Efficient Water Use for Agricultural Production (EWUAP) Project

BEST PRACTICES FOR WATER HARVESTING AND IRRIGATION

Burundi

By :

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GLOSSARY OF ACRONYMS

Acronym	Meaning
a.a	*Available at*
AAH	*Action Against Hunger*
ACORD	*Agency for Cooperation and Research in Development*
ADB	*African Development Bank*
ADRA	*Adventist Development and Relief Agency*
AEZ	*Agro-Ecological Zones*
AIBU	*Agronomy Institute of Burundi*
ARP	*Australian Relief Program*
AZRI	*Agricultural and Zootechnical Research Institute*
CMI	*Community Managed Irrigation*
CRS	*Catholic Relief Service*
DAEPL	*Department of Agricultural Engineering and the Protection of Land*
EWUAP	*Efficient Water Use for Agricultural Production*
FAO	*Food and AgricultureOrganization*
FAS	*Faculty of Agricultural Sciences*
GAA	*German agro-action*
GBAE	*Green Belt Action for the Environment*

GDAE	*General Directorate for Agriculture Extension*
GDP	*Gross Domestic Product*
IFAD	*International Fund for Agricultural Development*
IIMI	*International Irrigation Management Institute*
KBO	*Kagera Basin Organization*
MAS	*Monitoring of the Agricultural Sector*
NBI	*Nile Basin Initiative*
NEPAD	*New Partnership for Africa's Development*
NGO	*Non-Governmental Organization*
NPEC	*National Program for Erosion Control*
OPEC	*Organization of Petroleum Exporting Countries*
PDAL	*Provincial Directorate of Agriculture and Livestock*
POO	*Palm Oil Office*
PPMI	*Public/Private Managed irrigation*
PRASLM	*Project for Rehabilitation of Agriculture and Sustainable Land Management*
PRC	*People's Republic of China*
PRDRZ	*Program for Renewal and Development of Rural Zones*
RDCI	*Regional Development Corporation of Imbo*
SFD	*Stabilization of Foreign Trade*
SUCOMO	*Sugar Company of Moso*
TPPCR	*Transitional Program for Post-Conflict Reconstruction*
UNDP	*United Nations Program for the Development*
WB	*World Bank*
WH	*Water Harvesting*
WUAs	*Water Users Associations*
Units	*Meaning*
ha	*Hectare*
USD	*United States dollar*
l/s	*Litre per second*
m³	*Cubic meter*
FBu	*Burundian franc*
Conversion of the dollar into FBu *: 1USD ≈ 1100FBu*	

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I. INTRODUCTION

1.1 The country

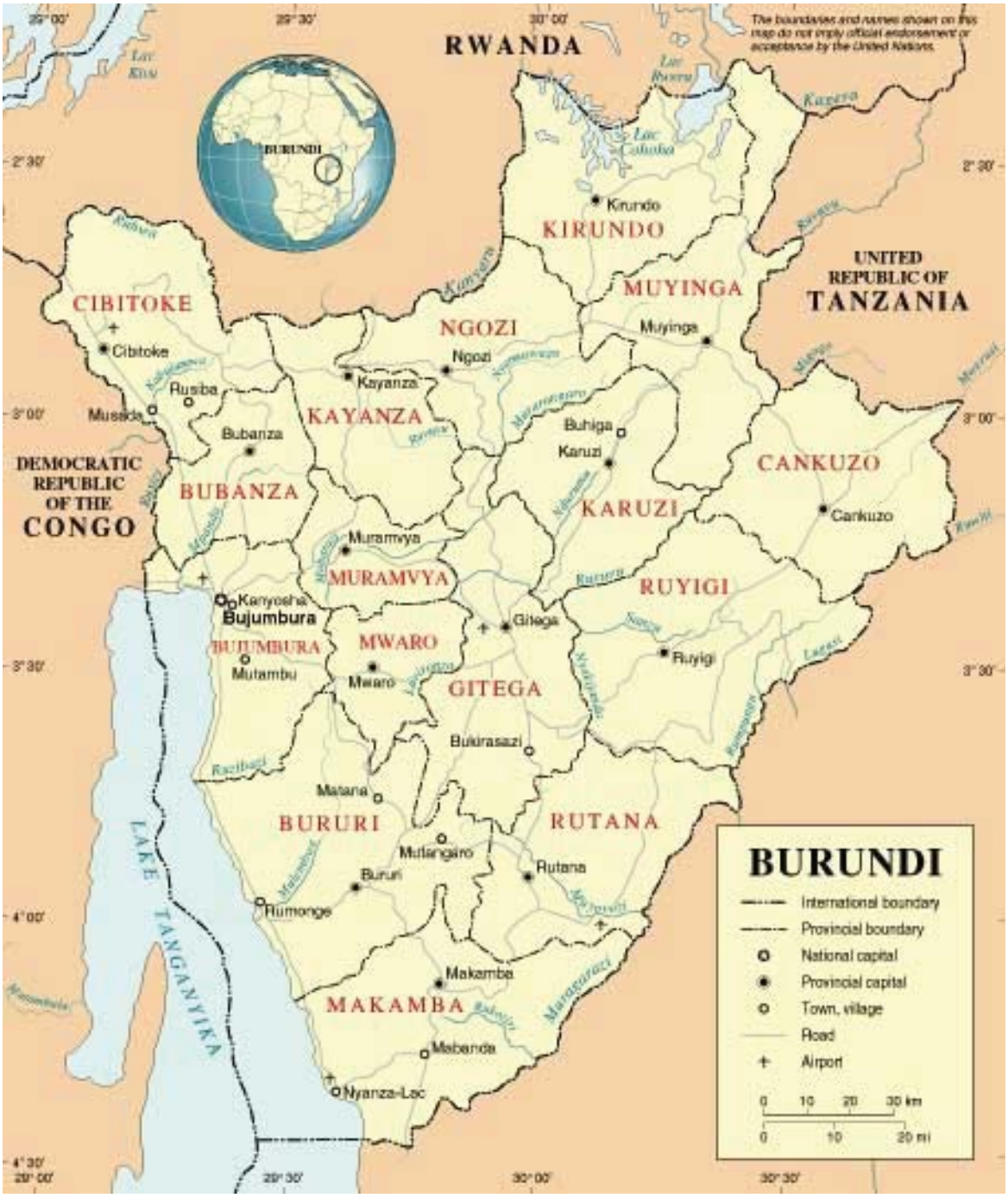


Figure 1: General view of Burundi

(Source : http://www.grandslacs.net/assets/cartes/burundi)

Burundi is situated between 2°20'and 4°27' South Latitude and between 28°50' and 30°53' East Longitude in the Great Lakes region, Central Africa. The country covers an area of 27834 sq km, of which 25200 sq km of land area and 2634 sq km of lakes. The natural and planted forests of paramount importance in maintaining the ecological and hydrological balances cover almost 200000ha but this area tends to decrease as a result of population growth pressure. The mountainous terrain of

the country gives it a tropical altitude climate, hot and humid on low altitudes, temperate and moist on the mountains. The river system of the country is divided into two major watersheds : the Nile and the Congo basins.

The statistical projections based on the census of people in 1979 and 1990 indicate a current population estimated around eight million. The average population density, taking into account land area would be of 317 inhabitants per sq km, with peaks of 400 to 500 inhabitants per sq km in densely populated areas (Buyenzi, Kirimiro, Mumirwa).

I.2 Socio-economy

Burundi is a country where the living of the majority (more than 90%) of the population is essentially based on extensive agriculture. In 2003, agriculture was providing 95% of food supply and contributed to 49% of GDP (95 USD per person per year) and 90% of foreign exchange earnings (FAO, 2005). According to socio-economic indicators, BURUNDI counts within the five poorest countries in the world.

The Efficient Water Use for Agricultural Production (EWUAP) Project comes at the right time. It will certainly improve the live standard of local population by increasing the agricultural production if all the sites potentially irrigable are equipped.

I.3 Relief, Climate and hydrography

The Burundian area is generally hilly with however some plains in the IMBO, BURAGANE and BUGESERA natural regions (first and fifth AEZ).The country has a tropical climate tempered by altitude. The average temperature varies between 15,7° and 23,8°. During the day, extreme temperatures can reach 33°C.

Despite climate challenges currently observed within the Eastern Africa Region, Burundi detains an important water (lakes and rivers) potential unfortunately underused in terms of targeted managed hydraulic systems such as irrigation.

Apart from the weather disturbances observed in recent years, Burundi has a sufficient rainfall with an annual average ranging from 700 to 2000mm / year. It is partly for this reason that rain-fed agriculture is by far dominant compared to irrigated agriculture. Agricultural activity is marked by two rainy seasons, the first from February to May, which provides 60% of precipitation and the second, from September to December, brings 40% of total rain water .

I.4 The agricultural sector [FAO-NEPAD, 2006]

I.4.1 The main crops

The agricultural sector, primarily oriented towards subsistence producers, is the dominant activity in

the national economy. Arable land under permanent crops occupy 1.200.000ha, that is about 43% of the territory. Agricultural production is highly dependent on weather conditions. The agricultural products are mainly food crops (90% of the area under crops and 46% of GDP), fish products (in natural lakes and rivers), oilseed and industrial crops (7% of GDP and 98 % of exports).

The climatic conditions prevailing in the country is conducive to a variety of food crops of which the most important in volume are : bananas, tubers (sweet potatoes, potatoes, cassava), legumes (beans), cereals (sorghum, rice), vegetables and fruits. Oil crops which are essentially made of peanuts, palm oil and cotton produce about 19000 tons of oil per year.

The industrial crop production (coffee, tea, cotton, palm oil, sugar cane, tobacco, rice, cinchona) is organized into agro-industrial sectors. This agricultural sector provides the main export products of the country and is the main source of foreign currency. That's why it has benefited from a preferential treatment while allocating financial resources for agricultural development.

I.4.2 The use of agricultural land

On the 2520000ha of available land, 2350000 ha are considered potentially agricultural. The cultivated area currently covers about 1400000ha of which 87% is earmarked for peasant mountain farms, 6% are occupied by the culture in marshes and 7% by industrial crops (coffee, tea, sugarcane and cotton). The total area of the marshes is estimated at 117993ha [FAO-UNDP, 2000]. Forests (public) and private afforestation cover 365000ha. The remaining area consists essentially of pastures and in a low proportion of public areas currently untapped.

I.4.3 operating systems

In Burundi, farms, estimated at one million, have an average size of 80 ares in which, we practice a mixed crops (dominated by food crops) incorporating more or less breeding and afforestation. In densely populated regions (Buyenzi, Kirimiro, Mumirwa centre), the average size of farms closes to 0.5ha. The largest holdings (2 to 5 hectares) are located in the plains regions of Imbo and Moso where population densities are lower.

The opportunity offered by three seasons of agricultural production in the year allows the small producer, through cropping intensity, to develop an cultivated area multiplied by 1.5 to 2 of the real size of holding. Nevertheless, without input of organic matter and without a refund of minerals, the soil fertility deteriorates, the production declines and the small farm is insufficient to nourish the family.

I.5 Objective of the study

As mentioned in the terms of reference, the main objective of this study is to :

- identify, list, document and describe best practices in water harvesting and irrigation in Burundi,
- profile sites of best practices,
- prepare inventory of institutions for twinning activities,
- identify gaps in any existing guidelines in the two areas mentioned above

I.6 Methodology

The methodology has been conducted according to the scheme above. In fact, as the main objective was to identify and document best practices in water harvesting and irrigation, we first reviewed relevant literature and identified the main actors in the two fields. We can cite mainly the National

Institute for Agricultural Research, the Ministry of Agriculture and Livestock, the Department of Agricultural Engineering in the former Ministry of Environment, the National Geographic Institute, NGOs, Schools (Institute of Agricultural Techniques) and Institutions of Higher Learning (Faculty of Agronomy, Upper Institute of Agronomy), International Organisations (UNDP, FAO). The full list of those actors are given in paragraphs VIII.1, VIII.2 and VIII.3.

Interviews done to key informants and meetings held with local specialists in water harvesting and irrigation allowed to select the sites for field visits and set out criteria for assessment of sites and techniques.

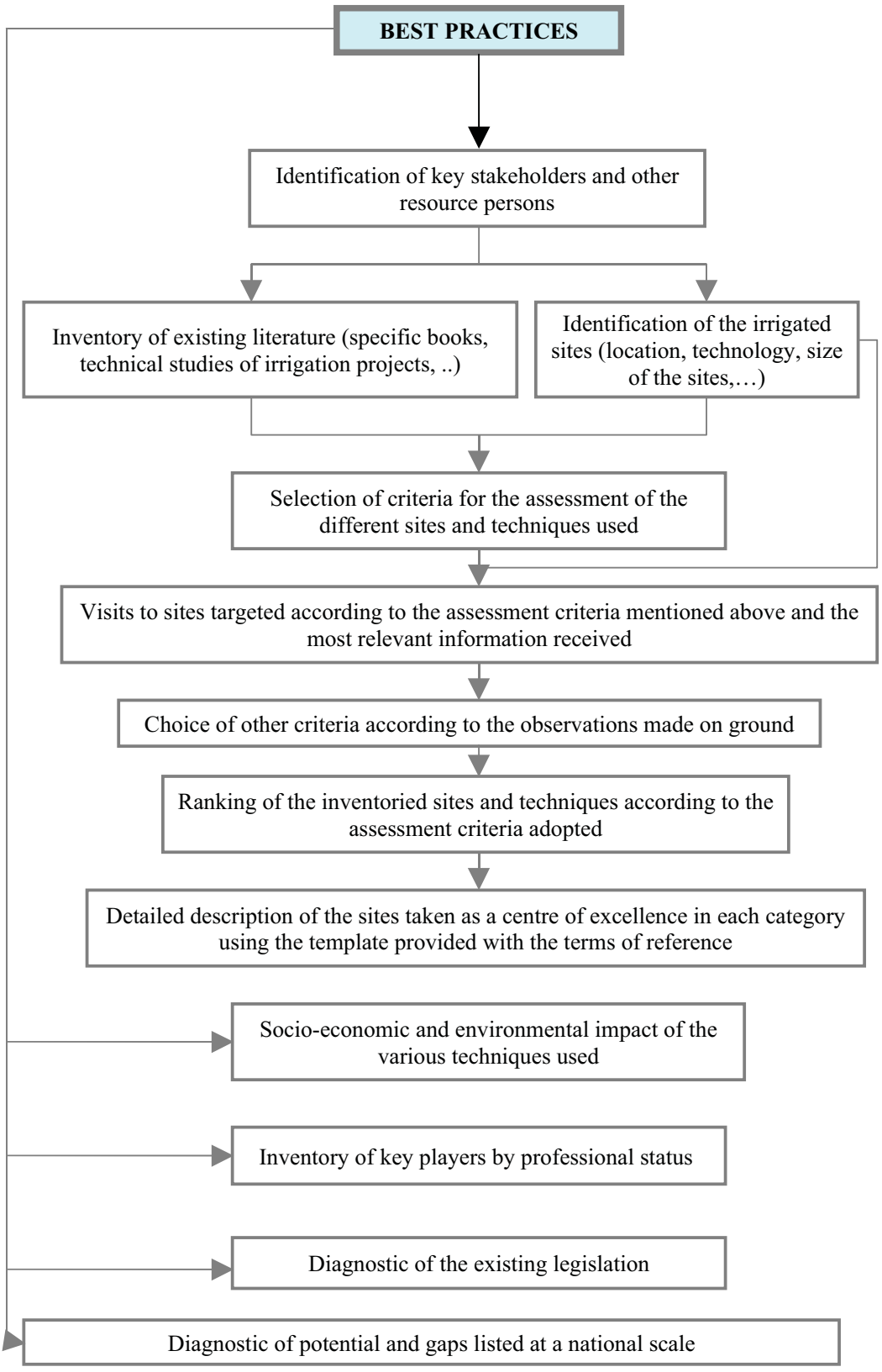
The evaluation criteria set permanently after field visits are given in paragraphs III.4.3 and III.5.4. These criteria have enabled us to the rank of main sites and techniques illustrated in tables 3 and 4. The sites that can be taken as centres of excellence in each category (WH, CMI, PPMI) were then presented in detail in accordance with the standard form provided by the EWUAP.

