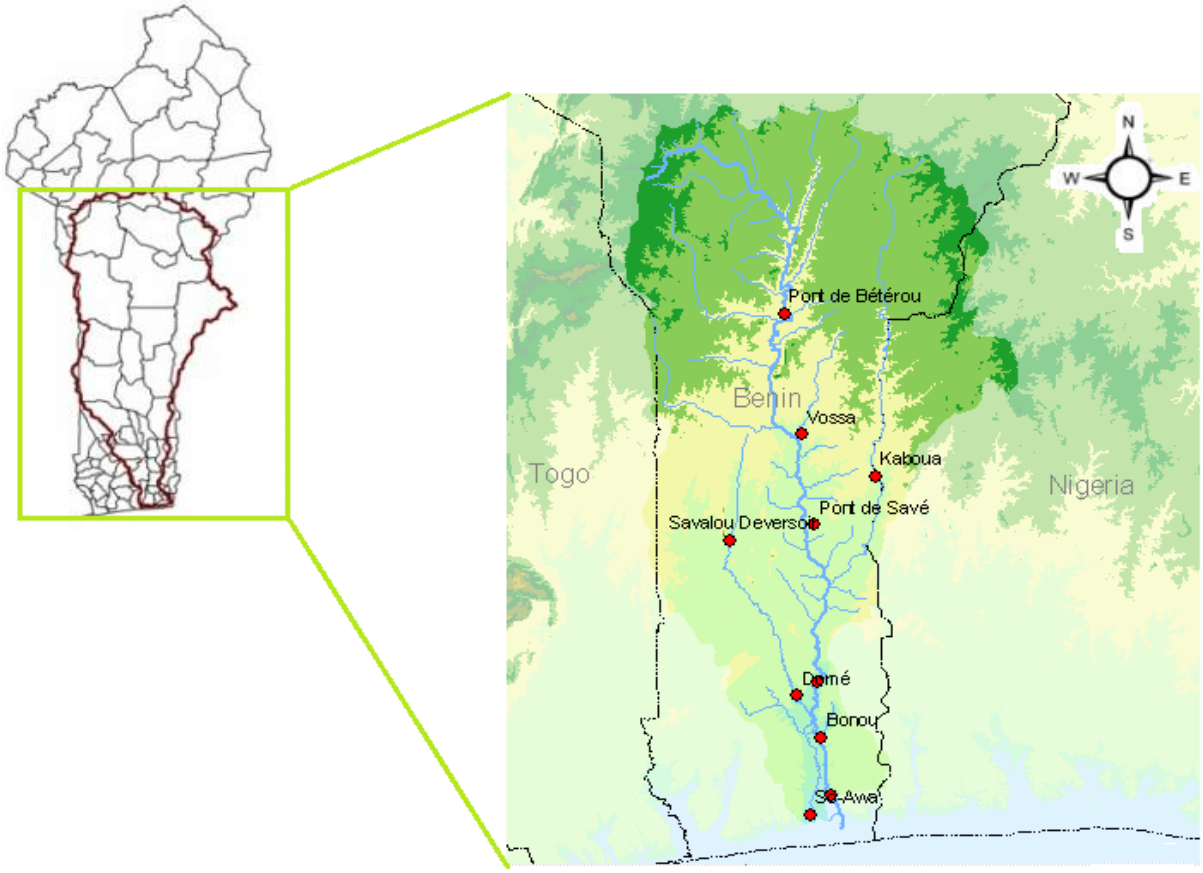
FEASIBILITY STUDY ON WATER WORK OF THE OCRI PROJECT
FVC-FAO-BENIN
Hydro-agricultural Development

Final Report



By Félix Gbaguidi
Last corrections Felix Gbaguidi, September 2021

Executive Summary

The Green Climate Fund (GCF), established by Decision 1/CP.16 of the United Nations Climate Conference in 2010, finances resilient, low-carbon projects/programmes in all developing country Parties to the UNFCCC with a view to contributing to the global effort to reduce greenhouse gases (mitigation) and adapt to the effects of climate change. To this end, the FAO Representation in Benin is developing a climate resilience initiative in the Ouémé Basin, entitled "Ouémé Basin Climate Resilient Initiative" (OCRI). The main objective of the project is to improve the climate resilience of agro-ecosystems and rural communities through the adoption and dissemination of adaptation/mitigation practices and technologies through the mobilization of stakeholders and the scaling up of local actions including those envisaged in the Determined National Contribution (DNC). The concept note was submitted to the GCF in December 2017.

The OCRI project aims at improving the availability and quality of productive and support works for adaptation to climate change, inherent to the sustainable development of the sectors adapted to Intelligent Agriculture in the face of climate change, particularly market gardening. To this end, it envisages actions such as (i) the construction of surface water mobilization works (micro-dams or water raising structures or overflow water control structures), (ii) the development of irrigated perimeters for vegetable crops, (iii) development of lowlands with partial water control for irrigated crops, (iv) development for the protection of springs, stream and river, (v) reforestation on degraded river banks; and (vi) the use of Good Agricultural Practices Resilient to Climate Change (GAPCR) including water and soil conservation techniques.

The project is in line with the new Agricultural Development Cluters (Pôles de Développement Agricole; ADC) promotion policy which considers the development of rural infrastructures as an important lever for improving the competitiveness of agricultural sectors. Within the specific framework of OCRI, the works will be developed above all for partnerships while providing a complementary structural solution to the constraints linked to climate change. The local authorities and the Regional department of agriculture, livestock and ficheries (Direction Départementale de l'Agriculture, de l'Elevage et de la Pêche), Regional Agricultural Development Agencies (Agences Territorial de Développement Agricole) will be stakeholders in the implementation which will be facilitated by project coordination. It will be carried out in five (05) communes of two (02) ADCs, namely the communes of Copargo, Djougou and Glazoué in ADC 4 and the communes of Zangnanado and Zogbodomè in ADC 5 (map n°1). The geographical area of the project does not include RAMSAR wetlands, and if this were the case, they would be excluded from the project intervention sites.

It emerges from this that ADC 4 and 5 are home to the development activities. In terms of geographical delimitation, clusters of action zones will be set up within each ADC, in order to avoid any dispersion, to facilitate the opening up and for more efficiency in the implementation. This is why high-potential areas (districts or villages), within the same production basin and not isolated, have been targeted. Also villages where other similar projects are concentrated or those with large areas of protected forests or large bodies of water will be avoided as far as possible.

The hydro-agricultural development (AHA : Aménagement Hydro-Agricole) component of the OCRI-Benin project will be organized essentially around innovations for the control and efficient and intelligent use of water, including innovative hydro-agricultural developments, irrigated perimeters, rainwater storage for adapting agricultural production to climate change and then the protection of springs or watercourses.

In accordance with these objectives and following the prospection and typology carried out, it was decided

(i) to build 30 new surface water collection structures (dams, micro-dams, weirs, over-embanked ponds, etc.),
(ii) to rehabilitate 23 old surface water collection structures (small earth dams, water reservoirs, weirs, overflow weirs, etc.), (iii) to rehabilitate the existing water storage facilities (water reservoirs, weirs, etc.)
(iii) to develop 680 ha of small irrigated perimeters including 105 ha downstream of the water collection structure to be built and/or rehabilitated and 220 ha downstream of the artesian boreholes in Zangnanado and Zogbodomè;
(iv) to reduce degradation over 95,000 ha of land in Upper and Middle Oueme, and
(v) to develop for the sustainable protection of 14 water sources and 44 artesian boreholes.

The dimensions of the project in terms of areas to be developed took into account the potential of the delimited area, the presence of similar projects in the area (PADMAR, PADAAM, PRIMA, PAIAVO, PSAAB, PDPIM, PADAC, etc.) and certain particularities related to natural resources (protected forests, plantations, proximity to major centres, lakes and lagoons, etc.), the constraints of targeting groups related to the structuring of professional organizations, and the constraints of available financial resources. On this basis, the physical objectives in terms of construction/rehabilitation and development relate to the actions for which the table below shows the preliminary breakdown by intervention commune and by ADC.;

Type of infrastructures / ***Municipality***	**Construction of micro-dams/weirs (unit)**	**Rehabilitation of micro-dams/weirs (unit)**	**Development of small irrigated perimeters (ha)**	**Development for the protection of springs and watercourses (unit)Development for the protection of springs and watercourses (Number of sites)**	**Land improvement through sustainable water and soil conservation practices (ha)**
Copargo	***8***	*5*	*200*	*2*	*20 115*
Djougou	***11***	*7*	*170*	*00*	*38 762*
Glazoué	***8***	*10*	*160*	*00*	*6 993*
Zangnanado	***2***	*1*	*25*	*14*	*11 509*
Zogbodomè	***1***	*-*	*125*	*40*	*17 622*
Total	**30**	**23**	**680**	**58**	**95 000**

The investment cost for carrying out the works related to the types of development contained in the above table is US$7,008,500 as indicated in the table below.

N°	**Component**	**Unit**	**Quantity**	**Unit price (*US$)**	**Amount (*US$)**
Construction/rehabilitation of surface water storage structures or surface water harvesting structures					
1.	*Construction surface water storage structures or harvesting structures (Small earth dams, water rising structures, etc.*	*u*	*30*	*110 000*	*3 300 000*
2.	*Rehabilitation of surface water storage structures or harvesting structures (Small earth dams, water rising structures, etc.*	*u*	*23*	*67 500*	*1 552 500*
TOTAL 1					***4,852,500***
Land development					
1.	*Development of small irrigated perimeters with full water control*	*ha*	*680*	*3 000*	*2 040 000*
2	*Development for erosion control*	*ha*	*95 000*	*PM*	
3	*Development for the protection of water sources (river, head of streams, artesian boreholes, etc.)*	*u*	*58*	*2 000*	*116 000*
TOTAL 2					***2 156 000***
TOTAL					**7,008,500**

The implementation of the activities will be preceded by a preparatory phase comprising of :

(i) an information campaign for the populations of the zone on the approach of the project and the modalities of access to its interventions;
(ii) the call for project applications, their centralization and evaluation in partnership with the partners of the project (RADA, RDALF and professional organisation of famers).

The selected applications will each be subject to validation in order to verify the technical feasibility of its development, to ensure the absence of land tenure conflicts and the viability of the PO (producer organisation) in connection with the planned reinforcement.

The sites selected will be the subject of detailed technical and economic studies to be carried out by design offices on a competitive basis. The development work will be carried out by local or international firms. The acceptance of the works will be participatory by associating the beneficiary OPAs but also the project partners in the field of hydro-agricultural development (RADA, DDPAE, DRE, etc.). The capacity building and training activities will be entrusted to support and advisory structures and to the DRE for certain technical topics concerning water management and the maintenance of works and infrastructures.

INTRODUCTION

Objective of this report

This study aims to locate, quantify and provide preliminary technical specifications for hydro-agricultural infrastructure that are necessary for the formulation of the OCRI project. It will facilitate and guide the choice of sites, and the types of infrastructure that could be carried out on these sites, and finally to provide advice on the types of production models to be used, on the basis of technical specifications and local demand, for the development of competitive agricultural value chains.

The specific objectives of this study are:

- To identify the sites favourable to the installation of the project on hydro-agricultural techniques and technologies for adaptation to climate change in each Commune of intervention;
- To characterize the irrigable potential identified by the intervention commune and to define the options of technological packages for hydro-agricultural development or irrigation according to priority speculations and with costs;
- To make an inventory of public and private interventions in favour of the promotion of hydro-agricultural developments in these communes;
- To evaluate the performance of the main interventions and highlight the main constraints to the promotion of irrigation;
- To analyze the relevance and feasibility of the actions planned in the document on hydro-agricultural techniques and technologies for adaptation to climate change.
  - To assess the operation and maintenance of the infrastructure
- To propose strategies, relevant actions and packages of measures for the efficient implementation of the project.

Methodology

Framework of the study

(a) In Benin, support for activities relating to hydro-agricultural development by State structures and projects is the responsibility of the Department of Rural Engeeniering (DRE). The department was set up by the Government of Benin more than 20 years ago with support from UNDP/FAO. The DRE has been able to build up appropriate expertise and experience on the inventory, characterization, evaluation and development of Benin's hydro-agricultural facilities.
(b) The criteria for identifying, selecting and validating suitable sites are described in the annexes and are based on those recommended by the RMD.
(c) In the past, the development of the lowlands in Benin was largely oriented towards the development of rice cultivation. The development of market gardening was not frequently taken into account. However, the experience recently acquired by BC shows that the combination of rice growing and market gardening on the same lowland improves the profitability of the developments. Special attention will therefore be paid to sites that allow this combination of crops (soils that are not too sandy, presence of a water source for market gardening).
(d) This study comes at a particular and crucial time in the reforms undertaken by the Government of Benin in the public sector in the field of rural development. As a result, key stakeholders consulted are of two types, namely technicians from the Regional Departement of Agriculture, Livestock and Fisherie (RDALF) and Regional Agriculture Development Agencie (RADA). In addition, several other actors were contacted during the mission. They are Farmers' Organizations (FOs), Non-Governmental

Organizations (NGOs), projects, other actors from sectors other than agriculture intervening in the field of climate change.
(e) The project will carry out its activities in five (05) communes that have already been identified in the Ouémé basin (fig. 1). The present study will therefore be limited to these communes. In addition, preliminary work has already been carried out in these communes and a provisional list of sites has been drawn up on the basis of existing directories at the commune Regional Departement of Agriculture, Livestock and Fisherie (RDALF) and Regional Agriculture Development Agencie (RADA) levels. These lowlands or sites are visited and when they fully meet the selection criteria, they are proposed as a priority and will be the subject of Preliminary Summary Project (PSP) and Detailed Preliminary Project (DPP) studies that will enable them to be validated and programmed for the work.

Literature Review

The review of the documentation focused on the various technical reports produced by both State services and private individuals or projects that have carried out activities in the field of hydro-agricultural development, particularly small-scale irrigation. Studies on hydrography, hydrology, physico-chemical characterization of soils and especially the consultation report on techniques and technology for adaptation to climate change were also consulted.

The baseline study carried out by FAO has identified the main lowlands in the five (05) communes concerned by this study. This information is very useful and has been taken into account in this report. A list of the documents consulted is given in the reference section in Annex 2.

Data collection and analysis

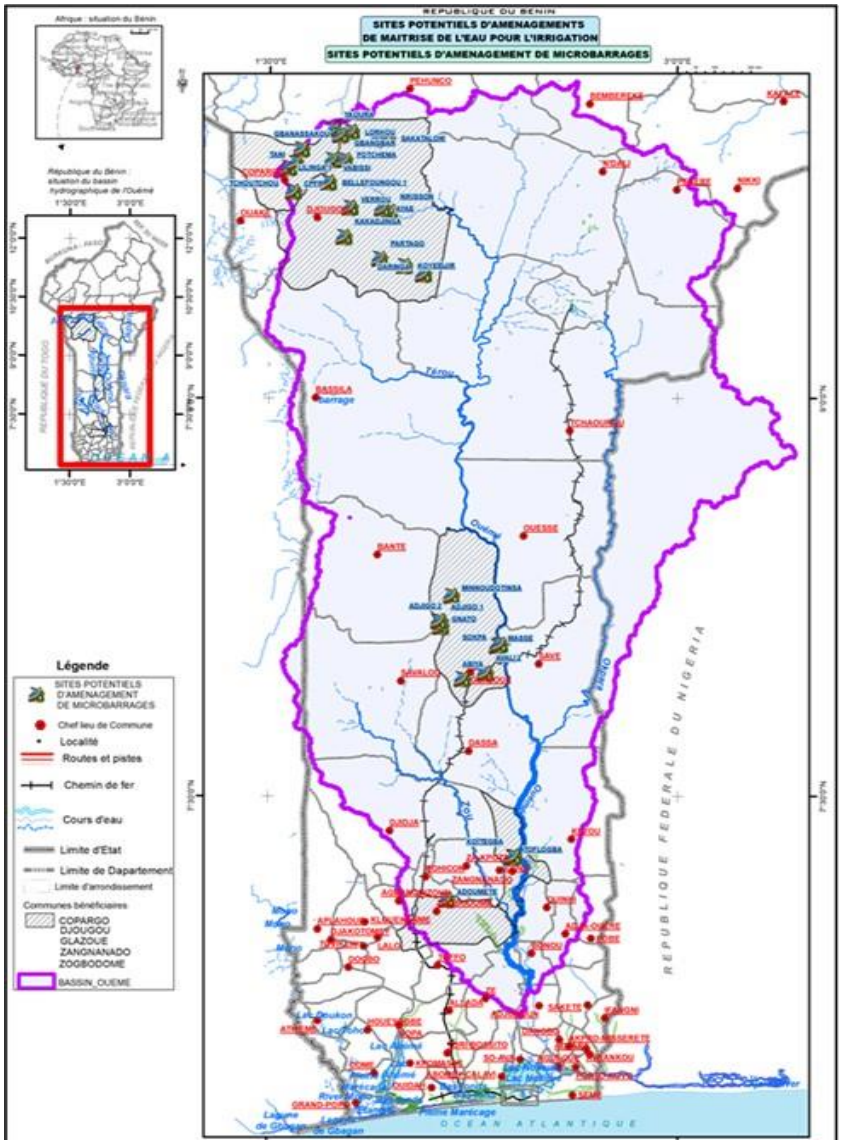
The study was largely based on the data available within the Department of Rural Engeeniering (DRE), the technical services of the municipalities concerned, the Regional Departement of Agriculture, Livestock and Fisherie (RDALF) and Regional Agriculture Development Agencie (RADA). Information on the sites collected during the study carried out by the preparation mission on seventy-seven (77) villages located in the five (05) communes or municipalities of the two (02) Agricultural Development Clusters (ADC) covered by the project was also used in the study. The field visits also made it possible to conduct interviews with farmers' representatives and NGO managers in charge of projects on the enhancement of the developed sites.
On the basis of the experiences acquired, the consultant, in relation with the technical agents of the Ministry in charge of agriculture, NGOs and development partners, agreed on a set of criteria for the selection of sites (an overall description of these criteria is given in Annex 1). These criteria are of a technical, socio-economic and environmental nature. The technical (physical) criteria are certainly the easiest to master and use for site selection from the fact sheets and reports. These criteria put particular emphasis on the characteristics that determine the type of infrastructure to be proposed, ease of implementation, quality, sustainability, reproducibility by farmers and cost. They include watershed area, longitudinal and transverse slopes, soil texture, lowland morphology, surface area.

Socio-economic criteria are probably the most difficult to identify properly in rapid selections such as this one. These criteria relate to the existence of demand and interest in development by the entire village community as evidenced by current use of the selected sites. They also emphasize the commitment and willingness of the populations concerned to participate and be involved in the development work.

In the selection process, the most tangible socio-economic information is likely to be that related to the history of use of the site or neighbouring sites by the surrounding communities. The presence of development and production activities on the lowland site may be evidence of the interest of these communities in lowland development.

The larger the number of farmers, the greater the chance that participation is democratic, that farmers are well organized and that there is no severe land ownership problem. Moreover, experience has shown that the greater the number of women farmers, the more sustainable the development is. These criteria were therefore taken into account when selecting lowland areas. Great care must be taken to avoid a single farmer and her family claiming to be representative of the village community, to benefit from the development and subsequently declare the site as private property.

Accessibility was also a criterion used for development work, monitoring and technical advice as well as for crop disposal and marketing of production, since the project did not provide for the construction of infrastructure such as tracks.



Map 1 : Location of potential sites micro-dams or water storage structures and land development

Results of the study

General problem of hydro-agricultural developments in the Ouémé basin

The literature review revealed that, like Benin's agriculture, agriculture in the Ouémé River basin is essentially rainfed and subject to climatic hazards that make agricultural production uncertain. Thus, in an attempt to reduce this dependence and take advantage of the enormous hydro-agricultural potential, the Beninese State has been engaged since colonial times in the development of hydro-agricultural facilities, thanks to the assistance of its technical and financial partners.

Several strategies have been developed and several structures have succeeded one another as difficulties have arisen. These include the implementation of large-scale developments (Savè, Koussin and Lélé, Zanganado, Adjohoun, Bonou and Dangbo), trials on small irrigated perimeters, trials of Soil Defence and Restoration (DRS) and Water and Soil Conservation (CES) works. Unfortunately, all these strategies and actions in the field of hydro-agricultural developments have not progressed very well with regard to the expected results. In fact, a critical assessment of these experiences was made during a workshop in 1991 whose main objective was to analyse the causes of successive failures and to establish a strategy to ensure the viability and reproducibility of land and water development systems and schemes.

Experiences in hydro-agricultural development in the Ouémé River basin at the level of the project communes cover some 17,914 hectares of all systems and are distributed by agricultural development pole as shown in Table 1.

Table 1: Distribution of hydro-agricultural developments by PDA located in the Ouémé Basin

Cluster	Type of land development (ha)			
	full water Perimeters		Lowland*1*	Private perimeters*2*
	Equipé	Exploité		
ADC4	*4 608*	*4 475*	*608*	*1 482*
ADC5	*1 439*	*792*	*177*	*256*
ADC6	*0*	*0*	*18*	*255*
ADC7 sans le Mono	*2 430*	*0*	*53*	*1 321*
TOTAL	**8 477**	**5 267**	**856**	**3 314**

***Source** : Direction du Génie Rural et B2A, 2016*

Reading the above table reveals that 8,477 ha of land have been equipped for development with total water control, of which 5,267 ha are still functional. The developed lowlands and private perimeters are 856 ha and 3,314 ha respectively. The project area comprising the five (05) communes of this basin has 6,047 ha of land equipped for development with total water control, of which 4,267 ha are still functional. The same is true for the lowlands and developed perimeters which are respectively 756 ha and 2,314 ha.

With regard to surface water mobilization works, Table No. 2 shows that the Ouémé River basin has some 131 water reservoirs, dams and marsh overburden with a cumulative storage capacity of 32.213 million cubic metres of water, i.e. less than 0.02% of the total water annually drained in Benin (13 billion cubic metres). It should be noted, however, that most of these water reservoirs are carried out within the framework of livestock promotion projects and are for pastoral purposes. Moreover, the diagnosis of the state of these water reservoirs reveals the urgency of their rehabilitation.

1Lowlands development involves installation of structures generally in earth to retain and spread rainwater in order to allow crops to complete their production cycle with less water stress

2 private perimeters are individual sites of small sizes (only a few hectares) developed by private individuals using their own resources. The systems put in place are diverse and varied (piping, motor pump, sprinklers etc.) but the search for efficiency and profitability of the system is a constant

.

Table 2: Distribution of existing water reservoirs in the Ouémé Basin

Département	Commune/Municipality	Units	Capacity (m^3)
BORGOU	*N'DALI*	*24*	*1 699 000*
	PARAKOU	*11*	*353 000*
	PERERE	*6*	*1 238 000*
	TCHAOUROU	*16*	*2 470 000*
TOTAL BORGOU		***57***	***5 760 000***
COLLINES	*BANTE*	*5*	*148 000*
	DASSA-ZOUME	*8*	*221 000*
	GLAZOUE	*10*	*236 100*
	OUESSE	*12*	*372 000*
	SAVALOU	*7*	*180 600*
	SAVE	*10*	*24 145 000*
TOTAL COLLINES		***52***	***25 302 700***
DONGA	*BASSILA*	*5*	*502 000*
	COPARGO	*5*	*170 000*
	DJOUGOU	*7*	*273 100*
TOTAL DONGA		***17***	***945 100***
ZOU	*ZANGNANADO*	*1*	*80 000*
TOTAL ZOU		***1***	***80 000***
PLATEAU	*KETOU*	*2*	*45 000*
	POBE	*2*	*80 000*
TOTAL PLATEAU		***4***	***125 000***
TOTAL		**131**	**32 212 800**

***Source** : Direction du Génie Rural et B2A, 2016*

The five (05) communes, subject of the present project, have approximately twenty-three (23) dams/water retention/pools with a total storage capacity of 759,200 m3 of water. These are structures with various levels of degradation requiring rehabilitation. The Karhum and Tanekakoko sites are spring catchments in the form of masonry basins and are in need of spring protection actions. The details of the sites concerned are recorded in table n°1 in appendix n°3.

In addition, within the framework of the implementation of the SDAGE, it is planned to build thirty (03) dams including three (03) multi-purpose hydroelectric dams and twenty-seven (27) others mainly for agricultural purposes. These structures will make it possible to store approximately 3.7 billion cubic meters of water.

2.1.1. Water resources and hydro-agricultural potential of the Ouémé basin

Water resources for plants, but also for people, livestock and industry come from precipitation, surface water and groundwater. From the North to the South of the Ouémé basin, the climate gradually changes from the tropical continental type with one rainy season to the sub-equatorial type with two rainy seasons. The rainy season extends over five (05) months in the North and six to seven months in the South and the average annual rainfall varies between 700 mm and 1400 mm According to data from the Ouémé SDAGE, the surface water of the basin is estimated at 5.4 billion m3 , i.e. about 40% of Benin's surface water resources. That is to say nearly 900 m3 of water per year and per person for the 6.00 million inhabitants of the basin (2012 estimate), or well below the threshold of 1,700 m3/year internationally considered as the limit where water problems could appear.

However, this rainfall is insufficient to achieve high and consistent crop yields and surface and groundwater resources must be used to supplement water inputs to plants:

The hydro-agricultural potential in the Ouémé basin can be estimated at 250 000 hectares of irrigable land. This potential includes 117,000 hectares of valley or floodplain land and 133,000 hectares of lowland land. The distribution of this potential is as shown in Table 3.

Table 3: Distribution of hydro-agricultural potential by agricultural development pole located in the Ouémé basin

Pole	Hydro agricultural potential		
	Weter flow	Land	
		Valley (ha)	Lowland (ha)
ADC4	Rain and groundwater inn rock area that are difficult to mobilize	-	72 500
ADC5 sans le coufo	Rain, streams of Ouémé river	33 000	28 500
ADC6	Rain and groundwater from the sedimentary basin with the possibility of artesian drilling in places	-	8 000
ADC7 sans le Mono	The Ouémé, Mono and the groundwater of the sedimentary basin easily exploitable by means of drilling	84000	24000
TOTAL		**117 000**	**133 000**

As regards the land to be irrigated from groundwater, it should be pointed out that the southern part of the Basin is favourable due to the existence of shallow water tables, even artesian, with good flow rates that can exceed 50 m3/hour. By exploiting only 50% of the annual refills, the irrigable potential is at least 20,000 (annual water needs 10,000 to 15,000 m3/ha).

Table n°4 shows the distribution of artesian boreholes in the Ouémé River basin. Details of the sites concerned are given in Table n°2 in Annex n°3.

