REQUEST FOR PROJECT/PROGRAMME FUNDING FROM THE ADAPTATION FUND

The annexed form should be completed and transmitted to the Adaptation Fund Board Secretariat by email or fax.

Please type in the responses using the template provided. The instructions attached to the form provide guidance to filling out the template.

Please note that a project/programme must be fully prepared (i.e., fully appraised for feasibility) when the request is submitted. The final project/programme document resulting from the appraisal process should be attached to this request for funding.

Complete documentation should be sent to:

The Adaptation Fund Board Secretariat
1818 H Street NW
MSN P4-400
Washington, D.C., 20433
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Email: afbsec@adaptation-fund.org

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ABBREVIATIONS AND ACCRONYMS

ADD	Association for the Development of Dionewar
AF	Adaptation Fund
ANA	National Agency for Aquaculture
ANACIM	National Civil Aviation and Meteorology Agency
ANSD	National Agency of Demography and Statistics
CADL	Local Development Support Center
CEGEP	General and Vocational College
CLPA	Local Artisanal Fisheries Committee
COGER	Management Committees of the Natural Resources
COMNACC	National Committee for Climate Change
CONAF	National Council for Functional Literacy
CSE	Centre de Suivi Ecologique
DADL	Direction de l'Appui au Développement Local
DEEC	Direction of the Environment and Classified Establishments
DNA	Designated National Authority
ENDA	Environment and Development Organization
FAO	Food and Agriculture Organization of the United Nations
FELOGIE	Federation of Local GIE
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIE	Economic Interest Groupings
GPF	Women's Promotion Groups
IPCC	Intergovernmental Panel on Climate Change
IRD	French Research Institute for Development
MEDD	Ministry of the Environment and Sustainable Development
MEP	Monitoring & Evaluation Plan
MERAS	Monitoring and Evaluation, Reporting and Analysis System

NAPA	National Adaptation Plan of Action
NGO	Non-Governmental Organization
NIE	National Implementation Entity
NSC	National Steering Committee
PAEL	Local Environmental Action Plan
PAP	Priority Action Programme
PAPIL	Support to Local Small-scale Irrigation Project
PISA	Program for International Student Assessment
PLAE	Local Plan of Action for the Environment
PLD	Local Development Plan
PMU	Project Management Unit
PSE	Strategic Plan for Senegal's Emergence
AWB	Annual Workplan and Budget
RBDS	Reserve of the Biosphere Delta of Saloum
SDLAO	Master Plan for the West African Coastline
SNDES	National Strategy for Economic and Social Development
SNEEG	National Strategy for Gender Equality
TURF	Territorial User-Rights Fsheries
ECOWAS	Economic Community of West African States (ECOWAS)
IUCN	International Union for Conservation of Nature
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

ADAPTATION FUND

PROJECT/PROGRAMME PROPOSAL TO THE ADAPTATION FUND

PART I: PROJECT/PROGRAMME INFORMATION

Project/Programme Category:	REGULAR PROGRAMME
Country/ies:	SENEGAL
Title of Project/Programme:	Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar)
Type of Implementing Entity:	NIE
Implementing Entity:	Centre de Suivi Ecologique (CSE)
Executing Entity/ies:	Comité National pour l'Alphabétisation et la Formation (CONAF), Agence Nationale pour l'Aquaculture (ANA)
Amount of Financing Requested:	1,351,000 (in U.S Dollars Equivalent)

I.1. Project Background and Context

I.1.1. Summary of problem the project aims to solve

Under the combined effects of climate change and human activities, the Saloum estuary's mangrove swamp has disappeared at an estimated 38.3 %. This degradation has led to significant ecological and economic losses, one of the main consequences being the opening of a breaches along the Sangomar Arrow (a sand spit), which threatens the existence of several human settlements. The village of Dionewar counts among those most affected.

Recent studies[1] conducted along the coast and on the Saloum estuary indicate that the recent climatic variations in Senegal (from 1971 until 2010) have had multiple effects on the mangrove ecosystems in particular. The lack of rainfall is among the main drivers, and indeed the succession of dry years has pushed back the tidal limits, allowing the salinity front to move further upstream. This is how extreme cases of hypersalinity have happened in the Saloum estuary. While salinity plays an important role in the metabolic efficiency of botanical species, it reduces the productivity of the mangrove in particular.

[1] ECOWAS, IUCN, 2010: Programme de lutte contre l'érosion côtière de l'ECOWAS. "Etude régionale pour le suivi du trait de côte et l'élaboration d'un schema directeur du littoral de l'Afrique de l'Ouest; Schéma directeur, prescriptions générales".

Dieye et al, 2013 : « Dynamique de la mangrove de l'estuaire du Saloum (Sénégal) entre 1972 et 2010 », *Cybergeo : European Journal of Geography* [En ligne], Environnement, Nature, Paysage, document 629, mis en ligne le 09 janvier 2013, consulté le 19 décembre 2015. URL : http://cybergeo.revues.org/25671 ; DOI : 10.4000/cybergeo.25671

These hydrological and ecological conditions help explain why mangroves in the Saloum estuary are so small, and also why its density, floral composition and productivity have been severely affected.

In addition to the climatic causes of the mangrove's degradation, there has also been extensive exploitation by communities. In particular, they have been harvesting the plants for oysters and using the mangroves themselves for firewood and timber.

The regression of the mangrove has directly weakened the sedimentary dynamics, which ensures the stability of the Sangomar Arrow. In 1987, the acceleration of marine coastal erosion caused a breach on the sand spit causing large ecological upheavals.

This project is therefore developed to address the threats posed by the above described dual effects of climate change and marine coastal erosion on the village of Dionewar. More specifically, this project seeks to answer:

- What are the economic and ecological consequences on the mangrove due to these climatic variations? This has had considerable effects on the productivity of the estuary's ecosystem on which the populations depend for their livelihood

- What are the risks related to coastal erosion (focusing on the breach opening of Sangomar) that threatens human settlements and the estuary ecosystems?;

- What has been the effect of recurrent flooding, resulting from extreme events such as storm surges and heavy rains? What affect has this had on loss of livelihoods and safety issues?;

- How can this project help fill the gaps where there is a deficit on climatic data, which are necessary to set good policies and strategies for local development? There is a rather weak legal and regulatory framework, characterized by low integration of climate change issues to local development strategies.

This is an adaptation project based on both ecosystem and community. Proposed activities focus on strengthening the resilience of the mangrove ecosystem, protecting infrastructures against flooding, and developing local regulatory conventions for protecting the ecosystems of the estuary in general and the mangrove in particular.

I.1.2. Background information

The municipality of Dionewar is located in the country's western coastal zone. It is part of the district of Niodior, the department of Foundiougne and the region of Fatick. It further includes the villages of Dionewar, Falia and Niodior. Based on the projections (2008-2025) of the National Agency of Demography and Statistics (ANDS), the population of the Municipality of Dionewar was 12,988 inhabitants in 2011 and 14,525 four years later, in 2015.

Dionewar is part of the archipelago of the Saloum Islands, a geographical area bounded by the sea inlets (called *bolong*) of Diombos and Saloum. This Niominka Island is historically called Gandoul. The archipelago consists of nineteen (19) inhabited villages and many other uninhabited ones (some of them are used for rice growing). They are mainly located in an environment characterized by a large mangrove ecosystem presence and surrounded by tidal reservoirs and bolongs.

The Saloum estuary (figure 1) is of particular interest due to its large rate of biodiversity. It is a big estuarine complex with a drainage basin of 29,720 km² (4,309 km² for the estuarine part), opening into the Atlantic Ocean by three main distributaries with an estuarine functioning: the Saloum to the north, the Bandiala to the south and the Diomboss in between[2]. The Saloum is relatively wide (1-2 km) and deep (13 to 25 m) between its mouth and the city of Foundiougne, but after this point and up until the city of Kaolack, it is narrow (<500m) with depths less than 8 m. The Diomboss has a main width of 4 km with depths running between 10 and 25 m.

This estuary isolates two large groups of islands: the Gandoul islands in the north, Betanti and Fathala in the south formed from beach ridges. The Saloum River is bordered by the Sangomar Arrow, a 15-18 km-long sand spit between Palmarin and its distal end.