The evaluation of the socio-economic and environmental (erosion, malaria, destruction of crops if the drainage system is not well implemented) impacts of the different techniques required first a review of research documents detailing those impacts and second a real assessment based on local realities. This will also include assessment of their impacts, on one hand on crop production, on the other hand on population health.

On the basis of climatic, topographic and social realities, we have evaluated the limitations and opportunities of the described techniques for replicability and scaling up (impossibility to cultivate the irrigated rice in the mountain using the technique of flooding, use of treated wastewater, lining of main canals to minimize losses by infiltration, the cost of the various techniques by comparing investment and performance).

Since the use of water (diversion, retention) has to be governed by certain rules (to meet the downstream needs for example), the penultimate paragraph of this work analyzes and sort out gaps in existing guidelines on water harvesting, community managed irrigation and public/private irrigation. This required to checkout and review the existing documents (environmental code, water code, bylaws, constitutions, group regulations) who could give some guidelines on WH, CMI and PPMI. The analysis has revealed the origin of possible non compliances by taking into account legal and technical aspects.

As mentioned in the beginning of his chapter, we have given in the last part of this report a full list of the main actors and potential institutions to be used in organizing and conducting capacity building activities and field level demonstrations and dissemination of best practices in the fields of water harvesting and irrigation.


BEST PRACTICES
Identification of key stakeholders and other resource persons
Inventory of existing literature (specific books, technical studies of irrigation projects, ..)
Identification of the irrigated sites (location, technology, size of the sites,…)
Selection of criteria for the assessment of the different sites and techniques used
Visits to sites targeted according to the assessment criteria mentioned above and the most relevant information received
Choice of other criteria according to the observations made on ground
Ranking of the inventoried sites and techniques according to the assessment criteria adopted
Detailed description of the sites taken as a centre of excellence in each category using the template provided with the terms of reference
Socio-economic and environmental impact of the various techniques used
Inventory of key players by professional status
Diagnostic of the existing legislation
Diagnostic of potential and gaps listed at a national scale

II. Criteria for potential for best practices and Agro-Ecological Zones

II.1 Potential for best practices

The previous overview of BURUNDI was presented to understand the challenges and potential of the country in the field of agriculture and water management. All the geographical factors described in this paragraph play an important role. The population density exceeding 300 inhabitants per square kilometre in a country with 90% of rural zones is a limiting factor with respect to the availability of farmland and hence of irrigable land. The length of the dry season, allows to evaluate the water shortage, or in other words the water needed for irrigation. According to this criterion, the Imbo plain and depressions of the East and North are the most needy in terms of irrigation facilities. Hydrography and rainfall are measures of the availability of potentially exploitable water for irrigation. In this context, most parts of the country have an important hydrographic network and sufficient rainfall; they are therefore potentially irrigable.

The terrain is also a limiting factor, and in the case of Burundi, the central highlands, the plains of IMBO and the North and the East depressions are more potentially irrigable. The temperature, relative humidity and average wind speed are climatic factors as a basis for assessing the losses by evaporation. Those parameters are particularly important when, as discussed below, rainwater is collected in open basins.

The population involvement which is a very important factor should normally be met in most of regions where the current crisis has reduced considerably the agricultural production

II.2 Natural regions and Agro-ecological zones

BURUNDI is divided into eleven natural regions and five agro-ecological zones (figures 1 and 2) :

The plain of Imbo (west area of the country along Lake Tanganyika), which is made of lowlands (774-1000 m) with a warm tropical climate (23°C mean temperature), a low rainfall (800-1000mm/an) and a dry season from five to six months. This zone occupies about 7 percent of the territory.

The west slope of the Congo-Nile ridge (Western escarpments) is a mountainous area with elevations ranging from 1000 to 2000 meters. The annual rainfall ranges from 1100 to 1800mm and the temperatures vary between 23°C and 17°C as a function of altitude. The area occupies about 10 percent of the territory.

The Congo-Nile ridge : the altitude ranges from 2000 to 2670m and the area is characterized by annual rainfall between 1500 and 2000mm, and an equatorial mountain climate with mean annual temperatures of 12 to 16 ° C. On the highest peaks, temperature drops. The dry season runs over three months, from June to August, while the rainy season is marked by almost daily rains, particularly abundant in April and November. This is the most watered zone of the country. The national park of the Kibira is located in that zone. This natural forest is a real water tower from which many rivers take their source. Evaporation is not very important because the rate of humidity remains high. The area occupies about 15 percent of the country.

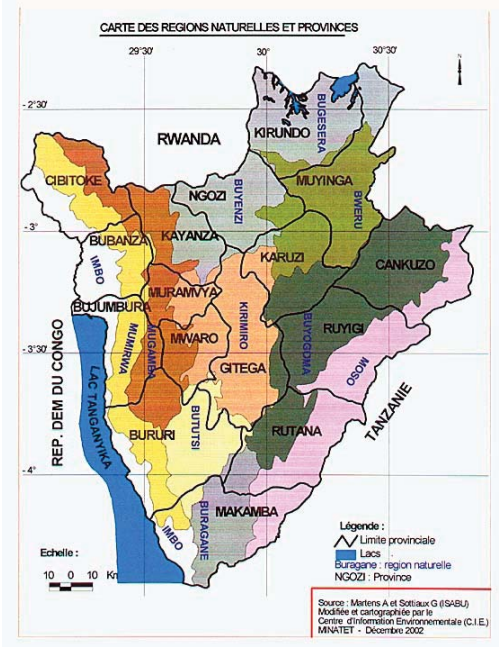


Figure 2: Provinces and natural regions

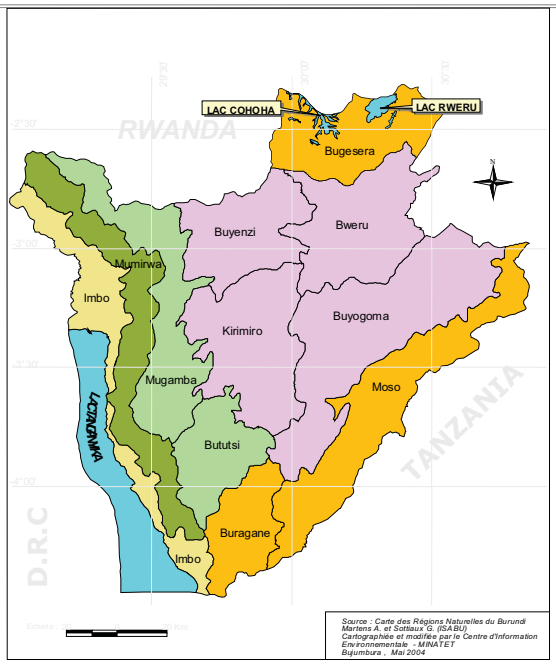


Figure 3 : Natural regions and AEZ

Natural regions		*Agro-ecological zones*	
1	*IMBO*	***1***	*IMBO plain*
2	*MUMIRWA*	***2***	*West side of the Congo Nile Crest*
3	*MUGAMBA*	***3***	*Congo Nile Crest*
4	*BUTUTSI*		
5	*KIRIMIRO*	***4***	*Central plateau*
6	*BUYOGOMA*		
7	*BWERU*		
8	*BUYENZI*		
9	*BURAGANE*	***5***	*East and North Depressions*
10	*MOSO*		
11	*BUGESERA*		

Table 1 : Natural regions and agro-ecological zones

The central plateau : the altitude is between 1500 and 2000 m, while the average annual rainfall varies between 1150 and 1500 mm. The climate is tropical with a short dry season of four months (June-September). The temperatures are cool and the averages vary between 16 and 18°C. This zone covers about 44 percent of the national territory.

The East and Northeast depressions : the altitude is between 1320 and 1500 m. This area is characterized by high temperatures, but above all, the drought is more severe. The mean annual temperatures are around 20 ° C. Annual rainfall rarely exceeds 1100mm, and can drop down around 600 mm. The humidity is not very high, the annual average varies between 65 and 70 percent. The number of dry months varies generally between five and six consecutive months. This zone covers 24 percent of the territory.

III IRRIGATION

III.1 Main features

As mentioned above, agricultural development in Burundi is characterized by small private farms where we practice mixed seasonal crops and by a lack of mechanization. These factors coupled with the mountainous terrain and the energy deficit are a major obstacle to the practice of large-scale irrigation. This agricultural practice is therefore very poorly developed in Burundi.

III.2 Irrigated areas

In Burundi, over than 99% of the irrigated fields are located in the plains of Imbo, Moso and Bugesera and in the marshes. Mountain Irrigation (eg Rwira in BURURI province) represents only a tiny fraction, less than 1% of the total irrigated area.

On the basis of :

- *Agro-ecological-map (Figure 2);*
- *The inventory of marshes and their watersheds*
- *Currently irrigated areas*

We find that the irrigated area represents :

- *0,65% of the total surface landmass;*
- *1,57% of the total irrigable area*

AEZ	Area (ha)		Irrigation		
	Total	Irrigable (ha)	Irrigated (ha)	Irrigated (% of total)	Irrigated (% of irrigable)
1	176400	123500	8739	4,95	7,08
2	252000	68595	260	0,10	0,38
3	378000	149915	910	0,24	0,61
4	1108800	406180	2286	0,21	0,56
5	604800	300140	4309	0,71	1,44
Total	**2520000**	**1048330**	**16504**	**0,65**	**1,57**

Table 2 : Irrigated areas in BURUNDI

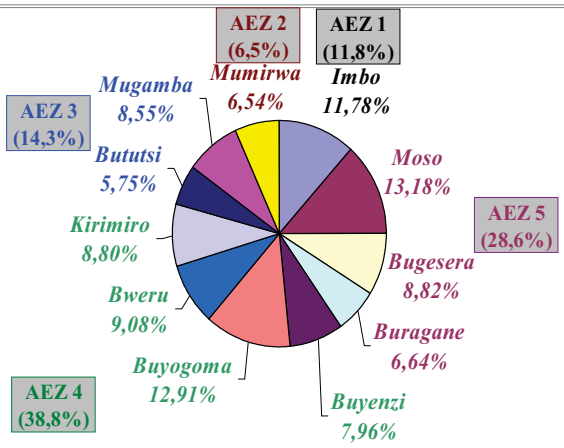


Figure 4 : Distribution of irrigable areas (per Agro-Ecological Zone)

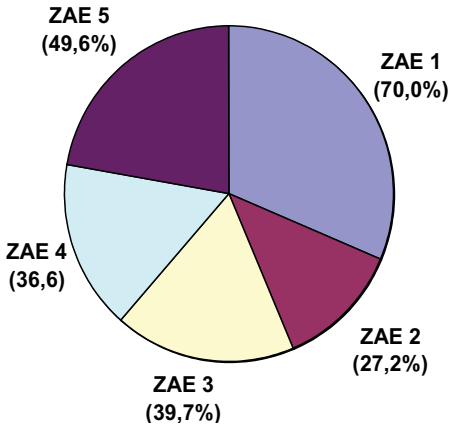


Figure 5 : Availability of irrigable zones within the AEZ

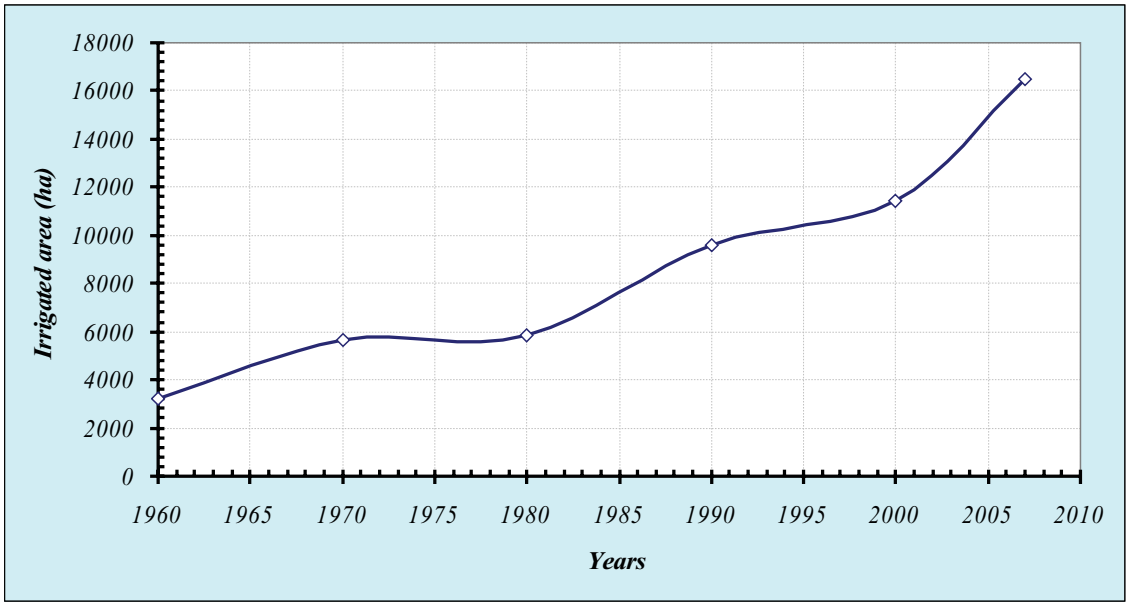
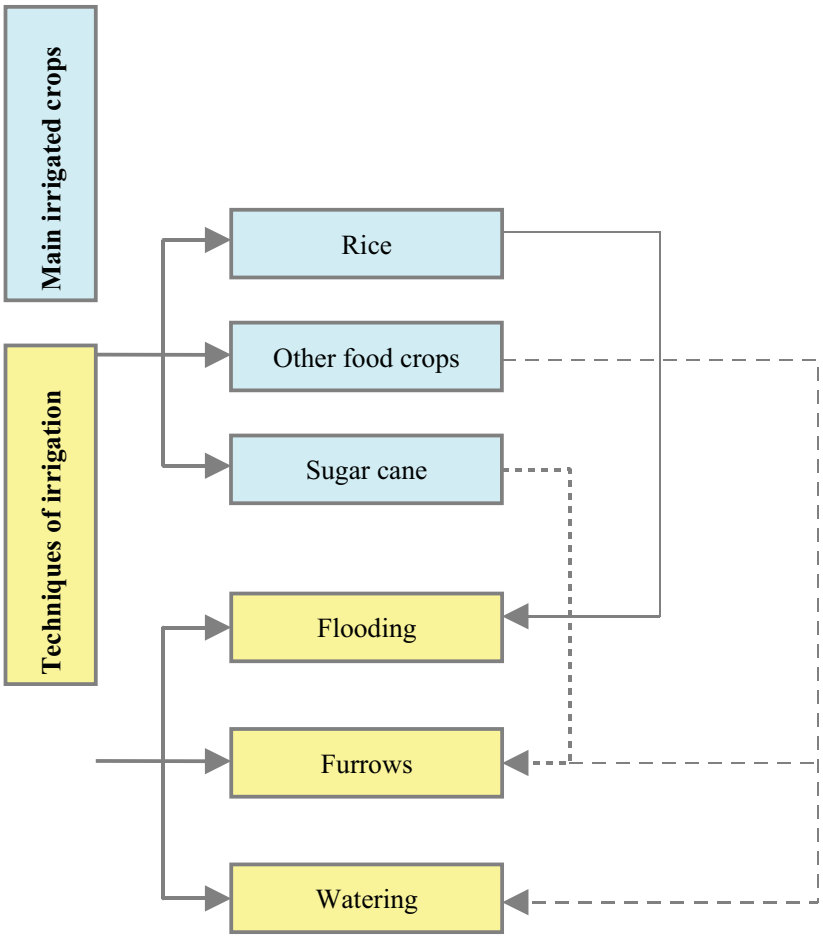


Figure 6 : Development of irrigated areas in BURUNDI

III.3 Irrigated crops and techniques used

The main irrigated (by flooding) crop is rice to the tune of more than 80%. Other industrial crops (sugar cane, palm grove) and food crops (tomatoes, onions, corn, potatoes), at the level of approximately 20%, are irrigated with the technique of furrows and at very small scale, with watering (hole pipes, buckets).