Table 4: Distribution of artesian boreholes in the Ouémé Basin

Departement	Commune	Arrondissement	Village	Site	statut of structures
Atlantique	*ALLADA*	*3*	*3*	*3*	*B*
	SO-AVA	*1*	*1*	*1*	*B*
	ZE	*2*	*4*	*6*	*B*
Total Atlantique	**3**	**5**	**8**	**10**	
Ouémé	*BONOU*	*3*	*3*	*3*	*B*
	DANGBO	*3*	*3*	*3*	*B*
Total Ouémé	**2**	**4**	**4**	**4**	
Plateau	*ADJA-OUERE*	*2*	*4*	*6*	*B*
	POBE	*2*	*2*	*2*	*B*
Total Plateau	**2**	**4**	**6**	**8**	
Zou	*OUINHI*	*4*	*17*	*33*	*B*
	ZANGNANADO	*1*	*3*	*3*	*B*
	ZOGBODOME	*6*	*21*	*41*	*B*
Total Zou	**3**	**11**	**42**	**78**	
TOTAL	**10**	**24**	**60**	**100**	

Two of the five (05) intervention communes have about forty-four (44) structures in acceptable condition out of the hundred or so in the Ouémé River basin. These structures continuously discharge water into the natural environment all year round. In some communes, there is land available downstream of these structures that can be used for irrigation at any time of the year. Within the framework of this project, at least 5 ha of land downstream of each irrigation structure will be put into operation with total control of water for market gardening production, particularly in the dry season. As most of the structures are in good condition, the areas to be irrigated will simply be developed. They are also sources of water to be protected and in this context it will be a question of repairing the

heads of these boreholes so as to limit water losses due to the high pressure under which water gushes from the ground, etc.

2.1.2. Revised strategies and approaches with a focus on water control and small-scale irrigation

National strategies and policies

The important role that the agriculture sector plays in the country's economy (it contributes nearly 33% of the Gross Domestic Product (GDP) and employs nearly 70% of the working population) and its very limited and irregular growth in the face of growing needs and demands, led Benin to develop a Strategic Plan for the Relaunch of the Agricultural Sector (PSRSA) in 2011. This plan aims to address three major challenges in the development of Benin's agricultural sector: (i) meeting food needs, (ii) increasing incomes, and (iii) improving the attractiveness of agricultural activity and the rural environment. The PSRSA would thus like to give the agricultural sector the dual role it is expected to play, that of accelerating economic growth and acting as a lever in the fight against poverty.

To meet these challenges, the PSRSA places particular emphasis on water management to increase agricultural productivity. To this end, the Plan gives high priority to actions supporting the development of lowlands/small areas for the development of rice cultivation and the promotion of intensive market gardening, alongside actions to rehabilitate major hydro-agricultural developments. In addition to size, the PSRSA explicitly lists certain desirable characteristics for both lowlands and small irrigated perimeters, namely: the low cost of the developments, their simplicity so that they can be managed autonomously and reproduced by farmers' organizations.

This plan was followed successively by the Strategic Plan for the Development of the Agricultural Sector (PSDSA) of the sectors, with an orientation to 2025 and the vision of Benin's development and particularly that of the agricultural sector as defined in the Government's Action Programme (PAG, 2016-2021). These are as follows: "To make Benin's agricultural sector a dynamic sector by 2025, competitive, attractive, resilient to climate change and a creator of wealth that equitably meets the food and nutritional security needs of the Beninese population and the economic and social development of all sections of the country's population".

This project, which supports the development of agricultural infrastructure and equipment, aims to contribute to the sustainable revival of Benin's economic and social development while respecting the environment.

In addition, the production facilities and equipment to be set up under this project will make it possible to improve the productivity and production of the various agricultural speculations in the beneficiary areas in the context of climate change, where innovation is a key element in guaranteeing access to water and food. Therefore, it is part of the Agenda 2030 and will contribute to the progressive achievement of objective 2 of the SDGs, which is to "Eradicate hunger, ensure food security, improve nutrition and promote sustainable agriculture in the context of climate change". This project also promotes progress towards achieving SDG 1 and SDG 15. Thus, in line with the PAG 2016-2021 and the strategic vision of the technical and financial partners regarding inclusive, sustainable growth and prosperity of the populations, Benin is proposing a project for integrated interventions in the agricultural sector through support for agricultural investments. This programme essentially covers the promotion of adapted and accessible hydro-agricultural facilities for men and women, to support the development of targeted value-added chains to ensure food security, sustainable economic growth and job creation. The realization of infrastructure and equipment to support productive activities must be on the scale of those envisaged under this initiative in order to remain within the financial limits and the category of FAO accreditation to the GCF.

Sectoral context of hydro-agricultural developments

In a context of increasing climate deterioration, particularly marked by an increase in the frequency of extreme events linked to rainfall (such as floods and pockets of drought during the crop cycle) and a growing demand for certain crops such as rice and market gardening, Benin has, since the early 1990s, undertaken to redefine and improve its policies and strategies in terms of water control and irrigation. Drawing lessons from its past experiences in hydro-agricultural development, the new policies and strategies, including the various strategies for guiding the agricultural sector, give greater importance to the development of lowlands and the promotion of small and medium irrigation.

The National Strategy for the Development of Lowlands, adopted in 2002, is the only reference in force in terms of small-scale irrigation policy. While integrating the factors and parameters of sustainability, this strategy is articulated around the following axes: (ii) the need to promote contractual development, based on the acceptance by all partners (village communities, supervisory structures and donors) of the obligations and advantages expected for the implementation of a programme previously established by mutual agreement; (iii) the training of the various actors (producers, supervisory staff) in development techniques, crop management and management of the developed sites through a substantial functional literacy programme; (iv) gender mainstreaming in all lowland development programmes and in the conditions of women's access to resources with a view to equitable development; (v) the diversification of crops and the improvement of production systems through the dissemination of appropriate technologies with the support of a specific research and development programme. The Strategy also defines the stages of implementation of lowland development, from raising awareness among producers, identifying sites, studies and development work to accompanying beneficiaries during development.

This strategy, the text of which is given in the box below, emphasizes community awareness, the needs and demands of the populations, participatory diagnosis and the use of local skills. Annex 1 presents a summary of this strategy. OCRI-Benin project activities in the area of AHA will take into account this national strategy.

2.1.3. Definition of the lowlands and areas of interest for efficient water use for agriculture in the context of this study and in the context of Benin

Lowlands/riverbanks in the strict sense of the term: Strictly speaking, researchers and agronomists working in intertropical Africa on lowlands for agricultural production purposes agree with Raunet (1985) in defining lowlands as "the flat or concave bottoms of valleys, small valleys and flood gutters which constitute the elementary drainage axes nested in the thick alterations of "penetrated" crystalline bases (...). These are the axes of preferential convergence of surface water, hypodermic flows and groundwater contained in the thick alteration mantle and fed by rainfall. (...) Their soils are waterlogged or submerged for a more or less long period of the year by a water table corresponding to outcrops of the water table and runoff contributions" (Raunet, 1985).
However, this internationally accepted definition places the upper limit of the catchment area at 75 km2. This limit may not be appropriate for Benin, where lowlands are generally associated with smaller basins.

Other areas favourable to small-scale irrigation (promotion of small-scale irrigation, mobilization of surface water through micro-dams, water reservoirs and all other forms of surface water harvesting devices, etc.) are not included.

Moreover, in addition to the lowlands, Benin has many sites with easily irrigable land due to the good availability of water resources. These sites are therefore in addition to the lowland areas in the strict sense and broaden the possible spectrum of interventions when it comes to development actions in the field of hydro-agricultural developments and the promotion of small-scale irrigation for the development of market gardening. Thus, a larger fringe of the country's agricultural population and more numerous and extended geographical areas are likely to be concerned. These sites and situations need to be taken into account in the concept of AHAs and promotion of small-scale village irrigation within the framework of this project.

Therefore, the Directorate of Rural Engineering, which is the state structure in charge of regulating and controlling AHAs in Benin, "in order to meet the imperatives of the strategy aimed at satisfying the populations in terms of development", in "all areas where the availability of surface or underground water could allow production activities (food crops, market gardening, etc.)" has adopted a working definition that takes into account the characteristics of the lowlands found in the country. This definition is as follows: "Lowlands are inland valleys, flat or concave with temporary or perennial flow axes, which are flooded for periods of at least several days of the year, and in which soils with hydromorphic characteristics and a relatively small catchment area are found" (APRM / Direction Génie Rural, 2010).

This study therefore takes into account the definition of the lowlands as adopted by the Lowlands Unit. This definition is furthermore taken in its broadest sense to include small-scale irrigation sites encountered in the project area.

Because their complex hydrological regime contributes to increasing soil water availability over time, especially when they benefit from even relatively simple and inexpensive development, some lowland sections can be considered as preferred areas for rice cultivation with partial water control. Hence the frequent association of lowland development with rice and vegetable production in particular.
Another association is that between lowlands or easily irrigable land on the one hand and market gardening on the other. Market gardening is practised in all regions of the Basin, in the alluvial plains, in the valleys and lowlands. They are made up on the one hand of traditional field crops such as tomato, pepper, onion, okra and on the other hand of leafy vegetables, exotic crops grown in urban and peri-urban areas (carrot, cabbage, lettuce, cucumber, leek, green beans, etc.). Vegetable crops play an important role in people's diets and contribute to the prevention of diseases due to micronutrient deficiencies.

In summary of this section, it can be noted that the hydro-agricultural infrastructure for the development of horticultural and market garden crops and to a lesser extent rice, proposed by the OCRI-Benin project are in line with the priorities of the 2016-2015 GAP. The concept of lowlands should of course be taken in its broadest sense and encompass all sites for water control, small-scale irrigation development and protection of water sources that can contribute to improving the living conditions of the smallholder and improving land productivity in the context of mitigation/adaptation to the negative effects of climate change.

The participatory approach advocated by the strategy must be maintained and strengthened so that all stakeholders are involved and taken into account. In the southern zones of the Ouémé basin where land tenure is a crucial issue, great attention must be paid to land tenure-related aspects. Modern tools and traditional arrangements in the communes should be intelligently combined to manage the likely land tenure problems and take into account the farming habits of the communities and their commitment to practice in the work of the AHAs. In the target communes, the land tenure problem is mitigated and is still manageable at the commune level; therefore, it is wise to ensure the involvement of communes in the process of site selection.

During the field visits to the sites, examples were encountered of sites where the populations are already committed and mobilized to intensive market gardening, but the lack of adequate development, insufficient water and the lack of technical itinerary masters do not help to put them out of the climatic risks.

2.2. General typology of irrigable sites in the Ouémé basin: General characterization

Following the failures of the major hydro-agricultural developments of the 1960s and 1970s, the Government of Benin decided a few years ago to give priority to the creation of small areas that could be better suited to and managed by producers. Hence the growing interest in the development of lowlands and the promotion of small-scale irrigation. The production systems that derive from this are those corresponding to the use of water that can be easily mobilised, i.e. surface water and water from the shallow water table, as well as water from artesian springs/boreholes.

OCRI-Benin, in the framework of the implementation of its project on the improvement of techniques for the mobilization of surface water in areas to enable farmers to produce even in times of water shortage (market gardening, etc.), is part of this approach. It is interested in seizing the various types of opportunities that are offered to it, in terms of water control through relatively modest developments, to judiciously and sustainably achieve its objectives aiming at sustainable land management vis-à-vis the effects of climate change and the improvement of the living standards of the beneficiary populations.

The sites, valleys and areas suitable for small-scale irrigation are thus unevenly distributed in the geographical landscape. Their hydrological and soil characteristics will obviously be influenced by the geology, geomorphology and climate prevailing in the geographical area with which they are associated.

Within the framework of this study for the implementation of the OCRI - Benin project, three (03) large groups of areas or sites of interest for development with partial or total control of water or small-scale irrigation have been selected. These are (a) lowland areas proper, (b) alluvial valleys and flood plains and (c) artesian springs and boreholes.

These areas all have potential for developing small-scale hydro-agricultural developments, small individual or collective farms with partial or total water control. Put together, they should ensure a good representativeness of the potential areas for AHAs and in particular for small-scale irrigation found in the communes of intervention of the OCRI-Benin project. An attempt at a summary description and characterization of each group is given below.

2.2.1. Lowlands and similar formations

Lowlands or similar formations are present throughout the Ouémé basin and are the areas par excellence for mobilising surface water for agricultural purposes. The Ouémé basin has more than 95,000 ha of lowlands which could be the subject of surface water mobilization through micro or dams/water retention of variable size, variable arrangements in terms of partial or total water control for the promotion of market gardening essentially.

According to the inventory carried out in 1986 with the support of the FAO, there are three categories of lowlands, depending on their morphology, with several different types of situations: i) lowlands with a flat/flooded bottom, ii) lowlands that are slightly or slightly concave or sunken; iii) flood plains. In the framework of this study, we will focus on flat and concave lowlands. Flat shallows are the easiest to develop. They correspond best to the objectives and resources available within the framework of the "lowland development" sub-component of the OCRI-Benin project. The concave shallows are also

a priority for this project in the sense that it is these formations that make it possible to plan the construction of micro-dams or medium-scale water reservoirs capable of storing a certain volume of water that can be used to develop off-season market gardening downstream of the structures.

Flat lowlands generally have a slight slope, longitudinal and transverse, generally less than or equal to 1%. These shallows are wide, elongated, with no preferential flow line, or a shallow line less than 0.30 m deep. There is also runoff. The duration of waterlogging is sometimes as long as 4 months. The management system that has been developed, tested and is currently being popularised is that of isophysical retention dykes complemented by water regulation structures allowing market gardening to be practised during the dry season.
In the case of OCRI-Benin, only lowlands will be considered, which are easily developed, as these developed sites will make a significant contribution to improving the resilience of producers.

Embanked/concave shallows are generally narrow (100-150 m) but with a greater longitudinal slope (1-2% or more) and with an often marked minor bed and transverse slopes greater than 2%. These are favourable lowlands for the construction of micro-dams and water reservoirs.

2.2.2. Alluvial valley and floodplain sites

Valleys: due to shallow water tables, some valleys may offer excellent sites for the development of small-scale gravity pumped irrigation. In addition, clay textured basins and settling areas are suitable for off-season market gardening.

Floodplains: These are flat areas with almost no slope. They are the major beds of large rivers and lakes. They are used for flood recession agriculture. They are found in the project area. The soils on these sites are either totally or temporarily hydromorphic depending on their topographical position. The soils of the low terraces have a very fine texture (swelling clays). Nevertheless, they are excellent supports for market gardening and food crops (rice in particular) and some vegetables. Coarser-textured soils can be found on the former bank ridges. These soils generally have a high fertility potential.

2.2.3. Artesian springs and boreholes

In the southern part of the Ouémé Basin, there are more than 136 boreholes/artesian sources that continuously discharge their water into the wilderness. In the area of the OCRI-Benin project, the Communes of Zogbodomè and Zangnanado have this type of resource. Both municipalities have 44 artesian boreholes. If the communities concerned showed real interest and commitment, relatively modest investments could make it possible to mobilize this water, which is unnecessarily discharged into nature, for the use of small-scale irrigation (market gardening, fruit growing, etc.).

In collaboration with local technical services (RADLF, RADA, Town Hall), NGOs and other actors, OCRI-Benin must ensure that communities are receptive and express the need. The risks of conflict of use (especially with livestock), should not be neglected
.
OCRI makes the option of easily developed sites with flat bottoms, and in the case of water mobilisation for irrigation with simple infrastructure, to areas where surface water collection is readily available for the dissemination of Integrated Soil Fertility Management Technologies (ISFM) for small producers.

2.3 Characterization and selection results

2.3.1. Typology of sites selected in the framework of the OCRI project

2.3.1.1. Potential sites for the construction of small dams/micro-dams

These are sites with widths ranging from 150 m to 300 m for those that are concave and 100 to 150 m for those that are incised. They all have steep transverse slopes (more than 2%) and longitudinal slopes greater than 1.5%, thus delimiting incised zones with concave areas with pits that can retain water.

On the basis of a hypothesis of the construction of modest, low-cost, medium-sized structures, it was decided to build structures with a capacity varying between 30,000 m3 and 80,000 m3 that could be easily managed by the operators and that would make it possible to develop off-season market gardening downstream of each structure. Taking into account a water requirement for market gardening equal to 10,000 m3/ha, it will be possible to sow an average of 3 ha of market gardening downstream of each structure and this in double cropping, i.e. 6 ha of sowing per site and per season. Farmers will be trained to follow a compatible agricultural calendar so as to set up market garden crops before the start of the dry season in order to benefit from the residual moisture of the winter season and then supplementary irrigation for the first season's crops. The crops of the second season, which is entirely in season, will be irrigated with the water retained in the micro-dams.

Table n°5 presents the synthesis of the characterization of these concave or incised sites. Table n°1 in appendix 4 presents the details of the sites characterized in the five (05) communes of intervention of the project to shelter the small dams/water retention/excavation of ponds, etc.

Table 5: Summary of potential sites identified for the construction of dams/micro-dams

N°	Agricultural Development Cluster (ADC)	Municipalities	Arrondis-sements (Unut)	Villages (Unit)	Sites (unit)	Crops developed	Capacity of reservoirs (m3)	area that can be covered with this reservoir capaity (ha)	Bassin catchment	Statut
1	ADC4	Copargo	2	8	8	Irrigated crops	320 000	21	Ouémé	undeveloped
		Djougou	6	11	11	Irrigated crops	440 000	26	Donga	existant small dams or reservoirs
		Glazoué	4	8	8	Irrigated crops	320 000	21	Zou (Gnatodji)	undeveloped
2	ADC5	Zangnanado	1	1	2	Vegetable crops	80 000	5	Ouémé	undeveloped
		Zogbodomey	1	1	1	Vegetable crop and sugar canne	40 000	2	Koto	undeveloped
Total			**15**	**27**	**30**		**1 200 000**	**75**		

A total of thirty (30) deep and concave sites suitable for the construction of dams or micro-dams were identified in twenty (27) villages and fifteen (15) districts of the five (05) municipalities where the project is to be implemented. The rough estimate of the water storage capacities of the projected structures is 1,200,000 m3. Taking into account a maximum water requirement for market gardening of 15,000 m3/ha per vegetative cycle, the average area to be sown will be 75 ha.

Figure 2 below shows the geo-referenced situation of the sites selected for the construction of micro-dams or dams in the five (05) municipalities where the project is to be carried out. Maps n°1 to 5 in appendix n°5 present the geographical location of the sites by commune for this category of sites.
In addition, the project area abounds in old degraded structures or water reservoirs that require rehabilitation. Table n°6 gives an overview of these structures that need to be upgraded and the pathologies corrected with a view to their enhancement.

Table 6: Summary of dams/micro-dams/soil to be rehabilitated

N°	Agricultural Development Cluster (ADC)	Municipalitiess	Arrondis-sements (unit)	Villages (unit)	Sites (unit)	Crops developed	Capacity of reservoirs (m^3)	area that can be covered with this reservoir capaity (ha)	Bassin catchment	Statut
1	ADC4	Copargo	4	5	5	Vegetable crops developed and livestock watering	170 000	08	Ouémé	to be rehabilited
		Djougou	5	7	7		273 100	12	Donga	to be rehabilited
		Glazoué	5	6	10		236 100	10	Ouémé et Zou	to be rehabilited
2	ADC5	Zangnanado	1	1	1		80 000	-	-	to be rehabilited
		Zogbodomey	-	-	-	-		-	-	-
Total			15	18	23		743 100	30		

A total of twenty-two (22) old structures (dams, water reservoirs, ponds, etc.) are located in the five (05) communes where the project is operating out of the twenty-three (23) in the Ouémé basin. Table n°2 in appendix 4 presents details on each of the sites characterized in the five (05) communes of intervention of the project.

Figure 3 below presents the geo-referenced situation of the structures to be rehabilitated. Table 2 in appendix 4 and maps 6 to 10 in appendix 5 present respectively the details of the characterized sites and the georeferenced location of the sites in the five (05) municipalities where the project is to be carried out.

These structures are in various states of degradation and require rehabilitation work except for Daringa. Indeed, the Daringa structure is in good condition and only requires downstream development. After rehabilitation, it would be possible to store about 743,100 m3 of water annually. As these dams were built primarily for livestock watering, this function will not be removed after rehabilitation. It is assumed that at least half of the stored water will be used for the installation of small market gardening perimeters downstream of these structures. Thus, it will be possible to install 30 ha of irrigated perimeters downstream of the works to be rehabilitated, except in Zangnanado where the already rehabilitated water reservoir is used exclusively for livestock watering.

All in all, thirty (30) works (dams, micro-dams, water reservoirs or over-creation of ponds) will be carried out to irrigate about 75 ha of land for off-season market gardening. Then, twenty-two (22) structures will be rehabilitated and will enable the development of about 30 ha of small perimeters downstream. This means that a total of 105 ha of land will be developed in small irrigated perimeters downstream of the works to be carried out or built.

2.3.1.2. Potential sites for the realization of irrigated perimeters

Classified in this category are the perimeters downstream of the surface water collecting structures (see Table 6), alluvial and flood plains (flood recession crops, etc.), sites adjacent to annual water courses, artesian borehole endorsements (Table 4), etc. Table n°7 presents the synthesis of potential sites for the creation of small irrigated perimeters. Table n°3 in appendix 4 and maps n°11 to 15 in appendix 5 present respectively the details of the sites characterised (sites downstream of the mini-dams / water reservoirs to be built / rehabilitated, sites downstream of artesian boreholes and sites naturally adapted for small irrigated perimeters) and their location in the five (05) communes of intervention of the project.

Table 7: Summary of potential sites for the realization of irrigated perimeters

N°	Agricultural Development Cluster (ADC)	Municipalities	Arrondis-sements (unit)	Villages (unit)	Sites (unit)	Crops developed	Capacity of reservoirs (m^3)	area that can be covered with this reservoir capaity (ha)	Bassin catchment
1	***ADC4***	***Copargo***	*2*	*18*	*31*	*Yams and others irrigated cops*	***408***	*45*	*undeveloped*
		Djougou	*6*	*10*	*29*	*Yams and others irrigated cops*	***354***	37	*Partial developed*
		Glazoué	*6*	*6*	*26*	*Yams and others irrigated cops*	***347***	21.75	*undeveloped*
2	***ADC5***	***Zangnanado***	*1*	*1*	*05*	*Yams and others irrigated cops*	***50***	*0,4*	*undeveloped*
		Zogbodomey	*1*	*1*	*02*	*Yams and others irrigated cops*	***269***	*30*	*undeveloped*
TOTAL			**16**	**36**	**93**		**1 428**	**134**	

A total of ninety-three (93) sites suitable for the development of irrigated perimeters were identified and retained. They total a surface area of 1,428 ha that can benefit from developments with total water control, including the 105 ha identified downstream of the surface water collection structures to be built and rehabilitated (i.e. 75 ha downstream of the new structures to be built and 30 downstream of the structures to be rehabilitated) and a surface area of 220 ha downstream of the artesian boreholes that continuously discharge water into nature in Zogbodomè and Zangnanado. Small irrigated perimeters of 5 ha each will be created downstream of the forty-four artesian boreholes.

Figure 4 shows the geo-referenced situation of the potential sites for the construction of the irrigated perimeters.

2.3.1.3. Potential sites for lowland development

These are flat/flabby shallows, concave shallows and floodplains that are suitable for developments with partial water control. Table 8 summarizes the characterization of the flat and flared sites. Table n°4 in appendix 4 and maps n°16 to 20 in appendix 5 present respectively the details of the characterized sites and their location in the five (05) municipalities of intervention of the project.

Table 8: Summary of potential sites for lowland development

N°	Pôle de Développement Agricole (ADC)	Communes (unit)	Arrondis-sements (unit)	Villages (unit)	Sites (unit)	Crops developed	available area (ha)	cultivated area (ha)	Statut
1	***ADC4***	***Copargo***	*2*	*5*	*9*	*Riz et Igname*	*394*	*67,5*	*undevelopped*
		Djougou	*6*	*9*	*12*	*Riz, Maraîchage et Igname*	**241**	**55,5**	*Partial developed*
		Glazoué	*7*	*12*	*15*	*Riz, Maraîchage, maïs, et soja*	**755**	**74,5**	*undevelopped*
2	***ADC5***	***Zangnanado***	*3*	*5*	*6*	*Riz*	***960***	***165***	*undevelopped*
		Zogbodomey	*2*	*2*	*2*	*Riz et Maraîchage*	*260*	*16,5*	*undevelopped*
TOTAL			**16**	**36**	**44**		**2 610**	**379**	

A total of forty-four (44) lowlands were identified and retained. These shallows have a total surface area of 2,610 ha that can benefit from developments with partial water control.
Figure 5 presents the georeferenced situation of the potential sites for the creation of irrigated perimeters.

2.3.1.4. Potential sites identified and retained for Integrated Soil Fertility Management (ISFM)

In the project intervention communes, it is reported that some sites have very insidious levels of degradation requiring land restoration and fertility enhancement actions. The extent of this phenomenon is more pronounced in the communes of Copargo and Djougou than in the other communes. The mission was not able to visit sites, but it should be noted that practically all the fields are subject to water erosion with the result that the skeletal gravelly soils lacking all the fertilising elements have appeared, said the resource persons met.

According to the agricultural statistics of the Directorate of Agricultural Statistics (DSA) compiled in Table No. 9, the land sown in the five (05) communes of the project is 227,257 ha for cereal crops, legumes and tubers and 5,060 ha for vegetable crops (tomatoes, peppers, onions, leafy vegetables, etc.).

Table 9: Synthesis of the characterization of Land Management and Soil Fertility Sites (GIFS).

N°	Agricultural Development Cluster (ADC)	Communes (unit)	Arrondissements (unit)	Villages (unit)	Sites (unit)	Crops developed	available area (ha)	cultivated area (ha)	Statut
1	ADC4	Copargo	ND	ND	ND	Maïs, Sorgho, Mil, Manioc, Igname, Patates douce, Niébé, Arachide, , Tomate, Piment, etc.	25 144	20 115	Dégradé
2		Djougou	ND	ND	ND		48 452	38 762	Dégradé
		Glazoué	ND	ND	ND		17 482	6 993	Dégradé
2	ADC5	Zangnanado	ND	ND	ND		17 482	11 509	Dégradé
		Zogbodomey	ND	ND	ND		28 774	17995	Dégradé
TOTAL GENERAL							**232 317**	**95 373**	

On the basis of the diagnosis, it was decided to plan demonstration actions for the restoration and management of soil fertility, improvement of rainwater infiltration through soil and water conservation practices (anti-erosion) on 95,373 ha as shown in Table 9.

2.3.1.5. Sources and watercourses to be protected

Apart from the Ouémé and Zou rivers, there are no other specific sources requiring protection. These are mainly the springs at the birth point of the Ouémé River in Tanéka, mineral water springs, and artesian boreholes that continuously discharge their waters into the wild, etc. Table 10 presents a summary of the springs to be protected.