One hundred and fourteen (114) species from fifty-two (52) families were identified in this estuary. The presence of manatee *(Trichechus senegalensis)* and dolphin *(Sousa teuszii)* in the Saloum and its “bolongs” shows the richness of the specific aquatic fauna of the river watershed[2].

[2] DIOP, I and al., 2002. Senegal national report. Phase 1: integrated problem analysis. GEF MSP Sub-Saharan Africa Project (GF/6010-0016): "Development and Protection of the Coastal and Marine Environment in Sub-Saharan Africa"

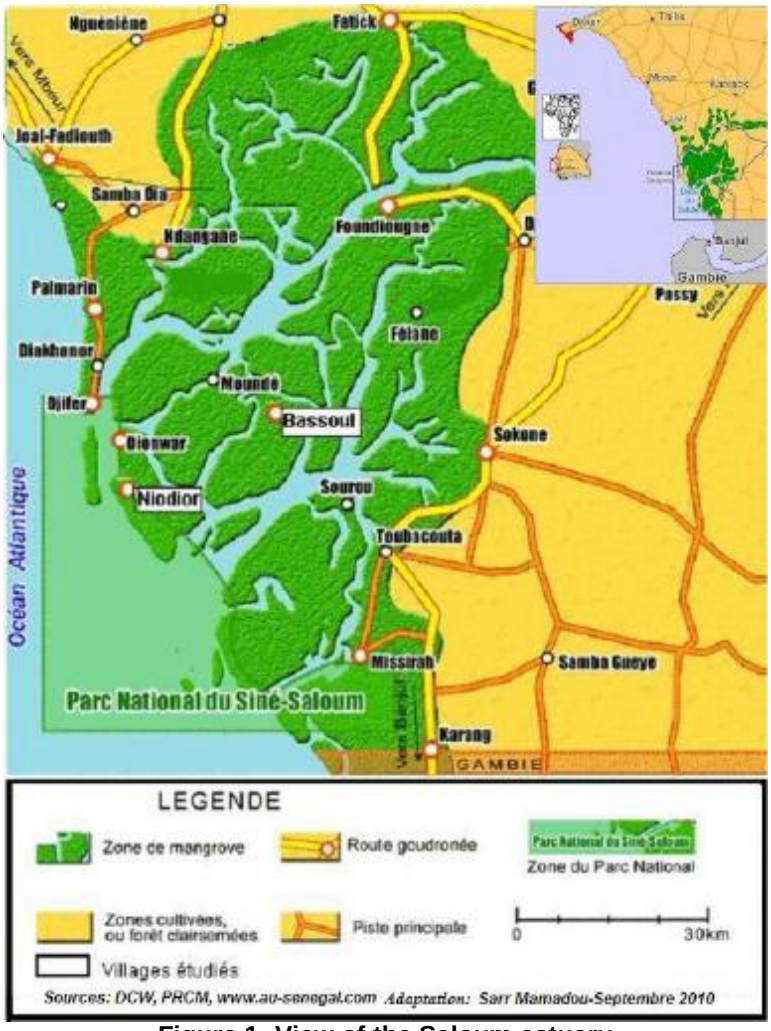


Figure 1: View of the Saloum estuary

I.1.2.1. The Senegalese coastal area: a key area for socioeconomic development

Senegal has 700 km of coastline which concentrate 60% of the population (estimated at 12.5 million inhabitants in 2010) and hold most of the country's urban sites and economic activities. This part of Senegal also has a high population growth rate. Prospective components from the Master Plan for the West African Coastline (SDLAO[3] in French) show a sharp increase in the coastal population, mainly in urban areas, and indeed 85% of industries and services are located here. This concentration is increasing and the coastal area will continue to play a key role in the national development process over the next decades.

The coastal zone is home to fishing, a major and strategic economic sector for Senegal, contributing 2% to the national GDP and generating 600,000 jobs, both directly and indirectly. On average, fishing comprises nearly 32% of the country's total exports.

[3] Conducted in 2011 in collaboration between IUCN and the WAEMU

Hence, coastal areas are host to important fishery related installations, such as fishing docks.

Fishing is also the major activity for the Saloum Estuary inhabitants. The annual fish production is estimated at 10,000 tons (on average). In 2003, landings reached a record of 29,290 tons. However, a depletion of fish stocks compared to the performance recorded in the 1960s and 1970s has been noted, which is largely due to climate change and over-exploitation.

The location of the Dionewar Island in the Delta area offers huge potential for fishing, which is the population's primary activity. This is why the Serer ethnic group (who live on the island) are by tradition mainly fishermen and are commonly known as "Serer Niominka" or "*Serer with feet in the water*". Fishing is considered the main income-generating activity, unlike other parts of the country where agriculture leads the way.

Women are very active in the processing (drying, smoking, salting and fermentation) of fish products. On Dionewar Island, they are grouped into more than 18 groups with around 270 members. Indeed, the collection of *Arca sinelis (*a bivalve shellfish locally known as ''*pâgne*'') and its processing and marketing are exclusively carried out by women. There is a fish processing factory at Dionewar, but there is limited access to markets. The amounts collected continue to decline, as do the number of individuals involved in this work. This is on top of the annual July to September break when all work ceases. It is also worth noting that in 1996 and 2003, the Federation of GIE (Economic Interest Groupings) "FELOGIE" Dionewar received the Presidential Award for women's empowerment. Fish products from the island (both fresh and processed) are marketed in nearby urban centres or in Dakar (PNDL, 2011, in Communauté Rurale de Dionewar, 2011[4]).

In the past, populations in Dionewar used to grow several hectares of rice on the island and uninhabited islands. But in the 1970s, drought cycles, seawater intrusion and a lack of varieties fit for the new rainfall context, meant rice cultivation was abandoned. Nevertheless, with the return of rainy periods over the last years, and thanks to support from various initiatives, some producers have slowly resumed rice cultivation.

Exploitation of non-timber forest products is of great importance for the local economy and for food security. However, the plant cover has gone through significant damages due to the combined effects of overexploitation and climate change. Vegetation on the island mainly comprises of mangroves along the submersible areas and their surroundings, while on the island one may find a Sudanian-type vegetation with mainly: *Detarium senegalense*, *Parinari macrophylla*, *Tamarindus indica*, *Ceiba pentandra*, *Elaeis guineensis* and *Cocos nucifera*. The mangrove has suffered the silting impact from the breaking of the land strip and its disappearance has accelerated coastal erosion on this island and neighbouring ones. Indeed, mangrove roots play a physical role in stabilizing soils and serve as a transition zone (or surge swell) to protect the coast from waves, storms and typhoons. The mangroves' depletion further impacts on

[4] Communauté Rurale de Dionewar, 2011. Plan Local de Développement 2011-2016

the wildlife that refuge here. Fish and crabs reproduce, mollusks grow, birds nest and predators come to hunt. Mangroves help fertilize the estuary, fostering the development of the phytoplankton — the first element in the food chain. They also provide the populations with seafood *(Murex sp, Anadara senilis, Crassostrea gasar, Thympanothonus sp, Cymbium sp,* etc.).

I.1.2.2. Environmental context

The environmental context in Dionewar is characterized by natural resource degradation under the combined effects of climatic variations, coastal erosion and anthropic activities. This context will be analyzed by means of the Pressure-State-Response (PSR) model by presenting the state of natural resources, the pressures they undergo (both natural and anthropic) and the developed responses to help reduce or end these pressures.

a) State of natural resources

Vegetal resources: the spaces covered with vegetation represent 45% of its total surface. The vegetation consists essentially of three strata:

- Tree stratum composed of two (02) types of forest areas: one on the littoral, constituted by the mangrove; and one on dry-land made up of Soudano-Guinean essences.

The dry-land forest is located in the continental zone, after the mangrove curtain. Approximately 8.7% of this area is dedicated to agriculture and breeding. It consists of Soudano-Guinean essences, such as *Neocarya macrophylla*, *Detarium senegalensis*, *Borassus aethiopium*, *Elaeis guineensis*, *Adansonia digitata*, *Cocos nucifera*, etc.