In summary, we can conclude that the techniques used, all by gravity feed, are undiversified, and we can also say that there are no specific technique peculiar to BURUNDI.

III.4 Identification and assessment of best sites

III.4.1 Organization of irrigation

The distinction between types of exploitation of irrigated areas as outlined in this paragraph shall take into account the size of farms, the existing hydraulic structures as well as stakeholders in the development of irrigated areas. They are as follows:

1° Small Scale Irrigation during the dry season in practice across the country and in which we use small unlined channels (provided that the land to be irrigated is located lower than the water source), or watering hose pipes (urban agriculture). The irrigated crops are generally vegetables (cabbage, onions and tomatoes). The irrigated area is most cases less than five ares.

2° Community Managed Irrigation without technical assistance **:**
This practice is common in the vast valleys and swamps of the central region (central plateau or AEZ 4), as well as in the east and north depressions (AEZ 5). Farmers who have holdings in the same valley or the same marsh organize themselves to ensure equitable sharing of water; in this context, administrative officials at the base play a leading role. The farm size ranges on an average between 10

and 50 ares depending on the region. A complete list of these farms managed without any known technical assistance could not be provided.

Technically, the beneficiaries :

- benefit from a natural flooding (figure 7) for rice; the lack of a drainage system led to the decrease in crop and can be a source of spread of diseases like malaria;
- build small dams and will water their fields (figure 8) with small seals. This technique used for irrigation during the dry season can not be illustrated on in situ pictures since the consultancy was carried out in the rainy season.

Figure 7 : Natural flooding (Nyabiho marsh in KARUZI)

Figure 8 : Example of food crops irrigated by watering during the dry season

3° Community Managed Irrigation with technical assistance (CMI) **:**

As stated above, these are modern farms (Figures 9 and 10) where irrigation is overseen by public technical services under financing of the government or of other donors. The beneficiaries are grouped into farmers' associations whose average size is 10 households. The average area of farms also varies between 10 and 50 ares, but some households have much larger parcels. This is because these plots are actually assigned by the administration to farmers in the form of rental and the households which are unable to meet the contract resell them to others who are able to ensure the development of their holdings.

Four key players are involved in this kind of exploitation:

- The Department of Agricultural Engineering and Protection of Land (DAEPL), which deals with hydraulic structures and their maintenance;
- The Provincial Directorates of Agriculture and Livestock (PDAL) for the development of the irrigated areas;
- Financial institutions;
- Beneficiaries who pay a fee (proportional to the size of the property) for the amortization and maintenance of the water infrastructures as well as the payment of agricultural inputs (fertilizers) used

The complete list of CMI is given in annex 4 (**joined excel file**)

Figure 9 : View of a rice field in the Nyabiho Valley (KARUZI province)

Figure 10 : View of a rice field in the RUKARAMU area (RDCI)

4° Private Managed Irrigation **:**
We understand by this type of farms a large irrigated farm belonging to an individual or a private company. The land fragmentation which characterizes agricultural occupation of the territory, the generally mountainous terrain of the country, the low-income of populations, all these factors mean that this kind of farms that requires a sizeable investment is rare.

The only private irrigated area (on a large scale), RUGO FARM, is located in the RUGOMBO-CIBITOKE perimeter and covers 1600 hectares of which about one third is irrigated. This is an old public property (RUZIZI) bought by a private, and it is for this reason that the field is irrigated with upstream water infrastructures under supervision of DAEPL.

5° Public Managed Irrigation (PMI)
The public holdings include agricultural areas belonging to the state (provinces, municipalities and communities) or to a public or semi-public company. While these farms are relatively large, the irrigated areas are rare and all belong to state companies.

In Burundi, there are two farms of this kind where irrigation is provided by the internal technical services of the firm :

- RWIRA farm where food crops (potatoes, onions, tomatoes, cabbage,….) are irrigated (by gravity) with garden hoses. The water used is collected from sources of Mount NGABWE;
- Sugar Company of MOSO where sugar cane fields are irrigated with water from the diversion dam built on the Mutsindozi river. It is a multi-purpose structure as the system also includes a pumping station (raw water for the production of drinking water) and a night storage tank (irrigation is practiced only during the day) which is at the same time a fish pond.

III.4.2 Inventory of irrigated areas

The inventory of the irrigated areas, per province and per AEZ, is given in annex 4 **(Joined excel file)**

III.4.3 Multi-criteria assessment and ranking of best sites

As mentioned during the two days (27 – 28th November 2007) inception workshop held in Nairobi, the best practice (sites and technologies) is one that gives optimum utilization of land and water resources for sustainable agricultural production and environmental management. General criteria that could be used have also been defined :

- *Sustainability of water source in terms of systems (durability, quantity and quality management, water control technique)*
- *Efficiency of the conveyance system*
- *Efficiency of water distribution system in the field to check whether the system within the best practice (BP) is being adequately involved*
- *Field Water Management (Users attitude, Organization, equity and reliability)*
- *Soil properties (chemical and physical) that provide for efficient crop water use*
- *Institutional and legal framework (WUAs, Private sector, Government / Government agencies involved in scheme management*
- *Participatory approaches in irrigation development and management- that there should be participatory approach at all levels*
- *Improved agronomic practices (that includes but not limited to nutrient management, pest and diseases)*
- *Yield per unit area and/or per unit volume of water used.*
- *Harvesting technology i.e. the type of technology*
- *Post harvesting management*
- *Marketing and marketing issues*
- *Financial management- whether there are any forms of financial managements and the issues revolving as around transparency and accountability of financial management*
- *Monitoring and evaluation system and review/implementation of new recommendations*

This list of criteria is not, however, exhaustive. In this paragraph, we have used criteria that we consider that they are more specific, objective and which take into account the local realities.

Sites	***Criteria***									
	Area of the irrigable zone	*Availability of water*	*Socioeconomic importance of the irrigated crops*	*Population involvement*	*Output (yield)*	*Marketing and marketing issues*	*Diversity of the crops*	*Accessibility*	***Total points***	***Rank***
	/10	***/10***	***/8***	***/8***	***/7***	***/7***	***/6***	***/6***		
RDCI	*10,0*	*8*	*8*	*8*	*7*	*7*	*6*	*6*	*60,0*	***1***
MPARAMBO	*3,9*	*9*	*8*	*8*	*6*	*6*	*6*	*4*	*50,9*	*2*
RUKOZIRI	*1,5*	*9*	*8*	*4*	*5*	*5*	*6*	*4*	*42,5*	*6*
RUMONGE	*1,9*	*8*	*6*	*6*	*7*	*6*	*4*	*4*	*42,9*	*5*
NYABIHO	*0,4*	*10*	*8*	*8*	*6*	*5*	*4*	*5*	*46,4*	*4*

MURAMBI	*0,5*	*10*	*8*	*8*	*6*	*6*	*4*	*6*	*48,5*	*3*

Table 3 : Multi-criteria assessment of best sites

Explanation

Area of the irrigable zone	C_i *: rate of site i* A_i *: area of site i*	$C_i = \frac{A_i * 10}{A_{max}}$
Availability of water	*Sufficient quantity at low cost*	*10*
	Sufficient quantity at moderate cost	*9*
	Sufficient quantity at high cost	*8*
Socioeconomic importance of the irrigated crops	*Very high*	*8*
	High	*7*
	Low	*6*
Population involvement	*Very active*	*8*
	Active	*6*
	Less active	*4*
Output (yield)	*Very high*	*7*
	High	*6*
	Medium	*5*
Marketing and marketing issues	*Near the centre of greater consumption (Bujumbura the capital of Burundi)*	*7*
	Less than 100 km of the Capital	*6*
	More than 100 km of the capital	*5*
Diversity of the crops	*Mixed crops*	*6*
	Single crops	*4*
Accessibility	*Very good*	*6*
	Good	*5*
	Difficult	*4*

Table 4 : Explanation of the listing procedure for best sites

III.5 Identification and assessment of best technologies

III.5.1 Selection process and salient features

The irrigation techniques are inventoried on the one hand, depending on the material used that will determine the mechanical efficiency (irrigated area per unit time) of the system and on the other hand according to their efficiency in the rational use of water. In this regard, we note:

- The basic techniques used in Class I and Class II. Those techniques (spray by hand with small containers, watering seals or irrigation pipes; earthen ditches with high uptake on an existing watercourse) have a low mechanical efficiency but they ensure a more economical use of water. The use of pumps which is a new technique improves significantly the mechanical efficiency;
- The more advanced technologies, common in categories III and IV (CMI, PPMI), which use the techniques of flooding or furrows. These irrigation methods are mechanically more profitable, but their effectiveness in saving water is low.

III.5.2 CMI and PPMI

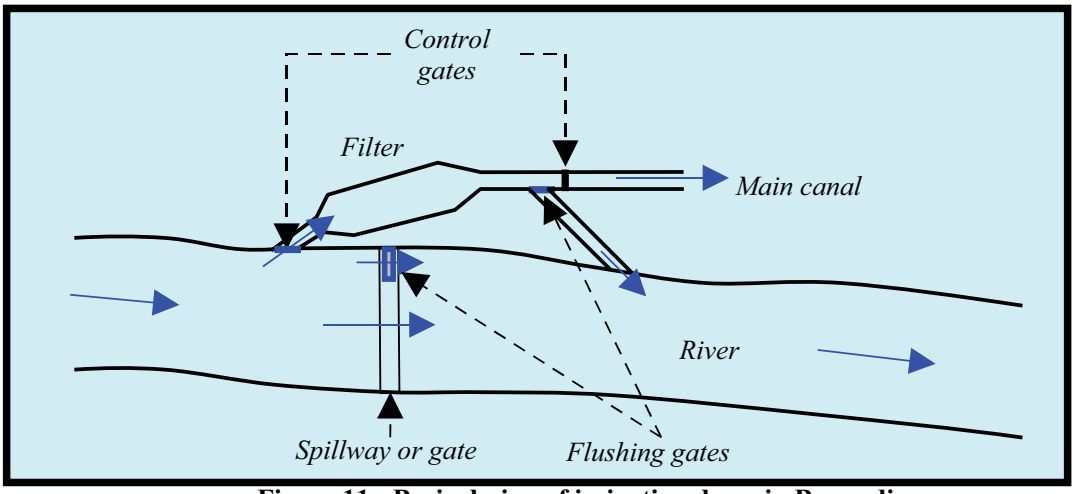


Figure 11 : Basic design of irrigation dams in Burundi

The hydraulic structures are the same and differ only in their size and simplicity. It is everywhere diversion dams (run-of-the river) with various supplementary constructions. The most comprehensive basic scheme is the one shown in Figure 11. Figures 12 and 13 illustrate two dams of the same basic design but with more sophisticated equipment for the first (Mpanda) and modest for the second (Muyogo).

Figure 12 : Upsteam view of the irrigation dam on the Mpanda river (RUKARAMU perimeter)

Figure 13 : Upsteam view of the irrigation dam on the Muyogo river (Rukoziri area in MAKAMBA)

III.5.3 List of the different technologies

In summary, the various irrigation techniques used in Burundi are:

- Micro-dams (1 to 2m³) in the marshes associated with manual spraying (with small conventional seals or watering);
- Earthen ditches (associated, in some times, to small basins for water collection on the spot and with a future use of an indigenous spraying equipment);
- Pumps, which is a new technique originally associated with the rainwater harvesting ponds;
- Watering pipes connected to an under pressure source
- Furrows
- Flooding

III.5.4 Multi-criteria assessment and ranking of best technologies

The conclusive evaluation criteria used are determined by the quality of the hydraulic structures and not on the technology used since, in BURUNDI, the same crops are virtually irrigated with similar techniques. That's why those criteria will be based logically on the observations made on land.

Figure 14 : Main canal in the RUKARAMU area (RDCI)

Figure 15 : Main canal in the RUKOZIRI area

Figures 14 (lined and well maintained canal), and 15 (non-coated and poorly maintained canal) are good examples to illustrate the difference in quality of irrigation facilities encountered in Burundi.

Sites	***Criteria***					***Total points***	***Rank***
	1. Proportion of lined canals (infiltration losses)	*2. Flow control and regulation at the intake*	*3. Operation and maintenance*	*4. Water reserve (reservoir)*	*5. Other equipments (filter, drains, security structures)*		
	/5	*/5*	*/5*	*/5*	*/5*		

SRDI	*3*	*5*	*5*	*0*	*4*	*17*	***1***
MPARAMBO	*0*	*5*	*4*	*0*	*2*	*11*	*5*
RUKOZIRI	*0*	*5*	*4*	*0*	*5*	*14*	*3*
RUMONGE	*0*	*5*	*4*	*0*	*3*	*12*	*4*
NYABIHO	*0*	*3*	*4*	*0*	*3*	*10*	*6*
MURAMBI	*3*	*5*	*4*	*0*	*4*	*16*	*2*

Table 5 : Multi-criteria assessment of best technologies

Proportion of lined canals	*Main canal*	*Lined*	*3*
		Unlined	*0*
	Secondary canal	*Lined*	*2*
		Unlined	*0*
Flow control and regulation	*Intake*		*3*
	By-pass		*2*
Operation and maintenance	*Very easy*		*5*
	Easy		*4*
	Difficult		*2*
Water reserve	*Seasonal reservoir*		*5*
	Short detention reservoir		*2*
	No reservoir		*0*
Other equipments	*Drains*		*3*
	Filter		*2*
	Security devices		*1*

Table 6 : Explanation of the listing procedure for best technologies

III.6 Detailed description of the best CMI site (DRCI)

Figure 16 : RDCI irrigated area

The RDCI perimeter is represented on the map below, which is not at all updated. The irrigated area of Rukaramu located on the west side of the former area is not represented on the general plan.

Figure 17 : General view of the diversion dam on the Mpanda river (RUKARAMU area)

Figure 18 : View of the main canal (RUKARAMU irrigated area)

The detailed description is given in annex 5 (**joined excel file**)

III.7 Detailed description of the best PPMI

III.7.1 Main features

As mentioned in paragraph III.4.1, there is only one true industrial exploitation of this kind: the Sugar Company of Moso (SUCOMO). Figures 21 and 23 illustrate the major hydraulic equipments of the irrigation system and the immensity of the extent of the perimeter.