Table 10: Summary of sources to be protected

N°	Agricultural Development Cluster **(ADC)**	Communes (unit)	Arrondissements (unit)	Villages (unit)	Name of source	**Description**
1	***ADC4***	***Copargo***	*Copargo*	*Saffassi*	*Saffassi*	*first source of birth of Ouémé river*
			Copargo	*Tanika-béri*	*Tanika-béri*	*2nd source of birth of Ouémé river*
		Djougou	-	-	-	-
		Glazoué	-	-	-	-
2	***ADC5***	***Zangnanado***	***Zangnanado***	*Awinvi*	*Aglui-glui*	*Slightly landscaped mineral water source*
			Agonlin-Houégbo	*Houégbo-Aga*	*Ahoho*	*Slightly landscaped mineral water source*
			Dovi /	*Todo*	*Dovè*	*Crystal clear water flowing from the rock*

			Dovi /	*Vêdji*	*Awaya*	*Natural water source springing from the ground*
			Zagnanado		*Ahounhouin*	*Natural water source springing from the ground*
			Agonlin-Houégbo		*Somètè*	*Natural water source springing from the ground*
			Don-Tan	*Don*	*Gninko*	*Lake full of fish in gallery forest*
			Agonlin-Houégbo	*Bamè*	*Lac Founta*	*Lake full of Diversity of fishery resources*
			Dovi	*Dovè*	*Lac Taffè*	*Lake full of Diversity of fishery resources*
			Kpédékpo	***Agonvè***	*Houandohoun*	*Water exchange channel (in both directions depending on the period) between the Ouèmé river and Lake Azl*
			Agonvè	***Agonvè***	*Lougbé*	*Upstream of Ouémé river (in the north) flowing into Lake Azli during flooding*
		Zogbodomey	*Avlamey*	*Alladaho*	*Agbogbohonou*	*Natural thermal spring*

In addition to these sources, it would be judicious to plan actions for the protection of artesian boreholes, in particular to limit the continuous discharge of water into the nation for many years. A total of 44 existing boreholes in two of the project's communes will be affected. These are the municipalities of Zangnanado (02 boreholes) and Zogbodomè (42 boreholes) as shown in Table 4.

2.3.2. Description of the types of infrastructure selected to be promoted in OCRI

In the area of hydro-agricultural development, the main objective of the project interventions is to improve and secure production conditions through efficient management of run-off water and flood transit in order to guarantee a regular water supply and better protection of crops against floods. They will integrate the lowland complex approach, which consists of considering the site and its slopes as a single functional entity. Within this framework, the sites whose slopes are bare, will benefit in addition to the infrastructure, from the distribution of plants adapted to climate change (cashew nut, palm, Nere, Shea, etc.) to the beneficiaries to make plantations at the level of the slopes to control water erosion, source of silting of the sites.

The adverse effects of climate change, particularly flooding, will be taken into account in the design of the facilities. The actions will target undeveloped sites, traditionally exploited sites or summarily developed sites requiring development according to the rules of the trade. This is in particular the case of poor quality sites exploited by women producers, the best developed and most productive sites being mainly occupied by men. Rehabilitation of existing dams, weirs, overburdened ponds and water reservoirs will be limited to sites that have not been previously rehabilitated, such as the Samiondji dam in Zangnanado, which was rehabilitated in 2018.

Within the framework of the implementation of the project, four (04) types of infrastructure are retained. These are:

- construction of surface water mobilization structures through micro-dams or raising thresholds with development of downstream market gardening perimeters;
- development of irrigated perimeters with total water control, particularly for off-season market gardening;
- development of lowlands with partial water control for market gardening and, to a lesser extent, rice growing;
- Development for the protection of springs and watercourses.

In addition to these types of infrastructure, development with water and soil conservation techniques will be considered with a view to disseminating the use of Good Agricultural Practices Resilient to Climate Change (ARC).

2.3.2.1 Construction/rehabilitation of micro-dams, weirs, spillways or reservoirs

The works concern micro-dams, spillway weirs, water retention areas, over-embanked ponds, etc. These are works for mobilising surface water that can be carried out in concave or incised shallows, on tributaries and sub-tributaries of the Ouémé River. They are relatively modest in size and capacity and are technically easy to maintain by the beneficiary communities. As such, the works to be promoted will have the following characteristics:

Sill or dike length: 100 to 150 m
Area dominated downstream: 1.5 ha to 2 ha
Average depth: 3 to 4 m
Water storage capacity: 30,000 m3 to 80,000 m3.

As indicated in point 2.4.1, this volume of water will allow the development of between 1 and 3 ha of off-season vegetable crops downstream of each planned structure. On the basis of the potential sites selected, it would be possible to sow about 75 ha of land for irrigation downstream of the works to be carried out. The standard construction and rehabilitation plans for these structures are given in Appendix 6.1.

In this category of infrastructure, a certain number of existing works that are under-utilised due to: their state of degradation; the lack of interest of the beneficiaries in the work due to a lack of awareness and; given that some works were initially exclusively pastoral in nature. An estimate currently made without taking into account the exclusively pastoral works shows an availability of nearly 743,100 m3. Considering that half of this water is used for livestock watering, the residual volume can irrigate at least 30 ha of land for a crop water requirement of 15,000 m3/ha.

In total, the construction of micro-dams, weirs, small water reservoirs and the rehabilitation of old structures will make it possible to mobilize the water necessary for the installation of about 105 ha of small irrigated perimeters for the development of off-season market gardening in the five (05) communes where the project is being implemented.
Other rainwater harvesting techniques such as (i) cisterns, (ii) tarpaulins, etc. could be envisaged if the soil conditions permit. The main problem with these works lies in their limited capacity to store water for the development of one (01) ha of irrigated perimeter in a single block.

2.3.2.2 Development of perimeters with total control of water for irrigation

These include land reclamation systems near watercourses, floodplains and all lands downstream of water collection structures, artesian boreholes. These systems may include permanent or semi-permanent stream intake or flood recession cultivation (Photo No. 1 in Appendix 6.2).

Furthermore, flood recession crops, which are the least developed forms of traditional irrigated cereal crops (maize) are classified in this category of infrastructure. It is an extensive agriculture practiced at the level of the overflow zones of permanent or temporary watercourses as well as at the level of the tidal zone of permanent water bodies.
The system of flood recession agriculture is practised and is expanding rapidly, especially on the lands of the flood plains of the Ouémé valley, especially in the communes of Zangnanado and Zogbodomey. Irrigation water comes from a network of canals or collectors that was set up in the early stages of development (or comes from other natural sources). Irrigation then essentially consists of sucking up water and pumping it directly into the rice traps during critical periods (Photo n°2 in appendix 6.2). It

should be noted that the dividing bunds are sometimes built from peaty material (poorly decomposed organic matter); in this case, they have a short lifespan and are not very effective in retaining water in the crates. On the other hand, when soil of good composition and texture is available, earthen bunds are more resistant and more perennial drainage channels can be made for the evacuation of excess water.

2.3.2.3 Lowland Development with Partial Water Control

The types of lowland development are dictated by the capacity and tolerance of dykes and sills to flooding and stream overflows. Table 11 gives some values used in practice for the definition and dimensioning of embankments or sills.

Table 11: Main Water Haversting techniques for lowland development with partial water control

N°	Type of bunds/Dikes	Tolerated overflow (m3/s/ml)	Water heigth accepted (m)
1	*Contours earth bunds*	*0,020*	*0,05*
2	*Contours stone bunds*	*0,200*	*0,21*
3	*Contours mixt earth and stone bunds*	*0,200*	*0,21*
4	*Contours mixt earth and stone bunds with geotextile*	*0,500*	*0,29*

The techniques for the development of lowlands or similar formations to be adopted within the framework of the project will be based on the standard technical models in force in Benin (Photos n°3 in annex 6.2). The choice of each model will depend on the morphological, edaphic and topographical characteristics of the targeted lowland.

Thus, according to the morphological and hydrological conditions of the project intervention area, the following management models will be adopted:

(i) Lowland or perimeter constructed with iso-physical dikes, protective dikes, compacted topsoil with small drainage works, bulkhead dikes made of soil taken from the site and/or non-channel drainage as appropriate (DCN-T);
(ii) Lowland or perimeter constructed with isohypses, dry stone/stone protection dike with small drainage works, field earth barrier dike, drainage channel as appropriate (DCN-P);
(iii) Lowland or perimeter constructed with isohypses of mixed materials (compacted earth fill bunds covered with geotextiles and then dry stone on lowland areas with a tolerance greater than 0.021 m3/s/ml), earth barrier bunds taken from the site;

A detailed description of these types of lowland development with partial water control is presented in Appendix 6.2.

2.3.2.4. Planning for soil and water conservation practices

It concerns the implementation and dissemination of Good Agricultural Practices Resilient to Climate Change (ARC), including water and soil conservation techniques. In this regard, about 95,000 ha of cultivated land are identified (Table n°9) on the basis of the agricultural statics of the DSA of the five (05) communes of the project to benefit from the treatment of degraded land whose rainwater infiltration is improved by soil and water conservation practices, in other words, anti-erosion techniques. To this will be added agroforestry, windbreaks and plantations.

2.3.2.5. Sources and watercourses to be protected

Developments for the protection of watercourses and water sources concern both reforestation of the banks of the said watercourses to limit silting. Actions such as the construction of headwalls at the outlet of springs, especially the first springs of the Ouémé River, springs with gushing water from the hills, artesian springs, etc. actions for the reforestation of the banks of watercourses. These actions will make it possible to protect springs and riverbanks against scouring or undermining and prevent water from ravaging the soil.

Under this heading, the development of artesian drilling heads will also be considered to limit water losses under pressure. A total of sixteen (16) sites and forty-four (44) artesian boreholes will be subject to special treatment for their protection.

2.4. Estimated exploitable areas by type of development proposed

Table 12 gives a summary of the areas to be developed by type of development described in point 2.3 above.

Table 12: Estimated number of structures and areas of land to be developed by municipality

Type of infrastructures / ***Municipality***	**Construction of micro-dams/weirs (unit)**	**Rehabilitation of micro-dams/weirs (unit)**	**Development of small irrigated perimeters (ha)**	**Development for the protection of springs and watercourses (unit)**	**Improved land through water and soil conservation practices (ha)**
Copargo	***8***	*5*	*200*	*2*	*20 115*
Djougou	***11***	*7*	*170*	*00*	*38 762*
Glazoué	***8***	*10*	*160*	*00*	*6 993*
Zangnanado	***2***	*1*	*25*	*14*	*11 509*
Zogbodomè	***1***	*-*	*125*	*40*	*17 622*
Total	**30**	**23**	**680**	**58**	**95 000**

In total:

- 30,00 new surface water haversting structures (dams, micro-dams, weirs, overburial of ponds, etc.) will be built;
- 23 old surface water heversting structures (water reservoirs, weirs, etc.) will be rehabilitated;
- 680 ha of small irrigated perimeters including 105 ha downstream of the water haversting structures to be built and/or rehabilitated and 220 ha downstream of the artesian boreholes in Zangnanado and Zogbodomè; and
- 14,00 water sources and 44 artesian boreholes to be developed for their sustainable protection.

Sustainability of the infrastructures

To sum up, it can be concluded that several relatively inexpensive furnishing systems are available and well mastered by technical services and design offices and construction companies. They generally have a relatively low average cost per hectare. Apart from the aspects related to the cost per hectare, particular attention should be given to systems that guarantee greater durability of the developments and works. Land development systems that require relatively large, arduous and frequent maintenance work by producers each season contribute to the disaffection of farmers and the abandonment of developed plots. For this reason, the work must be carried out according to the rules of the trade in a sustainable and attractive way for the beneficiaries. So-called summary development works, where everything is systematically resumed after a flood, must be avoided.

Whatever the development system, its sustainability will closely depend on the involvement and association from the outset of all the actors concerned in any way with the lowlands, and this as early

as possible in the process of selection and planning of the infrastructure. It is through this inclusive approach that certain actions such as the destruction of dykes due to trampling of animals or holes dug by rodent hunters can be mitigated.

A strategy approach for success and sustainability would be to start with very simple infrastructure in the first instance. This would particularly apply to municipalities and sites where a tradition of market gardening is not well established. Subsequently, based on the constraints, difficulties and opportunities identified by the producers and their partners, technical improvements and adapted works would gradually be added. This would contribute to a better internalization and appropriation of the developments.

2.5. Estimation of the costs of the facilities/planned interventions

The cost is estimated on the basis of the average unit price for the construction of the works, the number and type of weirs, the planned length of the weirs, the type and number of control works required, planned, the number of drainage works, the length of the protective dyke (layout variant), etc. Table 13 shows the costs per category of structure and type of development.

Table 13: Estimated cost of construction/rehabilitation of dams, micro-dams, water reservoirs

N°	Component	Unit	Quantity	Unit price (*US$)	Amount (*US$)
Construction/rehabilitation of surface water storage structures or surface water harvesting structures					
1.	*Construction surface water storage structures or harvesting structures (Small earth dams, water rising structures, etc.*	*u*	*30*	*110 000*	*3 300 000*
2.	*Rehabilitation of surface water storage structures or harvesting structures (Small earth dams, water rising structures, etc.*	*u*	*23*	*67 500*	*1 552 500*
TOTAL 1					***4, 852, 500***
Land development					
1.	*Development of small irrigated perimeters with full water control*	*ha*	*680*	*3 000*	*2 040 000*
2	*Development for erosion control*	*ha*	*95 000*	*PM*	
3	*Development for the protection of water sources (river, head of streams, artesian boreholes, etc.)*	*u*	*58*	*2 000*	*116 000*
TOTAL 2					***2 156 000***
TOTAL					**7,008,500**

The total investment cost is estimated at US$ 7,008,500 to carry out all the planned developments on the basis of the identification results. This cost far exceeds the available budget.

2.7. Description of hydro-agricultural development activities

The main activities are organized around 6 axes: (i) preparatory activities involving awareness-raising and information for beneficiaries and other actors; (ii) final selection of sites and development applications; (iii) development studies and environmental and social impact studies; (iv) development work and supervision of the execution of the work; (v) support for the establishment of sustainable management and maintenance of the developments.

(a) Preparatory activities

They will make it possible to inform the beneficiaries of the lowland development activities and the methods of intervention. They will include (i) an awareness-raising and information campaign for the populations of the intervention zone from the outset on the objectives, approach, targeting of beneficiaries, working methods and roles of the project and its partners as well as the responsibilities

of the beneficiaries. This information campaign will be renewed annually when the Programme of Activities and Budget is drawn up at the communal level; (ii) the preparation and launching of calls for projects to generate demand from target groups (OPA) and the screening and pre-selection of applications received;

(b) Selection and final validation of sites and applications
This involves making the final selection of pre-selected sites and applications to verify their feasibility. For each site, the following criteria will be taken into account: (i) the composition of the PO in terms of gender and its experience in irrigated crops; (ii) inclusion of the site in the Communal Development Plan and the existence of an acceptable land tenure security act; iii) the size of the site must not be less than 2 ha for vegetable crops and not less than 10 ha for others irrigated crops; (iv) sites classified as RAMSAR headwaters, forest gallery and confluence sites (of two drainage systems) will be excluded; (ii) the site must not be too deep and must not be peaty; (v) the status and current exploitation of the slopes and the possibility of integrating slope protection into the lowland development; (vi) technical criteria such as: general slope of the site (less than 3%), irregular topography, water regime of the site (hydromorphy, presence of a watercourse), flood risks, nature of the soil and its potential; (vii) the accessibility of the site should not be a major difficulty and should be within 5 km of a village where the site does not border a developed all-season road.

(c) Detailed rehabilitation studies, including:
(i) agro-socio-economic studies (current operating and land situation of the site, farmers' organization, strategy for the development and inclusion of women and young people, speculation and crop records and operating account and financial analysis, etc.);
(ii) basic technical studies (topographical studies, geotechnical and pedological investigations);
(iii) hydrological studies (characterization of the catchment area, water regime, evaluation of inputs, calculation of water requirements, project flooding for the design of the works);
(iv) detailed design studies (cutting, sizing of structures and infrastructures, preliminary measurements, slope protection plan);
(v) environmental and social impact studies for each site (or a group of sites in the same lowland) in accordance with Benin regulations;
(vi) preparation of simplified special technical clauses (for small works) and tender documents for works (for a group of sites); (v) preparation of a management and maintenance manual for each rehabilitated site.

(d) Development work:
These will cover (i) site clean-up work and the layout of the various infrastructures and structures; (ii) reprofiling work on the small stream (development types 2 and 3), serving as a collector drain with the construction of protective riders on both banks throughout the section to be developed. If possible, the stream reprofiling will be extended 100 m downstream of the developed part to improve flood evacuation (climate change mitigation measures); (iii) construction work on the upstream dike, the raising structure and possibly the intake structures of the irrigation canals (type 3 development); (iv) earthworks for the bank canals and construction of control structures along these canals (type 3 development) ; (v) earthworks for contour dikes and transverse dikes for parcels of land; (vi) parcel development works (subdivision of parcels of land into homogeneous cascades, levelling and laying of supply and drainage pipes) to be paid for by the beneficiaries; (vii) for bare lowlands, slope treatment works with the supply of useful plants (cashew nuts, citrus fruits, palm trees) and supervision of the beneficiaries for the establishment of plantations.

(e) Control and supervision of works

They include the activities of on-the-spot control (quality of materials and works, quantity of works executed, attachments, accounts, etc.), the organization of site supervision (with the project owner, the beneficiaries and the company) and the acceptance of the works.

(f) Establishment of a sustainable management and maintenance mechanism
The project will support the revitalization of the POs and the establishment of the Management Committees of the Developments (CGA) as well as the reinforcement of their capacity and that of the producers. At the level of each site, this will involve:

(a) facilitate the establishment of a management committee, responsible for administrative management (monitoring of works, organization of parcel work, distribution of plots, planning of activities for each season, collection of water charges) and technical management (management of hydraulic infrastructures, monitoring of irrigation, supervision of works, organization of routine maintenance works);

(b) to provide the committee with management tools and infrastructure maintenance manuals and to train its members to better perform their roles; (iii) to facilitate and support the committee in the introduction of a water charge to guarantee the maintenance and repair of the main hydraulic works; (iv) train producers during the works phase in the mastery of parcel development techniques (plot setting, construction of dykes, plot levelling, etc.) as well as in water supply and maintenance of parcel infrastructures.

(c) Implementation of development activities
Project interventions in lowland development will continue to be in line with the principles of the National Strategy for Lowland Development and will be based on a participatory approach that puts the FOs at the centre of the implementation process. They will be carried out in accordance with the following principles: (i) the receipt of a request for support from a PO is a condition for initiating the intervention process; (ii) requests for support must be included in the communal development plans, which must be amended beforehand if necessary; (iii) "faire faire" and partnership between public and private operators, beneficiary POs and the project through memoranda of understanding and service contracts; (iii) delegated project management (MOD) for the implementation of the project management activities (studies, works supervision) and development works in order to avoid slowness in the awarding of contracts; (iv) promotion of local supply by making use as much as possible of local/national SMEs for the implementation of works and the labour intensive method (HIMO).

The financing of each site by the project will be subject to the fulfilment of the eligibility criteria mentioned above and in particular the following: (i) the development does not contravene the communal and national land use plan; (ii) the site is neither a spring head, a forest gallery, a protected area or a recognized pastoral space; (iii) the provision of a formal act of land security for the site and the absence of any land conflict; (iv) it must be in operation at least on part of its surface and must not be very difficult to access; (v) for an already developed site requiring rehabilitation, it will only be eligible if this is its first rehabilitation; (vi) the technical, economic and social feasibility of the development of the site; (vi) priority will be given to POs with a high composition of women and young people.

(d) Arrangements at the level of the Project Coordination Unit
A person in charge of infrastructures, with a rural engineering profile, will be recruited to ensure the coordination and monitoring of this hydro-agricultural development component. He/she will be responsible for planning Hydro-agricltural activities, drawing up the terms of reference for the various services (engineering and control firms, technical services or private firms providing training, enterprises, etc.) and supervising the implementation of activities.

(e) Technical assistance
A Technical Assistant (regional or international) with an engineering profile in rural engineering or irrigation, with proven skills in the design of irrigated perimeters in general and lowlands in particular will be recruited for a period of three (3) years. He/she will provide expertise in lowland design and will support the Infrastructure Manager within the coordination team. He/she will be specifically responsible for : (i) the definition of types of development adapted to each agro-ecological zone of the project intervention area; (ii) the elaboration of the terms of reference of the project management activities (identification, technical and economic studies, control of works) of the sites to be developed; (iii) the review and quality control of the technical studies, technical specifications of the tender documents (DAO) and works control reports; (iv) and the support to the reinforcement of the capacities of the management committees.

(f) Directorate of Rural Engineering (DRE)
As part of its public mission, the DGGR, through its Lowland Unit, will ensure the general supervision of development activities on behalf of the APRM. Based on the field experience of the Lowland Unit, it will carry out prior site identification activities on the basis of precise terms of reference and a memorandum of understanding. It will also support the Coordination Unit in validating the studies and returning the results to the beneficiaries in conjunction with the delegated project owner.

(g) Producer Organizations (POs)
Beneficiary POs must be the owners of their project initiatives and fully play their role as project owners. To do so, they must be involved at all stages of implementation. For each site selected to be developed, a memorandum of understanding defining the content of the project support and the obligations of the beneficiary will be signed before the launching of works with the promoting FO. The project will also support the FOs to revitalize or set up management committees and strengthen their capacity.

(h) Other actors are private providers
These are design offices, building and public works firms, training firms or individual consultants, who will be recruited through competitive bidding to carry out the various activities (studies, works supervision, development work, formation of management committees).
Chronology and procedures for implementing the activities.
The different stages of implementation are:
(i) Information and awareness-raising among beneficiaries;
(ii) Receipt and examination of project applications from POs;
(iii) Identification of the sites of the pre-selected applications;
(iv) carrying out detailed studies;
(v) carrying out development works and supervision of the works;
(vi) setting up management committees and strengthening their capacities;
(vii) operating the site.

(i) Awareness-raising and information stage for beneficiaries.
This stage will be carried out at the start (launch) of the project and annually when planning activities. It is essential to generate demand. The coordination team and the URAs with the support of their public partners (RDALF, RADA, farmers organizations, town halls) will carry out information campaigns on the project activities, the technical, social and environmental eligibility criteria of the sites and the modalities of access to project support. Each URA will launch calls for projects in relation with the other partners to the POs in its coverage area.

(j) (ii) Stage of receipt and examination of applications.

Applications will be addressed and centralized at the level of town halls. Each town hall will set up a commission for the selection of applications including the DRE, the RADA, the RDALF concerned and the rice umbrella POs. This commission will examine the applications received in relation to the project intervention criteria and will make a selection.

(k) (iii) Site selection stage for pre-selected applications.
The pre-selected applications will be forwarded to the Coordination Unit, which will develop terms of reference for the final selection of sites and sign a protocol with the RMD to carry out the selection. The final selection reports will include a list of sites selected for techno-economic studies. The results will be returned to the various stakeholders at the communal level. The coordination unit will sign a memorandum of understanding with each of the POs whose sites have been selected, which is accompanied by a chronogram for the implementation of the sub-project of the PO in question. The terms of reference of the studies of the selected sites will be drawn up by the Technical Assistant and the Infrastructure Manager and transmitted to the procurement authority.

(l) (iv) Steps in the conduct of studies of the selected sites
Prior to this stage and on the basis of the results of the selected applications, the project coordination will have anticipated the EOI process and agreed on the short-list of consultancies. It will launch the consultations, evaluate the tenders and contract the firms for the detailed technical and economic studies. The firms will be contracted for studies and supervision of works. The provisional reports of the studies will be submitted to the DRE for comments, then will be returned to the poles in the presence of the beneficiary POs and project partners (RADA, RADLF, umbrella organizations, etc.). Observations and comments resulting from the review and restitution workshops will be transmitted by the coordination to the concerned consultancy firms for consideration and preparation of the final reports. The final reports will be accompanied by technical specifications of the works required for the preparation of the bidding documents. The Infrastructure Manager of the project coordination will finalize the DAOs by allotting works by commune and, if necessary, by groups of sites within each commune to take into account the implementation capacities of the SMEs.

(m) (v) Stage of implementation of the development works.
The coordination in connection with the Person in Charge of Public Contracts concerned will conduct the process of consultation of the enterprises and their contractualization while requesting the necessary non-objections in accordance with the procurement procedures. It will ensure that the number of work packages (e.g. 1 package) to be awarded to the same SME is limited in order to avoid the risk of delays in execution. It will organise monthly supervision of the works in the presence of the control office, the enterprises and representatives of the beneficiary POs. Each supervision will be the subject of minutes signed by all parties. Provisional acceptance of works will be made without reserve and in the presence of beneficiary POs, the project team and other actors. It is the same for the final acceptance.

(n) (vi) Support stage for the management and maintenance of the facilities.
Each beneficiary PO will set up, with the support of the project, a management committee from the works phase, which will be associated to all the implementation stages and will represent the PO at the meetings of supervision of the works and at the reception of the works. The members of the committee will be trained to carry out their respective roles and will be equipped with small earthmoving equipment (shovels, ladders, picks, wheelbarrows, cutters, etc.) to carry out maintenance work on the infrastructure. Training for producers will be carried out during the works (in the form of a field school), to enable them to carry out their plot development and at the time of the first development to better manage water and ensure the maintenance of plot infrastructures. Technical training will be provided with the support of the DRE.

(o) Overall chronological sequence of activities
It is important to ensure that the right season (November-March) for studies and work is rigorously respected. Indeed, work not completed before the great rainy season could lead to significant degradation during the rains, which will be difficult to correct when work resumes. As a special provision, the first site identifications will be carried out as soon as the funding comes into effect so that the studies can be carried out from the first year of the project.

(p) (vii) Development-Exploitation of developed sites
The expected result of the development activities is to deliver to beneficiary FOs functional developments with potential value added in terms of agricultural intensification, productivity improvement and production increase. This potential depends on the type of development and the level of water control.

2.6. Opportunities, Implementation Risks and Mitigation Measures

2.6.1. Opportunities.
Lowland development activities are good opportunities for several actors, namely:
(i) They offer beneficiary FOs a secure production tool, capable of contributing to the increase of production and productivity;
(ii) (ii) they give the opportunity to poor producers to have access to land and to a sustainable land tenure security of their farms;
(iii) They also provide work opportunities for young villagers due to the high demand for labour during development work;
(iv) They also provide business opportunities for private service providers (consultancy firms, construction companies, etc.) and strengthen the institutional capacities of the APRM departments (DRE, RADA, RDALF) involved in the implementation process.