The shrubby stratum is essentially made up of *Daniella oliveri*, *Raffia sudanica, Dialium guineensis*.

The herbaceous stratum is seasonal and depends on the rainfall which normally falls between June and October. During this rainy period, the grass cover is well supplied and highly varied. This stratum is important for the municipality, because it constitutes key source of fodder for the cattle.

The mangrove is made of *Rhizophora racemosa*, *Rhizophora mangle*, and *Avicenia africana* species. This crucial ecosystem covers 17% of the municipality's area. It also serves as breeding and growing areas for certain species of both flora and fauna, which explain the population's awareness of its needed protection.

The diachronic analysis[5] of Landsat and SPOT satellite images (1972-1986, 1986-2001 and 2001-2010) shows that rainfall is the major driver of the mangrove dynamics in the

5 EL Hadji Balla Dieye, Amadou Tahirou Diaw, Tidiane Sané et Ngor Ndour, « Dynamique de la mangrove de l'estuaire du Saloum (Sénégal) entre 1972 et 2010 », Cybergeo : European Journal of Geography [on line], Environnement, Nature, Paysage, document 629, mis en ligne le 09 janvier 2013, consulté le 12 janvier 2016. URL : http://cybergeo.revues.org/25671 ; DOI : 10.4000/cybergeo.25671

Saloum estuary. It indicates that during the decade from 2001-2010, while the mangrove evolution remained weak (18.96%), there was nevertheless a decrease in its disappearance (4.36%) and an increase in its regeneration (23.31%). This general trend in the Saloum estuary however contrasts with observations made in the municipality of Dionewar, which is located directly in front of the Sangomar Arrow breach, which opened in 1987. Indeed, the salinity increase, resulting from this break, caused a progressive disappearance of the mangrove swamp to the right of the breach which is in direct contact with the sea. The breaking of this strip of land has led to deep changes in both hydrodynamics and sedimentology of the Saloum estuary and has resulted in high tides leading to a strong salinity gradient from downstream to upstream. Hence, the islands located in the Saloum Delta are facing seawater intrusion which, coupled with the decline of rainfalls, has led to land salinization. The mangrove tree may be a halophyte that thrives in salty conditions, but it has an ongoing need of freshwater to buffer the seawater (which has a salinity level of around 33,3g/l). In Dionewar, the increasing salinity gradient has resulted in significant losses of mangrove swamp, and in particular the *Rhizophora* species (*Rhizophora mangle, Rhizophora racemose*) which is known for its fragility and sensitivity to salinity variation. In the Saloum estuary's northern area, Faye and al. (2007) showed that the bushy (degraded state) indicated a low rate of stand regeneration due to a very high salinity level of the substrate (more than 50‰). This confirms Blasco's 1982 work, which said that the size of *Rhizophora* decreases with the increase of the salinity level. These losses are closely linked to the decline of fishery resources, because the mangrove ecosystem provides many diverse species of birds, mammals, Crustacea and fish. The tree is the foundation in a complex marine food chain and detrital food cycle. As mangrove leaves drop into tidal waters they are colonized within a few hours by marine bacteria that convert difficult to digest carbon compounds into nitrogen rich detritus material. The resulting pieces covered with microorganisms become food for the smallest animals, such as worms, shrimp, mollusks, mussels and oysters, among others. These detritus eaters are food for carnivores, including crabs and fish[6].

Land resources: With only a small surface area (297 km²)[7] the municipality of Dionewar does not have enough land suited for agriculture. The majority of arable land is hardly affected by saltwater intrusions and by degradation due to an intensive monoculture and absence of fallow.

In terms of soil resources, there are several types of soils in the area, including: "dior" soils (tropical ferruginous washed soils) which are favourable to agriculture and located in the centre and the north; "deck-dior" soils (ferruginous tropical few washed) located mainly in the eastern and northern parts of the island and which are highly adapted to market gardening, arboriculture and rain-fed agriculture; and halomorphe soils which are found next to bolongs, behind the tidal reservoir, but which are constantly washed away by the tidal flows. Halomorphe soils are not generally covered by vegetation

[6] Mangrove.org: Ecological importance of mangrove

[7] Direction de la Prévision et de la Statistiques / Division des Enquêtes Démographiques et Sociales. Direction de L'Aménagement du Territoire (D.A.T.)

because of their clay-like texture, their salinity and acidity, and their continuous expansion is a source of concern when it comes to agriculture.

Water resources: the hydrographical network consists mainly of the Atlantic Ocean, bordering the entire western part of the municipality and the Saloum River, feeding several bolongs and puddles. The main bolongs are the sea inlet (called bolong of Falia) which originates from the Saloum river before splitting into two (02) streams between the villages of Dionewar and Falia; and the sea inlet (called bolong of Diagne) which runs through the eastern part of the village of Niodior after originating from the mouth of the Saloum river.

There are eighteen (18) temporary pools, which allow for market gardening and livestock watering.

Hydrology aspects relate to the harnessing of subterranean waters stemming from the groundwater. The freshwater used by the municipality comes from the Continental Terminal Aquifer caught by the numerous wells of three (03) villages. The depth of the aquifer varies from 4 to 7 m. This water is used for multiple purposes.

Aside from wells, there is no drinkable water network for Dionewar and Niodior. Only the village of Falia has a water conveyance, resulting from the Mounde (Municipality of Djirnda) drilling.

There are numerous drinking water supply constraints, which can be briefly summarized as follows: brackish water; absence of functionally-equipped drillings; non-utilization of the maestrichtian water table; rapid drying up of wells; bad quality water; absence of rainwater collection system.

b) Pressures on natural resources
The pressures on natural resources have natural and anthropic origins.

The pressures of natural origins: relate to the effects of climatic variations and marine coastal erosion further to the natural opening of the breach on the Sangomar Arrow.

- Effects of climatic variations:

The global surface temperature has increased significantly, around 0.8°C, since the beginning of the 20th century[8]. The last decades have had an even more pronounced warming, as shown by observation analysis affecting development sectors such as agriculture.

Recent analysis on the African continent and in particular in the West African Sahel region has shown a significant upward trend in temperatures, particularly since the 2000s. Global warming, which has been observed since the middle of the century, is

[8] Kevin E. Trenberth, John T. Fasullo, 2007, IPCC, 2013. An apparent hiatus in global warming? Earth's future journal. December 2013

characterized by climatic extremes manifested by an increase of the number of hot nights and heat waves across the sub-region[9].

The climate change projections based on 29 global models[10] indicate a significant increase, particularly from 1981 to 2010, of the surface temperatures across the sub-region. In the Sahelian regions, this surface temperature increase will exceed 2°C during the rainy season (June-September) over the mid-term (2040-2069) and weaken along the coastal regions (Figure 2). The projections on the precipitation (Figure 3) are translated by an increase estimated at around 30% along the eastern parts of the Sahelian region, from Mali, Niger and towards Chad. Whereas in the western regions the situation seems to be producing a deficit of around 20% in regards to the seasonal climatological average of 1981-2010 in Senegal, Mauritania, Guinea and the western part of Mali.