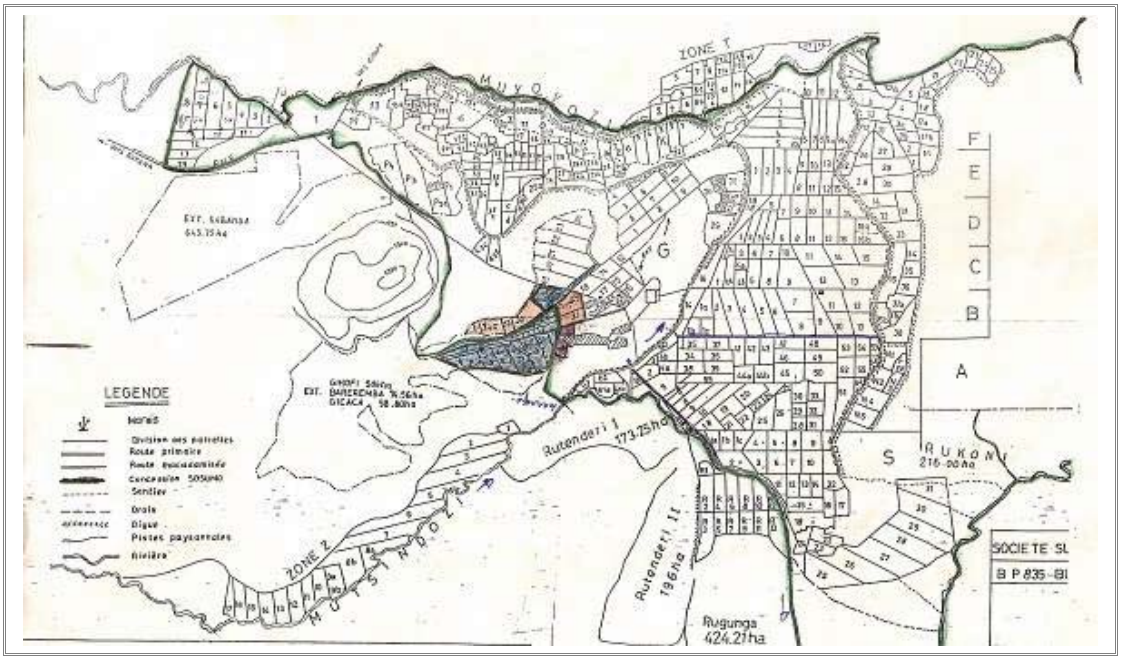


Figure 19 : Master plan of the SUCOMO area

Figure 20 : View of the spillway-dam on the Mutsindozi river (SUCOMO)

Figure 21 : View of the pumping station on the main canal (SUCOMO)

Figure 22 : View of a sugar cane field at GIHOFI (SUCOMO)

Figure 23 : Night storage reservoir (SUCOMO)

III.7.2 Detailed description of SUCOMO

The detailed description is given in appendix 6 (joined excel file)

IV. WATER HARVESTING

IV.1 Main features

The water harvesting for irrigation is a practice not common in Burundi. We note that initiatives are beginning to emerge, with however, a lot of gaps in terms of their economic viability.

The information collected from the best sources and field visits allowed to identify three types of facilities:

- The collection of rainwater through the gutters for domestic consumption (Figure 24) : The storage of water in the tank for a long time could degrade its quality ;
- The storage of water runoff in artificial ponds during the rainy season for irrigation during the dry season (figure 25). Four sites, including three in commune BUGABIRA (Nyamabuye, Gaturanda, Kigina) and the other in Bujumbura city, are currently operational. The cost of such constructions which is estimated at 25000FBu/m³ (≈ 25USD / m³) for a well-lined basin is difficult to amortize. It is in this context that a private association called AGAKURA (in

Makebuko commune, GITEGA province) has set a target to develop rainwater harvesting systems tailored to the socio-economic situation of the country.

- Facilities for water conservation (progressive or radical terraces) and combating erosion (Figures 26, 27) with eleven achievements in provinces GITEGA, KARUZI, MWARO, KAYANZA and CIBITOKE (Table 7). Under the supervision of the DAPL and PDALs, radical terraces were introduced in 2001 as part of erosion control and increasing agricultural production. The initiators of the technique were inspired by results of this practice in Rwanda. Initiated under PRDRZ financing, the project currently under responsibility of PDALs has not spread as planned although its effectiveness in water conservation and improvement of agricultural production is evident.

Figure 24 : Collecting rainwater for domestic consumption at GASORWE (MUYINGA)

Figure 25 : Collecting rainwater for irrigation at BUGABIRA (KIRUNDO)

Location		*Total area (hectares)*
Province	***Commune***	
CIBITOKE	*Mugina*	*2.5*
	Mabayi	*6.0*
KAYANZA	*Kabarore*	*5.0*
	Kayanza	*1.5*
	Gatara	*5.5*
KARUZI	*Buhiga*	*5.0*
	Gitaramuka	*6.7*
GITEGA	*Gitega*	*3.0*
	Bugendana	*4.0*
	Mutaho	*5.0*
MWARO	*Gisozi*	*18.0*

Table 7: Radical terraces sites

Figure 26 : Construction of a radical terrace in KARUZI province

Figure 27 : View of a radical terrace recently constructed at GITEGA

Let's note however that there are other practices at the individual level, such as:

- traditional troughs (for cattle);
- The collection of roof water in small containers for domestic consumption in rural areas;
- The collection of roof water in largest PVC or steel tanks for domestic use, other than direct consumption (drinking), in urban areas (washing-up, flushing in toilets, watering of gardens)

IV.2 Detailed description of the water harvesting pond of Nyamabuye

Initiative	GBAE
Funding	GAA
Irrigated crops	cereals, sweet potatoes, potatoes and fruits

Parameter	**Value**
Rainfall (mm/an)	1000
Watershed area (ha) at the intake	Unkown
Total volume (m^3)	2400
Evaporation (mm/year)	1200
Total cost (US D)	9000
Unit cost (US D / m^3 of basin)	3,750
Irrigated area (ha)	3
Number of beneficiaries	1

Table 8 : Specifications of the WH pond of Nyamabuye

Remark:

The basins had to be filled in the rainy season but are nearly empty (Figure 25) certainly because no serious study (topography, hydrology, soils) has been performed before the construction of those ponds. Normally, the DAEPL which is responsible for setting up irrigation works should have been consulted to endorse their construction, but that did not happen.

The cost of 3,75 USD/m^3 calculated for these basins is very low because they are not watertight and the system of collecting water is not effective. The actual cost of construction is estimated at 25USD/m^3 as mentioned above.

V. Location of the main irrigation and WH sites

Figure 28 : Location (communes) of the main irrigation and water harvesting sites

VI FIELD VISITS AND FINDINGS

VI.1 Potential for development

The field visits have enabled us to detect the enormous potential of the country in terms of irrigable areas and availability of water resources : dense network of waterways, lakes (figures 29, 30), possibility of stormwater reservoir, wastewater reuse.

Figure 29 : Lake Dogodogo in RUGOMBO (outlet of drains)

Figure 30 : Lake Rwihinda in KIRUNDO

While irrigation in marshes is growing, mountain land irrigation, which could be realized in several areas of the country, is almost non-existent.

The opportunities to develop are:

- A large and young population who could be employed in irrigation and development works; some of them, as in the plain of the IMBO have already mastered irrigation techniques;
- Very favourable climatic conditions allowing multiple cropping cycles in rain-fed agriculture, and an adaptation of a wide range of plant species;
- A dense river network allowing a total or partial irrigation over large areas of lowland or high plateau;
- Plains, plateaus, pasture land and marshes that could be fertilized and developed for irrigated agriculture and forestry;
- A important leeway in terms of intensive agriculture, forestry, fisheries and diversification of crops;
- Integration into dynamic subregional or regional organizations, particularly in the Common Market for Eastern and Southern Africa (COMESA);
- International solidarity (IFAD, FAO, WB,…) which has always played an important role in agricultural development

VI.2 Impact of the different practices

- **Environment** : various facilities have a positive impact on the environment because they enhance vegetative cover. However, the absence of drainage structures in some irrigated areas leads to a stagnation of the irrigation water and the proliferation of mosquitoes, which can lead to outbreaks of malaria. The stagnant water can also be a source of spread of schistosomiasis. After rice harvesting, mainly in the west part the country, the cattle herds which are attracted by the abundance of fodder destroy the secondary and tertiary canals and compress the soil which loses its structure and therefore its fertility.

- **Socio-economy** : Irrigation has helped to fight hunger in many areas, particularly in KARUZI, through greater production and diversified crops. The various developments have also enabled local people to earn money during the time of construction. Irrigation can however be a source of conflict. For example, in the Bubanza province, there is a fierce

competition for water between farmers who are supervised by the SRDI and those located outside the perimeter. Indeed, the first pay a fee for the water used while the latter does not pay.

- **Efficiency of the water use** : the irrigation methods used do not allow a rational water management. Within the RUKOZIRI area for example, it was noted that the technique of furrows used for food crops causes a gradual erosion because farmers wanted to use the maximum flow to finish the job in the shortest time. In other sites, the technique of flooding leads to a hardening of land, which makes plowing difficult in areas with two harvest seasons per year.

VI.3 Limitations and opportunities for replication and scaling up

VI.3.1 Irrigation

The expansion of irrigation at the national level is limited by the relief which is very mountainous in many parts of the country.

As mentioned in the preceding paragraphs, two major irrigation techniques are used on a large scale:

- the flooding technique can be used everywhere in low-lying areas and wetlands (swamps and plains), but the best yields are obtained in hot weather;
- Furrows used for food crops can also be applied in the all areas where irrigable lands are available. It does not, however, ensure an efficient use of water and should be replaced by another technique more effective like spraying. The cost of the required energy remains an insurmountable financial constraint in BURUNDI.

VI.3.2 Water harvesting

The collection of water (running water, storm water) for irrigation is a good practice that should extend throughout the country. This practice is effective because it can temporarily store a volume of water required to be used when needed.

The best practice in this area, however, would consist in building storage dams with high-capacity wherever topography is favourable and where irrigable areas are available. The expansion of water harvesting in artificial ponds is limited by three parameters:

- the pond (tank) must be lined and evaporation controlled in order to minimize the losses;
- the catchment's area must be large enough to harvest large quantities of water in a short time;
- the irrigable area must be large enough in order to obtain return on the costs invested

VI.4 Challenges

1. A low level of involvement of beneficiaries in some cases, as in Makamba for example, due to the lack of training and information on the merits of the facilities put in place. The involvement of users and beneficiaries will not solve all the problems, but will help to implement more effective participatory approaches and an appropriation of the irrigation developments.
2. An insufficient coordination of the services involved in the field of irrigation. This leads to mismanagement of resources, bureaucracy and inefficiency of the actions taken. Indeed, agriculture (and water) is multisector-based and therefore its structures are divided among several ministries of which the most involved are (i) the Ministry of Agriculture and Livestock, (ii) the Ministry of Public Works, Land Planning and Environment, (iii) the Ministry of Development Planning and Reconstruction and finally the Ministry of Finance. In addition there is some overlapping between different departments and even within some of them. The result is a reduction in efficiency, duplications and malfunctions.

3. The stoppage of cooperation programs has greatly weakened public support for producers, both in terms of staffing and financial resources. The same is true in the structures of research (AIBU, FAS, AZRI, …) whose role in the development of good practices should be dominant.
4. In the design phase of irrigation projects, there is always a weakness in the establishment of instruments needed to make the project sustainable. The prerequisite for the sustainability of irrigation projects are among other respect for the environment, sustainable management of water, and a setting up of plans for a successful integration and transfer of the results to persons or of structures prepared for that purpose.
5. As a consequence of the foregoing, the maintenance is deficient everywhere and vandalism is observed in most of the irrigated areas of the country (Figures 31 to 34).

Figure 31 : Uncomfortable road to the dam of Nyakagunda (RUGOMBO)

Figure 32 : An non cleaned irrigation canal in the RUGOMBO-CIBITOKE area

Figure 33 : Marks of cattle in an irrigated area (MAKAMBA)

Figure 34 : Gates stolen on a small dam (Kadohaka river in KARUZI)

6. A lack of specialists in natural resources management and irrigation techniques which could only be remedied by training ;
7. The demographic pressure due to a high population growth (average rate of 3% per year) leads to reduction of arable (which is a source of social conflict) land in general and irrigable areas in particular;
8. The extension of the urban area of Bujumbura, which significantly reduces an agricultural area very fertile and easily irrigable;
9. The remoteness of certain areas of production, the degradation of rural roads, the destruction of socio-economic infrastructures, the disruption of the functioning of trading centres and the lack of trade flows, constitute obstacles which do not encourage an increase in production and as corollary, the lack of enthusiasm towards the use of irrigation.
10. A professional organization almost non-existent in the rural zone. This lack of organization prevents farmers to develop themselves and defend their rights

11. A low purchasing power of all segments of the population including urban centres which normally constitute the backbone of the local market.

VII GUIDELINES AND LEGISLATION

VII.1 Guidelines

VII.1.1 Policy of management of water resources environment

The national policy management of the water resources of Burundi has been prepared and discussed at a workshop held in February 2000. Unfortunately, the programs and projects relating thereto have not yet borne fruit. We seriously regret the lack of centralization of data that makes difficult and often false the different technical studies on the development of irrigation systems.

Three ministries are directly responsible for the management of natural resources and the environment: the Ministry of Agriculture and Livestock (MAL), the Ministry of Energy and Mines (MEN) and the Ministry of Public Works, Land Planning and Environment (MPW & LPE).

The management, protection and conservation of the water resource is under the MPW & LPE, while the responsibility for the operation and land use lies with the other ministries involved in water resources management, by the nature of their activities or the activities under their supervision.

The DAEPL (MPW & LPE) is normally responsible for the design and monitoring of irrigation, structures and agricultural buildings. It is also responsible for the collection and management of hydrometeorological data, the extension of the methods of conservation of water and soil, as well as the monitoring of their application.

It was established a National Water Commission, an interdepartmental apparatus for water resources management under the supervision of the Ministry of Energy and Mines. The Ministry of Agriculture and Livestock is responsible, among other things, to supervise the farmers in the area of agricultural production, livestock , water management and soil conservation .

In terms of quality, despite the erosion due to the rugged terrain and inadequate anti-erosion devices, the quality of surface water is suitable for irrigation and fish farming.

VII.1.2 Prospects for water management in agriculture

The overall objective of the sector-based policy of MPW & LPE in terms of water resources is to improve their management and protection. The specific objectives are:

- to evaluate the availability of water, water demand and pollution risks,
- water management with a view to increasing agricultural production and awareness of government and policy makers for their implication in the ongoing negotiations regarding water sharing.

The Ministry of Agriculture and Livestock, in consultation with the MPW & LPE, intends to promote small-scale irrigation, improve knowledge of the potential of marshes and put in place a blueprint for their development and enhancement. Thus an irrigation project of all the seed centres was developed. However, the general implementation of this project has not yet been achieved.

In the water management field, the DAEPL has developed a program to retain rainwater, development of small-scale irrigation, development of wetlands, and anti-erosion actions. These initiatives have not yet seen the success.

VII.2 Legislation

The legislation on water management can be found in the following documents:

1. *Decree of 6/5/1952 amending articles 16 and 20 of the Civil Code, Book II*
2. *Decree of 6/5/1952 (Groundwater water, lakes and rivers, as well as their use)*
3. *Decree-Law No. 1 / 41 of 26 November 1992 (Institution and organization of the hydraulic public domain)*
4. *Proposed Water Law 1992, Chapter II: Irrigation*
5. *Code of the Environment*
6. *International agreements (NBI, KBO, TANGANYIKA) for the management of transboundary water*

The various pieces of legislation are not at all explicit and do not practically contribute to an efficient use of water for agricultural production. For example, the chapter irrigation in the proposed water law of 1992 is written in five articles as follows:

Article 51
The owners of irrigated farmland are required to conduct a rational development and an optimal use of water resources.

Article 52
Each beneficiary must ensure that the water used for irrigation is not a source of diseases spreading, especially by avoiding stagnant water.

Article 53
The use of water for irrigation is set by regulation.

Article 54
The technical conditions for realization of irrigation projects, operation and maintenance of facilities for irrigation, are set by regulation.

Article 55
The management of the irrigation and/or drainage infrastructures, can be carried out by farmers, individually or grouped into WUAs, with the assistance of the public technical service supporting this kind of activity

VIII INVENTORY OF THE MAINS ACTORS

The main actors or institutions for twinning the activities can be sorted in three categories :

VIII. 1 Public services

The Government, through the Ministries of (i)Agriculture and Livestock; (ii)Public Works, Land Planning and Environment; (iii)Education (Research) of and their various technical services (PDAL, AIBU, AZRI, GDAE, DAEPL), draws up and monitors the implementation of the agricultural development policy.