2.6.2. Risks and Mitigation Measures.
The main potential implementation risks could be:
(i) the risk that landowners could challenge land deeds with POs in the early years of development, despite the involvement of city councils in the process;
(ii) the risk of delay in the execution of the work entrusted to the SMEs because of their weak capacities (material and financial).
To mitigate these risks, the project will undertake prior information and awareness raising activities on its modalities of intervention and will organize consultation sessions with the competent administrative authorities, communities and umbrella organizations. Communal and customary authorities will be involved upstream to ensure that land contracts respect customs and that all parties (POs and landowners) benefit from them. POs will include landowners or their family members in their membership to better guarantee land tenure arrangements. Sites with major land problems will be avoided at the time of identification to minimize this risk. The allotment of works in lots of adequate size in relation to the capacity of the SMEs and the annual evaluation of the performance of the SMEs contracted to take out bad contractors are measures to minimize this risk of delay in execution.

Environmental and social impacts and mitigation measures
Lowland development could have negative impacts on the environment during construction and operation:
During the work phase the negative impacts are minor and of very limited extent. At
small works with no major land clearing, limited to the right-of-way of the current lowlands with a high labour-intensive (labour-intensive) use of the mainly small earth-moving equipment (small compactors) and very limited use of some large equipment (trucks, loaders, graders) earthmoving

machinery. The benefits in view of the protection of the slopes of some of the shallows denuded by the distribution of seedlings to the beneficiaries is a positive impact compared to the initial situation;

During the exploitation phase, the increase in agricultural production induced by the project activities (introduction of high-performance varieties, improvement of techniques, etc.). Management, better water management, use of fertilizers, etc.) will help improve the income levels and living conditions of the beneficiaries. On the other hand, negative impacts could result from the overuse of fertilizers and pesticides, that can lead to pollution of downstream surface waters. As the surface areas are very limited and dispersed, its impacts are moderate but limited in scope.

The environmental issue will be considered in all project activities, particularly during the development and operation phases of the rehabilitated lowlands. To this end, the site studies will include environmental and social impact assessments with mitigation measures and a monitoring plan in compliance with the regulations in force in Benin. Thus, all environmental problems will be known prior to the start of works so that appropriate mitigation measures are taken into account in the technical specifications of the contracts and implemented during the works and during the operation of the sites. The mitigation plan must specify the technical choice made to deal with environmental damage. It must also specify the nature of the intervention, which may be either preventive (if implemented before the project), mitigating (if implemented during the project) or compensatory (if implemented after the project).

Beneficiary populations must fully grasp mitigation measures so that they really take them into account in a sustainable development perspective. Monitoring the implementation of these measures is primarily the responsibility of the POs and their management committees, the competent technical services (RADA, RDALF) of the APRM and the Beninese Environment Agency with the support of the project.

The Mitigation Measures Monitoring Plan, developed within the framework of the studies, will be widely disseminated to the beneficiaries, communities and other competent authorities with a view to its implementation.

ANNEXES

Appendix 2: Documents consulted

AERM&C / DIS / REPD - CQ / June 2005: Cost reference for the construction of collar dams

Annex 3: Potential available in the Ouémé Basin

Table 1: Distribution of water reservoirs in the Ouémé Basin

Département	Commune	Arrondissement	Village	Localité	Programme	Capacité RE (m3)	Type ouvrage	Nom de la RE	Etat de la RE
BORGOU	N'DALI	OUENOU	TAMAROU	TAMAROU BLOC A	DGH&DRE/CEAO II	250 000	Barrage	TAMAROU	Besoin d'entretien
BORGOU	N'DALI	N'DALI	N'DALI PEULH		MONASTERE	70 000	Mare	MONDURO BANSOU	Besoin d'entretien
BORGOU	N'DALI	GBEGOUROU	DOUROUBE		DGH&DRE/CEAO II	375 000	Barrage	ATTAGARA	Besoin d'entretien
BORGOU	N'DALI	N'DALI	SAKAROU	SAKAROU	DGH&DRE/CEAO II	180 000	Barrage	SAKARA (SAKAROU)	Bon
BORGOU	N'DALI	N'DALI	N'DALI PEULH		PDEBE	-	Barrage	TCHAKPAROU	Besoin d'entretien
BORGOU	N'DALI	N'DALI	N'DALI PEULH		MONASTERE	70 000	Mare	BAMA MANOMI	Besoin d'entretien
BORGOU	N'DALI	N'DALI	N'DALI PEULH		CEAO II	8 000	Mare	GANDE	Besoin d'entretien
BORGOU	N'DALI	N'DALI	N'DALI PEULH			15 000	Mare	BAH MOUSSA	Besoin d'entretien
BORGOU	N'DALI	N'DALI	N'DALI PEULH		MONASTERE	80 000	Mare	BABARE	Besoin d'entretien
BORGOU	N'DALI	N'DALI	N'DALI PEULH		CHINOIS	80 000	Barrage	KAKATINKOU	Besoin d'entretien
BORGOU	N'DALI	N'DALI	N'DALI PEULH		MONASTERE	70 000	Mare	WOBICO SARUBI	Besoin d'entretien
BORGOU	N'DALI	N'DALI	BANHOUN	BANHOUN CAMP PEULH		12 000	Surcreusement de mare	BANHOUNKPO	Bon
BORGOU	N'DALI	SIRAROU	SIRAROU	SIRAROU BLOC A	DEDRAS	12 000	Barrage	SIRAROU	Bon
BORGOU	N'DALI	BORI	BORI		MONASTERE	70 000	Mare	MOUNOUMI	Besoin d'entretien
BORGOU	N'DALI	SIRAROU	KOMIGUEA	KOMIGUEA BLOC B	CEAO II	70 000	Mare	Peulh de KOMI (KOMIGUEA 1)	Bon
BORGOU	N'DALI	SIRAROU	KOMIGUEA	KOMIGUEA BLOC A		10 000	Mare	CHABI TOURNEUR (KOMIGUEA 2)	Besoin d'entretien
BORGOU	N'DALI	SIRAROU	BOKO	BOKO BLOC A	BDBD	12 000	Mare	BOKO	Besoin d'entretien
BORGOU	N'DALI	BORI	BORI	Bori		40 000	Barrage	BORI	Besoin de réfection
BORGOU	N'DALI	GBEGOUROU	DOUROUBE	DOUROUBE		5 000	Surcreusement de mare	DOUROUBE	Besoin d'entretien

BORGOU	N'DALI	BORI	KORI	KORI	CARITAS	60 000	Barrage	KORI	Bon
BORGOU	N'DALI	BORI	MAREGOUROU	MAREGOUROU BLOC A		15 000	Barrage	MAREBOROU	Besoin d'entretient
BORGOU	N'DALI	BORI	BORI		MONASTERE	70 000	Mare	AREMOU	Besoin d'entretien
BORGOU	N'DALI	BORI	BORI		MONASTERE	70 000	Mare	MAROGUI	Besoin d'entretien
BORGOU	N'DALI	SIRAROU	KOMIGUEA		BDBD	55 000	Barrage	DIBLE WEROU	Bon
		1 699 000							
BORGOU	PARAKOU	3e Arrondissement	GUEMA		BDBD	10 000	Surcreusement de mare	GUEMA	Besoin d'entretien
BORGOU	PARAKOU	1erArrondissement	BOUNDAROU		PDEBB-FED	20 000	Surcreusement de mare	CENTRE SONGHAÏ (ATTAGARA)	Bon
BORGOU	PARAKOU	3e Arrondissement	GUEMA		BDBD	50 000	Barrage	TINRE	Besoin d'entretien
BORGOU	PARAKOU	3e Arrondissement	GUEMA		BDBD	10 000	Surcreusement de mare	CHABI KOBOUROU	Besoin d'entretien
BORGOU	PARAKOU	1erArrondissement	TOUROU V		BDBD	30 000	Surcreusement de mare	DABOU GANDO	Besoin d'entretien
BORGOU	PARAKOU	2e Arrondissement	ASSAGBINE-BAKA			50 000	Surcreusement de mare	KOKOMA GANDO	Besoin de réfection
BORGOU	PARAKOU	1erArrondissement	TOUROU V		CEAO II	82 000	Surcreusement de mare	DABOU	Besoin d'entretien
BORGOU	PARAKOU	1erArrondissement	BAPEROU	BAPEROU BLOC A	CHINOIS	10 000	Surcreusement de mare	BEYEROU	Besoin d'entretien
BORGOU	PARAKOU	1erArrondissement	TITIROU			8 000	Mare	OKE DAMA	Besoin d'entretien
BORGOU	PARAKOU	2e Arrondissement	ASSAGBINE-BAKA	ASSAGBINE BAKA	UDPC	8 000	Surcreusement de mare	BAKA	Bon
BORGOU	PARAKOU	2e Arrondissement	ASSAGBINE-BAKA		CEAO	75 000	Barrage	KPEKPIKINOU (TINKOBONROU) BAKA 2	Besoin de réfection
		353 000							
BORGOU	PERERE	KPANE	KPANE GUEA	KPANE GUEA	CEAO II	18 000	Surcreusement de mare	PANEGUE	Besoin d'entretien
BORGOU	PERERE	GNINSY	GNINSY-PEULH		CEAO II	35 000	Surcreusement de mare	KOKOU	Besoin d'entretien
BORGOU	PERERE	GUINAGOUROU	GUINAGOUROU	GUINAGOUROU (BLOC)	CEAO II	950 000	Barrage	GUINAGOUROU	Bon

BORGOU	PERERE	PERERE	PERERE I		CEAO	180 000	Barrage	DOBOKOURANOU(PERERE)	Bon
BORGOU	PERERE	PERERE	PEREGOUROU	PEREGOUROU BLOC A	BDBD	25 000	Surcreusement de mare	PERERE-GOUROU	Besoin d'entretien
BORGOU	PERERE	GUINAGOUROU	SONON	SONON CENTRE	CARITAS	30 000	Surcreusement de mare	SONNO	Besoin de réfection
	1 238 000								
BORGOU	TCHAOUROU	TCHATCHOU	BADEKPAROU	BADEKPAROU BLOC B	PDE III	4 000	Barrage	WARU GARE	Besoin de réfection
BORGOU	TCHAOUROU	TCHAOUROU	WOROGUI		BDBD	25 000	Surcreusement de mare	SOKOUNON	Besoin d'entretien
BORGOU	TCHAOUROU	TCHAOUROU	PAPANE		DGH&DRE/CEAO II	75 000	Barrage	YABOURO	Bon
BORGOU	TCHAOUROU	TCHATCHOU	TCHATCHOU		PDEBE	75 000	Barrage	BOUKOUSSERA	Bon
BORGOU	TCHAOUROU	ALAFIAROU	ALAFIAROU	ALAFIAROU BLOC A	ADEOTI, PDE/BAD	120 000	Barrage	ALAFIAROU	Bon
BORGOU	TCHAOUROU	TCHATCHOU	BADEKPAROU	BADEKPAROU BLOC A		20 000	Surcreusement de mare	BATOURE N'KPAROU	Besoin d'entretien
BORGOU	TCHAOUROU	KIKA	KIKA II		CEAO	220 000	Barrage	WINRA	Besoin d'entretien
BORGOU	TCHAOUROU	TCHATCHOU	BADEKPAROU	BADEKPAROU BLOC A	BDBD	10 000	Surcreusement de mare	GOROBANI	Bon
BORGOU	TCHAOUROU	SANSON	SEBOU	SEBOU CENTRE	PDPA/FA0/BAD	110 000	Barrage	KOUBOURE (SEBOU 1)	Bon
BORGOU	TCHAOUROU	SANSON	SEBOU	SEBOU CENTRE		35 000	Surcreusement de mare	SEBOU 3	Besoin d'entretien
BORGOU	TCHAOUROU	SANSON	SEBOU	SEBOU CENTRE		70 000	Surcreusement de mare	SEBOU 2	Besoin d'entretien
BORGOU	TCHAOUROU	KIKA	KPASSA	TCHAOUROU BLOC A	PDPA/FA0/BAD	800 000	Barrage	Ferme de l'Okpara (PARC 7)	Bon
BORGOU	TCHAOUROU	TCHAOUROU	WOROGUI	WOROGUI CENTRE	CHINOIS	18 000	Surcreusement de mare	WOROGUI	Besoin d'entretien
BORGOU	TCHAOUROU	BETEROU	BETEROU	KAKI KOKA BLOC A	CEAO II	70 000	Barrage	KAKI KOKA	Bon
BORGOU	TCHAOUROU	GORO	GORO I	GORO I BLOC A	CEAO II	18 000	Surcreusement de mare	KORO	Besoin d'entretien
BORGOU	TCHAOUROU	TCHATCHOU	KINNOU-KPANNOU		PDPA/FA0/BAD	800 000	Barrage	FERME DE L'OKPARA: Parc 5	Bon
	2 470 000								

COLLINES	BANTE	GOUKA	SAKO	GBANGBALOKE		30 000	Barrage	GBANGBALOKE	Besoin de réfection
COLLINES	BANTE	GOUKA	GALATA	KOKO	SUISSE	8 000	Barrage	TOBE	Bon
COLLINES	BANTE	BOBE	BOBE	BOBE	AUTRES	30 000	Barrage	BOBE	Besoin de réfection
COLLINES	BANTE	ATOKOLIGBE	ATOKOLIBE	PEHOUDIE		60 000	Barrage	PEHOUDIE	Bon
COLLINES	BANTE	AKPASSI	OKOTO	OKOTO	AUTRES	20 000	Barrage	OKOTO	Besoin de réfection
		148 000							
COLLINES	DASSA-ZOUME	AKOFODJOU	BETEKOUKOU	CAMP PEULH BETEKOUKOU	PDE3	20 000	Barrage	BETECOUCOU II	Bon
COLLINES	DASSA-ZOUME	AKOFODJOU	AKOFODJOULE	AKOFODJOULE BLOC A	CARDER	30 000	Surcreusement de mare	AKOFFODJOULE	Besoin de réfection
COLLINES	DASSA-ZOUME	AKOFODJOU	AKOFODJOULE	TCHACHEGOUN-TANKOSSI	COLAS	5 000	Surcreusement de mare	TCHACHEGOUN-TANKOSSI	Besoin de réfection
COLLINES	DASSA-ZOUME	AKOFODJOU	BETEKOUKOU	BETEKOUKOU	PDE3	50 000	Barrage	BETECOUCOU I	Bon
COLLINES	DASSA-ZOUME	DASSA I	AGBEGBE	AGBEGBE	CARDER	40 000	Barrage	DASSA-ZOUME CENTRE	Bon
COLLINES	DASSA-ZOUME	KERE	IGOHO	IGOHO	MAEP	1 000	Barrage	D'IGOHO	Besoin de réfection
COLLINES	DASSA-ZOUME	KERE	ITAGUI	ODO O CHERE	CARDER	68 000	Barrage	ODO OTCHERE	Besoin d'entretien
COLLINES	DASSA-ZOUME	PAOUINGNAN	AGNANDE	AGNANME BLOC F	MOTA	7 000	Surcreusement de mare	TCHCHEGOUN-TANKOSSI	Besoin de réfection
		221 000							
COLLINES									
COLLINES	GLAZOUE	SOKPONTA	CAMATE	CAMATE	CARDER	3 100	Barrage	TCHAKALOKE-CAMATE/OKE-AGO	Besoin de réfection
COLLINES	GLAZOUE	SOKPONTA	TCHAKALOKE		CHINOIS	30 000	Surcreusement de mare	TCHAKALOKE-CAMATE	Besoin de réfection
COLLINES	GLAZOUE	GOME	TCHATCHEGOU	TCHATCHEGOU BLOC A	CARDER	10 000	Barrage	TCHATCHEGOUN	Besoin de réfection
COLLINES	GLAZOUE	ZAFFE	MENDENGBE	MENDENGBE I	CHINOIS	30 000	Surcreusement de mare	MADENGBE I	Besoin de réfection

COLLINES	GLAZOUE	SOKPONTA	CAMATE	KPAKO	CHINOIS	30 000	Surcreusement de mare	KPAKO	Besoin de réfection
COLLINES	GLAZOUE	SOKPONTA	CAMATE	KPAKO	CHINOIS	30 000	Surcreusement de mare	KPAKO	Besoin de réfection
COLLINES	GLAZOUE	SOKPONTA	CAMATE	IBIYEMI	CHINOIS	30 000	Surcreusement de mare	KPAKPO	Besoin de réfection
COLLINES	GLAZOUE	KPAKPAZA	SOWE I	SOWE I BLOC A	PHPA	40 000	Barrage	SOWE-IGODO	Bon
COLLINES	GLAZOUE	GOME	TANKOSSI	TANKOSSI	MOTA	3 000	Barrage	TANKOSSI	A reconstruire
COLLINES	GLAZOUE	ZAFFE	MENDENGBE	AWODO MENDENGBE II	CHINOIS	30 000	Surcreusement de mare	MADENGBE II	A reconstruire
		236 100							
COLLINES	OUESSE	CHALLA-OGOI	KOKORO	KOKORO GARE	CHINOIS	28 000	Surcreusement de mare	KOKORO2	Besoin de réfection
COLLINES	OUESSE	KILIBO	YAOUI	YAOUI I BLOC A	CHINOIS	28 000	Surcreusement de mare	YAHOUI A	Bon
COLLINES	OUESSE	TOUI	TOUI-VAP	VAP	CARDER	3 000	Barrage	TOUI-VAP	Besoin d'entretien
COLLINES	OUESSE	TOUI	TOUI-GARE	VAP	CARDER	3 000	Barrage		Bon
COLLINES	OUESSE	TOUI	TOUI CENTRE	ANDRE WARIAKA	CHINOIS	45 000	Surcreusement de mare	ODO ILA	Besoin de réfection
COLLINES	OUESSE	KILIBO	YAOUI	YAOUI II	CHINOIS	15 000	Surcreusement de mare	YAHOUI B	Bon
COLLINES	OUESSE	KILIBO	KILIBO OLATA	KILIBO ADJOUGOU BLOC A	CHINOIS	80 000	Barrage	KILIBO	Besoin de réfection
COLLINES	OUESSE	KILIBO	KILIBO GARE	KILIBO GARE	AUTRES	20 000	Barrage	KILIBO MALETE GARE	Besoin d'entretien
COLLINES	OUESSE	KEMON	AKPERO	AKPERO BLOC A	CHINOIS	25 000	Surcreusement de mare	D'AKPERO	Besoin de réfection
COLLINES	OUESSE	CHALLA-OGOI	BOTTI HOUEGBO	BOTTI HOUEGBO	PDE3	30 000	Barrage	BOTTI OUEGBO	Bon
COLLINES	OUESSE	CHALLA-OGOI	KOKORO	KOKORO GARE		80 000	Surcreusement de mare	KOKORO1	Bon
COLLINES	OUESSE	KILIBO	YAOUI		CHINOIS	15 000	Surcreusement de mare	YAHOUI C	Besoin de réfection
		372 000							
COLLINES	SAVALOU	SAVALOU-AGBADO	ZOUNZOUNKANME	ZOUNZONKANME	SONEB	15 000	Barrage	AGBADO II	Bon

COLLINES	SAVALOU	DOUME	ABALA	ABEOKOUTA	PHPA	25 000	Barrage	ABEOKOUTA	Bon
COLLINES	SAVALOU	DOUME	DOUME-LAKOUN	CEG DOUME		75 600	Barrage	DOUME	A reconstruire
COLLINES	SAVALOU	KPATABA	MINIKI	BLOC MINIKI		20 000	Surcreusement de mare	MINIKI	Besoin de réfection
COLLINES	SAVALOU	LOGOZOHE	LOGOZOHE	LOGOZOHE	CHINOIS	3 000	Barrage	KLOU	Bon
COLLINES	SAVALOU	SAVALOU-AGA	HONNOUKIN	HONNOUKON	CARDER BORGOU	12 000	Barrage	AGBLAKINDJI	Besoin de réfection
COLLINES	SAVALOU	SAVALOU-AGA	KPAKPASSA	KPAKPASSA	CENTRE SONGHAI	30 000	Barrage	KPAKPASSA	Bon
	180 600								
COLLINES	SAVE	OFE	ATCHAKPA I	BLOC A	BENIN_NIGERIA	24 000 000	Barrage	ATCHAKPA	Bon
COLLINES	SAVE	KABOUA	GOGORO	GOGORO	CHINOIS	30 000	Surcreusement de mare	GOGORO	Bon
COLLINES	SAVE	OKPARA	AKON GBERE	AKON	AUTRES	20 000	Barrage	ATAO	Besoin de réfection
COLLINES	SAVE	KABOUA	OKE OLOU II	OKE OLOU II	CHINOIS	10 000	Barrage	KABOUA	Besoin de réfection
COLLINES	SAVE	OFE	ATCHAKPA II	BLOC A	CARDER ZOU-COLLINE	12 000	Barrage	OKE ODO/KINGOUN (SAVE CENTRE)	Besoin d'entretien
COLLINES	SAVE	OKPARA	AKON GBERE	FOUN FOUN I	AUTRES	31 000	Barrage	FOUN-FOUN	Bon
COLLINES	SAVE	SAKIN	OUOGHI GARE	OWOGHI GARE	CHINOIS	10 000	Surcreusement de mare	OUOGHI 2	Besoin de réfection
COLLINES	SAVE	SAKIN	OUOGHI-CENTRE	OUOGHI	SRC	20 000	Surcreusement de mare	OUOGHI 1	Besoin de réfection
COLLINES	SAVE	SAKIN	DIHO I	CCS DIHO	SRC	10 000	Barrage	DIHO	Bon
COLLINES	SAVE	KABOUA	ALAFIA	ALAFIA	CHINOIS	2 000	Barrage	ALAFIA	Besoin de réfection
	24 145 000								
DONGA	BASSILA	BASSILA	BASSILA 1			95 000	Barrage	BASSILA	Bon
DONGA	BASSILA	MANIGRI	MANIGRI IKANNI			224 000	Barrage	MANIGRI	Besoin de réfection (rupture de digue)
DONGA	BASSILA	ALEDJO	ALEDJO KOURA			113 000	Barrage	ALEDJO KOURA	

DONGA	BASSILA	BODI	NAGAYELE			70 000	Barrage	NAGAYELE	
		502 000	Barrage						
DONGA	COPARGO	SINGRE	SINGRE	KATABAN (TCHANDEGOU)		50 000	Barrage	SINGRE	Besoin de réfection
DONGA	COPARGO	SINGRE	SINGRE			20 000	Barrage	SINGRE	Bon
DONGA	COPARGO	PABEGOU	PABEGOU			20 000	Surcreusement		
DONGA	COPARGO	TCHANDEGOU	TANEKA			50 000	Surcreusement		
DONGA	COPARGO	COPARGO	TCHANDOGA			30 000	Surcreusement		
		170 000							
DONGA	DJOUGOU	BELLEFOUNGOU	BELLEFOUNGOU			25 000	Barrage	BELLEFOUNGOU	Besoin de réfection
DONGA	DJOUGOU	BELLEFOUNGOU	BELLEFOUNGOU	ANGBA		25 000	Barrage	BELFOUNGOU	Besoin de réfection
DONGA	DJOUGOU	KOLOKONDE	KOLOKONDE	FOUNBEA		20 000	Barrage	KOLOKONDE	Besoin de réfection
DONGA	DJOUGOU	ONKLOU	DARINGA	DARINGA CENTRE	PHPA	138 100	Barrage	DARINGA	Bon
DONGA	DJOUGOU	DJOUGOU I	FOUNGA			20 000	Barrage	DJOUGOU	Bon
DONGA	DJOUGOU	BAREI	GONDESSAR			25 000	Barrage	BAREI	Besoin de réfection
DONGA	DJOUGOU	KOLOKONDE	KOLOKONDE	KOLOKONDE BLOC A		20 000	Barrage	KOLOKONDE	Besoin de réfection
		273 100							
Zou	ZANGNANADO	ZANGNANADO	SAMIONDJI	SAMIONDJI	PAFILAV	80 000	Barrage	SAMIONDJI	réhabilité en 2017
		80 000							
PLATEAU	KETOU	IDIGNY	EFEHOUNTE	AYEKOTONIAN III	PAFILAV	30 000	Barrage	IDIGNY	Bon

PLATEAU	KETOU		AKPAKANMEY	AKPAKANMEY	PAFILAV	15 000	Barrage		
		45 000							
PLATEAU	POBE	TOWE	OTEKOTAN	GBAGUI		70 000	Barrage	TOWE	Besoin de réfection
PLATEAU	POBE		ISSABA	ISSABA		10 000	Surcreusement de mare		
		80 000							

Table 2: Breakdown of artesian boreholes in the Ouémé Basin

Département	Commune	Arrondissement	Village	Localité	Nom Local	Type Exhaure	Longitude	Latitude	xCoord	yCoord
ATLANTIQUE	ALLADA	AYOU	TOKPA	GLEME	GLEME	Jaillissant	02°07'03.5"E	06°44'16.0"N	2,117639	6,737778
	ALLADA	AYOU	ZINDAGBA	HOUEMOUHOUE	Adjagbléhoue	Jaillissant	02°07'00.8"E	06°44'15.0"N	2,116889	6,7375
	ALLADA	TOKPA-AVAGOUDO	BOLI	AVOWLANHOUE	BOLLI CENTRE	Jaillissant	02°03'41.3"E	06°42'46.4"N	2,061472	6,712889
	SO-AVA	VEKKY	HOUNHOUE	HOUNHOUEGBO	HOUNHOUEGBO	Jaillissant	02°24'36.6"E	06°28'06.9"N	2,410167	6,468583
	ZE	DJIGBE	WO-TOGOUDO	WO TOGOUDO	WO TOGOUDO	Jaillissant	02°23'00.4"E	06°51'56.6"N	2,383445	6,865722
		HEKANME	AWOKPA	AWOKPA CENTRE	AWOKPA CENTRE	Jaillissant	02°18'14.3"E	06°47'28.3"N	2,303972	6,791194
		HEKANME	AWOKPA		AWOKPA CENTRE	Jaillissant	02°18'12.9"E	06°47'02.4"N	2,303583	6,784
		ZE	AKPALI	AKPALIDAHO	AKPALIDAHO	Jaillissant	02°19'46.1"E	06°43'08.9"N	2,329472	6,719139
				WINDJINNAWA	WINDJINNAWA	Jaillissant	02°19'28.1"E	06°43'15.0"N	2,324472	6,720833
			DOKOTA	HOUINGNONKPA	HOUINGNONKPA	Jaillissant	02°16'55.2"E	06°46'55.8"N	2,282	6,782166
OUEME	BONOU	ATCHONSA	DOGBA	DOGBA AKPA	DOGBA CENTRE/AEV	Jaillissant	02°27'22.3"E	06°50'33.4"N	2,456194	6,842611
	BONOU	BONOU	ATCHABITA	ZOUKOU-HOUNVENOU	ATCHABITA	Jaillissant	02°27'11.8"E	06°53'40.9"N	2,453278	6,894694
	BONOU	DAME-WOGON	ASSROSSA	GBEFADJI	GBEFFADJI	Jaillissant	02°26'29.6"E	06°55'39.8"N	2,441556	6,927722
	DANGBO	KESSOUNOU	HETIN-SOTA	DOGODO	HETIN-SOTA	Jaillissant	02°30'14.1"E	06°35'16.7"N	2,503917	6,587972
PLATEAU	ADJA-OUERE	ADJA-OUERE	GBAGBATA	ITCHANFAN	GBAGBATA	Jaillissant	02°37'13.3"E	07°00'05.7"N	2,620361	7,001583
	ADJA-OUERE	ADJA-OUERE	HOUELI GABA	ITA ITELE	ITA-TELE	Jaillissant	02°33'11.7"E	07°06'20.7"N	2,55325	7,10575
	ADJA-OUERE	MASSE	ABADAGO	CHÂTEAU	AHOLOU	Jaillissant	02°31'31.4"E	07°13'24.6"N	2,525389	7,2235
	ADJA-OUERE	MASSE	OKE OLA	AYETORO	AYETORO	Jaillissant	02°30'55.6"E	07°11'43.1"N	2,515445	7,195305
	ADJA-OUERE	MASSE	OKE OLA	ITCHANGNI	TCHANGNI	Jaillissant	02°30'34.2"E	07°12'43.7"N	2,5095	7,212139

