; water availability; water quality issues and water saving technologies).
- Enhanced efforts for investment resources mobilization if the estimated Irrigation Strategy budget of USD 600 million is to be accomplished in the next 10 years. Despite the crucial role of irrigation in increasing food production in Mozambique, it has to compete for resources with other 18 investment areas in the agricultural sector within the scope of the implementation of the Strategic Plan for Development of the Agriculture Sector (PEDSA), hopefully from 2013.

In general, the role, cooperation and partnerships among Government, private sector, farmers organizations/WUAs and development partners needs to be taken into account in the formulation and implementation of public irrigation policies. Overall, the success of irrigation policies, in terms of contributing to the expansion and improved use of irrigated land, depend critically on other agriculture sector-wide policies, suggesting that it is important to have a comprehensive agricultural development policy in place. In this context, the role of the Strategic Plan for Agriculture Sector Development (PEDSA) in providing a comprehensive prioritization of strategic irrigation related interventions and/or investments in

the agricultural sector is vital in contributing to sound and sustainable irrigation development and, subsequently, to increased food production and enhanced food security in Mozambique.

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