However, the budget decrease has been a handicap to the functioning of these structures. This situation is somewhat tempered in the Provinces of intervention programmes financed by IFAD and the World Bank (PRDRZ, TPPCR, PRASLM, NPEC). The list of the major governmental projects and agencies involved in the field is given in Table 8.

Acronym	*Signification*	*Main address*	*Contact*
DAEPL	*Department of Agricultural Engineering and the Protection of Land*	*Gitega*	*0025722402281*
PDAL	*Provincial Directorate of Agriculture and Livestock*	*Provincial centers*	
GDAE	*General Directorate for Agricultural Extension*	*Bujumbura*	*0025722223437*
RDCI	*Regional Development Corporation of Imbo*	*Gihanga*	*0025722272037*
AIBU	*Agronomy Institute of Burundi*	*Bujumbura*	*0025722218743*
BP	*Bututsi Project*	*Bururi*	*0025722502101*
SUCOMO	*Sugar Company of Moso*	*Gihofi, Bujumbura*	*0025722275002 0025722224819 sosumo@cbinf.com*
PRDRZ	*Program for Renewal and Development of Rural Zones*	*Bujumbura*	*0025722243096*
TPPCR	*Transitional Program for Post-Conflict Reconstruction*	*Avenue du 13 Octobre Bujumbura*	*0025722249251*
PRASLM	*Project for Rehabilitation of Agriculture and Sustainable Land Management*	*Blvd du 1er Nov Bujumbura*	*0025722248696*
NPEC	*National Program for Erosion Control*	*Bujumbura*	*00257222173003*

Table 9:Inventory of the main publics services involved in the irrigation and WH sectors

The **PRDRZ** seeks (i)to increase the productive capacity of poor farming communities, (ii)to increase household food security, (iii)to promote a participatory and decentralized development (iv) ensuring environmental protection. Particular attention is given to technological innovation and biological methods of soil conservation. In terms of implementation, more than 2000 hectares of swamp have already been developed (irrigation and drainage) for the benefit of intensive agricultural production.

The **TPPCR** will participate in the increasing of agricultural production by the revitalization of the seed sector, the supply of inputs and livestock restocking. It will also undertake training activities leading to a community participatory development. In practice, basic rural infrastructure, such as systems for drinking water, wells and roads will be rehabilitated. Marshland development (irrigation and drainage) is being implemented to increase arable land and hence agricultural production.

The **PRASLM** has as main objective to restore the productive capacity of rural areas, through investments in production and sustainable land management, and through capacity building for producer organizations, and local communities. The Project has three main components:

1. ***Support for production and sustainable land management investments***, will finance demand-driven subprojects, and their effective planning, and implementation by producer organizations and local communities. It will also provide emergency support for returnees, and internally displaced persons, seeking their reintegration in the agricultural sector;
2. ***Support for capacity building and institutional strengthening***, will enhance access to information, and capacity of producer organizations, local communities, and local project's implementing agencies.
3. ***Support for Project coordination and management***, will finance Project management activities, including monitoring and evaluation.

VIII.2 NGO's

NGOs are involved in disseminating improved technologies, the implementation of irrigation systems, support and advice, research funding, the organization of agricultural production. They sometimes ensure the role as a link between the government and producers. The addresses of these NGOs are given in Table 9.The main NGOs working or having worked in the agricultural sector are:

CRS

This NGO is implementing a integrated watershed management program from 2003 in Kirundo Province, in the extreme northwest of Burundi on the Rwandan border. The goal is to improve food security and strengthen livelihoods among rural households through agriculture and watershed management. The detailed objectives consist in :

1. *Development of 150 hectares of wetlands*
2. *Development of 4000 hectares of steeplands/watershed*
3. *Making available improved seeds and other agricultural inputs throughout program area in collaboration with national and regional agricultural research institutes*
4. *Improving access to markets by rehabilitating 50 km of rural roads*
5. *Improving access to potable water by constructing 7 km of water pipe, 10 water sources, and six water troughs*
6. *Creating agro-enterprise opportunities within target communities*

GAA

The GAA has as main objective the improvement of food and agricultural training. This NGO which has funded the construction of the water harvesting ponds of Bugabira and the development of many swamps in Kirundo province.

AAH

The Action Against Hunger organisation focuses on training (including irrigation techniques) in order to increase agricultural production. Its area of operations covers mainly the provinces of Ruyigi, Bubanza, Kayanza and Ngozi

ACORD

ACORD is supporting communities mainly returnees and displaced people to reconstitute their food security (displaced and returnees) through rebuilding their means of production in area of livestock and agriculture. The approach is that the community organizations and social systems around these livelihood activities, including the emerging structures, become segments of the social movement that demands and claim for its rights.

ADRA BURUNDI

The agency works mainly for the development of the rural zones. This NGO funded and monitored the construction of the rainwater retention tanks in the site of persons displaced by war in Gasorwe

ARP

The organization has funded and monitored the irrigation system of the Rugombo-Cibitoke irrigated area between the years 1979 and 1984.

CARE BURUNDI

CARE helps families produce more food and increase their income while managing their natural resources and preserving the environment for future generations. CARE works with farmers to increase their crop and livestock yields through activities such as planting new seed varieties, animal husbandry, home gardening and irrigation. Its area of operations covers mainly the provinces of Cibitoke, Bubanza, Ngozi, Bururi, Muyinga and Gitega

GBAE

This NGO is disseminating a stormwater retention program and it is, in this context, that it has built the water harvesting ponds of Bugabira and Bujumbura.

Acronym	*Signification*	*Main address*	*Contact*
GAA	*German Agro Action*	*JRR avenue, 45 Bujumbura*	*00257 22 2256 76* aaabdi@cbinf.com
AAH	*Action Against Hunger*	*Avenue Muyinga, 37 Bujumbura*	*0025722242331*
GBAE	*Green Belt Action for the Environment*	*Hotel NOVOTEL, room 205 Bujumbura*	
ACORD	*Agency for Cooperation and Research in Development*	*Chaussée PLR, 7 Bujumbura*	*00257 22 21 83 09* Acord@cbinf.com
ADRA	*Adventist Development and Relief Agency*	*UPRONA avnue, 111 Bujumbura*	*00257 22 21 21 46* Adrabdi@cbinf.com
ARP	*Australian Relief Program*	*Martin Luther King, 24 Bujumbura*	*00257 22 21 74 06* Arpbdi@cbinf.com
CARE		*Boulevard du 28 Novembre, 3 Bujumbura*	*00257 22 21 46 60* Carebur@cbinf.com
CRS	*Catholic Relief Service*	*Muyinga avenue, 5 Bujumbura*	*00257 22 22 40 07* crs@cbinf.com

Table 10: Inventory of the main NGOs involved in the irrigation and water harvesting fields

VIII.3 Financial organizations and bilateral cooperation

The main donors or lenders involved particularly in the development of the agricultural sector (table 10) are the ADB, WB, IFAD, the Belgian and Chinese cooperation.

The **World Bank** supports the Government in its post conflict and transition to development programme through a strategic plan based on several types of projects such as:

- Agricultural production and land productivity;
- Diversification of sources of income in rural areas;
- Sustainable land management;
- Promoting agricultural services which are easily accessible and of good quality;
- Institutional capacity building

The **African Development Bank** (ADB) is financing several development programmes particularly in the area of food security through the financing of projects for (i)intensification and diversification of agricultural production, (ii)support for the livestock and fisheries, (iii)the preservation of natural

resources, (iv)technology transfer, (v)development of rural infrastructure (upgrading of the road network for better integration of agricultural production zones to the local and regional markets) and (vi) support for income-generating activities. The main projects funded (through the IFAD) are PRDRZ and TPPCR.
The **International Fund for Agricultural Development** (IFAD) operates in the country since the 1980 through various agro-zootechnical projects. Since January 2000, IFAD is financing the PRDRZ and the TPPCR. The outlook of IFAD in Burundi fall within the general framework of the national development policy in the agricultural sector.

The **Belgian cooperation** aims, at the medium term, to the resumption of agricultural research programmes (ISABU, IRAZ, FACAGRO) abandoned since the beginning of the crisis. The Belgian cooperation also supports the PDALs in carrying out some tasks entrusted to them.

The **FAO** operates particularly in Burundi through the Special Programme for Food Security (SPFS) and the Regional Programme for Food Security (RPFS). In Burundi, these projects are focused on the development of integrated and participatory marshes (and lowlands) development. The goal is to make available additional agricultural potential by, (i) restoring and improving the fertility of watersheds, (ii) the setting up of anti-erosion fodder and (ii) the strengthening of local capabilities (training / demonstration) for the grassroots communities, for a self-supported development activities. The FAO intend to extend its pilot programs to all agro-ecological zones of the country in order to ensure a sustainable growth (at low cost) of agricultural production and improve food security.

It was thanks to the **Chinese Cooperation** that was constructed the irrigation works in the Rukaramu irrigated area.

The list of the main Financial organizations and bilateral cooperation which supports the agricultural sector is given in table 10.

Acronym	***Signification***	***Contact (in Burundi)***
SFD	*Stabilization of Foreign Trade*	
(FAO	*Food and Agriculture Organization*	*Blvd du Peuple Murundi* *0025722222655*
UNDP	*United Nations Program for the Development*	*3, Avenue du Marché* *00257 22 22 31 35*
IFAD	*International Fund for Agricultural Development*	
ADB	*African Development Bank*	
OPEC	*Organization of Petroleum Exporting Countries*	
KB	*Kingdom of Belgium*	*22, Rue du 18 Septembre* *0025722223931*
PRC	*People's Republic of China*	*Quartier Vugizo* *00257 22 2 4307*
WB	*World Bank*	*6, Avenue du 18 Septembre* *00257 22 22 24 43*

Table 11: Inventory of the main donors supporting the agriculture and water harvesting sectors

Remark
Farmer organizations that ensure the coordination of activities and the protection of the agricultural producers' interests can also be considered as partners.

IX Conclusion and recommendations

The present work had as main objective the identification and evaluation of the best irrigation sites and techniques in Burundi. To get there, we conducted a thorough literature review followed by other deep investigations and targeted field visits. The latter were very decisive for an updated assessment of existing irrigation systems.

The field visits have enabled us to detect the enormous potential of the country in terms of irrigable areas and availability of water resources (dense hydrographic network, lakes, possibility of stormwater reservoir, wastewater reuse,…). However, this potential is under-exploited because irrigation is practiced only on about 15000 hectares for a potentially irrigable area of over one million hectares, that is about 1.57% of the irrigable area.

The main handicap to the development and expansion of irrigation are essentially (i)a very mountainous terrain in most regions, (ii)poor coordination of stakeholders, (iii) the energy deficit not permitting the use of modern technologies more efficient in terms of water management and mechanical performance (to be evaluated in terms of irrigated area per unit time).

During the inventory of best practices in the field of irrigation, it was very difficult to assess separately the irrigated sites and the technologies used since, in BURUNDI, we practically use the same methods to irrigate the same crops. As mentioned above, these techniques are poorly diversified and are inefficient in terms of water saving and mechanical performance. For this reason, the previous study to identify and assess sites and existing irrigation techniques should be followed by another aimed this time, on the one hand, to develop appropriate technologies and elucidate their impact and, secondly, to propose the principles and considerations to improve the current technology.

The other negative specificity of Burundi is the lack of centralization and updating of data. For this reason, one should not overly rely to bibliographical documents found here and there because a significant proportion of these documents (based on false data) do not conform to the reality. The latter requires a lot of field visits and investigations and hence a lot of resources (in terms of funding and time) that some authors had not, and that others have not exploited. Indeed, data related to a given irrigation facilities can usually only be obtained within the PDAL of the constituency or the agency that funded or monitored the development of the irrigated area. In our report, the figures used are derived mainly from field investigations and FAO websites.

An Economic Feasibility Study (in terms of payback) for water harvesting ponds is required. Indeed, their costs estimated at around 25USD / m^3 seems to be exorbitant and dissuasive. One should rather focus on dams which typically allow to store a considerable volume of water at a more competitive price.

Ultimately, the challenges that determine appropriate strategies are:

- The coordination of the main actors in the field and developing a suitable legal framework;
- The centralization of data and studies : the DAEPL, PDAL, GDAE should have a copy of all studies related to the development of irrigated perimeters ;
- The setting of reservoirs in sensitive areas;
- An increasing of the energy capacity in order to widen the irrigated area and use more efficient irrigation methods;
- A search for funding to expand the irrigated area and rehabilitate damaged infrastructures;

- An effort in the maintenance of infrastructure and awareness in order to perpetuate the different irrigation projects.
- Family planning to reduce population growth pressure;
- Expansion of markets and developing of a policy for conservation of crops; these initiatives would encourage farmers to produce more;
- Technical training at all levels and strengthening of research institutions;
- To promote farmers' associations and instill in them the right road in the management of natural resources and the respect of common property;
- Restoration of the land fertility by integrating agriculture, forestry and zootechnical associated with a rational management of water and soil. In fact, the farmers who practice irrigation would be encouraged if their efforts are rewarded, i.e. if the yield is significantly improved.

Following the example of SUCOMO with its multi-purpose hydraulic systems, the country could benefit from the availability of water to build fish ponds in order to increase fish production and thereby enrich the diet of the population.

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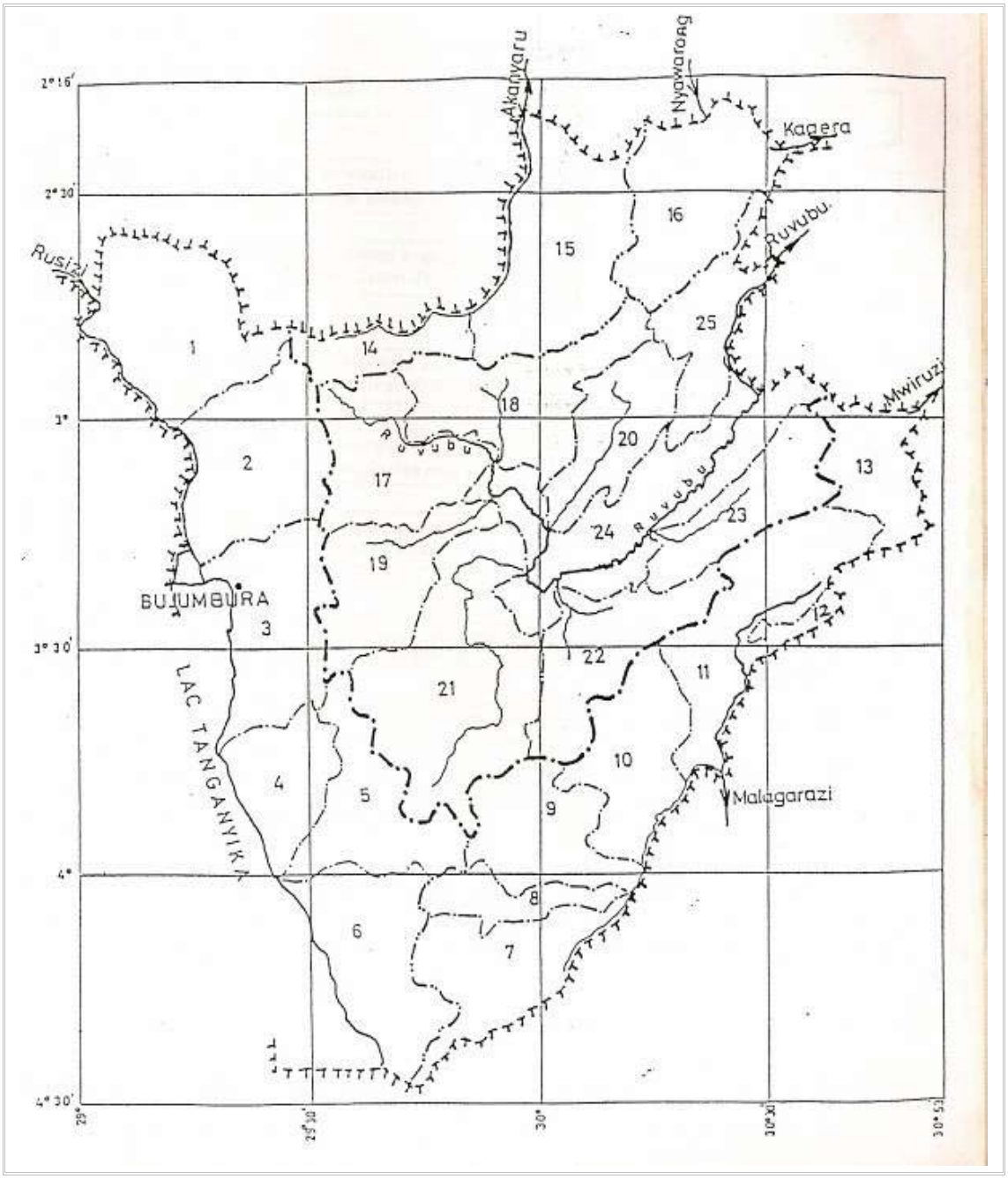
XI. APPENDICES