	POBE	IGANA	IGANA	IGANA CENTRE	FANIKO	Jaillissant	02°42'31.0"E	07°02'16.9"N	2,708611	7,038028
	POBE	IGANA	IGANA	IGANA CENTRE	FANIKO	Jaillissant	02°42'11.3"E	07°02'14.1"N	2,703139	7,03725
	POBE	IGANA	IGANA	IGANA CENTRE	ODJIBON	Jaillissant	02°42'39.4"E	07°02'31.8"N	2,710944	7,042167
	POBE	ISSABA	ISSABA	ABBA YATAN	ABABAYATAN	Jaillissant	02°34'14.0"E	07°06'46.8"N	2,570555	7,113
ZOU	AGBANGNIZOUN	ZOUNGOUDO	TOKPA	TOPKA CENTRE	KPOTO TOKPA	Jaillissant	02°00'01.0"E	06°57'28.0"N	2,000278	6,957778
	OUINHI	DASSO	AGONKON	AGBETOME	AGBETOME	Jaillissant	02°26'11.0"E	06°57'49.8"N	2,436389	6,963833
	OUINHI	DASSO	BOSSA II	BOSSA TOGOUDO	BOSSA II	Jaillissant	02°27'40.0"E	06°59'58.7"N	2,461111	6,999639
	OUINHI	DASSO	GBOKPAGO	HOUE-AGA	HOUE AGA	Jaillissant	02°28'25.8"E	07°00'01.8"N	2,473833	7,0005
	OUINHI	OUINHI	AHICON	SANGO	SANGO	Jaillissant	02°30'19.8"E	07°04'14.1"N	2,5055	7,070583
	OUINHI	OUINHI	AKANTE ZALOKO	AVISSA	AVISSA	Jaillissant	02°32'11.8"E	07°06'11.9"N	2,536611	7,103305
	OUINHI	OUINHI	AKANTE ZALOKO	ZALOKO CENTRE	ZALOKO CENTRE	Jaillissant	02°31'15.4"E	07°06'02.2"N	2,520944	7,100611
	OUINHI	OUINHI	AKANTE ZOUNGO	ZOUNGO	AKANTE ZOUNGO	Jaillissant	02°30'53.0"E	07°06'27.8"N	2,514722	7,107722
	OUINHI	OUINHI	GANHOUNME	ADJINAKOU	ADJINAKOU-HOUE	Jaillissant	02°31'51.1"E	07°06'58.7"N	2,530861	7,116305
	OUINHI	OUINHI	GANHOUNME	EGNI-ODO	EGNI IDO	Jaillissant	02°30'18.7"E	07°08'48.9"N	2,505194	7,146917
	OUINHI	OUINHI	HOLLI	HOUNBONOU	Centre des LOISIRS Jeunes	Jaillissant	02°30'30.5"E	07°05'05.0"N	2,508472	7,084722
	OUINHI	OUINHI	HOLLI	TOSSO	TOSSO	Jaillissant	02°30'33.1"E	07°04'25.9"N	2,509194	7,073861
	OUINHI	OUINHI	MONZOUNGOUDO	ADOGON	ADOGON	Jaillissant	02°31'38.0"E	07°04'23.4"N	2,527222	7,073167
	OUINHI	OUINHI	MONZOUNGOUDO	MONZOUNGOUDO	MONZOUNGOUDO F2	Jaillissant	02°31'31.4"E	07°04'25.4"N	2,525389	7,073722
	OUINHI	OUINHI	MONZOUNGOUDO	MONZOUNGOUDO	MOZOUNGOUDO CENTRE F1	Jaillisant	02°31'31.8"E	07°04'25.4"N	2,5255	7,073722
	OUINHI	OUINHI	OUOKON-AHLAN	AHLAN-CENTRE	AYIWEDJI	Jaillisant	02°27'57.0"E	07°06'02.3"N	2,465833	7,100639
	OUINHI	OUINHI	OUOKON-AHLAN	OUOKON-KPODJI	AHLAN	Jaillisant	02°27'47.0"E	07°06'23.7"N	2,463056	7,106583
	OUINHI	OUINHI	OUOKON-ZOUNGOME	ZOUNGOME	ZOUNGOME	Jaillisant	02°27'47.4"E	07°05'48.7"N	2,463167	7,096861
	OUINHI	OUINHI	OUOKON-ZOUNGOME	ZOUNGOME	Zoungomè	Jaillisant	02°27'43.6"E	07°05'43.6"N	2,462111	7,095445
	OUINHI	SAGON	ADAME	ADAME	ADAGBODJI	Jaillisant	02°25'37.6"E	07°09'30.2"N	2,427111	7,158389
	OUINHI	SAGON	AHOGO	ADAGBODJI	ADAGBODJI	Jaillisant	02°26'10.8"E	07°06'53.6"N	2,436333	7,114889
	OUINHI	SAGON	AHOGO	HOUNWANOU-HOUE	HOUNWANOUHOUE	Jaillisant	02°26'01.8"E	07°06'59.4"N	2,433833	7,1165
	OUINHI	SAGON	AIZE	AHIZE CENTRE	AHIZE 1 CENTRE	Jaillisant	02°30'08.0"E	07°09'57.0"N	2,502222	7,165833
	OUINHI	SAGON	AIZE	AHIZE CENTRE	GBAGBALA	Jaillisant	02°29'44.2"E	07°09'53.3"N	2,495611	7,164805
	OUINHI	SAGON	AIZE	AHIZE CENTRE	LEGBADO	Jaillisant	02°30'04.6"E	07°09'53.6"N	2,501278	7,164889
	OUINHI	SAGON	AIZE	ATI-AGA	ATTI-AGA F2	Jaillisant	02°31'07.0"E	07°09'11.0"N	2,518611	7,153056
	OUINHI	SAGON	AIZE	AYELAWADJE	AYELAWADJE	Jaillisant	02°29'37.4"E	07°09'36.8"N	2,493722	7,160222
	OUINHI	SAGON	AIZE	GANKOU	CAFE	Jaillisant	02°17'57.4"E	07°10'29.3"N	2,299278	7,174806
	OUINHI	SAGON	AIZE	OTCHENOU	OTCHENOU	Jaillisant	02°30'01.7"E	07°09'46.0"N	2,500472	7,162778
	OUINHI	SAGON	DOLIVI	AGNON-GON	AGNONGON (AGNONGONHOUE)	Jaillisant	02°25'49.6"E	07°08'06.6"N	2,430444	7,135167
	OUINHI	SAGON	DOLIVI	DOLIVI	Dolivi Centre	Jaillisant	02°25'39.9"E	07°09'14.4"N	2,42775	7,154
	OUINHI	SAGON	DOLIVI	DOLIVI	Dolivi-Centre	Jaillisant	02°25'40.2"E	07°09'04.5"N	2,427833	7,15125
	OUINHI	SAGON	DOLIVI	HINVEDO	CSA	Jaillisant	02°25'54.6"E	07°09'13.0"N	2,431833	7,153611
	OUINHI	SAGON	HOUEDJA	VESSAME	VESSAME	Jaillisant	02°27'18.9"E	07°07'21.3"N	2,45525	7,122583

	ZAGNANADO	KPEDEKPO	AHLAN	VOSSA	AHLAN	Jaillisant	02°24'35.2"E	07°15'30.5"N	2,409778	7,258472
	ZAGNANADO	KPEDEKPO	KPOTO	AÏDJEDO	KPOTO Centre Marial	Jaillisant	02°27'25.2"E	07°13'27.3"N	2,457	7,22425
	ZAGNANADO	KPEDEKPO	LOKO-ALANKPE	LOKOSSA	LOKO ALANKPE	Jaillisant	02°27'25.5"E	07°12'27.0"N	2,457083	7,2075
	ZOGBODOMEY	AVLAME	AVLAME	ABADJINAKOU	AVAVI	Jaillisant	02°12'51.0"E	07°04'51.0"N	2,214167	7,080833
	ZOGBODOMEY	AVLAME	AVLAME	AVAVI MIGANGON	AVAVI Centre	Jaillisant	02°12'46.9"E	07°04'26.9"N	2,213028	7,074139
	ZOGBODOMEY	AVLAME	AVLAME	GBATA AVAVI	GBATA AVAVI	Jaillisant	02°12'25.4"E	07°04'21.2"N	2,207056	7,072556
	ZOGBODOMEY	AVLAME	AVLAME	HOUNDANOU	HOUNDANOU (AVAVI)	Jaillisant	02°12'55.2"E	07°04'36.3"N	2,215333	7,07675
	ZOGBODOMEY	AVLAME	KOTOKPA	KOTONOU	KOTONOU	Jaillisant	02°09'26.2"E	07°05'40.4"N	2,157278	7,094555
	ZOGBODOMEY	AVLAME	SAMIONKPA	AGBODOKPOSSIGON	AGBODOKPOSSIGON	Jaillisant	02°13'56.8"E	07°05'38.8"N	2,232445	7,094111
	ZOGBODOMEY	DOME	AGOITA	SOTINKANME	SOTTINKANME	Jaillisant	02°18'14.9"E	07°02'07.6"N	2,304139	7,035444
	ZOGBODOMEY	DOME	AGOITA	YOVOTONOU	AGOITA (Yovogléta)	Jaillisant	02°19'00.1"E	07°01'54.4"N	2,316694	7,031778
	ZOGBODOMEY	DOME	BOLAME	MAHESSOU	MAHESSOU	Jaillisant	02°22'08.4"E	07°03'38.0"N	2,369	7,060555
	ZOGBODOMEY	DOME	BOLAME	SAVE	SAVE	Jaillisant	02°21'61.4"E	07°04'16.7"N		7,071306
	ZOGBODOMEY	DOME	DOME CENTRE	Agnamey	Agnanmè	Jaillisant	02°19'02.9"E	07°06'12.9"N	2,317472	7,103583
	ZOGBODOMEY	DOME	DOME CENTRE	GO	GO	Jaillisant	02°19'51.3"E	07°04'26.6"N	2,330917	7,074056
	ZOGBODOMEY	DOME	GOHISSANOU	DEKANVIMIN	Gohissanou	Jaillisant	02°23'14.4"E	07°02'18.9"N	2,387333	7,038583
	ZOGBODOMEY	DOME	GOHISSANOU	VIDJINNAVO	VIDJENAVO	Jaillisant	02°22'02.7"E	07°02'10.1"N	2,367417	7,036139
	ZOGBODOMEY	KOUSSOUKPA	DEME	DEME	DEME 2	Jaillisant	02°14'54.3"E	07°03'29.0"N	2,248417	7,058055
	ZOGBODOMEY	KOUSSOUKPA	DEME	DEME	DEME1	Jaillisant	02°14'51.8"E	07°03'24.4"N	2,247722	7,056778
	ZOGBODOMEY	KOUSSOUKPA	KOUSSOUKPA	HOUEDAHOGBE	KOUSSOUKPA Centre	Jaillisant	02°16'18.6"E	07°03'35.7"N	2,271833	7,059916
	ZOGBODOMEY	KOUSSOUKPA	KOUSSOUKPA	KOUSSOUKPA CENTRE	LOKOLI F1	Jaillisant	02°14'52.0"E	07°03'43.0"N	2,247778	7,061944
	ZOGBODOMEY	KOUSSOUKPA	KOUSSOUKPA	LOKOLI	LOKOLI F3	Jaillisant	02°15'57.6"E	07°03'40.1"N	2,266	7,061139
	ZOGBODOMEY	KOUSSOUKPA	SAMIONTA	LATAMEGON	LATAMEGON	Jaillisant	02°15'45.7"E	07°04'45.1"N	2,262694	7,079195
	ZOGBODOMEY	KOUSSOUKPA	SAMIONTA	SAMIONTA CENTRE	EPP SAMIONTA	Jaillisant	02°12'57.1"E	07°04'17.4"N	2,215861	7,0715
	ZOGBODOMEY	KOUSSOUKPA	SAMIONTA	SAMIONTA CENTRE	SAMIONTA	Jaillisant	02°14'07.5"E	07°05'24.8"N	2,235417	7,090222
	ZOGBODOMEY	KPOKISSA	DEHOUNTA	DEHOUNTA CENTRE	DEHOUNTA-CENTRE	Jaillisant	02°24'04.8"E	06°59'34.8"N	2,401333	6,993

	ZOGBODOMEY	KPOKISSA	DEHOUNTA	GANHOUNGBE	GANHOUNGBE	Jaillisant	02°23'59.6"E	06°59'54.0"N	2,399889	6,998333
	ZOGBODOMEY	KPOKISSA	HINZOUNME	SOUHOUANDJOHOUE	HINZOUNME	Jaillisant	02°21'04.2"E	06°56'24.7"N	2,351167	6,940195
	ZOGBODOMEY	KPOKISSA	KPOKISSA	AYOGO AZOZOUME	AYOGO	Jaillisant	02°23'04.5"E	07°00'13.8"N	2,384583	7,003833
	ZOGBODOMEY	KPOKISSA	KPOKISSA	KPOKISSA CENTRE	KPOKISSA CENTRE	Jaillisant	02°23'37.6"E	07°00'21.6"N	2,393778	7,006
	ZOGBODOMEY	MASSI	HLAGBA-DENOU	HLAGBA DENOU	EYONHLE	Jaillisant	02°13'22.2"E	07°01'55.0"N	2,222833	7,031944
	ZOGBODOMEY	MASSI	HLAGBA-LONME	SONOUNAMETOHOUE	GESTHEMANE	Jaillisant	02°13'52.1"E	06°58'45.0"N	2,231139	6,979167
	ZOGBODOMEY	MASSI	HLAGBA-OUASSA		AGLAKANME	Jaillisant	02°15'55.5"E	07°00'31.4"N	2,265417	7,008722
	ZOGBODOMEY	MASSI	HLAGBA-OUASSA	ADOGBE	ADOGBE	Jaillisant	02°15'25.9"E	07°01'00.2"N	2,257195	7,016722
	ZOGBODOMEY	MASSI	HLAGBA-ZAKPO	ZAKPO	AKLIKPA	Jaillisant	02°13'07.0"E	06°59'38.0"N	2,218611	6,993889
	ZOGBODOMEY	MASSI	HLAGBA-ZAKPO	ZAKPO	ZAKPO-ALIKPA	Jaillisant	02°12'58.1"E	06°59'34.7"N	2,216139	6,992972
	ZOGBODOMEY	MASSI	HON	AZONME	AZONME	Jaillisant	02°17'57.4"E	06°58'49.9"N	2,299278	6,980528
	ZOGBODOMEY	MASSI	MASSI CENTRE	DOKPA	BAVE	Jaillisant	02°14'22.0"E	06°58'15.4"N	2,239444	6,970944
	ZOGBODOMEY	MASSI	MASSI CENTRE	HOUEGNONTA	MASSI AGA	Jaillisant	02°14'43.9"E	06°58'56.7"N	2,245528	6,982417
	ZOGBODOMEY	ZOUKOU	BOGNONGNON	AGBLAGON	ASSOGON	Jaillisant	02°10'05.0"E	07°03'40.0"N	2,168056	7,061111
	ZOGBODOMEY	ZOUKOU	DOHOUE	DOHOUE	DOHOUE YAHOUE	Jaillisant	02°12'10.0"E	07°03'05.5"N	2,202778	7,051528
	ZOGBODOMEY	ZOUKOU	DOHOUE	DOHOUE	GOUGBELEHOUHOUE (DOHOUE F2)	Jaillisant	02°12'06.1"E	07°03'02.6"N	2,201694	7,050722
	ZOGBODOMEY	ZOUKOU	HLANHONOU	ZANSA	HLANHONOU GNANLI-ZASSA	Jaillisant	02°10'34.1"E	07°04'05.8"N	2,176139	7,068278
	ZOGBODOMEY	ZOUKOU	HLANHONOU	ZANSA	TOHOUE	Jaillisant	02°10'34.0"E	07°04'05.9"N	2,176111	7,068305

Appendix 4: Potential identified by municipality and by category of works and development

Table 1: Distribution of sites characterized to shelter the construction of dams/water retention/thresholds

N°	ARROND.	VILLAGE	BAS-FONDS	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PERSONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
					LAT.	LONG.	AL.				
1	Copargo	YAOUROU	YAOURA	OUEME	10° 0'46.71"N	1°43'59.55"E	417m	KAKPI ALLASAN	97 38 06 32	Non aménagé	BARRAGE
2	Copargo	TCHOUTCHOU	TCHOUTCHOU	Afèhou	9°52'9.17"N	1°34'14.32"E	450m	KAKPI ALLASAN	97 38 06 32	Non aménagé	BARRAGE
3	Copargo	TANI	TANI	Afèhou	9°53'17.60"N	1°35'37.57"E	447m	ABARKA Yaro	67 57 26 63	Non aménagé	BARRAGE
4	Copargo	GOSSINA	LORHOU	GBANGBAR	10° 0'18.78"N	1°47'57.35"E	403m	SALIFOU Yaya	97 49 84 30	Non aménagé	BARRAGE
5	Copargo	KPASSABEA	GBANASSAKOU	OUEME	9°56'24.00"N	1°36'55.10"E	431m	TCHEGNELOUM damou	96 28 06 09	Non aménagé	BARRAGE
6	Pabegou	GNANFOUROUM	GBANGBAR	GBANGBAR	9°59'34.61"N	1°45'34.93"E	391m	TCHANDO Alidou	66 20 23 81	Non aménagé	BARRAGE
7	Pabegou	BAMISSO	VABISSI	OUEME	9°53'59.92"N	1°43'45.47"E	405m	BONI Zakari	64 96 18 09	Non aménagé	BARRAGE
8	Pabegou	PABEGOU	CPFR	OUEME	9°46'45.10"N	1°35'11.30"E	474m	KAKPI ALLASAN	100 38 06 32	BARRAGE CPFR EXISTANT	Réhabilitation
9	BELLEFOUNGOU	BELLEFOUNGOU	BELLEFOUNGOU 1	Donge	9°48'50.76"N	1°42'56.10"E	414m	BOUKARI Silbawésé	99 87 73 04	BARRAGE existant	Réhabilitation
10	KOLOKONDE	KPEBOKO	FOTCHEMA	Fotcheme	9°58'34.67"N	1°53'29.43"E	376m	BOUKARI Silbawésé	102 87 73 04	Non aménagé	BARRAGE
11	KOLOKONDE	BARE	SAKATALOW	Alluent de Sany	9°58'53.37"N	1°55'53.92"E	396 m	BOUKARI Silbawésé	104 87 73 04	Non aménagé	BARRAGE
12	KOLOKONDE	LILINGA	LILINGA 1	Lilinga	9°53'55.52"N	1°46'26.43"E	398m	BOUKARI Silbawésé	106 87 73 04	BARRAGE existant	Réhabilitation
13	PARTAGO	PARTAGO	PARTAGO		9°31'36.91"N	1°54'17.86"E	388 m	BOUKARI Silbawésé	108 87 73 04	Non aménagé	BARRAGE
14	SERO	ALFA-KPARA	KAKADJINGA		9°36'35.66"N	1°46'22.12"E	387 m	BOUKARI Silbawésé	110 87 73 04	Non aménagé	BARRAGE
15	ONKLOU	ONKLOU	KOYEÏDJIR	Donge	9°30'4.57"N	1°59'42.03"E	394 m	BOUKARI Silbawésé	111 87 73 04	Non aménagé	BARRAGE
16	ONKLOU	ONKLOU	DARINGA	Donge	9°28'8.80"N	2° 3'56.94"E	337 m	BOUKARI Silbawésé	112 87 73 04	Seuil déversant	Réhabilitation
17	BARIENOU	FOYO	NIKISSON		9°42'16.08"N	1°56'24.23"E		BOUKARI Silbawésé	112 87 73 04	Non aménagé	BARRAGE
18	BARIENOU	NONDJANGNI	VERROU		9°43'11.21"N	1°47'43.38"E	420 m	N'tcha Oscar:	99.13.58.61	Non aménagé	BARRAGE
19	BARIENOU	ANANIGA	AYAE	Affluent de la Donga	9°42'59.04"N	1°54'48.69"E	349 m	BOUKARI Silbawésé	112 87 73 04	Non aménagé	BARRAGE
20	OUEDEME	YAGBO	GNATO	ZOU (GNATODJI)	8° 8'22.88"N	2° 8'1.40"E	223 m	Abert	97 35 75 03	Non aménagé	BARRAGE
21	OUEDEME	AMAGAVISSA	ADJIGO 1	ZOU	8° 9'27.21"N	2° 7'54.72"E	197 m	Abert	97 35 75 03	Non aménagé	BARRAGE
22	OUEDEME	AMAGAVISSA	ADJIGO 2	ZOU	8° 9'40.82"N	2° 7'27.02"E	188 m	Abert	97 35 75 03	Non aménagé	BARRAGE
23	AKLAMPA	Minnoudotinsa	MINNOUDOTINSA	OUEME	8°15'22.06"N	2°10'14.87"E	224 m	GODOSSOU Barnabé	95216816	Non aménagé	BARRAGE
24	AGOUAGON	DOKOUNDJI	MASSE	OUEME	8° 4'4.18"N	2°20'27.71"E	148 m	Abert	97 35 75 03	Non aménagé	BARRAGE
25	AGOUAGON	DOKOUNDJI	SOKPA	OUEME	8° 4'24.12"N	2°21'0.10"E	132 m	Abert	97 35 75 03	Non aménagé	BARRAGE
26	AGOUAGON	AGOUAGON	AVALI 2	OUEME	7°57'55.55"N	2°17'48.17"E	187 m	Abert	97 35 75 03	Non aménagé	BARRAGE
27	GLAZOUE	AFFECIA	ABIYA	OUEME	7°56'34.04"N	2°12'44.50"E	211 M	Abert	97 35 75 03	Non aménagé	BARRAGE
28	DON-TAN	DON	TOFLOGBA	OUEME	7°16'13.72"N	2°23'48.86"E	72 m	Claude	66 55 82 29	Plaine non aménagée	BARRAGE
29	DON-TAN	DON	KOÏTEGBA	OUEME	7°16'21.20"N	2°24'4.58"E	54 m	Claude	66 55 82 29	Plaine non aménagée	BARRAGE
30	AVLAME	YOKON	ADOUMETE	KOTO	7° 6'37.53"N	2° 9'22.91"E	45	LEDJI Robert HOUNDANGBADE Toussin	66 12 87 82 94 14 12 32	Plaine Non aménagé	BARRAGE

Table 2: Distribution of old dams/water retentions/blocks/overburdened ponds to be rehabilitated

Département	Commune	Arrondissement	Village	Localité	Programme	Capacité RE (m3)	Type ouvrage	Nom de la RE	Etat de la RE
DONGA	COPARGO	SINGRE	SINGRE	KATABAN (TCHANDEGOU)		50 000	Barrage	SINGRE	Besoin de réfection
DONGA	COPARGO	SINGRE	SINGRE	SINGRE		20 000	Barrage	SINGRE	Besoin de réfection
DONGA	COPARGO	PABEGOU	PABEGOU	PABEGOU		20 000	Surcreusement	PABEGOU	Besoin de réfection
DONGA	COPARGO	TCHANDEGOU	TANEKA	TANEKA		50 000	Surcreusement	TANEKA	Besoin de réfection
DONGA	COPARGO	COPARGO	TCHANDOGA	TCHANDOGA		30 000	Surcreusement	TCHANDOGA	Besoin de réfection
Capacité des retenues de Copargo						**170 000**			Besoin de réfection
	COPARGO : 05								
DONGA	DJOUGOU	BELLEFOUNGOU	BELLEFOUNGOU	BELLEFOUNGOU		25 000	Barrage	BELLEFOUNGOU	Besoin de réfection
DONGA	DJOUGOU	BELLEFOUNGOU	BELLEFOUNGOU	ANGBA		25 000	Barrage	BELFOUNGOU	Besoin de réfection
DONGA	DJOUGOU	KOLOKONDE	KOLOKONDE	FOUNBEA		20 000	Barrage	KOLOKONDE	Besoin de réfection
DONGA	DJOUGOU	ONKLOU	DARINGA	DARINGA CENTRE	PHPA	138 100	Barrage	DARINGA	Bon
DONGA	DJOUGOU	DJOUGOU I	FOUNGA	FOUNGA		20 000	Barrage	DJOUGOU	Besoin de réfection
DONGA	DJOUGOU	BAREI	GONDESSAR	GONDESSAR		25 000	Barrage	BAREI	Besoin de réfection
DONGA	DJOUGOU	KOLOKONDE	KOLOKONDE	KOLOKONDE BLOC A		20 000	Barrage	KOLOKONDE	Besoin de réfection
Capacité des retenues de Djougou						**273 100**			
	DJOUGOU : 07								
COLLINES	GLAZOUE	SOKPONTA	CAMATE	CAMATE	CARDER	3 100	Barrage	TCHAKALOKE-CAMATE/OKE-AGO	Besoin de réfection
COLLINES	GLAZOUE	SOKPONTA	TCHAKALOKE		CHINOIS	30 000	Surcreusement de mare	TCHAKALOKE-CAMATE	Besoin de réfection
COLLINES	GLAZOUE	GOME	TCHATCHEGOU	TCHATCHEGOU BLOC A	CARDER	10 000	Barrage	TCHATCHEGOUN	Besoin de réfection
COLLINES	GLAZOUE	ZAFFE	MENDENGBE	MENDENGBE I	CHINOIS	30 000	Surcreusement de mare	MADENGBE I	Besoin de réfection
COLLINES	GLAZOUE	SOKPONTA	CAMATE	KPAKO	CHINOIS	30 000	Surcreusement de mare	KPAKO	Besoin de réfection
COLLINES	GLAZOUE	SOKPONTA	CAMATE	KPAKO	CHINOIS	30 000	Surcreusement de mare	KPAKO	Besoin de réfection
COLLINES	GLAZOUE	SOKPONTA	CAMATE	IBIYEMI	CHINOIS	30 000	Surcreusement de mare	KPAKPO	Besoin de réfection
COLLINES	GLAZOUE	KPAKPAZA	SOWE I	SOWE I BLOC A	PHPA	40 000	Barrage	SOWE-IGODO	Bon
COLLINES	GLAZOUE	GOME	TANKOSSI	TANKOSSI	MOTA	3 000	Barrage	TANKOSSI	A reconstruire
COLLINES	GLAZOUE	ZAFFE	MENDENGBE	AWODO MENDENGBE II	CHINOIS	30 000	Surcreusement de mare	MADENGBE II	A reconstruire
Capacité des retenues de Glazoué						**236 100**			
	GLAZOUE : 10								
Zou	ZANGNANADO	ZANGNANADO	SAMIONDJI	SAMIONDJI	PAFILAV	80 000	Barrage	SAMIONDJI	Réhabilité en 2017
Capacité des retenues de Glazoué						**80 000**			
	ZANGNANADO : 1								
NOMBRE TOTAL DU BASSIN DE L'OUEME : 23									
VOLUME TOTAL D'EAU STOCKEE : 753 100 m³									