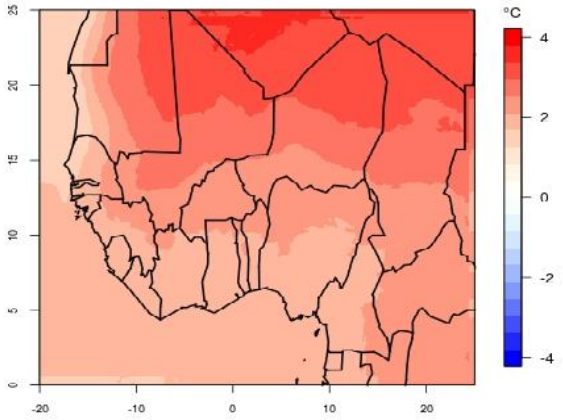


Figure 2: Median of the difference of temperature °(C) of the air on the surface of the Earth on the season JJAS between reference period 1981-2010 and the future period 2040-2069, simulated by 29 global models by considering the extreme scenario RCP8.5 for the evolution of the radiative forcing on the mid-term (2040-2069). (Source: AGRHYMET)

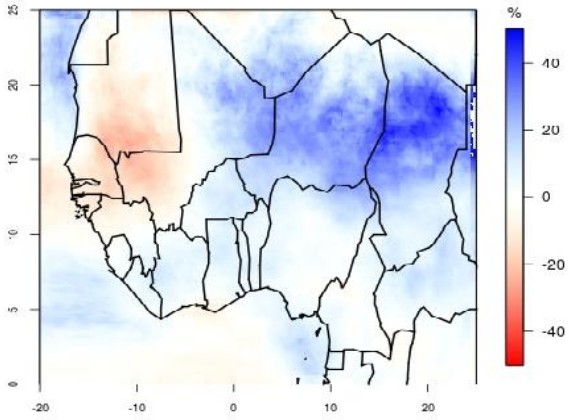


Figure 3: Median of the rate of precipitation (%) on the season JJAS between reference period 1981-2010 and the future period 2040-2069, simulated by 29 global models by considering the extreme scenario RCP8.5 for the evolution of the radiative forcing on the mid-term (2040-2069). (Source: AGRHYMET)

According to a World Bank-funded study in 2013, observations suggest climate change has had profound effects over the last 50 years, including a protracted dry period from 1968 to 1969. This climate deterioration manifested through erratic inter-annual rainfalls, but also decreases in rainfall volumes resulting in a significant shift of isohyets towards the south (Figure 4).

[9] Agali and al, 2013. Évolution des risques agroclimatiques associés aux tendances récentes du régime pluviométrique en Afrique de l'Ouest soudano-sahélienne. Science et changements planétaires / Sécheresse. 2013;24(4):282-293. doi:10.1684/sec.2013.0400

[10] Experience CMIP5 for the horizon 2041-2069 with regard to the most pessimistic scenario or RCP8.5

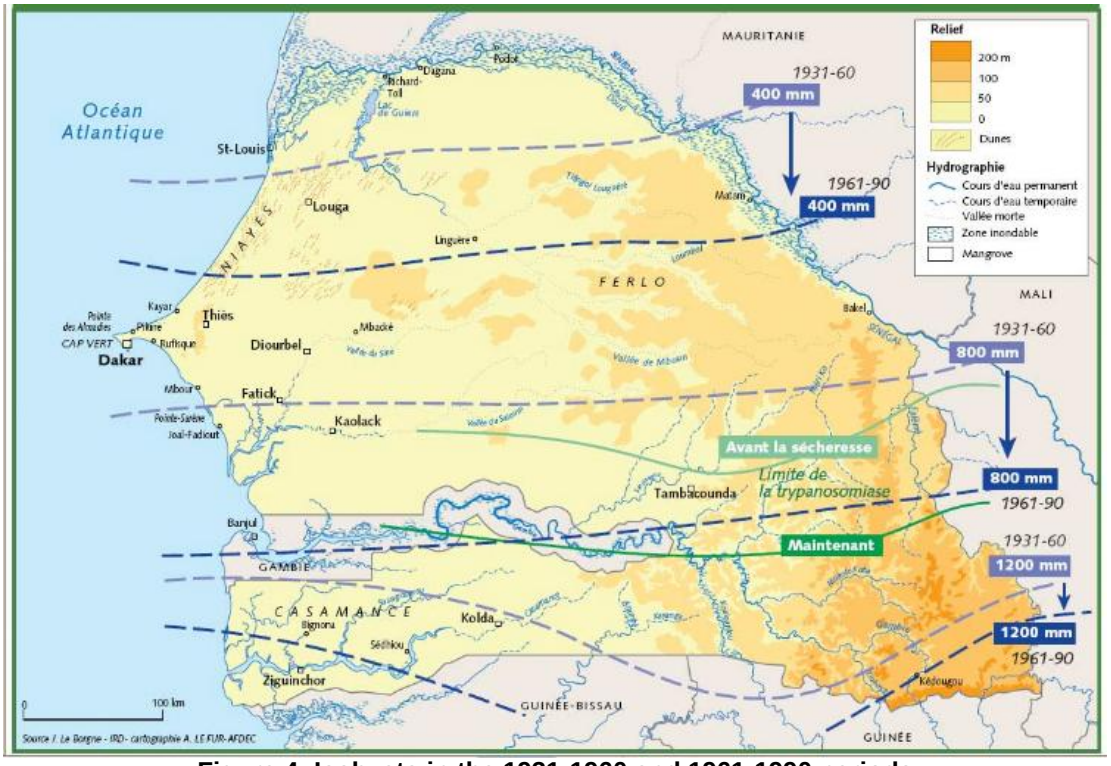


Figure 4: Isohyets in the 1931-1960 and 1961-1990 periods
Source : Institut de Recherche et Développement
(http://www.cartographie.ird.fr/SenegalFIG/secheresse.html)

With the reduction in the pluviometry observed since the 1970s, the Sahelian countries entered a period of drought resulting in considerable consequences for the vegetation in general and the mangrove in particular[11]. The supply of fresh water strongly decreased, drastically reducing the flow of rivers throwing into the Saloum estuary. The flow of the Nema Bah River, the tributary of Bandiala in the southeast of the estuary, decreased from 0.29 $m^3.s^{-1}$ in 1976 to 0.03 $m^3.s^{-1}$ or less in 1981[12]. This reduction in fresh water supply, combined with a strong evaporation and penetration of marine water, caused an increase in salinity.

As a result, this rainfall variability has led to increased salinity with rates above 50‰ during the rainy season. This phenomenon persisted in the 1990s with surface water becoming hypersaline, especially in rivers upstream where the salinity levels exceed 150‰. This salinization influences the size of the fish at maturity[13], their growth and movements[14]. Moreover, various studies[15] have associated mangrove degradation with

[11] Marius C., 1995, « Effet de la sécheresse sur l'évolution des mangroves du Sénégal et de Gambie », *Revue Sécheresse,* No.1, vol. 6, 123-125.
[12] Diop E.S., 1986, « *Estuaires holocènes tropicaux. Etude de géographie physique comparée des 'Rivières du Sud' du Saloum à la Méllacorée* », Doctorat d'Etat, Strasbourg, Université Louis Pasteur, 498 p.
[13] Panfili and al. 2004a, 2004
[14] Diouf & Goudiaby 2006

the dynamics in rainfall variability, while this ecosystem plays a key role in the development of fishery resources.

In Senegal, the climate is Sahelian in the north and Sub-Guinean in the south, and is characterized by an alternating dry season, from November to May, and rainy season, from June to October. The average annual rainfall ranges from 300 mm in the semi-desert north to 1,200 mm in the south with inter-annual variations. The country suffers the adverse effects of climate change, which is felt more on its 700 Km long coastline and from the impact of the rising sea level with, as corollary, costal erosion, seawater intrusion in farmlands, salinization of water resources and destruction of infrastructures.

The main characteristic of the rainfall in the Saloum estuary remains its strong inter-annual variability with large deficits during the1970s and 80s (Figure 5).