Annex 1 : Watersheds' map of Burundi

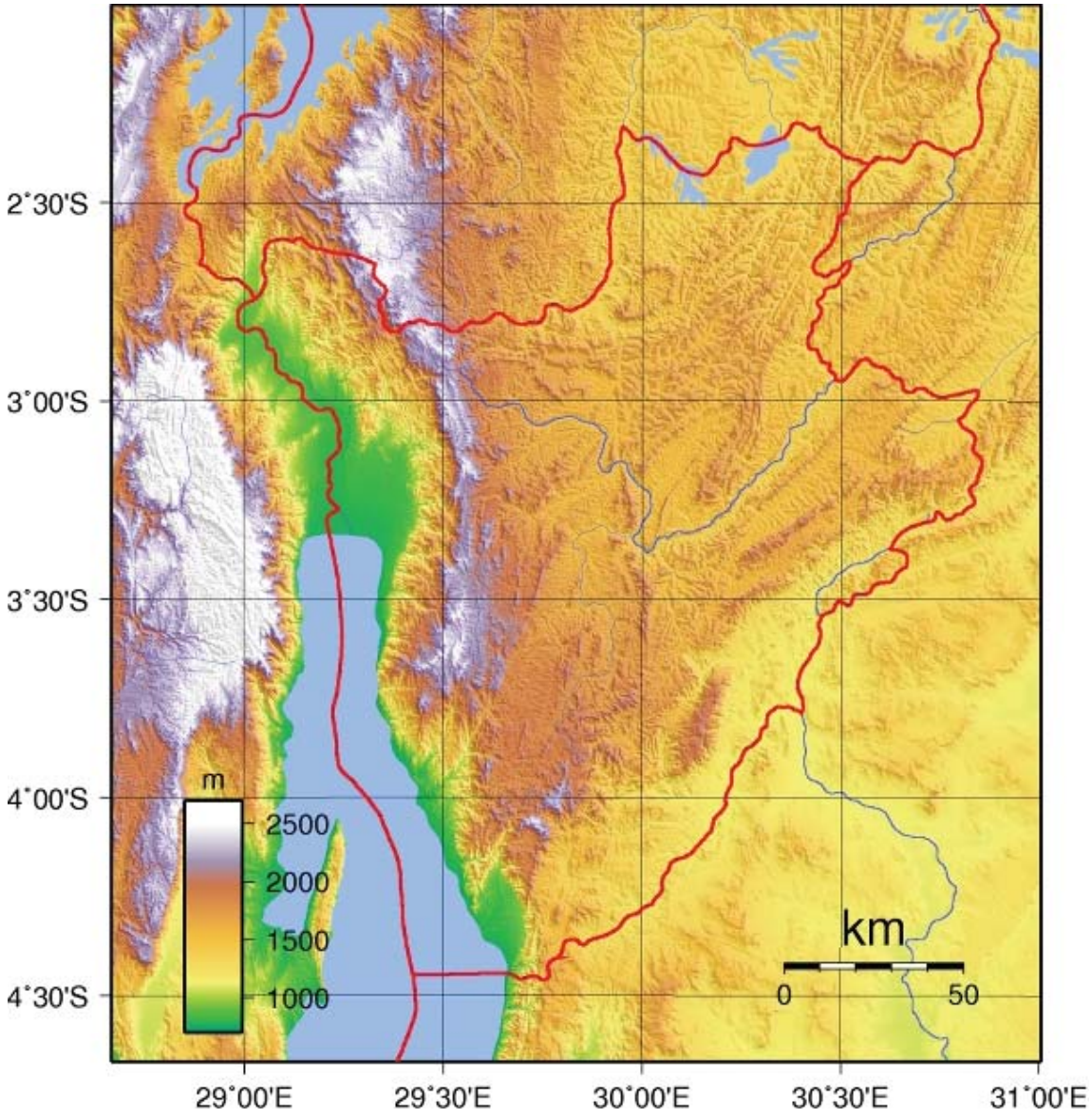


Boundary between the two main watersheds

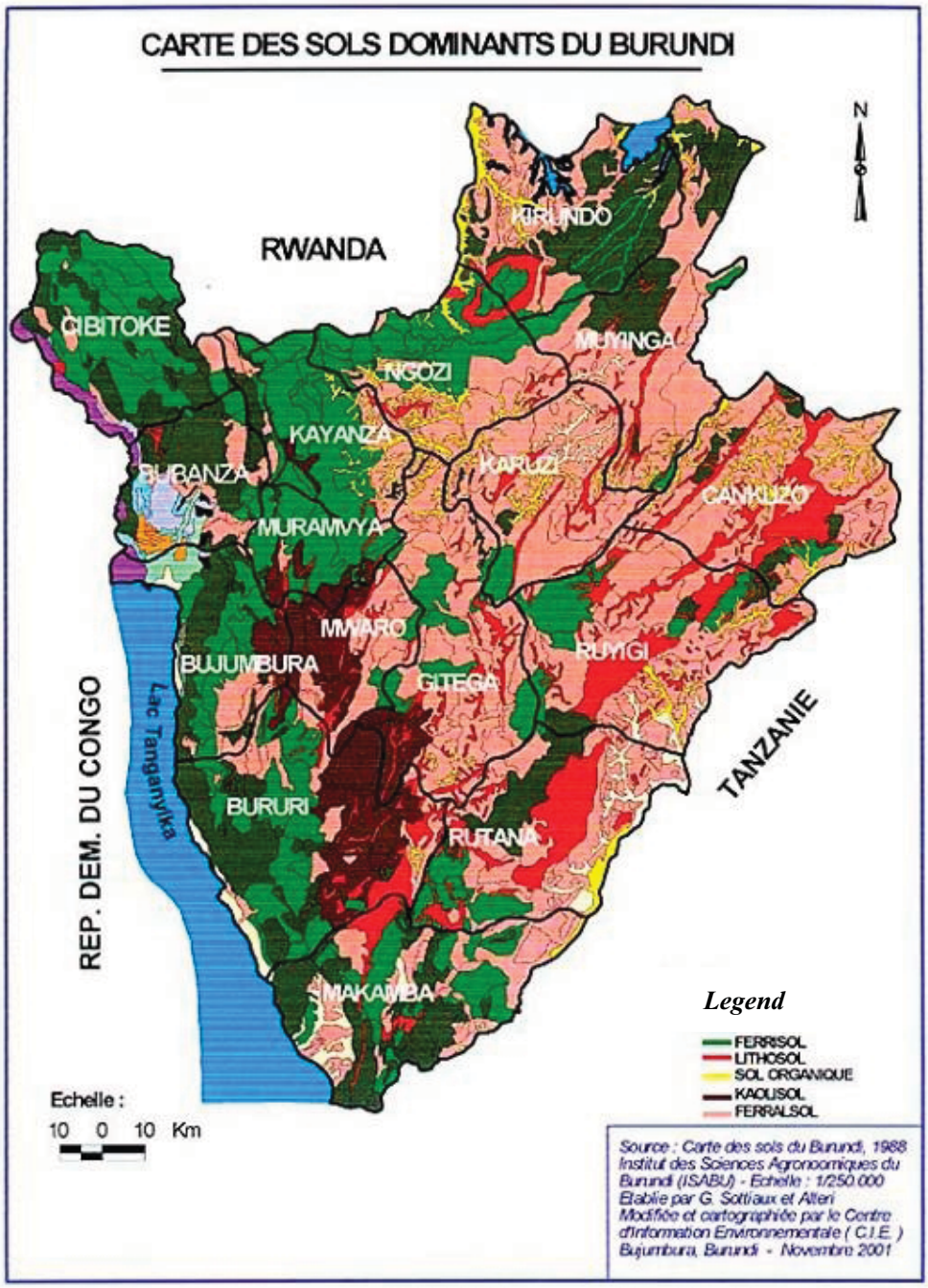
Boundary between secondary watersheds

Boundary between tertiary watersheds

Annex 2: Topography's map of Burundi


2°30'S
3°00'S
3°30'S
4°00'S
4°30'S
29°00'E
29°30'E
30°00'E
30°30'E
31°00'E
m
2500
2000
1500
1000
km
0
50

Annex 3 : Soils' map of Burundi



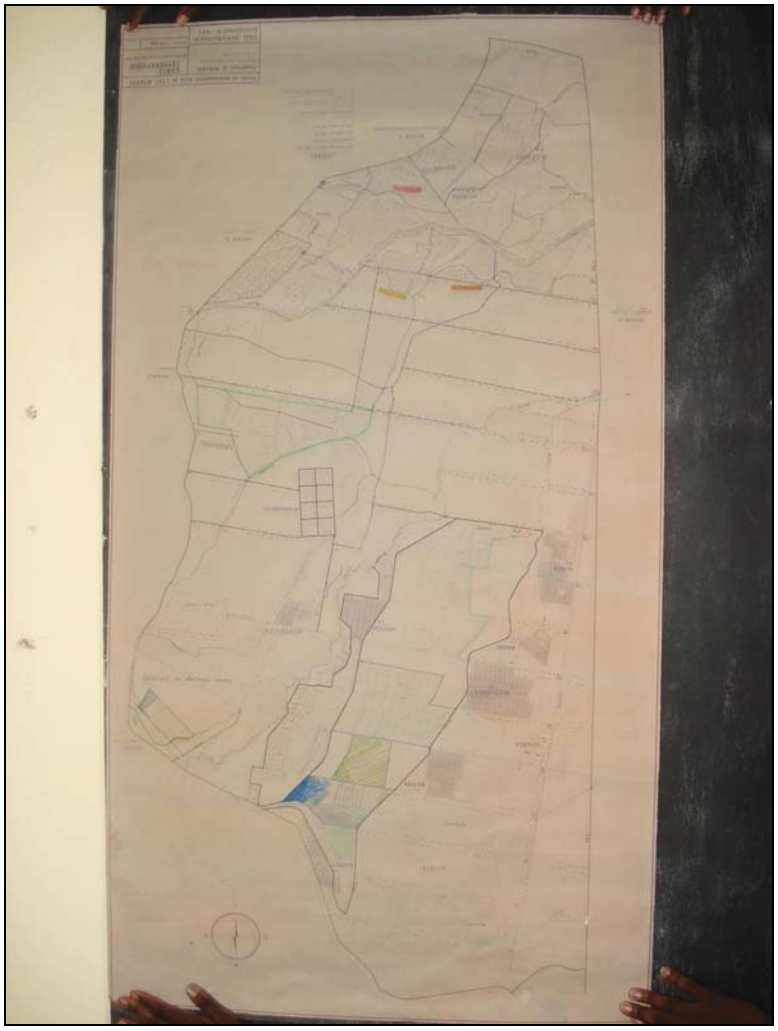
Annex 4 : Inventory of irrigated areas in Burundi

Inventory of irrigated areas per province and per AEZ									
Province	N°	Site	Construction	AEZ	Irrigated crops	Area	Beneficiaries	Supervision	Funding

			n						
		(Perimeter)				(ha)			
BUBANZA	1	Mugerero	1969	1	Rice, food crops, palm grove	2490	5702	RDCI	
	2	Mpanda Est	1984	1	Rice	1700	3893		
	3	Rukaramu	1998	1	Rice, food crops	1050	2405		
BUJUMBURA	4	Gikoma	2007	2	Rice	260	1040	TPPCR	WB
	5	Bugoma	2007	1	Rice	128	512		
BURURI	6	Rumonge	1986	1	Palm grove	1000	1000	POO	POO
	7	Rwira	1986	3	Food crops	95	**PMI**	BUTUTSI Project	ADB
	8	Gateza	2007	3	Food crops	74	162	TPPCR	
CANKUZO	9	Nyabibugu	2006	5	Rice	60	574	FAO	
	10	Gahama	2007	5	Rice	50	408		
CIBITOKE	11	Rugombo-Cibitoke(Mparambo)	1960	1	Rice, food crops	2043	3960	PRDRZ	IFAD, OPEC
	12	Murambi	2001	1	Rice	268	518		
	13	Kansenga	2004	1	Rice	60	145		
GITEGA	14	Kagoma	2003	4	Rice	178	419	PRDRZ	IFAD, OPEC
	15	Kagogo - Gisuma	2001	4	Rice	91	3294		
	16	Ntawuntunze	2003	4	Rice	107	1823		
	17	Kiganga	2004	4	Rice	115	1145		
	18	Kibuye	2004	4	Rice	22	235		
KARUZI	19	Nyabiho I	2003	4	Rice	70	675	PRDRZ	IFAD, OPEC
	20	Nyabiho II	2003	4	Rice	77	331		
	21	Nyabiho Centre	2003	4	Rice	81.81	667		
	22	Nyamugari	2004	4	Rice	30.62	324		
	23	Ruhamba	2002	4	Rice	93	780		
	24	Gisuma	2002	4	Rice	62	515		
	25	Kigina	2004	4	Rice	42.14	460		
	26	Rusheri	2004	4	Rice	33.65	421		
	27	Busosa	2004	4	Rice	21.06	270		
	28	Gatare	2004	4	Rice	21.48	256		
	29	Nyaruntundwe	2004	4	Rice	42.6	780		
	30	Gisiduka	2004	4	Rice	32	820		
	31	Ndamuka I	2004	4	Rice	48.79	823		
	32	Ndamuka II	2004	4	Rice	17.39	267		
	33	Cogo	2004	4	Rice	17.5	185		
	34	Nyakigezi	2004	4	Rice	21	202		
	35	Cintama	2004	4	Rice	50	755		
	36	Nyabizi	2004	4	Rice	42	545		
KAYANZA	37	Nyamutobo	2002	3	Rice, food crops	100	1529	PRDRZ	IFAD, OPEC
	38	Nyakagezi	2003	3	Rice, food crops	187	2056		
	39	Nyarubanda	2004	3	Rice, food crops	147	1889		
	40	Rumira	2003	3	Rice, food crops	87	1734		