Table 3: Distribution of sites characterized and selected to shelter/protect small irrigated perimeters

LISTE DES SITES RECENSES DANS LA COMMUNE DE COPARGO POUR PERIMETRES IRRIGUES														
N° d'ORDRE	ARROND.	VILLAGE	SITES	SPECULATION EN PLACE	SUP._ DISPO. (Ha)	SUP._ CULTI. (Ha)	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PERSONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
								LAT.	LONG.	AL.				
1	Copargo	YAOUROU	YAOURA	RIZ	70	0.5	OUEME	10° 0'46.71"N	1°43'59.55"E	417m	KAKPI ALLASAN	97 38 06 32	Non aménagé	Aménagement à maîtrise partielle d'eau
2	Copargo	TCHOUTCHOU	TCHOUTCHOU	RIZ	25	1.5	Afèhou	9°52'9.17"N	1°34'14.32"E	450m	KAKPI ALLASAN	97 38 06 32	Non aménagé	Aménagement à maîtrise partielle d'eau
4	Copargo	TANI	TANI	RIZ	35	2	Afèhou	9°53'17.60"N	1°35'37.57"E	447m	ABARKA Yaro	67 57 26 63	Non aménagé	Aménagement à maîtrise partielle d'eau
5	Copargo	GOSSINA	LORHOU	RIZ	45	15	GBANGBAR	10° 0'18.78"N	1°47'57.35"E	403m	SALIFOU Yaya	97 49 84 30	Non aménagé	Aménagement à maîtrise partielle d'eau
7	Copargo	KPASSABEA	GBANASSAKOU	RIZ	45	5	OUEME	9°56'24.00"N	1°36'55.10"E	431m	TCHEGNELOUM Adamou	96 28 06 09	Non aménagé	Aménagement à maîtrise partielle d'eau
14	Pabegou	GNANFOUROUM	GBANGBAR	RIZ, IGNAME	35	10	GBANGBAR	9°59'34.61"N	1°45'34.93"E	391m	TCHANDO Alidou	66 20 23 81	Non aménagé	Aménagement à maîtrise partielle d'eau
15	Pabegou	BAMISSO	VABISSI	RIZ, IGNAME	60	10	OUEME	9°53'59.92"N	1°43'45.47"E	405m	BONI Zakari	64 96 18 09	Non aménagé	Aménagement à maîtrise partielle d'eau
18	Pabegou	PABEGOU	CPFR	RIZ	35	1	OUEME	9°46'45.10"N	1°35'11.30"E	474m	KAKPI ALLASAN	100 38 06 32	Non aménagé	Aménagement à maîtrise partielle d'eau
TOTAL					350	45								
LISTE DES SITES OCRI RECENSES DANS LA COMMUNE DE DJOUGOU POUR AMENAGEMENT DE PERIMETRES IRRIGUES														
N° D'ORDRE	ARROND.	VILLAGE	BAS-FONDS	SPECULATION EN PLACE	SUP._ DISPO. (Ha)	SUP._ CULTI. (Ha)	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PERSONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
								LAT.	LONG.	AL.				
1	BELLEFOUNGOU	BELLEFOUNGOU	BELLEFOUNGOU 1	Riz, Cultures maraîchères	15	1	Donge	9°48'50.76"N	1°42'56.10"E	414m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
2	KOLOKONDE	KPEBOKO	FOTCHEMA	Riz	30	1	Fotcheme	9°58'34.67"N	1°53'29.43"E	376m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
3	KOLOKONDE	BARE	SAKATALOW	Riz, Cultures maraîchères	30	2	Alluent de Sany	9°58'53.37"N	1°55'53.92"E	396 m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
4	KOLOKONDE	LILINGA	LILINGA 2	Riz, Cultures maraîchères	50	2	Lilinga	9°54'1.82"N	1°46'33.36"E	411m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
5	PARTAGO	PARTAGO	PARTAGO	Riz	21	7		9°31'36.91"N	1°54'17.86"E	388 m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
6	SERO	ALFA-KPARA	KAKADJINGA	Riz, Cultures maraîchères	15	9		9°36'35.66"N	1°46'22.12"E	387 m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
7	ONKLOU	ONKLOU	KOYEÏDJIR	Riz, Cultures maraîchères	12	2	Donge	9°30'4.57"N	1°59'42.03"E	394 m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
8	ONKLOU	ONKLOU	DARINGA	Riz, Cultures maraîchères	30	5	Donge	9°28'8.80"N	2° 3'56.94"E	337 m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
9	BARIENOU	FOYO	NIKISSON	Riz, Cultures maraîchères	20	4		9°42'16.08"N	1°56'24.23"E		BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
10	BARIENOU	NONDJANGNI	VERROU	Riz, Cultures maraîchères	15	2		9°43'11.21"N	1°47'43.38"E	420 m	N'tcha Oscar :	99.13.58.61	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau
11	BARIENOU	ANANIGA	AYAE	Riz	40	2	Affluent de la Donga	9°42'59.04"N	1°54'48.69"E	349 m	BOUKARI Silbawésé	99 87 73 04	Bas fond non aménagé	Aménagement à maîtrise partielle d'eau

TOTAL					278	37								
LISTE DES SITES RECENSES DANS LA COMMUNE DE GLAZOUE POUR AMENAGEMENT DE PERIMETRES IRRIGUES														
N° D'ORDRE	**ARROND.**	**VILLAGE**	**BAS-FONDS**	**SPECULATION EN PLACE**	**SUP._ DISPO. (Ha)**	**SUP._ CULTI. (Ha)**	**AFFLUENT EXPLOITE**	**COORDONNEES DE REPERE**			**PAESONNE RESSOURCE**	**CONTACT**	**STATUT**	**TYPE AMENAG. PROJETE**
								LAT	**LONG**	**AL**				
1	OUEDEME	YAGBO	GNATO	Riz, Cultures maraîchères	40	5	ZOU (GNATODJI)	8° 8'22.88"N	2° 8'1.40"E	223 m	Albert	97 35 75 03	Non aménagé	BARRAGE
2	OUEDEME	AMAGAVISSA	ADJIGO 1	Riz, Cultures maraîchères	35	0.5	ZOU	8° 9'27.21"N	2° 7'54.72"E	197 m	Albert	97 35 75 03	Non aménagé	BARRAGE
3	OUEDEME	AMAGAVISSA	ADJIGO 2	Riz, Cultures maraîchères	40	1	ZOU	8° 9'40.82"N	2° 7'27.02"E	188 m	Albert	97 35 75 03	Non aménagé	BARRAGE
4	AKLAMPA	Minnoudotinsa	MINNOUDOTINSA	Riz, Cultures maraîchères	70	0.25	OUEME	8°15'22.06"N	2°10'14.87"E	224 m	GODOSSOU Barnabé	95216816	Non aménagé	BARRAGE
5	AGOUAGON	DOKOUNDJI	MASSE	Riz, Cultures maraîchères	10	3	OUEME	8° 4'4.18"N	2°20'27.71"E	148 m	Albert	97 35 75 03	Non aménagé	BARRAGE
6	AGOUAGON	DOKOUNDJI	SOKPA	Riz, Cultures maraîchères, soja	10	5	OUEME	8° 4'24.12"N	2°21'0.10"E	132 m	Albert	97 35 75 03	Non aménagé	BARRAGE
7	AGOUAGON	AGOUAGON	AVALI 2	Riz, Cultures maraîchères, soja, maïs	20	2	OUEME	7°57'55.55"N	2°17'48.17"E	187 m	Albert	97 35 75 03	Non aménagé	BARRAGE
8	GLAZOUE	AFFECIA	ABIYA	Riz, Cultures maraîchères	60	5	OUEME	7°56'34.04"N	2°12'44.50"E	211 M	Albert	97 35 75 03	Non aménagé	BARRAGE
TOTAL					**285**	**21.75**								
LISTE SITES RECENSES DANS LA COMMUNE DE ZANGNANADO POUR AMENAGEMENT DE PERIMETRES IRRIGUES														
N° D'ORDRE	**ARROND.**	**VILLAGE**	**BAS-FONDS**	**SPECULATION EN PLACE**	**SUP._ DISPO. (Ha)**	**SUP._ CULTI. (Ha)**	**AFFLUENT EXPLOITE**	**COORDONNEES DE REPERE**			**PERSONNE RESSOURCE**	**CONTACT**	**STATUT**	**TYPE AMENAG. PROJETE**
								LAT.	**LONG.**	**AL.**				
1	DON-TAN	DON	TOFLOGBA	Cultures Maraîchères	10	0.25	OUEME	7°16'13.72"N	2°23'48.86"E	72 m	Claude	66 55 82 29	Plaine non aménagée	Périmètre maraîcher
2	DON-TAN	DON	KOÏTEGBA	Cultures Maraîchères	15	0.15	OUEME	7°16'21.20"N	2°24'4.58"E	54 m	Claude	66 55 82 29	Plaine non aménagée	Périmètre maraîcher
TOTAL					**25**	**0.4**								
LISTE DES SITES RECENSES DANS LA COMMUNE ZOGBODOMEY AMENAGEMENT DE PERIMETRES IRRIGUES														
N° D'ORDRE	**ARROND.**	**VILLAGE**	**BAS-FONDS**	**SPECULATION EN PLACE**	**SUP._ DISPO. (Ha)**	**SUP._ CULTI. (Ha)**	**AFFLUENT EXPLOITE**	**COORDONNEES DE REPERE**			**PERSONNE RESSOURCE**	**CONTACT**	**STATUT**	**TYPE AMENAG. PROJETE**
								LAT.	**LONG.**	**AL.**				
1	AVLAME	YOKON	ADOUMETE	Riz, Cultures maraîchères Bananier, canne à sucre	60	30	KOTO	7° 6'37.53"N	2° 9'22.91"E	45 m	LEDJI Robert HOUNDANGBADE Toussin	66 12 87 82 94 14 12 32	Plaine Non aménagé	BARRAGE
TOTAL					**60**	**30**								

Table 4: Distribution of sites characterized and retained to shelter/protect lowland developments with partial water control

N°	ARROND.	VILLAGE	SITE	PRODUITS CULTIVES	SUP._ DISPO. (Ha)	SUP._ CULTI. (Ha)	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PERSONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
								LAT.	LONG.	AL.				
1	Copargo	TCHIMILIGOU	TCHIMILIGOU	RIZ, IGNAME	45	8	Afèhou	10° 0'41.39"N	1°40'37.41"E	437m	KAKPI ALLASAN	97 38 06 32	Non aménagé	Aménagement Bas-fonds
2	Copargo	COPARGO	SAFASSI	Cultures maraîchères, Igname et Riz	40	12	OUEME	9°50'46.78"N	1°31'32.27"E	516m	KAKPI ALLASAN	97 38 06 32	Non aménagé	Aménagement Bas-fonds
3	Copargo	DJESSEKOU	BORAGNAM PEHOUN	RIZ	40	11	Afèhou	10° 1'23.31"N	1°41'27.24"E	434m	KAKPI ALLASAN	97 38 06 32	Non aménagé	Aménagement Bas-fonds
4	Copargo	DJESSEKOU	DJESSEKOU	RIZ	45	8	Afèhou	9°58'58.98"N	1°38'38.10"E	421m	KAKPI ALLASAN	98 38 06 32	Non aménagé	Aménagement Bas-fonds
5	Copargo	DJESSEKOU	SEHFOWR	RIZ	41	4.5	Afèhou	10° 1'38.27"N	1°41'55.42"E	432m	KAKPI ALLASAN	99 38 06 32	Non aménagé	Aménagement Bas-fonds
6	Pabegou	SANKOWI	SANKOWI	RIZ	60	11	OUEME	9°49'56.28"N	1°39'39.03"E	404m	KAKPI ALLASAN	99 38 06 32	Non aménagé	Aménagement Bas-fonds
7	Pabegou	SANKOWI	YAMBAGA	RIZ	50	1	OUEME	9°50'57.42"N	1°40'39.18"E	401m	KAKPI ALLASAN	100 38 06 32	Non aménagé	Aménagement Bas-fonds
8	Pabegou	PABEGOU	PABEGOU	RIZ	35	5	OUEME	9°47'16.67"N	1°34'34.32"E	477m	KAKPI ALLASAN	101 38 06 32	Non aménagé	Aménagement Bas-fonds
9	Pabegou	PABEGOU	BOM-BOM	RIZ, IGNAME	38	7	Afèhou	9°50'18.30"N	1°39'33.94"E	412m	KAKPI ALLASAN	102 38 06 32	Non aménagé	Aménagement Bas-fonds
TOTAL					**394**	**67.5**								

LISTE DES SITES RECENSES DANS LA COMMUNE DE DJOUGOU POUR AMENAGEMENT DE BAS-FOND

N°	ARROND.	VILLAGE	BAS-FONDS	SPECULATION EN PLACE	SUP._ DISPO. (Ha)	SUP._ CULTI. (Ha)	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PERSONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
								LAT.	LONG.	AL.				
1	BELLEFOUNGOU	SOSSO	KANGOUROU	Riz, Cultures maraîchères	17,86	10,5	Donge	9°50'19.74"N	1°44'56.72"E	395m	BOUKARI Silbawésé	97 87 73 04	partiellement aménagé par Protos	Extension aménagement
2	BELLEFOUNGOU	BELLEFOUNGOU	SAOUDJIRA	Riz, Cultures maraîchères	18,89	13	Donge	9°48'38.34"N	1°43'13.70"E	402m	BOUKARI Silbawésé	98 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
3	BELLEFOUNGOU	BELLEFOUNGOU	BELLEFOUNGOU 2	Riz, Cultures maraîchères	30	2	Donge	9°49'5.75"N	1°43'41.81"E	408m	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
4	KOLOKONDE	BARE	KOUROULI	Riz, Cultures maraîchères	25	7	Donge	9°54'12.04"N	1°59'8.59"E	347m	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
5	KOLOKONDE	KPERE	KPERE	Riz, Cultures maraîchères	20	0.5		9°59'51.24"N	1°54'0.97"E	403 m	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
7	KOLOKONDE	AFFON	AFFON	RIZ	30	1		9°57'27.48"N	1°51'47.64"E	361 M	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
8	PARTAGO	VANHOUI	TEWEGOU	Riz, Cultures maraîchères, igname	13	4		9°34'5.97"N	1°49'2.83"E	389 m	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond

9	BARIENOU	MONE	KPAKPA	Riz, Cultures maraîchaires, igname	16	8	Affluent de la Donga	9°44'43.97"N	1°50'59.33"E	363 m	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
10	PELEBINA	PELEBINA	YOBAGOU	Riz, Cultures maraîchères, igname	50	10	Affluent de la Donga	9°27'44.88"N	1°38'13.40"E	437 m	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
11	PELEBINA	PELEBINA	ADJAGBAVEI	Riz, Cultures maraîchères, igname	40	8	Affluent de la Donga	9°29'6.29"N	1°38'5.11"E	418 m	Issifou Alidou :	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
12	BAREI CENTRE	BAREI	DOKRIHA	Riz, Cultures maraîchères, igname	17	2		9°40'17.82"N	1°34'21.02"E	470 m	BOUKARI Silbawésé	97 87 73 04	Bas fond non aménagé	Aménagement de bas-fond
TOTAL					**241**	**55.5**								

LISTE DES SITES RECENCES DANS LA COMMUNE DE GLAZOUE POUR AMENAGEMENT DE BAS-FOND

N°	ARROND.	VILLAGE	BAS-FONDS	SPECULATION EN PLACE	SUP._ DISPO. (Ha)	SUP._ CULTI. (Ha)	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PAESONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
								LAT	LONG	AL				
1	MAGOUMI	Monso	Monso	Riz, Cultures maraîchères, maïs	50	7	ZOU	X413810	Y O887318	199m	AKORIDJI Florent	95165865	Non aménagé	Aménagement à de bas-fond
2	OUEDEME	Atakpadoxo	ABIA 1 & 2	Riz, Cultures maraîchères	105	8	ZOU	8° 5'46.68"N	2° 9'22.65"E	210 m	ATAKPA Fidele	96205337	Non aménagé	Aménagement à de bas-fond
3	OUEDEME	YAGBO	YAGBO	Riz, Cultures maraîchères, maïs	85	8	ZOU	8° 6'11.85"N	2° 8'16.83"E	205 m	Albert	95 35 75 03	Non aménagé	Aménagement à de bas-fond
4	OUEDEME	Kpassassa	KPASSASSA	Riz, Cultures maraîchères	50	5	ZOU	8° 6'18.78"N	2° 7'6.80"E	206 m	AHOSSINOU Jean Baptiste	97925683	Non aménagé	Aménagement à de bas-fond
5	OUEDEME	YAGBO	KLOU	Riz, Cultures maraîchères	30	15	ZOU	8° 6'59.33"N	2° 7'52.46"E	213 m	Albert	95 35 75 03	Ancien périmètre	Aménagement à de bas-fond
6	OUEDEME	YAGBO	ATTINDEDJI	Riz, Cultures maraîchères	40	2	ZOU	8° 7'36.52"N	2° 7'30.01"E	196 m	Albert	95 35 75 03	Non aménagé	Aménagement à de bas-fond
7	OUEDEME	AMAGAVISSA	DANDEWADJI	Riz, Cultures maraîchères	30	2	ZOU	8° 8'54.89"N	2° 8'17.14"E	205 m	Albert	95 35 75 03	Non aménagé	Aménagement à de bas-fond
8	AKLAMPA	AKLAMPA	AKLAMPA	Riz, Cultures maraîchères	30	2	OUEME	8°12'44.69"N	2°10'47.40"E	198 m	HUEFONDE Claver	95407096	Non aménagé	Aménagement à de bas-fond
9	AKLAMPA	Allawenonsa	HASSAGBAKA	Riz, Cultures maraîchères	45	2	OUEME	8°12'59.06"N	2°10'35.81"E	203 m	DAHIN Nicolas	97344599	Non aménagé	Aménagement à de bas-fond
10	AKLAMPA	Konou	KONOU	Riz, Cultures maraîchères	80	15	OUEME	8°16'12.53"N	2° 9'42.90"E	228 m	HUEFONDE Claver	95407096	Non aménagé	Aménagement à de bas-fond
11	AKLAMPA	Djamandji	Todjotin	Riz, Cultures maraîchères	20	1	OUEME	X 0401935	Y 0923743	232m	AHOUANYINYIN Alban	97460292	Non aménagé	Aménagement à de bas-fond
12	AGOUAGON	AGOUAGON	AVALI 1	Riz, Cultures maraîchères, soja, maïs	10	0.5	OUEME	7°58'31.18"N	2°17'43.64"E	201 m	Albert	95 35 75 03	Non aménagé	Aménagement à de bas-fond
13	AGOUAGON	AGOUAGON	GANDJITOVLAME	Riz, Cultures maraîchères igname, maïs	100	2	OUEME	7°59'29.50"N	2°20'24.91"E	136 m	Albert	95 35 75 03	Non aménagé	Aménagement à de bas-fond
14	ZAFFE	KPAKPAZOUME	ERIN' DJAN	Riz, Cultures maraîchères	70	4	OUEME				YAHA K MARTIN	95344685	Non aménagé	Aménagement à de bas-fond

15	ASSANTE	Houin	HOUIN	Riz, Cultures maraîchères	10	1	OUEME	X 0422664	Y 0898655	160m	DANDONOUGBO Hubert	95164837	Non aménagé	Aménagement à de bas-fond
TOTAL					**755**	**74.5**								

LISTE DES BAS -FONDS RECENSES DANS LA COMMUNE DE ZANGNANADO

N°	ARROND.	VILLAGE	BAS-FONDS	SPECULATION EN PLACE	SUP._ DISPO. (Ha)	SUP._ CULTI. (Ha)	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PERSONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
								LAT.	LONG.	AL.				
1	DOVI	DOVI ZOUNNOU	DOVI ZOUNNOU	RIZ	600	120	OUEME	7° 7'6.40"N	2°21'25.52"E	23 m	Chef du Village	95 42 61 18	Une partie aménagée	Extension périmètre rizicole
2	DOVI	LEGBADO	DOKOUNTIN	RIZ	100	10	OUEME	7° 9'52.74"N	2°23'57.17"E	20 m	Chef du Village	96 92 80 86	Plaine non aménagée	Aménagement rizicole
3	ZAGNANADO	ZONMON	ZONMON	Maïs, Arachide, Riz, Cultures maraîchères Manioc, Patate	200	20	ZOU & OUUEME	7°11'37.59"N	2°24'39.40"E	24 M	Sourou Pierre	96 36 78 26	Ancien périmètre	Périmètre a réhabilité
4	GBANAME	AVOGBEGON	AVOGBEGON	Riz	15	5	ZOU	7°29'51.38"N	2°16'6.87"E	125 m	Sourou Pierre	96 36 78 26	Ancien périmètre	Réhabilitation et extension
5	GBANAME	AVONOUHOUIDE	AVONOUHOUIDE 1	Riz	20	5	ZOU	7°31'22.07"N	2°17'35.41"E	149 m	Sourou Pierre	96 36 78 26	Plaine non aménagée	Aménagement rizicole
6	GBANAME	AVONOUHOUIDE	AVONOUHOUIDE 2	Riz	25	5	ZOU	7°32'12.18"N	2°16'27.19"E	168 m	Sourou Pierre	96 36 78 26	Ancien périmètre	Réhabilitation extension
TOTAL					**960**	**165**								

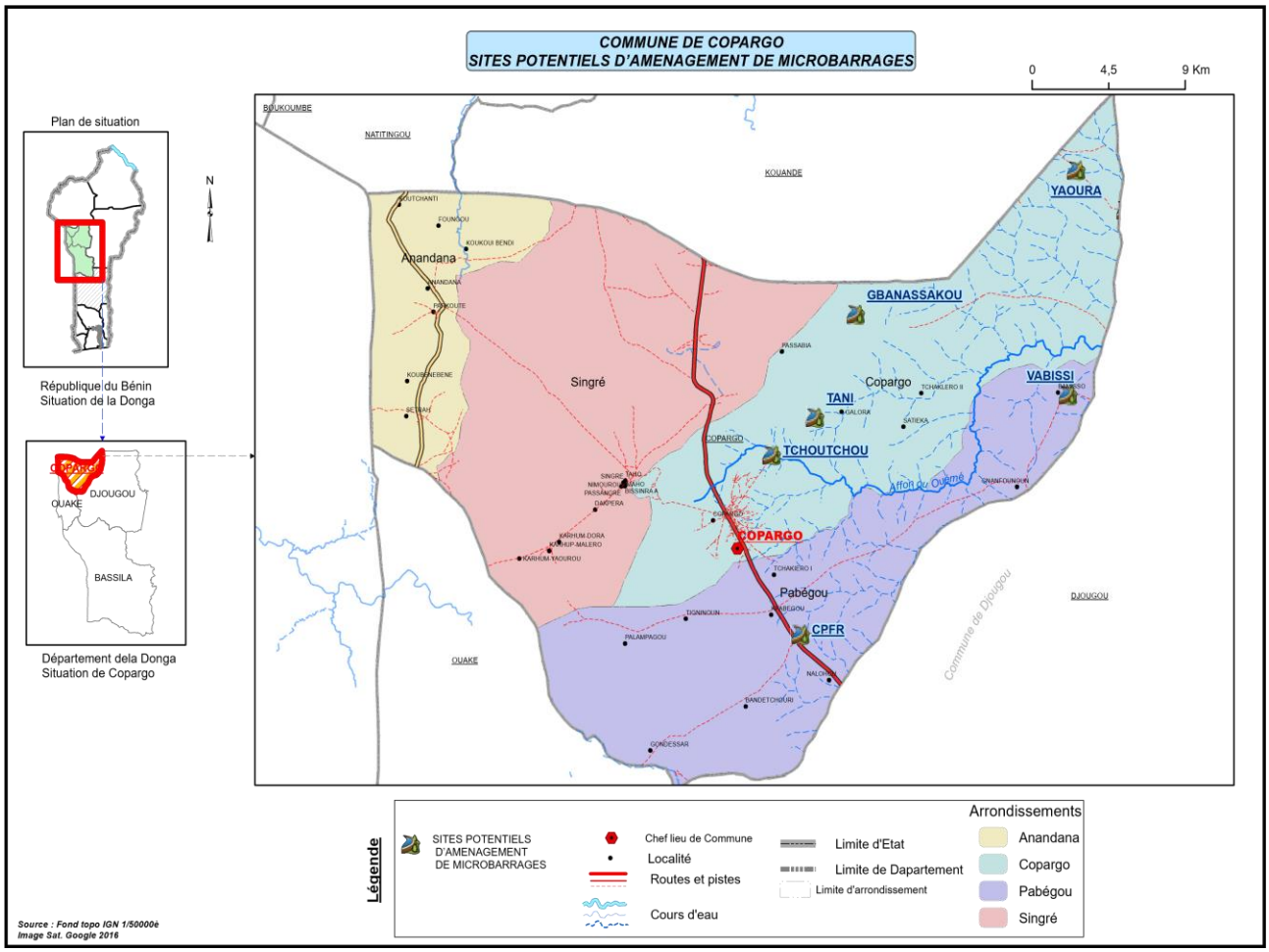
LISTE DES SITES RECENSES DANS LA COMMUNE ZOGBODOMEY POUR AMENAGEMENT DE BAS-FOND