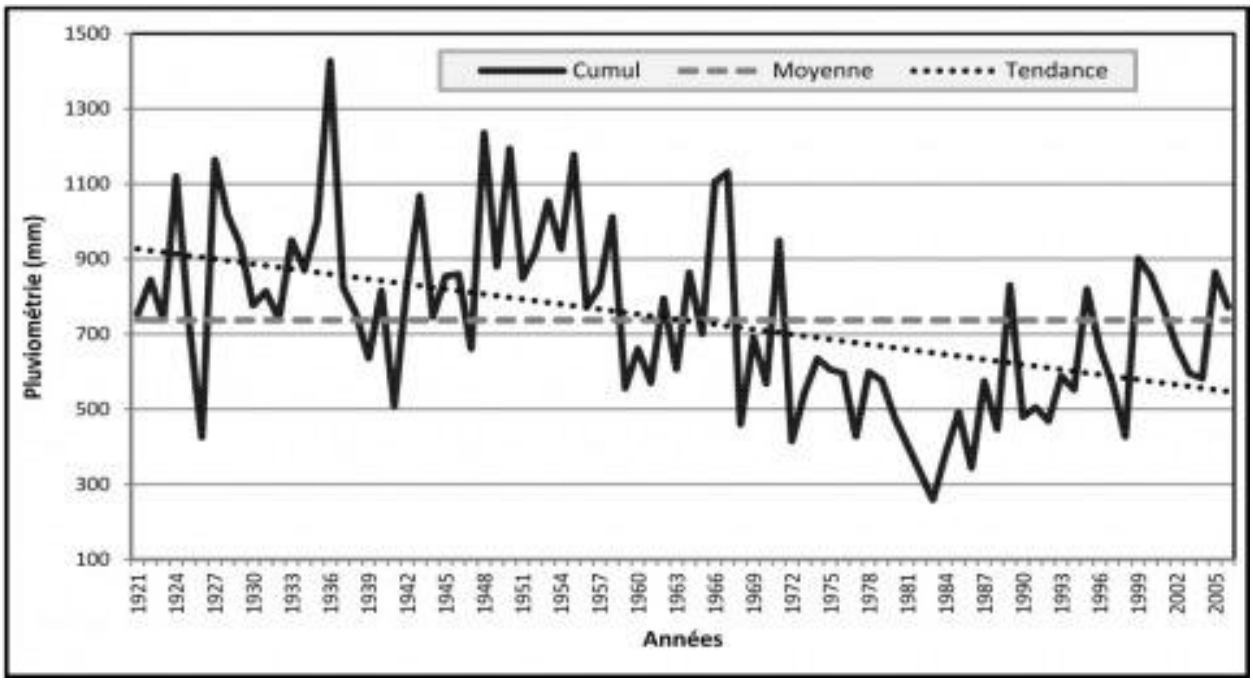


Figure 5: Annual rainfall deviation from the mean value at Foundiougne (1950-2003)

Future projections for around 2030 (2010-2039) and 2080 (2070-2099) (IPCC Data Center) forecast an increase in average annual temperature on the Senegalese coasts from 1.12 to 1.23°C. This will further increase by 2080 from 2.65 to 4°C in coastal areas.

As for rainfall, predicted variations in the northwest quarter of Senegal range from -4.5 to -19% by 2030 to -18% to - 55% by 2080. For the same period, and from a more pessimistic climate scenario, rainfall on the Senegalese coastlines could drop almost two-fold.

[15] Diaw, 1990, 1999, 2000; Soumare 1992; IUCN 1998; Diop and al 2000; Moreau 2005; Dièye and al 2008; Andrieu and al 2008; Niang 2009

Therefore, considering the country as a whole, there is reason for deep concern. It is expected many more years of severe drought are to come and a global sea level may rise to 20 cm by 2030 and 80 cm by 2080.

According to Senegal's second National Communication to the UNFCCC, although changes in precipitations suggest a general downward trend in most of the country, there are few indications on their variations, particularly in terms of extreme events. On the one hand, global warming could reduce rainfall levels, leading to increased droughts. And yet on the other hand, increasing the holding capacity of moisture in the atmosphere due to rising temperatures could result in rainfall events of much larger intensity than expected, which would make the region even more vulnerable to flooding.

At the Foundiougne station (studied here as the closest station to Dionewar), the rainiest years were during the 1950-1970 period; and the least rainy were in 1971, with a few years with normal to surplus pluviometry in 1989, 1995, 1999, 2000, 2001 and 2004.

In the Saloum estuary, salinity increases from downstream to upstream (120 per thousand salinity, measured upstream Saloum), which comes with certain peculiarities about the tide's penetration into the river. Indeed, there is a time and flow speed higher than those of the ebb[16], and the amount of water flowing into the estuary is much larger than that coming out. This is partly due to the inertia caused by the adjacent areas of mangroves, salt flats and "bolongs". This very special hydrological functioning is essentially attributed to a low slope, particularly in the downstream part of the river, and the rainfall deficit recorded since the late 1960's leading to a virtual absence of freshwater flows during rainy season[17] and a concentration of salts by evaporation[18].

Fish catches in the Saloum Delta shrank from 30,000 to 10,000 tons between 1970 and 1990, along with declining populations' livelihoods[19].

Predicted temperature increases, ranging from 1.4°C to 5.8°C by 2100 (IPCC, 2007) will have significant effects on fishing stocks in terms of distribution, composition and abundance. By 2030, there will likely be a major decrease in captures and the estimated market value of fishery products. As a result, accumulated losses could amount to as much as USD 136 million between 2020 and 2050, which represents 3.23% of the country's average GDP from 1981-2005.

This situation has created great distress among the population and especially the youth, among which many have sought desperate measures — turning to clandestine emigration in poor security conditions — often resulting in death. And finally, from a purely nutritional standpoint, the drop of fish and seafood consumption will automatically impact the amount of animal protein intake in people's diets.

[16] Barusseau and al., 1985, 1986
[17] Dacosta, 1993
[18] MEPN, 2005
[19] Diouf, 1996, in Ndour and al., 2011

- Coastal erosion:

Under the combined effect of all these changes, the Senegalese coastline shows widespread erosion (Figure 6). Parts most sensitive to this occurrence are the deltas and estuaries of the three major rivers, as the sediment supplies can barely compensate losses to erosion in these low zones. Since these areas are of great ecological importance, erosion can cause significant losses of biodiversity. Erosion rates generally do not exceed 2 m/year, but the beaches may recede by more than 10 m/year locally.

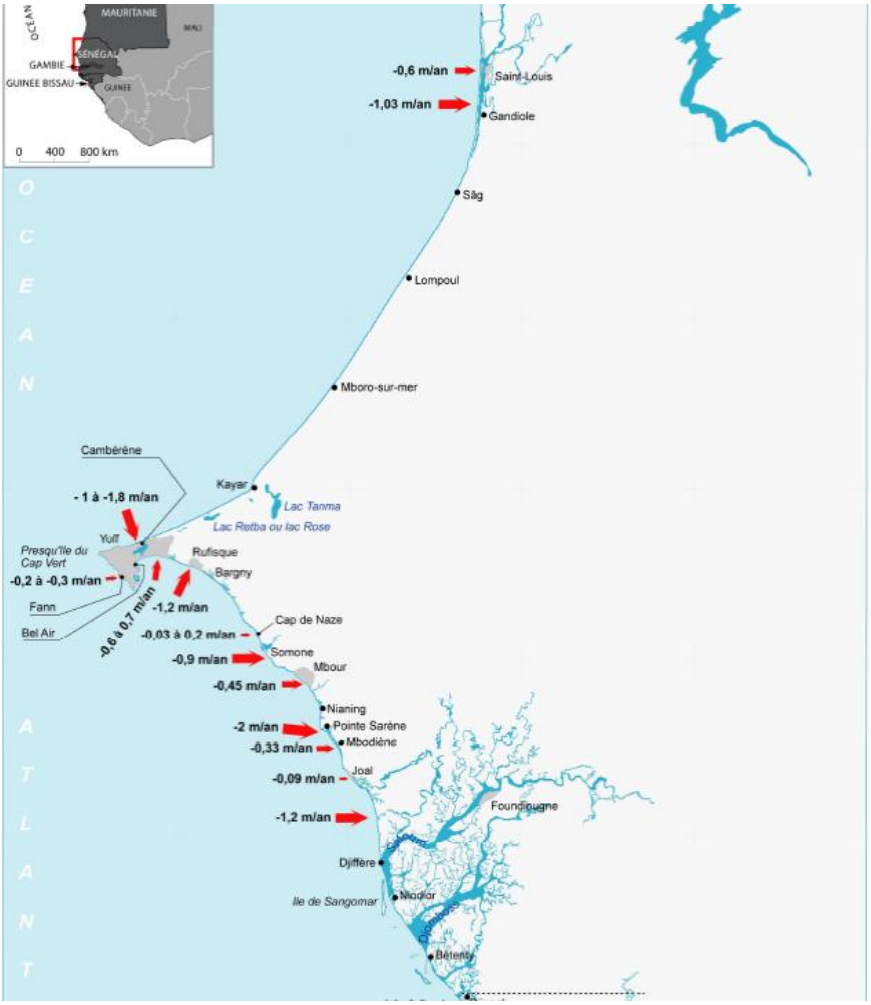


Figure 6: Erosion of sandy coasts from the 1950s according to bibliographic data (source: I. FAYE)

One of the most severe signs of these effects is the breaking of the Sangomar Arrow on 27 February 1987 in the wake of an extraordinary swell. This event occurred towards Lagoba (or Diohane), which is the most fragile part (80 to 110 m wide).