	41	Mbarara	2007	3	Rice, food crops	100	715		
KIRUNDO	42	Kabuyenge	2006	5	Rice, food crops	80	1715	FAO	FAO, UNDP
	43	Muramba	2006	5	Rice, food crops	45	956		
	44	Kinwamagana	2006	5	Rice, food crops	80	1394		
	45	Gasura	2006	5	Rice, food crops	30	552		
MAKAMBA	46	Gagi-Rwaba	1985	5	Rice	200	215		
	47	Rukoziri	1991	5	Rice, food crops	780	1850		FAO, UNDP
	48	Mugweji	2006	5	Rice	80	600		
	49	Zingure	2007	5	Rice	50	525		
MURAMVYA	50	Nkokoma	1988	3	Food crops	40	125	DAEPL	
	51	Cizanye	1988	3	Food crops	80	204		
MUYINGA	52	Cizanye	2006	5	Rice	60	185	FAO	
	53	Kigina	2007	5	Rice	50	169		
	54	Nyabibugu	2006	5	Rice	21	65		
NGOZI	55	Kagoma	2007	4	Rice	122	200	FAO, PRASLM	WB
	56	Nyaruteke	2006	4	Rice	129	917		
	57	Nyakagezi	2006	4	Rice	300	1620		
	58	Bwerakare	2007	4	Rice	40	437		
	59	Nkaka	2003	4	Rice	45	465		
RUTANA	60	SOSUMO	1988	5	Sugar cane	500	**PMI**	PRASLM	WB, IFAD
	61	Bugiga	1960	5	Rice	30	86		
	62	ISABU	1960	5	Rice, food crops	1000	3048		
	63	Bigina	1989	5	Rice	150	426		
	64	Musasa	2007	5	Rice	120	365		
	65	Rugwe	1957	5	Rice	117	323		
	66	Nyamikungo	2006	5	Rice	79	240		
	67	Ntimbwe	2007	5	Rice	80	263		
	68	Ruhuma	2006	5	Rice	72	225		
	69	Mazimero	1974	5	Rice	160	501		
	70	Rugwe (extension)	2006	5	Rice	115	429		
	71	Mukazye	2007	5	Rice	300	957		
RUYIGI	72	Mucankende	2006	4	Rice	21	82	FAO, TPPCR	UNDP, WB
	73	Nyamiko	2007	4	Rice	20	69		
	74	Nyakerero	2007	4	Rice	62	159		
	75	Nyakagege	2006	4	Rice	21	78		
	76	Rugoma	2007	4	Rice	110	430		
	77	Nyamabuye	2007	4	Rice	99	396		
Total						**16504**	**64505**		

Annex 5 : Detailed description of the RDCI irrigated area (excel file)

Date of Visit : Wednesday November, 13th /2007	**Category:** CMI
Name of Site: Regional Development Corporation of Imbo (RDCI)	
	Sketch Map of Site 
Geographic location of practice: IMBO plain (AEZ 5)	
(GPS) Coordinates: Latitude 3°15' South – Longitude 29°22' East	
Description of the Community : The beneficiary community counts about 12000 households grouped into associations of farmers. The beneficiaries lives mainly in the municipalities of Mpanda, Gihanga, Mutimbuzi, Kinama and Buterere.	

Characteristics of the area The site is located in the plain of the IMBO (north of Bujumbura) and covers 5240 hectares of which: - 4050 ha of rice fields - 140 ha of palm grove, - 1050 ha of polyculture (food crops)	
Climate (AEZ) + Description : Warm tropical climate with an average of 24°C	
Average annual rainfall (mm) : 900mm	
Months of Short Rains:	September -December
Months of Main Rains:	January - April
Mean annual ref. crop Evapotranspiration (mm):	1193
Predominant soil type:	Mineral
Topography:	Plain
Slope:	Less than 5‰
Erosion:	Wick
Period of year during which used:	Food crops : during the dry season and for rice : from September to march
Period of year during which benefits utilised:	from September for food crops and from April for rice
Water Source : Run-of-the river (diversion dams)	
Irrigated area : 5240 hectares	
Method of water abstraction : Gravity	
Water delivery infrastructure : Open channels (the main canals are lined, the others are unlined)	
Type of water distribution : Supply oriented	
Predominant on-farm irrigation practice : - Flooding for rice, - Furrows for food crops and palm grove	
Major crops (with percentages of total irrigated area) : Rice (77,3%); food crops (20,0%), palm grove (2,7%)	
Average farm size : 50 ares	
Type of management : Joint government agency / farmers	
Technical Description : The RDCI result of a merger of three irrigation projects: - FED-IMBO Project (1969) with the development of the MUGERERO irrigated area which covers 2490	

hectares;

- East-MPANDA Project(1984) funded by the ADB, which covers 1700 hectares;
- RUKARAMU Project (1998) funded by the Chinese government and covers 1050 hectares.

The perimeter provides more than half of the rice consumed locally with a yield around 5 tonnes/hectare. The main customers are the communities (barracks, schools, prisons,…) and urban centers.

Technical Details : As mentioned above, two irrigation techniques are used:

- Flooding for rice, which covers 77,3% of the perimeter;
- Furrows for the rest of the field (22,7%)

The salient technical data are :

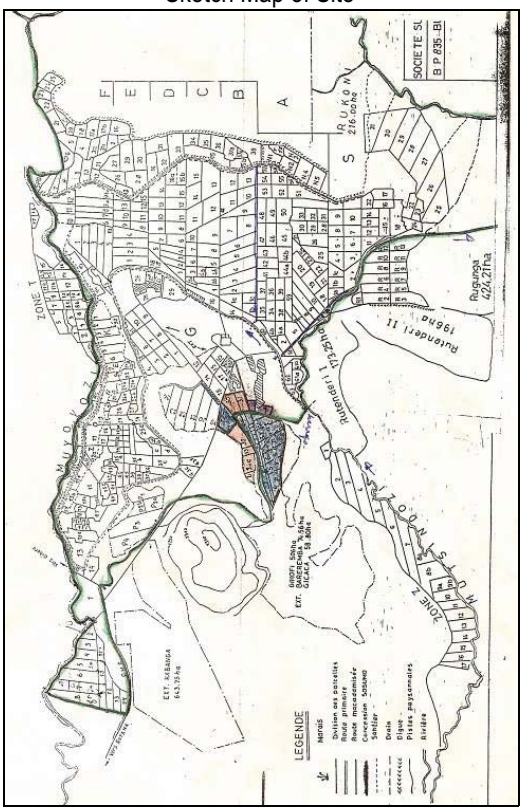
- Flow rate provided to users : 1,2l/s/ha;
- 8 dams on the three rivers (Mpanda, Kinyankonge, Mutimbuzi) that pass through the area;
- 105 km of irrigation canals;
- 117,5 km of drains and sewers of drains;
- 115 km of track access

Useful in: The irrigated rice cultivation can be practiced throughout the country but the best yields are obtained in the hot plains of the IMBO and MOSO (AEZ 1)	**Limitations:** Yields are low in less hot regions
Geographical extent of use : All marshes and all plains where we can get water in sufficient quantity	**Effectiveness** : The three perimeters were built with a view to increase agricultural production in order to ensure food self-sufficiency by really involving the beneficiaries (local populations). The project is doubly profitable because on the one hand, the value of production has increased, and secondly, the local population earns money for plowing, weeding and harvesting.
Other Sites where used: Mainly in the provinces : Cibitoke, Karuzi, Makamba, Rutana, Muyinga, Kirundo and Ngozi	
Cost: : The cost of infrastructure would be indicative because projects are old and Burundian currency was sharply devalued. It should be noted that beneficiaries currently pay 200 USD/ha/yr, while the real needs for the sustainability of the project are estimated at 500 USD/ha/yr	**Operation and Maintenance arrangements** : The simple maintenance (cleaning out of channels for example) is carried out by the associations of farmers while maintaining mechanical equipment is provided by the technical services of the RDCI.
Benefits : With irrigation, the yield has risen at an average of 30% for rice and 100% for food crops (two harvests a year instead of one)	**Water User Association or User Group** : Farmers are grouped into associations of an average of 10 households. Each association elect a leader who will coordinate the activities and represent the association to the RDCI
Stakeholders and beneficiaries : The initiator is the Burundian government under-funding of European Development Fund (EDF).The main players are: - RDCI that ensures the	**Enabling Environment** : Government Initiative

enhancement of the perimeter; - Farmers associations; - The government which provides temporary funding for the company The RDCI is experiencing a problem of funds and is looking for a financial organization. Who are the main beneficiaries	beneficiary involvement demand based interventions
Training support: The RDCI supervises the population in the flow control, the application of chemical fertilizers and handling the mechanical structures.	**Extension support:** Awareness sessions are organized so that the beneficiaries become responsible for the farming and maintenance of the area (sustainability of the project).
Environment benefits: As mentioned above, the three projects (Mugerero, East Mpanda and Rukaramu) merged to become the RDCI had as main objective the increasing of the agricultural production in order to ensure food self-sufficiency and, if possible, export surplus production. Sustainability economic aspects cultural environmenta l aspects technical	**Social/Cultural acceptability** : very good
Advantages : The site covers a very large irrigated area and is located near the main point of consumption, which is the capital city of Bujumbura	**Disadvantages** : Some important infrastructures have been destroyed during the war and must be repaired in order to maintain production at its optimum.
Scaling Up: Irrigation could be extended to other areas by taking advantage of the various available sources of water (rivers, Lake Tanganyika, reuse of the wastewater from the capital Bujumbura)	**What is potential for applying all/parts of initiative elsewhere?** 7 I [ ] Transfer of practice to another group/culture/land-use system, etc. **II [ ] Easy to transfer the practice, but with minor adaptations for local conditions**

	III [ ] Transfer possible, but significant modifications/prerequisites to consider.
	IV [ ] Difficult to transfer the practice. Need experienced support.
	V [ ] It would be impossible to transfer the practice. Too site specific.
	Other specific remarks: The SRDI has no particular technique as well as for rice and mixed crops. It uses surface irrigation practiced all over the country.
Best Practices: The site is high ranked in the category of CMI because of its size, the quality of irrigation works, the socio-economic importance of the irrigated crops and the population interest.	
Contact Organisation : (For further information; site visits' etc)	
Type of organisation:	**Contact person**: Eng. MASUMBUKO Prosper (Director of constructions)
[ ] government organization	**Contact details** : Phone number (00257 22 27 21 38)
[ ] private organization	
[ ] NGO &/or CBO	
[ ] international agency	
[ ] other: **CMI**	
Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon future similar interventions)	
Planning: The organization is good, but public awareness must be permanent.	
Design : The original concept was good but all the main collectors should be lined to minimize losses by infiltration	
Construction : The structures are robust and valuable (Figures 16 and 17)	
Implementation : The implementation is appreciable	
O&M : The system functioned very well before the war but now, the destroyed works are not yet repaired and certainly generate many malfunctions.	
Beneficiary involvement : The beneficiaries are charged a fee intended to the maintenance of the hydraulic works, the purchase of agricultural inputs and the water used for irrigation.	
Realisation of benefits: Rice cultivation is very profitable because it is the most consumed food in urban centers	
Other Remarks or observations: The government must make a great effort to find the necessary funds for the construction of unfinished works and sustainability of the company (RDCI).	
Contact person completing form:	
Contact details : by phone or by visit to the office of the company located at Gihanga (about 20 km from Bujumbura)	

Annex 6 : Detailed description of the SUCOMO irrigated area (excel file)

Date of Visit : Friday, November 8th /2007	Category : PMI
Name of Site : SUCOMO	Either water Harvesting; Community Irrigation or Private Public Irrigation
Geographic location of practice: East Depression (AEZ 5)	Sketch Map of Site 
(GPS) Coordinates: Longitude 30°10' East – Latitude 3°50' South	
Description of the Community	
Characteristics of the area : : The site covers an area of 5000 hectares of which 3000 ha are used and 500ha are irrigated.	
Climate (AEZ) + Description : Humid tropics	
Average annual rainfall (mm) : 900	
Months of Short Rains:	September - December
Months of Main Rains:	January - April
Mean annual ref. crop Evapotranspiration (mm):	1205
Predominant soil type:	Mineral
Topography:	flat
Slope:	(< 5‰)
Erosion:	wick
Period of year during which used:	According to needs (mainly during he dry season)
Period of year during which	June - December

benefits utilised:	
Water Source : Run-of-the river (three rivers located in the area)	
Irrigated area: 500 hectares	
Method of water abstraction: Gravity from a diversion dam	
Water delivery infrastructure: Open channel (the main canal is lined and the others are unlined)	
Type of water distribution: Supply oriented (only during the day)	
Predominant on-farm irrigation practice : Furrows	
Major crops (with percentages of total irrigated area): Sugar cane	
Average farm size:	
Type of management: : Government agency (managerial autonomy)	
Technical Description: The Sugar Society of Moso is a public company with managerial autonomy created in 1988 under the initiative of the government of Burundi. It has a cultivable area of 5000 hectares of which 3000 hectares are being exploited. The half part of the area is made of marshes, constantly moist. Irrigation covers 500 hectares, that is about 17% of the land used. The company practices a surface irrigation by siphons (along the main channel) and furrows. Although the irrigation technique is not rational, it is very beneficial because it increases the yield from 75 to 100 tonnes of cane per hectare, which is an increase of 33%. The plant employs about 3450 workers (450 contractual and 3000 temporary workers). The current annual production of 22000 tons should completely cover local needs. In 2000, the company exported to neighboring countries 5213 tonnes of sugar on a total production of about 20000 tons, equivalent to 26% of the total production.	
Technical Details: The main technical elements are : - A diversion dam on the Mutsindozi; - Average flow of the river : 4.5 m³/s; - Main channel (lined) with a length of 4.5 km and a slope of 4 ‰; - Maximum derivable flow of 1.5m³/s; - Filter (sand remover) at the entrance of the main channel - Pumping Station (drinking water production) on the primary channel; - Secondary and tertiary Channels (unlined) with a total length of 12,88 km; - Drains and collectors of drains with a total length of 28,71 km; - Irrigation of parcels along the main channel through siphons; - Night lined storage reservoir with a capacity of 40000m ³, which is also a fish pond For more details, see : "Technical study of the irrigation and drainage project in the Sugar Company of Moso by SBBM and G. CONSULT enterprises (1987) "	
Useful in: Sugar cane is cultivated (very small scale) all around the country but produces best results in hot regions (AEZ 1 and 5)	Limitations: Need for large areas and a close processing plant to make the production cost-effective
Geographical extent of use: Large, hot and humid Zones	Effectiveness: The company produces a sufficient quantity of sugar for the local market and another part is exported to neighboring countries
Other Sites where used: None	
Cost:	Operation and Maintenance arrangements: By the agricultural engineering service of the society

Benefits: With irrigation, the yield increases of 33% : from 75 tons / ha to 100 tons / ha, that is from 7,5 tons to 10 tons of sugar per hectare. As the price of sugar is currently about 1USD per kilogram, the monetary yield passes from 75000 to 100000 USD /ha.	Water User Association or User Group:
Stakeholders and beneficiaries: Who are the main beneficiaries	Enabling Environment: Government Initiative beneficiary involvement demand based interventions
Training support: the company has in internal technical service specialised in the irrigation practices	Extension support:
Environment benefits: The project was initiated within the framework of, on the one hand, agricultural diversification, and on the other hand, regional and national economic development. Sustainability economic aspects cultural environmental aspects technical	Social/Cultural acceptability: Good
Advantages: 1. Multi-purpose constructions (drinking water, irrigation, fish pond); 2. Considerable irrigable area; 3. Availability of water ensured (three rivers in the area (Mutsindozi, Muyovozi, Rumpungwe); 4. All the operations (irrigation) are carried out and funded by the company itself	Disadvantages: The technique of furrows causes a great loss of water. The losses would be even greater if the irrigation is extended to the entire perimeter with the same technique for irrigation.
Scaling Up: As mentioned above, the profitability of irrigated sugar cane is dependent on two elements: - The availability of wide wetlands in hot weather ; - The presence of a close processing plant	What is potential for applying all/parts of initiative elsewhere?
	5
	I [ ] Transfer of practice to another group/culture/land-use system, etc.
	II [ ] Easy to transfer the practice, but with minor adaptations for local conditions
	III [ ] Transfer possible, but significant modifications/prerequisites to consider.
	IV [ ] Difficult to transfer the practice. Need experienced support.
	V [ ] It would be impossible to transfer the practice. Too site specific.
	Other specific remarks: The wastewater reuse project can be extended to the irrigated plains of the IMBO. For instance, in retouching its size, the wastewater treatment plant (waste stabilisation ponds) of BUTERERE located near the irrigated

	area of RUKARAMU, can provide a reusable water volume of more than 35000 m³/d. The technique of spraying, which is in project in SUCOMO, may also be extended to other sites by using solar energy, for example

Best Practices: The site is ranked according to the assessment criteria mentioned above including mainly the extent of the area, the water availability and the economic viability of sugar cane.