N°	ARROND.	VILLAGE	BAS-FONDS	SPECULATION EN PLACE	SUP. _ DISPO. (Ha)	SUP. _ CULTI. (Ha)	AFFLUENT EXPLOITE	COORDONNEES DE REPERE			PERSONNE RESSOURCE	CONTACT	STATUT	TYPE AMENAG. PROJETE
								LAT.	LONG.	AL.				
1	DOME	GBAFFO	KESSEDJOGON	Riz, Cultures maraîchères	100	15	ZOU	7° 6'46.33"N	2°18'57.86"E	22 m	LOKONON Clément	61 47 76 39	Plaine Non aménagé	Aménagement à maîtrise partielle de l'eau
2	DOME	AGOITA HANTAN	YOVOGLETA	Riz, Cultures maraîchères Bananier	50	1.5	Affluent de l'Ouémé	7° 2'4.32"N	2°19'1.10"E	12 m	ZOUNGBONON Athanase	96 48 89 03	Plaine Non aménagé	Extension aménagement rizicole PAIAVO
TOTAL					**260**	**16.5**								

Appendix 5: Mapping of selected sites

Appendix 5.1: Mapping of sites characterized to shelter small dams/water retention/pools for in the five (05) communes

Map 1: Location of the sites of the Commune of Copargo

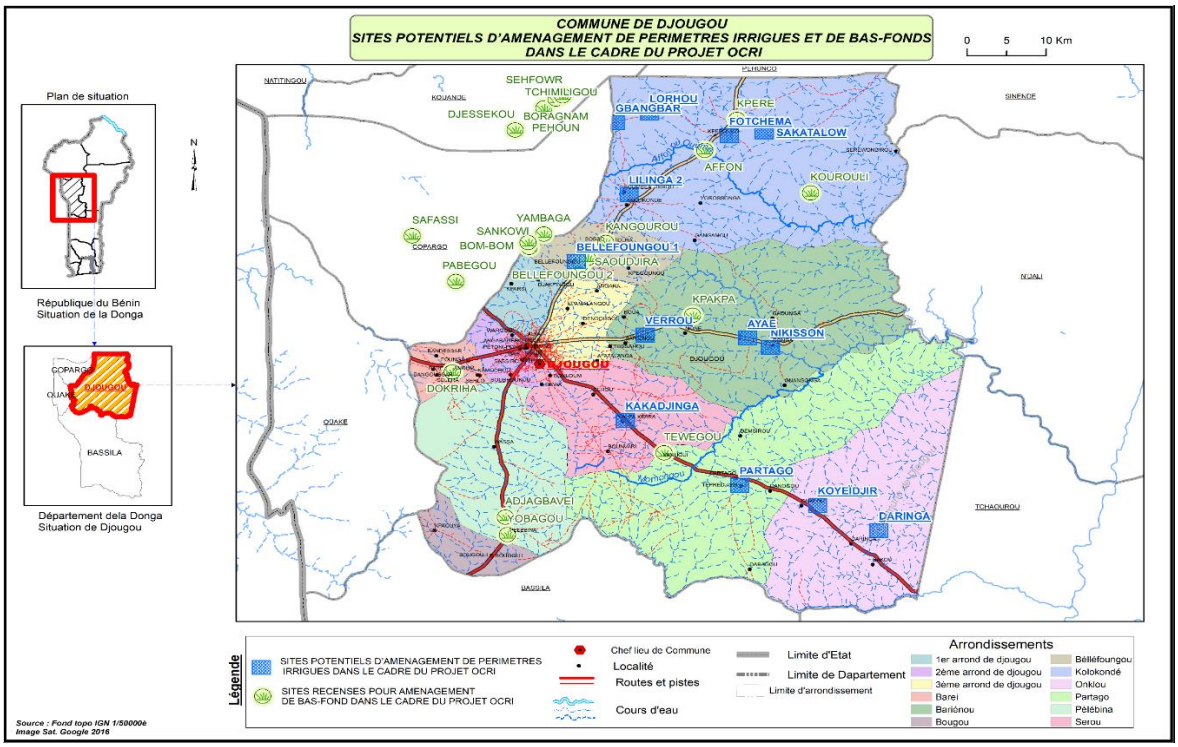


Map 2: Location of the sites of the Commune of Djougou
Map 3: Location of the sites of the Commune of Glazoué
Map 4: Location of the sites of the Commune of Zangnando
Map 5: Location of the sites of the Commune of Zogbodomè

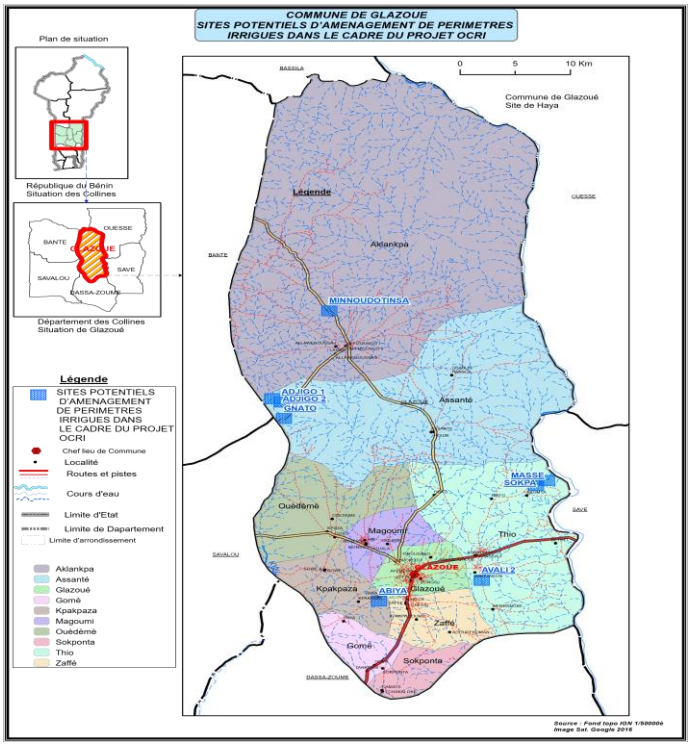
Appendix 5.2: Mapping of sites characterized to shelter small irrigated perimeters with total water control in the five (05) communes

Map 6: Location of the sites of the Commune of Copargo

Map 7: Location of the sites of the Commune of Djougou



Map 8: Location of the sites of the Commune of Glazoué



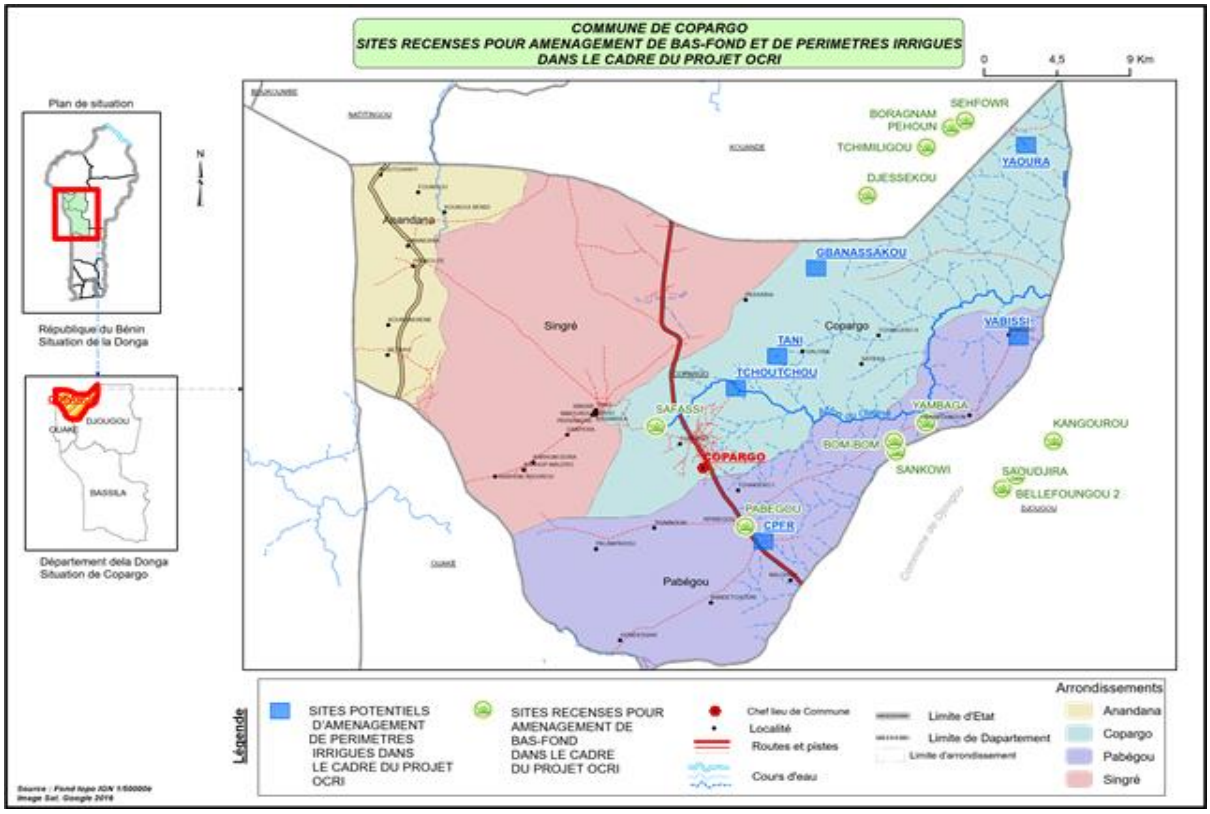
Map 9: Location of the sites of the Commune of Zangnando

Map 10: Location of the sites of the Commune of Zogbodomè

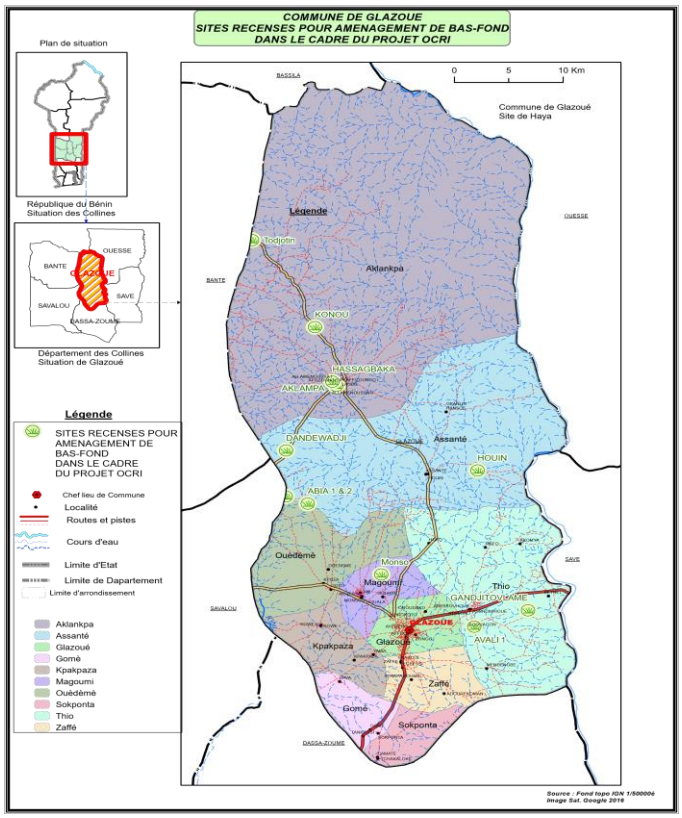
Appendix 5.3: Mapping of sites characterized for lowland development with total water control

Map 11: Location of the sites of the Commune of Copargo

Map 12: Location of the sites of the Commune of Djougou



Map 13: Location of the sites of the Commune of Glazoué



Map 14: Location of the sites of the Commune of Zangnando
Map 15: Location of the sites of the Commune of Zogbodomè

Appendix 5.4: Mapping of sites characterized for lowland development with partial water control

Map 11: Location of the sites of the Commune of Copargo

Map 12: Location of the sites of the Commune of Djougou
Map 13: Location of the sites of the Commune of Glazoué

Map 14: Location of the sites of the Commune of Zangnando
Map 15: Location of the sites of the Commune of Zogbodomè

Appendix 6: Description of Development (water conservation and management) Types

Appendix 6.1: Description of surface water collection works (mini-dams, weirs, water retention, etc.)

This development system consists of installing a dyke or raised weirs to raise the water level by boat. These weirs (dikes) will be made of concrete masonry which will discharge at both lateral ends. The weirs will each be equipped with a cofferdam. A bottom sill will be provided at the central level of the dyke to facilitate maintenance or to be used as a catchment in case of necessity. These are small dams that will allow surface runoff water to be stored for later use. Depending on the water reserve thus created, these structures can be operated either in the rainy or dry season. It should be noted that large dams are not eligible under this project.

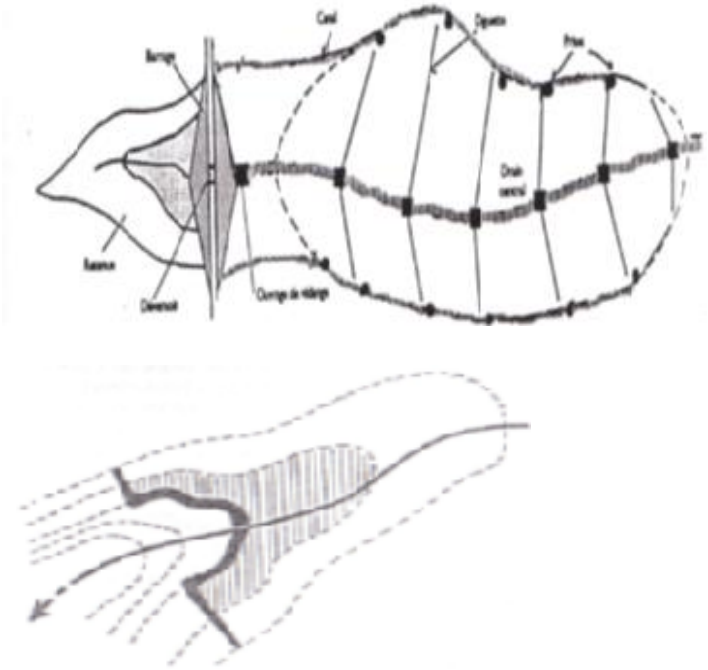


Figure 10: Layout with one or more thresholds creating a micro-dam

In the rainy season, the water retention allows: Supplementary irrigation of the rice perimeter downstream of the dam, then flooded and rainfed rice cultivation around the reservoir. In the dry season, the stored water will be used either for livestock watering, but primarily for watering market garden crops downstream and rice growing upstream.
The technical characteristics of the profile used in the construction of these structures are as follows:

- Water spill: less than 0,5 m
- Height of the dyke: 1.5 to 2 m
- Storage capacity: variable according to the site, the height and length of the dyke;
- Water regulation system: bottom sluice in the middle, and sets of cofferdams at the level of the spillways;
- Upstream facing: vertical sealing wall;
- Downstream facing: 1:2 slope

- Depth of sealing trench: 2 m
- Length: 80 m on average

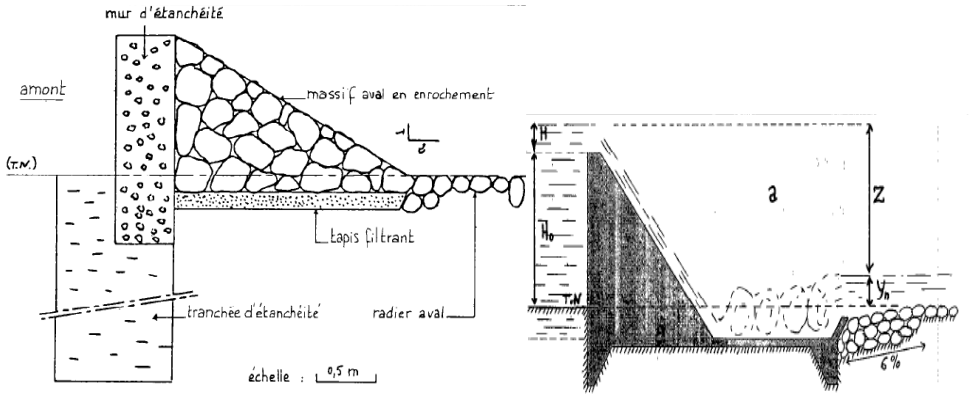


Figure 11: Typical profile of a cyclopean concrete dike and gabion rockfill counter-bracing and a concrete spillway

Appendix 6.2: Description of the development of small irrigated perimeters with total water control

These include land reclamation systems near watercourses, floodplains and all lands downstream of water collection structures, artesian boreholes. These systems may include permanent or semi-permanent stream intake or flood recession cultivation (Photo No. 1 in Appendix 4.2).

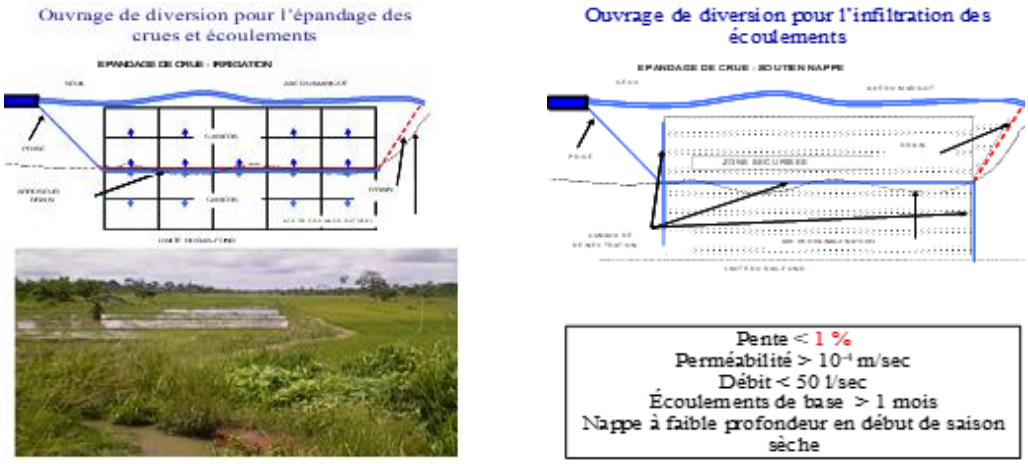


Figure 2: Gravity system with run-of-river connection

In addition, it is classified in this category of development, flood recession crops which are the least developed forms of traditional irrigated cereal crops (rice, maize) suitable for the Rice Intensification System (RIS) which is a method of Intelligent Agriculture in the face of climate change (IAC). It is an extensive agriculture practised at the level of the overflow zones of permanent or temporary watercourses as well as at the level of the tidal zone of permanent water bodies.
The system of flood recession agriculture is practised and is expanding rapidly, especially on the lands of the flood plains of the Ouémé valley, especially in the communes of Zangnanado and Zogbodomey. Irrigation water comes from a network of canals or collectors that was set up in the early stages of development (or comes from other natural sources). Irrigation then essentially consists of sucking up water and pumping it directly into the rice traps during critical periods (Photo n°3 in appendix 4.2). It should be noted that the dividing bunds are sometimes built from peaty material (poorly decomposed organic matter); in this case, they have a short lifespan and are not very effective in retaining water in the traps. On the other hand, when soil of good composition and texture is available, earthen bunds are more resistant and more perennial drainage channels can be made for the evacuation of excess water.

Photo 2: Photo of a run-of-river system and flood recession culture.

Appendix 6.3: Description of Lowland Development with Partial Water Control

Type 1- Isohypsed Lowland with Isohypsed Dikes or Contour Thresholds (DNC)

- Type 1.1. Compacted earth sluice gates/levelling gates with small drainage structures (DCN-T)

The development is made up of successive bunds, following the contour lines, which divide the shoal into successive stages of impluvium. The bunds are spaced according to the longitudinal slope of the shoal so as to respect a 20 cm difference in level between two consecutive bunds. Each dike consists of a small breakwater structure equipped with cofferdams for emptying. The structure is located at the crossing point of the lowland talweg. At the edge of the shoal, the dyke line leaves the contour line and rises towards the shore of the nominal water level, thus forming a discharge zone in the downstream trap when the water level rises above the nominal level. Isohyps dikes will have a crest width of 50 cm, slope 1/1 and a height of 40 cm at the time of construction, reaching a height of 30 cm after consolidation. The network of isohypsic dikes is completed by dividing dikes. As a specialist flood protection measure, the first iso-hypical dike will have a larger cross-section (1 m crest width and 3/2 slope). **This type of arrangement is suitable for flat, flared shallows with a very low slope (less than 1%) as shown in Figures 5 and 6.**

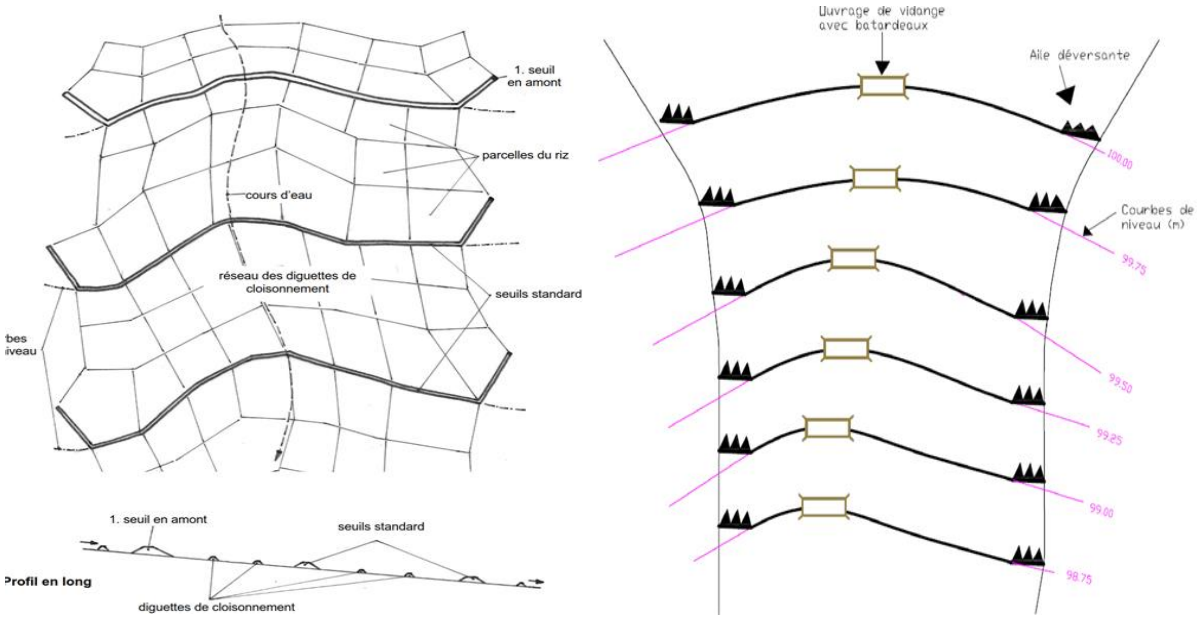


Figure 5: Landscaped with isohypsical dikes/seils made of compacted earth or stones equipped or no drainage works (DCN-T or DCN-P)

These developments are used for flat and concave shallows with the following characteristics (i) slight longitudinal and transverse slopes; (ii) catchment area between 2 and 5 km² and a very shallow minor bed not exceeding 0.3 m in depth. Isohypsic retention bunds provide for the retention of run-off water and drainage works provide for drainage. The regulation of the water level in the traps is ensured by the so-called overflow wings.

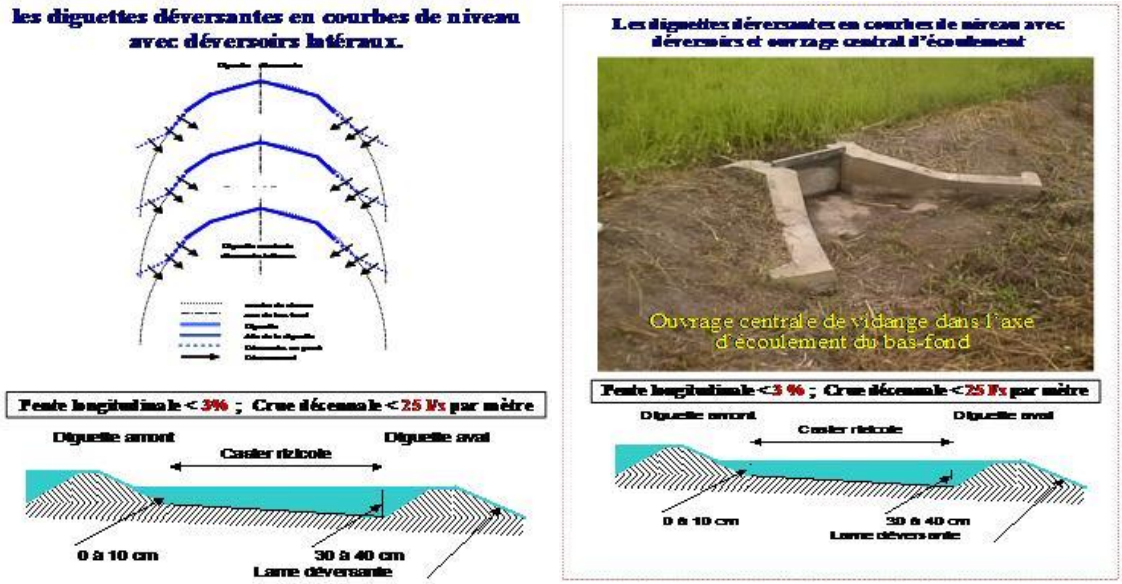


Figure 6: Isohypsic retention diguettes with sloping wings equipped with drainage structures

Depending on the intensity of the flood, variants based on the materials and dimensions of the dikes. Thus, one can distinguish between (i) Arrangements with isohypsical dikes made of compacted earth taken from the site or as a contribution, (ii) Arrangements with isohypsical dikes made of dry stone/crushed rubble lined with earth partitioning dikes, and (iii) Arrangements with lined isohypsical dikes whose core is made of compacted earth of contribution covered with geotextiles and then rubble.