The natural functioning of this arrow is an extension to the south in favour of littoral drifts that dump part of its sediments there, appearing as successive hooks partly from shoals bordering the tip of the arrow. From1927 to 1987, it was reported to have increased by 4 km. Hooks identify small lagoons, which are filled gradually and inhabited by mangrove or marsh vegetation. Based on bathymetric, photographic and satellite topographic substrates, the evolution of the Sangomar Arrow distal end was restored between 1907 and 1987[20]. It is primarily characterized by a period of decline northward between 1907 and 1927, with 88 m annually, and by a nearly continuous southward extension from 1927, with 31 m annually and values higher than 100 m annually (between 1946 and 1969). Meanwhile, the end experienced strong thickening between 1954 and 1969.

There is also a sharp slowdown in the expansion rates to the south, which varied from 22 to 35 m annually between 1969 and 1981. The 1981-1984 period was characterized by stability of the Arrow. Then from 1984 until 1987, extension resumed southward at a rate of 175 m annually. It should also be noted that the hooks seemed to appear only from 1958 onward. Between 1986 and 1987, two small hooks, surrounding a lagoon, formed successively at the Arrow's tip.

According to Diaw (1997, 2003) and Thomas and Diaw (1997) the breakdown of this Arrow could be explained by a range of sedimentological, geomorphological and hydro-climatological factors each one non-exclusive to the other: temporary absence of "upstream" sedimentary power by reduction of products from northern areas of the Petite Côte; strong tightening and fragility of the Arrow at a place called Lagoba; improvement of the rainfall situation contributing to the ebb flushing effect and slowing fattening changes; preferential erosion of the inside of the Arrow against the configuration of the river bed and the existence of inter-hooks corridors; modifying pre-littoral shoals at Lagoba which can be seen on the SPOT *ante* and *post breakdown* satellite images, waves of high amplitude (2.5 to 3.5 m) combined with high water tides (levels of 1.71 m in Dakar and 1.95 m in Banjul).

With the Arrow breakdown in 1987, a new evolution was marked by erosion of the northern edge of the breach and the external shore, while the end of the new Sangomar Island continues to advance southward at average annual rate of 229 m (Figure 7) with the development of two hooks[21]. Based on these observations, several authors believe that sedimentary transits by longshore drift are thought to be estimated between 160,000 and 180,000 cubic meters annually[12].

[20] Diaw and al, 1991 and Diaw, 1997

[21] Diaw, 1997

Figure 7: Dynamic of the Sangomar Arrow between 1972 and 2010 (Thomas and Diaw, 1997)

This event feeds into the formation and evolution process of the Saloum Delta and comes with (Diaw, 1997):

- an intense erosion of the northern edge of the Arrow with rates up to 128 m annually (down to 640 m between 1987 and 1992);

- a continuity and even acceleration of the southward extension of the distal end of the new Sangomar Island at an annual rate of 198 to 264 m between 1987 and 1991. One year after the breakdown, the gap measured 1 km wide, 10 years later, it reached 4 km.

This breaking occurred just opposite Dionewar Island, leading to profound changes in the estuary hydrodynamics and sedimentation. With this breach, the Atlantic Ocean runs into the Saloum River at the island bringing about deep changes in both the estuary's hydrodynamics and sedimentology.

These phenomena compound the depletion of fish stocks, coastal erosion and degradation of the vegetation on the island due to human pressure and drought cycles that prevailed from the early 70s into the mid-2000s. In Dionewar, the impacts are felt particularly in the mangrove which, since the breach was opened, has been hit by silting, fostering its depletion, thus compounding erosion and flooding. Mangrove ecosystems provide refuge and are reproduction zone (spawning areas) for fish and seafood.

Figure 8: Overview of coastal erosion in Dionewar (CSE, January 2015)

All these changes have heavily affected the island's socioeconomic situation, because most economic activities are driven towards the use of resources from the sea (fish, shrimps, shellfish, etc.).

Flooding associated with storm surges is another impact of climate change, which, in conjunction with sea-level rise, places more people and socioeconomic infrastructures (mainly fishing docks and hotels) at risk in the coastal zones.

The pressures of anthropogenic origins are linked to the overexploitation of natural resources, the demographic pressure and the pollution by household waste.

The numerous services of the mangrove ecosystems allow a multitude of economic and social activities, related to the vital needs of the populations. Among those, are fishing, harvesting of oysters and using mangrove wood for the processing of halieutic products and for manufacturing work or house-building.

This pressure on the mangrove ecosystem is all the more disturbing as it is happening in conjunction with a growing population. In 1988, the general population and housing census estimated the population of the Municipality of Dionewar was 8,437 inhabitants, while the 2011 and 2015 projections of the population (2008-2015), given by the Statistics and Demography National Agency (ANDS), are 12,988 inhabitants and 14,525

inhabitants respectfully — a doubling over 25 years.

The growing needs in resources therefore also threaten the ecological balance of these zones and the well-being of the populations. This situation further contributes to a worsening degradation process in the littoral (Ndour, 2005).

Illegal logging of the green mangrove wood also remains an important issue in some villages, particularly in Dionewar and Niodior. This phenomenon, which feeds and maintains sales network of mangrove wood, is the main anthropogenic aggression of the mangrove today.

c) Responses

In order to stop and reverse the degradation trend of natural resources, several strategies are developed and implemented by the communities, which act either on their own, or supported by the government or development partners. Among these strategies, the most remarkable are the following:

Fighting erosion: the marine erosion causes the destruction of the vegetation cover and the mangrove ecosystem's loss of biodiversity. It also results in the reduction of the cultivable land area and the destruction of the physical resources (wells, houses). The silting phenomenon slows down the mobility of dugouts and stresses the navigation risks.

In face of these threats, the populations have developed several strategies. Some are effective and long-lasting, such as the reforestation of filaos (*Casuarina sp.*) intended for the fixation of the beaches or the fish farming which assures the availability of quality products. It is also the case for the relocation of infrastructures destroyed by the erosion and bypassing of the bar - the only solution to avoid sandbanks in the sea.

If the occupation of new lands allows these populations to continue the agricultural activity, it will nevertheless need large financial investment because most of the individuals have themselves low incomes. However, as land reserves are available on the uninhabited islands, the envisaged alternative solution is to set up a collective field to share investments (water, transport, food, etc.). The conditions favourable to this project are the existence of an associative dynamics, including a women's group (GPF) who had the initial idea. This will bridge the insufficiency of the farm inputs, and assure an efficient implementation of that initiative.

To avoid navigation risks, the practice of de-silting the channels with shovels has proven neither effective nor long-lasting. The viable strategy would be the dredging of the channels which asks for hefty means, and thus government intervention. However, it is also delayed in becoming a reality, because of insufficient lobbying on behalf of local authorities.

Strategies to combat flooding:

The flooding hazard can be seen in two different forms: river flooding and flood run-off. These floods are caused by weather, although of different nature: river flooding caused by cumulative rainfall during the rainy season and urban flooding caused by short heavy rains. In coastal areas, the sea level can be an aggravating factor.

Figure 9: Dike protecting against rising sea water built by populations in Colbasssy (CSE, January 2015)

Damaged houses are rehabilitated through social mobilization, and waterborne diseases (malaria and the diarrhea) are addressed by means of vector-control actions. However, local populations are struggling to find an appropriate solution to the disruptions to the school year due to the use of premises as shelter for affected populations. Floods hinder economic activities and entail loss of incomes. Seasonal exodus for the youth and money transfer from expatriated natives often constitute the only recourses.

In case of extreme weather events, the dikes built to prevent flooding are destroyed or damaged, often requiring restoration actions. The best solution would be to raise the height of these dikes, which are mainly built by local populations. The workforce and the required material (sand and shells) are locally available. However, the lack of logistic means (trucks and tractors) and financial resources make it difficult to carry out an appropriate rehabilitation.