The project of modernization of irrigation and rational utilization of water also contributes to the proper assessment of the site.

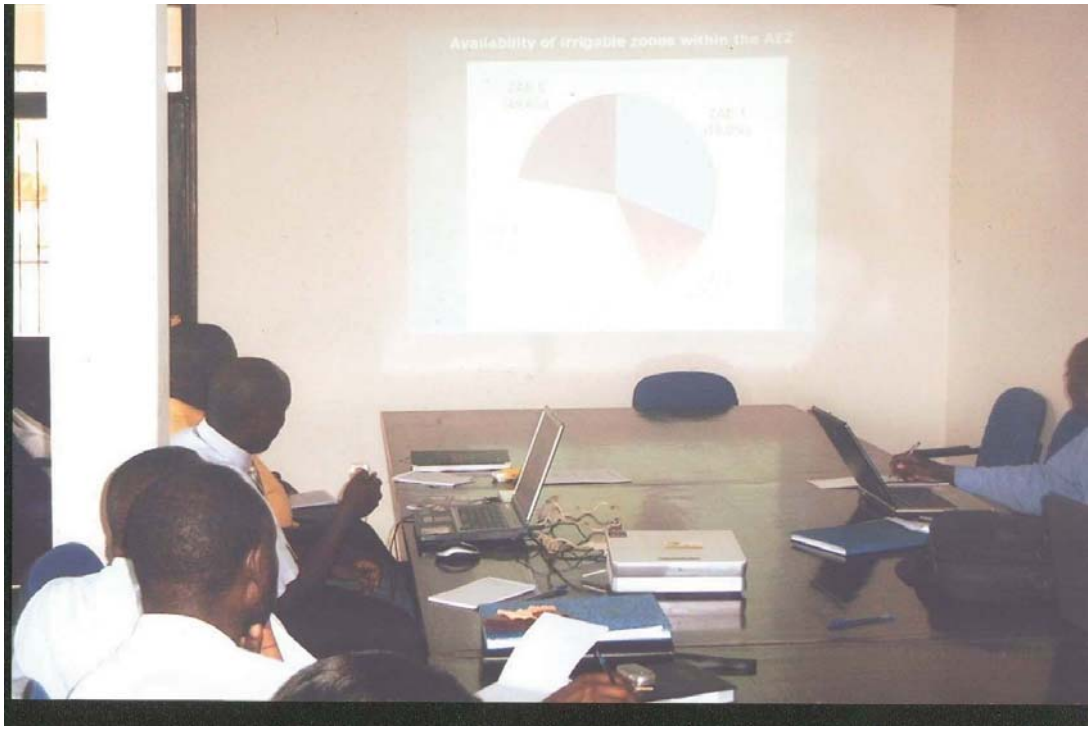
Contact Organisation: (For further information; site visits' etc)	SUCOMO
Type of organisation:	Contact person: Eng. BINDARIYE Pascal (Agricultural Director)
[ ] government organization	Contact details : by phone or by fax phone number : Gihofi (00257-22 50 70 02 and 00257-22 50 70 03); Bujumbura (00257-22 22 16 62 and 00257-22 22 65 76) fax : Gihofi (00257- 22 50 70 04); Bujumbura (00257-22 22 30 28)
[ ] private organization	
[ ] NGO &/or CBO	
[ ] international agency	
[ ] other:	
Lessons learnt: (at various stages of the realisation of the works, describe any lessons learnt that would improve upon future similar interventions)	

0. Introduction

En date du 10 mars 2008 s'est tenu, au restaurant « Le Royal » un atelier de validation d'un travail de consultance sur les meilleures pratiques dans les domaines de l'irrigation (privée, communautaire, publique) et de la collecte des eaux destinée à la production agricole. Il était en outre question d'analyser l'expérience du Burundi en terme de gestion efficace de l'eau en vue de l'augmentation de la production agricole.

Après un mot de bienvenue prononcé par Jean-Marie BUKURU, coordonnateur du projet EWUAP au BURUNDI, les différents participants ont passé à leur présentation.

Avant de passer à l'exposé des résultats, le consultant a d'abord rappelé aux différents participants, venus des principaux services intervenant dans les domaines de l'irrigation et de la collecte des eaux, qu'il ne s'agira pas d'une séance de questions-réponses mais plutôt d'un atelier d'échanges en vue de rendre le document le plus complet possible.



1. Présentation des résultats par le consultant

Le consultant a d'abord rappelé les objectifs du travail réalisé tel que stipulés dans les termes de référence :

- Identification, inventaire, et description des meilleures pratiques en matière de collecte de l'eau et d'irrigation au Burundi,
- Description des sites de meilleures pratiques,
- Inventaire des institutions intervenant dans le pilotage des activités et les possibilités de leur jumelage,
- Identification des lacunes au niveau des directives et législation existantes dans les deux domaines (irrigation et collecte des eaux).

Le travail a été présenté en 7 principaux chapitres :

Au premier chapitre, le consultant a exposé la méthodologie suivie dont l'essentiel se résume ci-dessous :

- identification des intervenants ou personnes ressources (privés, services étatiques, ONG, projets gouvernementaux, organisations financières, …)
- fouille de la bibliographie (technique et législation) existante ;
- localisation géographique des périmètres irrigués et des sites de collecte d'eaux ;
- choix des critères d'appréciation des sites et des techniques existants ;
- visites de terrains ciblées et réévaluation des critères d'appréciation mentionnés plus haut ;
- classement et description des sites et techniques d'excellence

Le deuxième thème abordait, dans un premier temps, la présentation générale du pays (axée en particulier sur la subdivision agro-écologique du pays et ses potentialités en termes de facteurs climatiques divers, de ressources hydrauliques et de terres irrigables) suivie de la description du secteur de l'irrigation au Burundi. Les tableaux ci-dessous résument les résultats les plus saillants :

Zone agro-écologique		**Superficie (ha)**			**Taux d'irrigation**
		Totale	Irrigable	Irriguée	
1	Plain de l'IMBO	176400	123500	8739	7,08
2	Versant ouest de la crête Congo-Nil	252000	68595	260	0,38
3	La crête Congo-Nil	378000	149915	910	0,61
4	Plateaux centraux	1108800	406180	2286	0,56

5	Dépressions de l'Est et du nord	604800	300140	4309	1,44
Total		**2.520.000**	**1.048.330**	**16.504**	**1,57**

Cultures irriguées	**Proportion (%)**	**Techniques d'irrigation**
Riz	80,0	Submersion
Canne à sucre	3,0	Sillons
Palmiers à huile	6,9	Sillons
Cultures vivrières	10,1	Sillons

Type d'irrigation	**Taille des exploitations**	**Intervenants et domaine d'intervention**
Privée à petite échelle	Moins de 5 ares	Les paysans bénéficiaires
Privée à grande échelle (Rugo Farm)	1600	Service technique de la ferme
Communautaire sans assistance technique	De 10 à 50 ares	Les paysans bénéficiaires
Communautaire avec assistance technique	De 10 à 50 ares	DGRPPF (Conception et mise en place d'ouvrages hydrauliques)
		DPAE (Mise en valeur agricole et encadrement des bénéficiaires)
		Organisations financières (Financement)
		Bénéficiaires (Exploitation et payement de redevances)
Publique à grande échelle	De 500 à 1000 ha	Services techniques internes des sociétés gestionnaires

Au troisième point, le consultant a donné une liste de critères potentiels pour évaluer les sites et les techniques utilisées dans les domaines de l'irrigation et de la collecte des eaux. Cette liste globale avait été arrêtée à Nairobi lors d'un atelier de travail tenu fin novembre 2007 dans le cadre du projet EWUAP.

Les critères appropriés au BURUNDI pour l'appréciation des sites sont dans l'ordre d'importance :

- *l'étendue de la surface irrigable*
- *la disponibilité de l'eau*
- *l'importance socio-économique des cultures irriguées*
- *la participation des populations bénéficiaires*
- *le rendement*

- *la disponibilité des marchés*
- *la diversité des cultures irriguées*
- *l'accessibilité du périmètre*

Selon ces critères, les différents périmètres se classeraient comme suit :

1er : SRDI
2ème : Mparambo (Rugombo – Cibitoke)
3ème : Murambi
4ème : Nyabiho
5ème : Rumonge
6ème : Rukoziri

Le consultant a par ailleurs rappelé que dans le cas du Burundi, il était difficile d'apprécier séparément les sites irrigués et les techniques utilisées dans ce sens que l'on utilise pratiquement la même technique pour irriguer le même type de culture. Ce qui fait que les critères appropriés (par ordre d'importance) pour l'appréciation des technologies mises en place devraient tenir compte de la qualité des ouvrages d'irrigation et non de la technique elle-même :

- *proportion des canaux revêtus*
- *possibilité de réglage et de contrôle du débit dérivé*
- *manœuvrabilité et maintenance*
- *quantité d'eau en réserve*
- *autres équipements (de sableurs, drains, ...)*

La présentation et le classement des sites irrigués a été suivi par une description détaillés des meilleurs sites (SRDI, SOSUMO) dans les deux catégories principales respectives à savoir **l'irrigation communautaire avec assistance technique** et **l'irrigation publique à grande échelle**.

Au niveau de la collecte des eaux abordée au 4ème point, les techniques de collecte inventoriés sont :

- collecte des eaux de toiture destinées à la consommation domestique
- collecte d'eaux pluviales dans des étangs artificiels
- aménagements destinés à la conservation des eaux et à la lutte anti-érosive (terrasses progressives et radicales)

Prenant l'exemple de l'étang de Nyamabuye (en commune Bugabira) qui a coûté neuf milles dollars et qui est malheureusement très mal conçu, le consultant conclue qu'il s'agit d'une pratique relativement récente et qui requiert une pré-évaluation sérieuse avant sa diffusion à l'échelle nationale.

L'ensemble des périmètres irrigués inventoriés au point 2 et des sites de collecte d'eaux ont été présentés sur une carte synthétique qui les localise par commune.

Le 5ème point de l'exposé présentait les leçons de terrain en termes de potentialités, d'impact des différentes pratiques ainsi que des lacunes recensées. Dans cette optique, le consultant a fait remarquer que le pays dispose de nombreux atouts (en terme de ressources hydriques disponibles et des terres potentiellement irrigables) malheureusement sous-exploités.

Bien que l'aménagement des périmètres irrigués (qui a repris de l'ampleur à partir de l'an 2000) peut être source de propagation de maladies comme la malaria, cette pratique a été très bénéfique au Burundi du fait qu'elle a permis de réduire sensiblement la faim (en particulier en province Karuzi) par l'augmentation de la production agricole et l'octroi d'un travail rémunéré aux populations riveraines.

Parmi les nombreuses lacunes recensées, le consultant a surtout insisté sur :

- le manque de coordination des nombreux services impliqués dans les deux domaines
- l'absence de centralisation des données
- l'entretien des ouvrages qui est très déficient
- l'absence de dispositions préalables à la pérennisation des différents projets

L'avant dernier point traité était relatif à la législation existante en la matière. Le consultant a souligné que les différents textes de loi existants ne sont pas du tout explicites et ne permettent pas de résoudre les nombreuses lacunes structurelles recensées.

Au dernier point, le consultant a fait un inventaire détaillé des principaux intervenants qu'il a regroupés en 5 catégories :

- les populations bénéficiaires
- les services publics (ministère de l'agriculture et de l'élevage, ministère des travaux publics et de l'environnement, la DGRPPF, les DPAE, …)
- les projets gouvernementaux avec financements extérieurs (PRDMR, PTRPC, PRASAB, …)
- les ONG (AAA, CARE, CRS, ADRA, …)
- les bailleurs de fonds (FIDA, FAO, PNUD, …).

3. Contribution des participants

Irrigation

Les différents participants ont reconnu et déploré le manque de centralisation des données et le chevauchement existant au niveau des différentes activités menées par les différents intervenants. Ils ont ainsi recommandé la mise au point d'une législation précise et la clarification des limites de compétence de chaque intervenant.

Comme atout majeur à exploiter, ils ont soulevé le fait que certains agriculteurs aient déjà maîtrisé les techniques d'irrigation et ont ouvert eux-mêmes des périmètres irrigués, surtout du côté de Mpanda et de Rugombo.

De l'autre côté, l'extension de la ville de Bujumbura constitue un handicap supplémentaire à l'expansion de l'irrigation dans la plaine de l'Imbo.

Au niveau des critères d'évaluation des différents sites et technologies employées, l'on aurait souhaité que l'entretien des ouvrages soit le critère principal, proposition que le consultant n'a pas voulu honorer du fait qu'il s'agit surtout d'un manquement local et conjoncturel.

Les participants ont également suggéré au consultant de redessiner le périmètre SRDI en incluant le périmètre de Rukaramu. La réponse fût que ce dernier n'a pas pu être représenté du fait que son original à la SRDI est pratiquement illisible.

Collecte des eaux

Les participants ont unanimement reconnu avec le consultant que les bassins de collecte des eaux de pluie actuellement opérationnels ont été mal aménagés du fait que la DGRPPF ayant en charge la mise en place des ouvrages d'irrigation n'a pas été contactée. Ils ont noté en outre que les différentes techniques de retenues collinaires à grande échelle, bien qu'indispensables pour notre pays, doivent être bien étudiées afin de les adapter à la réalité locale. L'association « Agakura » ayant son siège à Makebuko (province Gitega) oeuvre dans ce sens et entend donc promouvoir des techniques de collecte des eaux conformes à la situation socio-économique du pays.

Les participants ont également suggéré de mettre sur pied, dans l'avenir, des techniques adaptées afin que l'eau de ruissellement ne soit un handicap, comme c'est pratiquement le cas actuellement, mis plutôt un avantage à exploiter.

Conservation des eaux et lutte anti-érosive

La technique des terrasses radicales a été initiées en 2001 sur inspiration des activités similaires déjà menées au Rwanda. Les participants oeuvrant dans ce domaine notent cependant que la vulgarisation de telles pratiques doit être précédée par des études techniques assez pointues. Les contraintes majeures liées à la mise en place des terrasses radicales sont :

- pentes de terrain relativement faibles,
- chambardement de la structure du sol,
- nécessité d'une grande quantité de fumure afin de restaurer la fertilité du sol,
- risques de glissement pour les terrains fragiles,
- nécessité de zones relativement vastes pour rentabiliser les investissements consentis.

La liste complète des aménagements déjà réalisés a été donnée et l'on a recommandé au consultant de modifier à cet effet la carte de localisation des principaux périmètres irrigués et des sites de collecte ou de conservation des eaux.

4. Appréciation générale

Les différents participants ont reconnu la grande qualité du travail réalisé et ont félicité le consultant pour l'ensemble des données récoltées dans un contexte aussi délicat ainsi que les nombreuses visites de terrain effectuées. Ils auraient aimé tout de même que le présent travail soit suivi d'un autre ayant pour objectif d'étudier les modalités de mise à profit des eaux de ruissellement d'une part et d'autre part de proposer des techniques d'irrigation adaptées au contexte local.

Fait à Bujumbura, le 18 Avril 2008

Le Rapporteur

Pierre SINZOBATOHANA

Directeur Général de la Mobilisation pour l'Auto Développement et la Vulgarisation Agricoles