- *Type 1.2. Compacted earth coated dikes/levelling pads (DCN-R)*

These are iso-hypsical bunds, also called thick, low-lying sills, built across the shallows along the contour lines and whose main function is to form a 30 cm deep body of water upstream. The height of the water body is imposed by the type of crops to be grown. Each structure consists of four parts:

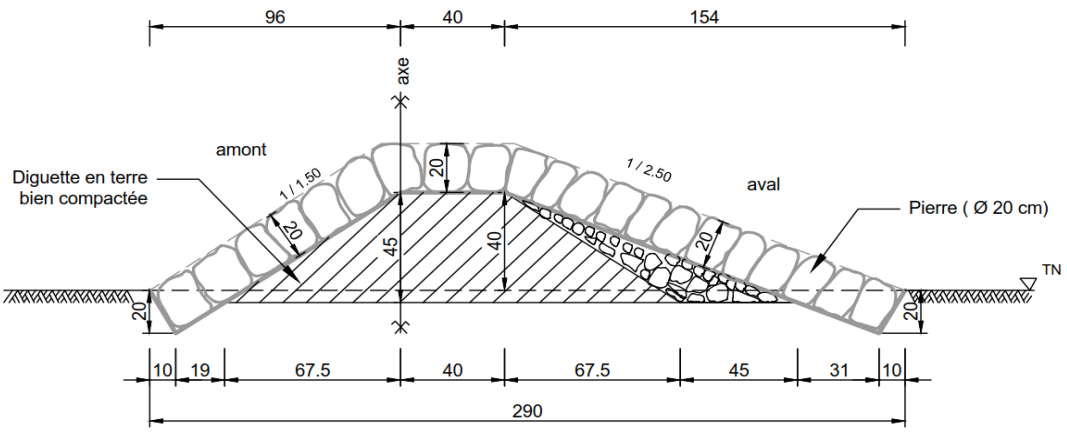
- *Compacted fill*: it makes it possible to create a watertight barrier at a low height in order to constitute a water reserve. The compacted backfill is made of low-swelling clay material. It will have an upstream and downstream slope of 1/1.5 with a crest width of 50cm.

- *Geotextile (polypropylene*): its function is to protect the embankment and the foot of the dikes against groundwater erosion due to submersion and runoff. It prevents the escape of fine particles from the embankment with the flow. It has a width of 4.45 m/ml.

- *Riprap*: since the dikes are spillway weirs, the function of the riprap is to stabilize the entire structure by protecting it from erosion due to runoff and falling water. The riprap will be laid on a slope of 1/1.5 upstream and 1/2.5 downstream. The volume of stones to be mobilized will follow while integrating an additional volume of 10% of the calculated volume.

- *Downstream stop*: its function is to prevent the rockfill from loosening.

The typical section or cross section of a lined contour dike (DCN-R)



Seuil "BEPASO"

Echelle: 1/20

Figure 7: Cross profile of a lined dike/threshold (geotextile and rubble)

The geometrical characteristics of these coated bunds or rice thresholds of the coated type are:
- Width in crest: 0.50 m
- Total height: 0.60 m
- Height of the core in the ground: 0.40 m
- Upstream slope: 1/1.5
- Down slope: 1/2.5
- Right-of-way: 2.90 m

Photo 1: Dike made of earth, dry or coated stone

- Partitioning diguettes/Diguettes de cloisonnement (Dcl)
This involves dividing the site into different types of enclosures of varying shapes and sizes (20 x 20, 30 x 30, etc.) depending on the topography of the site. The enclosures are

delimited by the dividing bunds. This is a seasonal plot development to be carried out during each season to ensure a good distribution of water in the pigeonholes through good levelling. They will be built in materials with good mechanical properties and implemented with the required care.

The characteristics of their cross profile are as follows:

- crest width: 0.20 m
- height: 0.30 m
- Upstream slope: 1:1
- downstream slope: 1:1
- right-of-way: 0.80 m

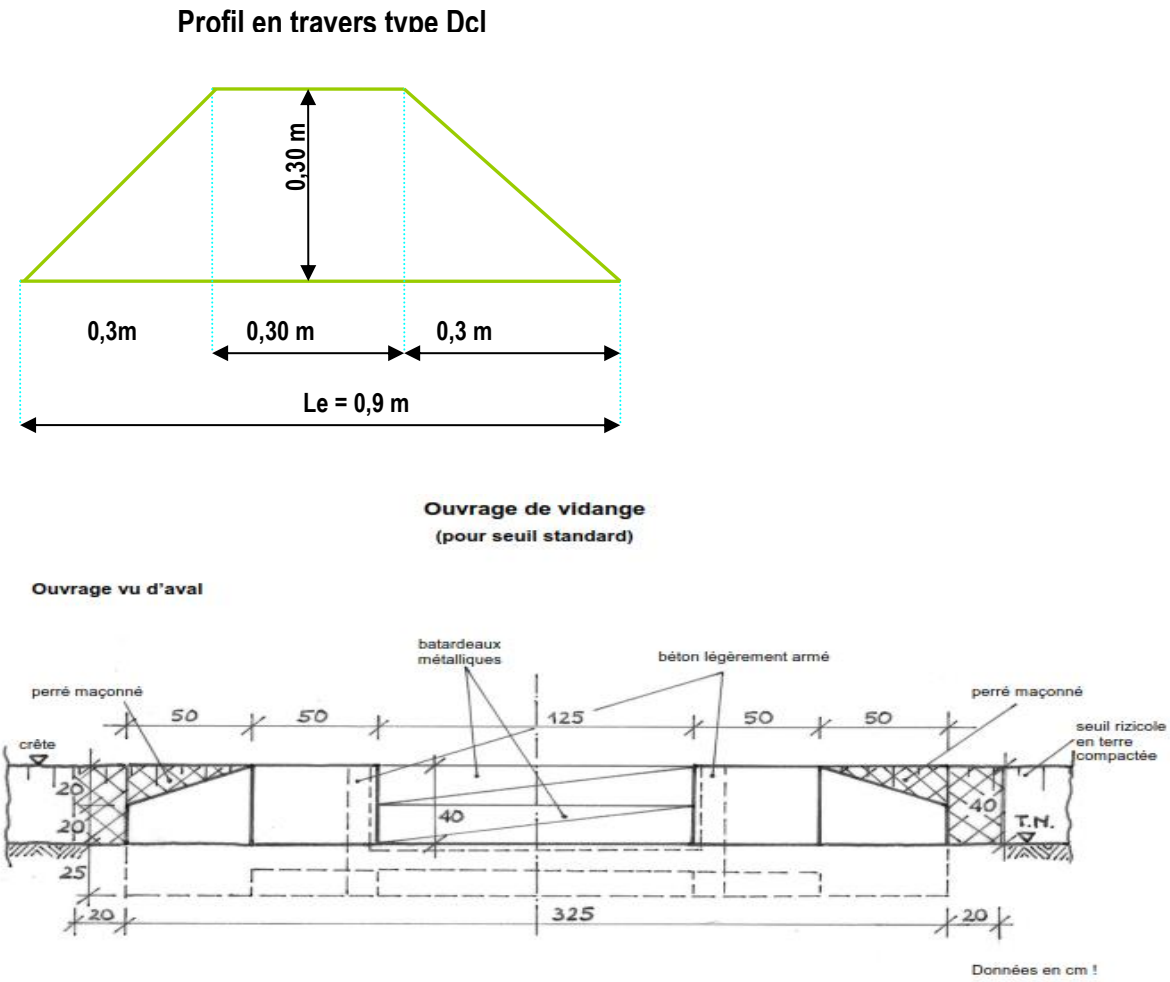


Figure 8.1: Drainage structure for standard weir (Structure seen from downstream)

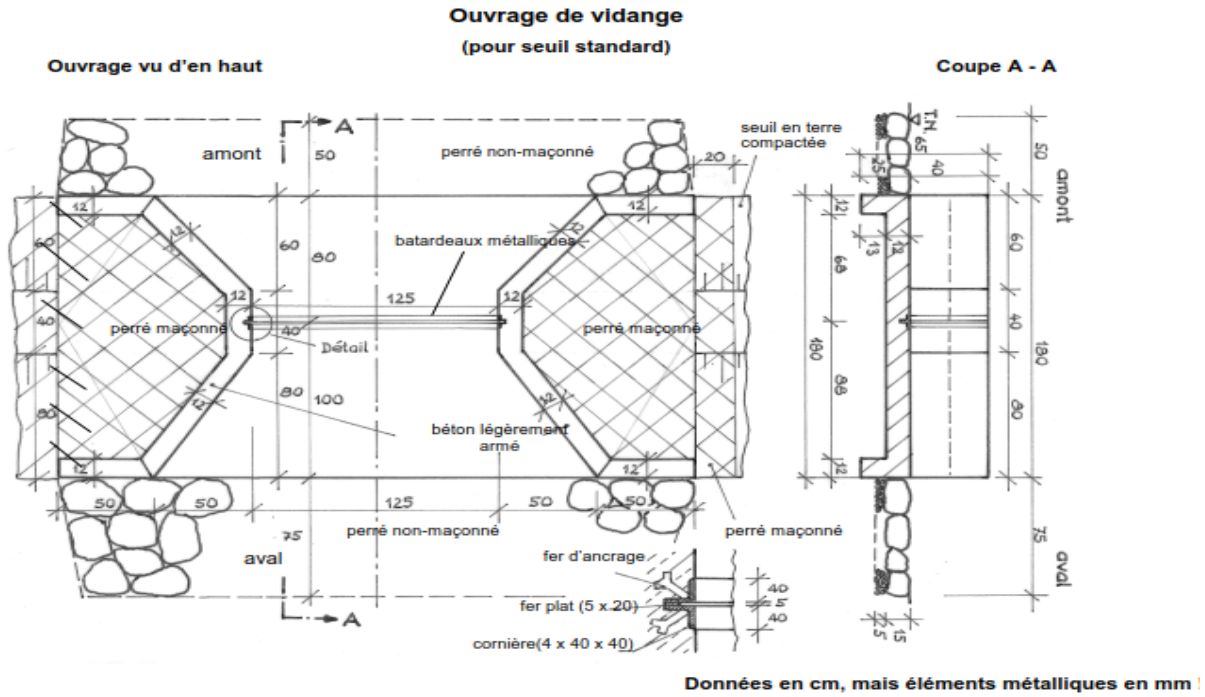


Figure 8.2: Drainage structure for standard sill (top view and section A-A)

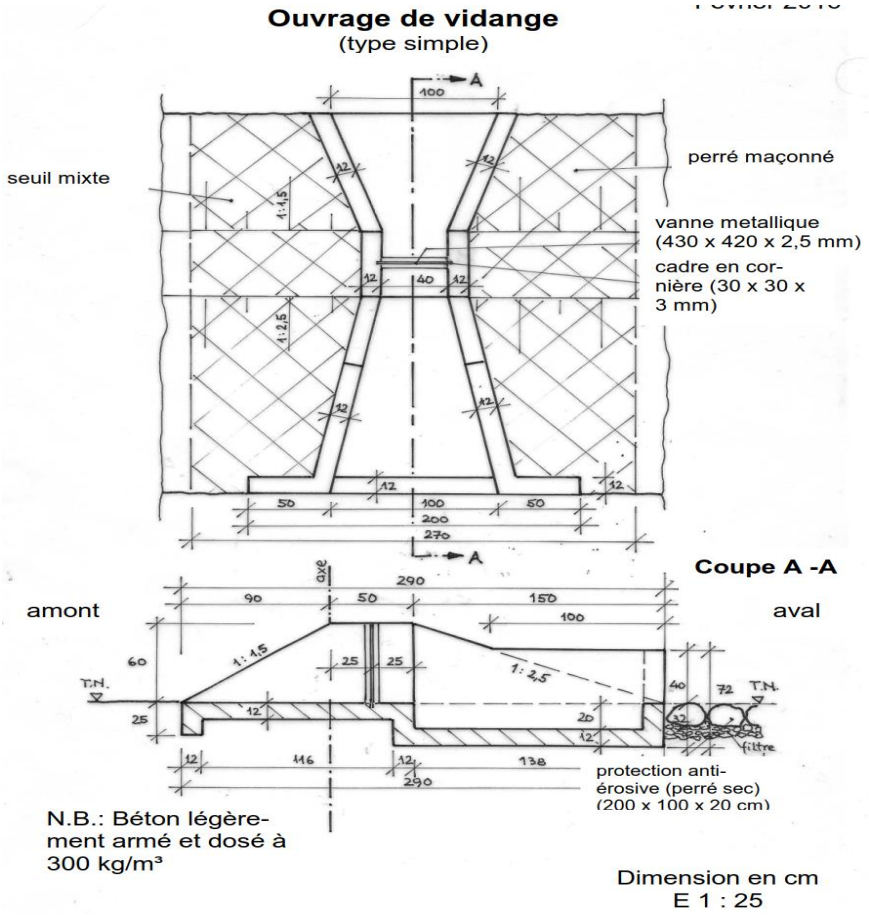


Figure 8.3: Drainage structure for single sill (Top view and section A-A)

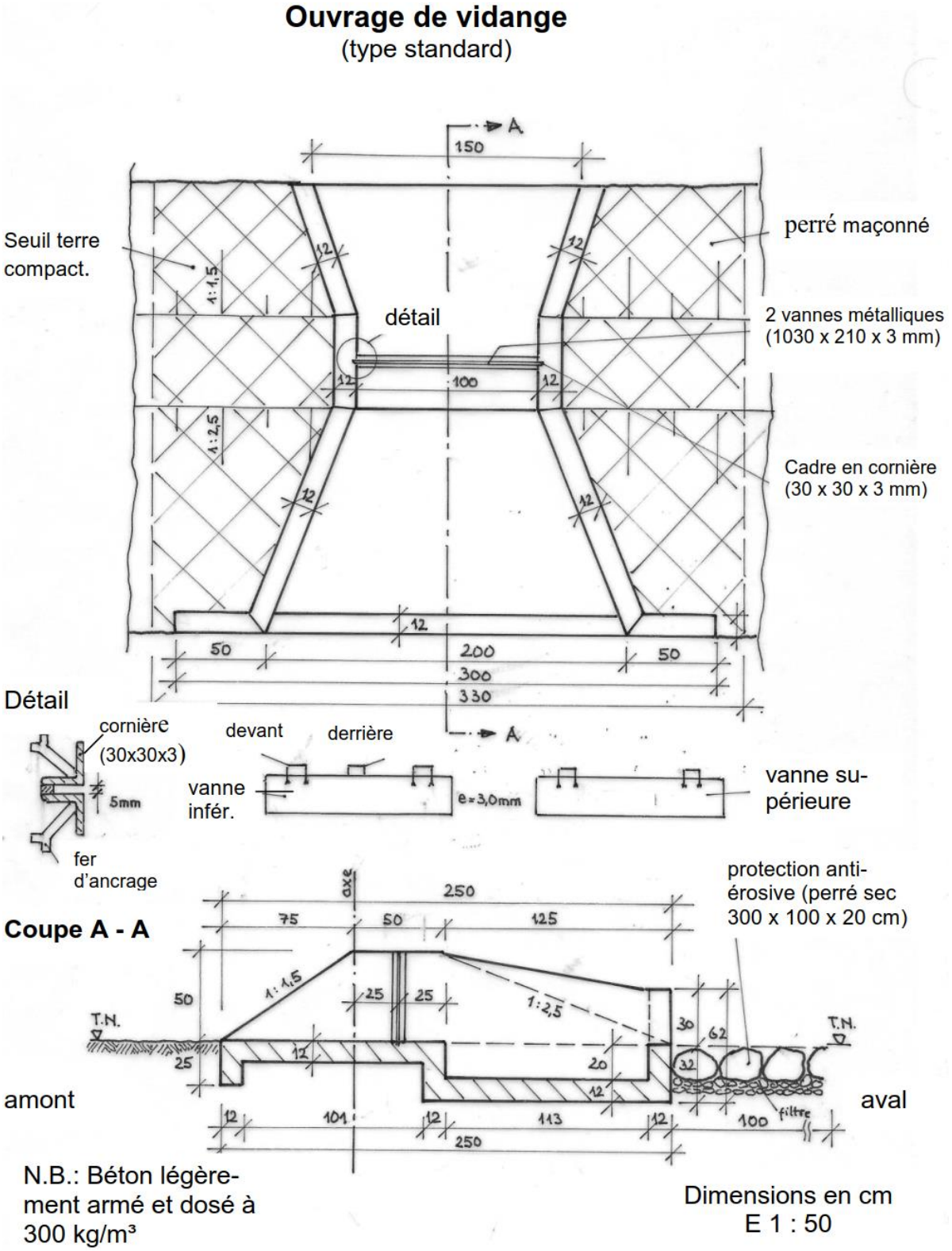


Figure 8.4: Drainage structure for single sill (detail and section A-A)

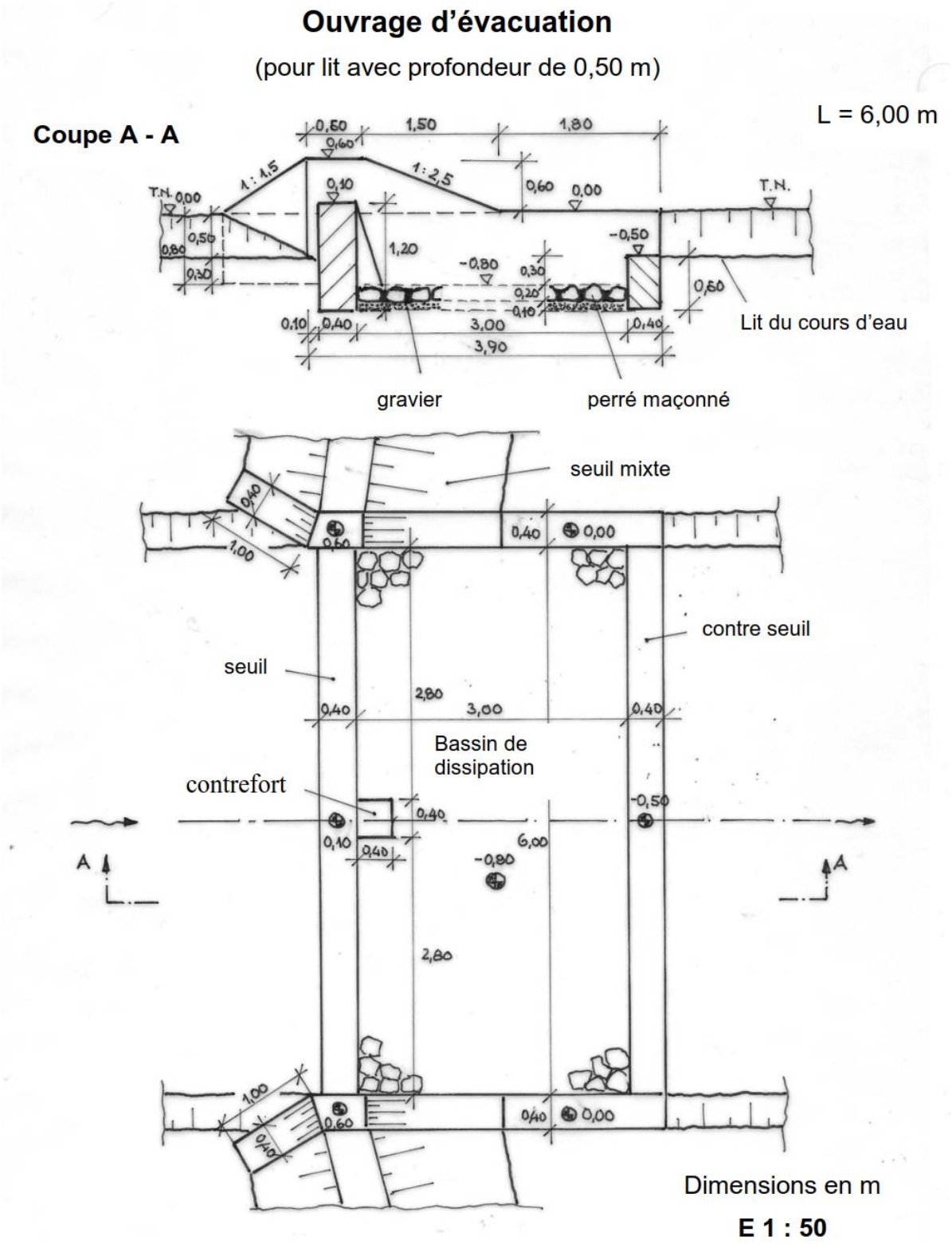


Figure 8.5: Drainage structure at minor bed level

The building materials here can be soil taken from the site or brought in, dry stones (rubble), geotextile.

- Type 2- Lowland with protective dyke, drainage channel with small control structures, isohypses and casierage dykes.

It is similar to Type 1, but with the addition of a central channel for the evacuation of floods. The natural channel will simply be recalibrated by widening it if necessary (without overcrowding) and by providing risperms on both sides, limited by riders. Each rider will have a ridge width of 50 cm, a height of 50 cm and a slope of 3/2. The upstream dike will have a larger section than type 1, with a width of 1 m, a maximum height of 1 m, and a slope of 1/2. The control structure at the dike will have a larger cross-section, but it will depend on the cross-section of the channel. As a specific provision in relation to floods, the channel will be recalibrated at least 100 m immediately downstream of the constructed section in order to improve flood transit. In the case where the watercourse is lateral, and the lowland is subject to flooding, a protective dike with the same characteristics as the upstream dike will be built in parallel, leaving a berm of about 2 m from the edge of the channel. This type of development is suitable for shallows with a low slope (maximum 1%) and a well-marked channel.

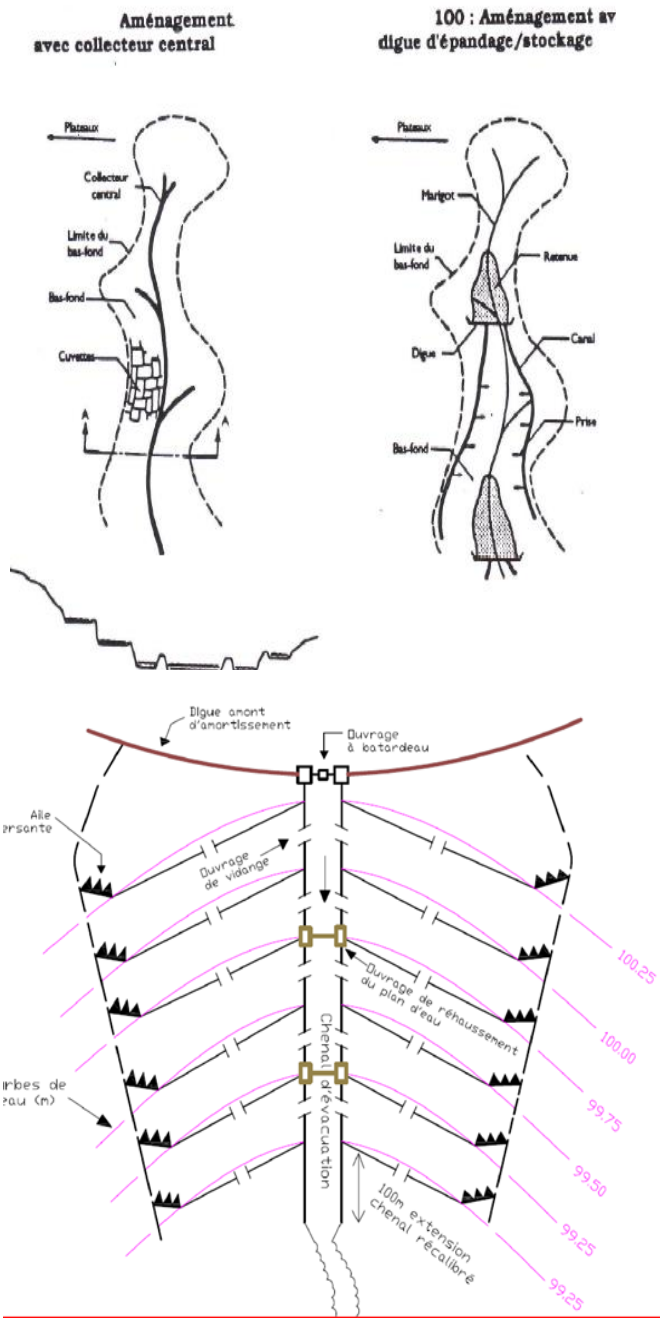


Figure 9: Development with flood spreading dyke

- Type 3- Lowland developed with upstream dike/regulation works, lateral intake works, bank canals for irrigation, central channel with small regulation works, isohypses dykes, and casierage dykes.

This development system is similar to type 2, but with the addition of 2 lateral intake structures (with cofferdams) at the level of the upstream dike, feeding 2 belt irrigation canals. The water flowing through the canals can be distributed to the different traps by small "all-or-nothing" type dividing structures or by PVC or bamboo siphonage. The bank canals will be made of earth and generally of mixed profile (cut and fill) with a width at the ceiling of 30-50 cm, slopes of 3/2 and longitudinal slope corresponding to that of the lowland. Each channel will have a 30 cm wide ridge-side rider and a slope of 1/1. As in type 2, the channel will be recalibrated and extended at least 100 m downstream of the developed part of the shoal as a special flood protection measure. This type of development is suitable for embanked, permanently hydromorphic concave lowlands with a natural channel with a longitudinal slope of 1 - 2% and a transverse slope of 1 - 2%. This system also allows for an off-season campaign.

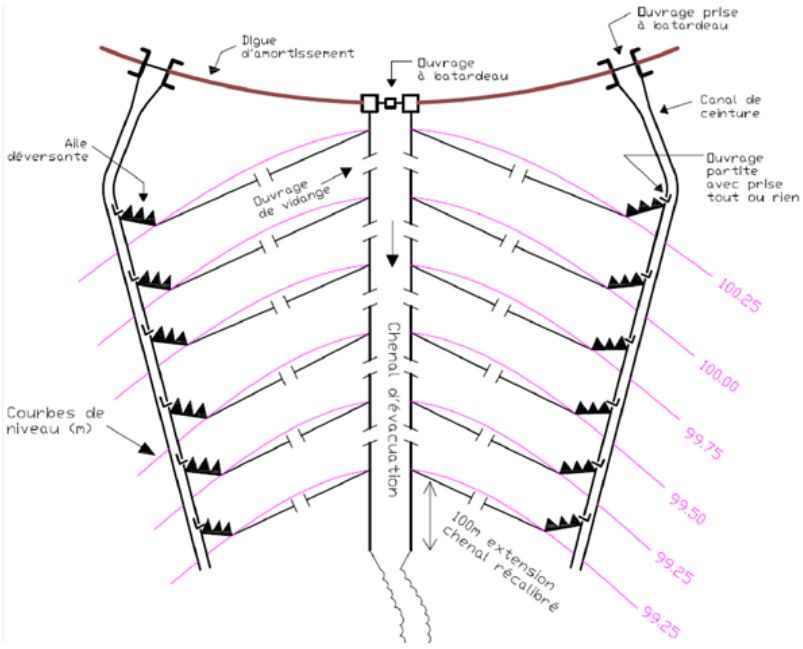


Figure 10: Development with upstream dyke and water control structure