Strategies to deal with pluviometric deficit:

The pluviometric deficit entails loss of productions and causes the lowering of the water table. To stock up with water, communities are obliged to dig deeper existing wells or to open new ones altogether. These strategies are effective, but not long lasting. The problem could be settled by the water conveyance, but this strategy also requires heavy investments.

The pluviometric deficit further results in land salinization, forcing communities to abandon their fields and move to new cultivable lands. This is effective, but not sustainable, especially in a context of limited land availability. Salinization due to the pluviometric deficit also causes a loss of biodiversity. The strategy developed by communities consists in mangrove and rangelands reforestation, which is an effective and sustainable solution. The building of an anti-salt dike is a priority to properly address the salinization issue. The material (sand, shell, wood), the workforce and the know-how are all locally available, but the heavy equipment and the financing are not.

To address the issue of quality drinking water (salinisation), the populations also dig shallow wells (4m) to access the fresh water lens. This may be effective over the short term, but it is not long-lasting.

Strategies to address poor natural resource management: the most remarkable initiative in this regard is the establishment of a biological rest period, which is strictly observed. Every year, for three months, the community suspends all fishing and shell extraction activities. This allows the species to reproduce and grow. These joint local initiatives have proven fruitful, because according to the population they note a considerable increase and diversity of halieutic resources as a result. In addition, over the last ten (10) years, the populations undertook a vast mangrove reforestation campaign, leading to the reforestation of five (05) hectares. Management committees of the Natural Resources (COGER) have also been established in every village to follow these experiences and replicate them.

The municipality of Dionewar has developed a Local Development Plan (PLD), as well as a Local Action Plan for the Environment and Natural Resources (PLAE), which is a sectorial plan. The latter is an instrument of strategic orientation and planning that comes to improve the visibility of a sector that matters. Natural resources in the region are rather seriously threatened today on this island.

I.1.3. Issues identified

The Senegalese coastline is morphologically fragile and suffers from the effects of an almost anarchic occupation, combined with coastal erosion. This situation entails a degradation process and the destruction of hotels and housing, loss of productions (agriculture and fishing), reduction or loss of beaches, as well as disturbances to mangrove ecosystems and natural habitats.

More specifically, the vulnerability assessment has highlighted the following three (03) major issues:

Issue 1: Reduction of the ecosystems' ecological functions and socioeconomic services

Due to the combined effects of climatic variations, coastal erosion and anthropic pressures, the ecosystems of the estuary (including the mangrove) are losing their ecological functions (natural habitat of birds and fishes, protection against the floods, etc.) and show a reduction in their productivity.

To address this problem, a number of activities were proposed under the ***component 1*** of the project "***Enhancing resilience for productive ecosystems in Dionewar Island***"

Issue 2: Human settlements and infrastructures threatened by coastal erosion.

Many houses and numerous community infrastructures (schools, fish processing areas, dikes, etc.) are exposed to recurring floods, which cause enormous material damages to the populations and seriously affect the local economy.

To address this problem, a number of activities were proposed under the ***component 2*** of the project "***Protection against flooding, coastal erosion and salinization in Dionewar***"

Issue 3: Poor knowledge of adaptation strategies for an island environment

Although Senegal has a long coast, experiences of adaptation in coastal and island zones are still not yet well documented.

There is also a low availability of data and specific climatic knowledge in the area for the promotion of a legal and regulatory environment that supports the resilience of the estuary's productive ecosystems.

The deficit of climatic data specific to Dionewar is striking. There is no meteorological station in the locality and the climatic events are neither well documented nor disseminated. In addition, this climatic data deficit reduces the reach and relevance of the diagnoses that underpin all the strategies of local development.

To address this problem, some activities are proposed under the ***component 3*** of the project "***Strategic planning and knowledge management***".

I.1.4. Selection of the project intervention area

The reasons for selecting these areas of intervention are essentially due, for the following considerations: a) the severity of these combined hazards in the Saloum Islands; b) the heavy disruptions caused by these hazards on the lives of thousands of populations, especially women; c) the significant impacts of these disruptions on the natural habitats and the biodiversity.

The project will therefore intervene on the Island of Dionewar and its satellite islands (Figure 10), which host major economic activities for the local populations.

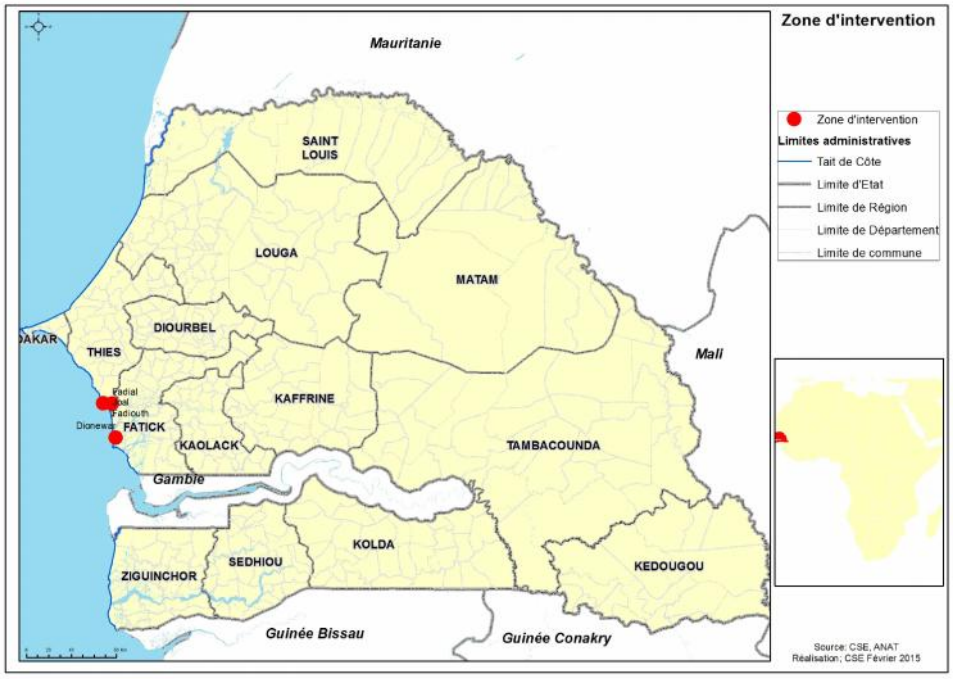


Figure 10: Location of the intervention areas

The location of planned realizations (ridges, dikes, fish farms) is shown in the next figure.

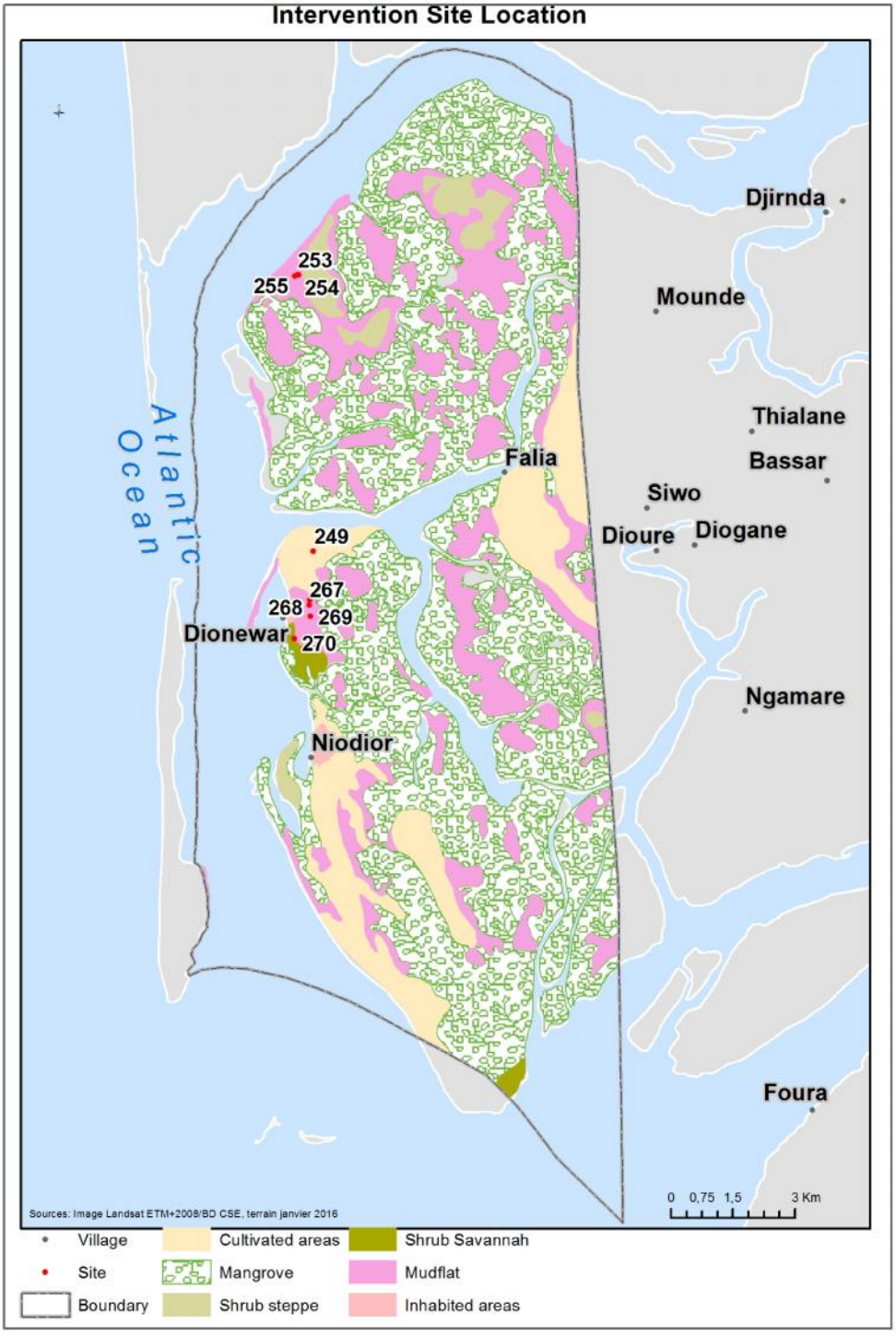


Figure 11: Location of planned realizations

249: Oil palm and coconut palm trees area
253 : Djimsane anti-salt dike

254 : Rice field
255 : Mudflat at Djimsane
266: Fish processing unit
267-269 : Ndiar dike
270: Ndioundiouré dike

I.2. Project Objectives

Overall project objective

The project's overall objective is to reduce the vulnerability of populations in Dionewar to flooding. The resilience of natural habitats and populations will be enhanced through the implementation of protective measures, revival of the main productive sectors and promotion of local adaptation strategies to cope with the adverse effects of climate change.

Specific objectives

The project's specific objectives are to:

SO1: Improve the resilience of the productive sectors such as fishing, oyster-farming and forestry to natural hazards.

SO2: Reduce the vulnerability of populations and natural habitats to hazards through the establishment of structures to better regulate flooding and fight against land salinization.

SO3: Enhance local development planning through integration of climate change, setting up local conventions and documenting lessons learned.

I.3. Project Components and Financing

Table 1: Project's components and budget

Project Components	Expected Concrete Outputs	Expected Outcomes	Amount (US$)
1. Enhancing resilience of main ecosytems on Dionewar island	1.1. Alternative fish and oyster farming production system developed for 18 women associations, including the setup of 30 growing cages, 200 spat collectors and 1000 growout bags (USD (53,710).	Outcome 1: Improved resilience of the main ecosystems on Dionewar Island and sustainable livelihoods of populations.	298,418

Project Components	Expected Concrete Outputs	Expected Outcomes	Amount (US$)
	1.2. At least 6 ha of trees planted (enrichment planting primarily with coconut and oil palms) and 5 ha of mangrove rehabilitated in Dionewar and its satellite islands to revitalize the main productive sectors (USD 151,983). *1.3.* At least 18 economic interest women's groups and natural resource management committees trained to improve their technical performance (USD 40,800). 1.4. Business plan for fish and oyster farms management developed *(USD 15,400).* *Implementation of the ESMP (36,525)*		
2. Protection against flooding and salinization in Dionewar	2.1. Protect, rehabilitate and extend the two (02) dikes against flooding over 2 km area (USD 624,000). 2.2. Build ridges around rice plots on a satellite Island (USD 36,837). 2.3. Develop a maintenance plan, involving key stakeholders (USD 21,000). *Implementation of the ESMP (72,120)*	<u>Outcome 2</u>: Reduced population vulnerability and improved socioeconomics infrastructures in Dionewar in relation to climate hazards through the construction or rehabilitation of protection infrastructures.	753,957

Project Components	Expected Concrete Outputs	Expected Outcomes	Amount (US$)
3. Strategic planning and knowledge management	3.1. The Local Development Plan (PLD) is reviewed in order to integrate adaptation to climate changes options & cost benefits (USD 21,000). 3.2. Rules governing the exploitation of timber and non-timber forest products and the biological rest updated and formalized through a Local Convention (USD 7,946). 3.3. Project's lessons learned are documented and shared (USD 16,150). 3.4. One (01) meteorological station is installed in Dionewar (USD 29,400).	Outcome 3: Strengthened capacity of local institutions to mainstream climate change in local development planning, sustainable natural resources management strategies and to document and disseminate lessons learned.	74,496
4. Project Execution cost			118,290
5. Total Project Cost			1,245,161
6. Project Cycle Management Fee charged by the Implementing Entity (CSE)			105,839
Amount of Financing Requested			**1,351,000**

I.4. Projected Calendar

Table 2: Project Calendar

Milestones	Expected Dates
Start of Project Implementation	June 2016
Mid-term Review (if planned)	December 2017
Project Closing	June 2019
Terminal Evaluation	December 2019

PART II: PROJECT / PROGRAMME JUSTIFICATION

A. Description of project components

Climate change/variability is impeding development efforts on Dionewar Island. The populations are making their earnings mainly from fishing activities, agriculture and forestry. Since the breaking of the Sangomar Arrow, contact has been established between the sea and the river. This has increased salinity and resulted in the degradation of the mangroves, a key to fishing activity but also one that plays an important role in the control of flooding. The increase of salinity has been exacerbated by rainfall decreases in the seventies and the eighties. Extreme climate events like heavy rains, combined with rising sea-levels have resulted in more frequent and more unpredictable floods that threaten populations' security and goods. The fisheries sector is facing fish stock scarcity linked to changing climatic conditions, but also to overfishing. This situation forces fishermen to go farther out to sea to fish, which also places more demands on the time and fuel invested.

The project "***Reducing vulnerability and increasing resilience of coastal communities in Dionewar"*** aims to be a response to the economic hardships and environmental challenges faced by populations due to a high exposure to natural hazards. It will be implemented through: (1) investments for the development of aquaculture, the revival of fishing and processing of fishery products and replenishment of vegetation; (2) the establishment of protection infrastructures for Dionewar to face flooding; (3) the development of planning and local regulations activities associated with a knowledge management system that ensures equitable and sustainable use of productive assets.

The three components work in perfect synergy to achieve the project's general objective.

Component 1 aims to enhance the resilience of the main productive sectors on Dionewar Island through the development of fish and oyster farming, the replenishment of the vegetation cover and capacity-building activities. It includes a set of measures to strengthen value-chains for improved market access through better quality products, marketing development and greater efficiency in the use of natural resources. To cope with the rarefaction of fishery resources, due to climate change and over-exploitation, quality improvement is one of the alternatives offered for maintaining or increasing incomes. Moreover, markets that guarantee fair and remunerative prices for seafood are those requiring stringent quality and safety standards. Therefore, the introduction of new production, processing and conservation techniques will help generate added value for local productions, resulting in increased incomes and food security for the whole community. Planned activities will ultimately help increase the influence of local producers in the various links of the value chain: production, processing, marketing. Component 1 is closely linked with Components 2 and 3.

Through Component 2, the resources of the project ***"Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar)"*** will be used to protect production areas, housing, processing and conservation facilities against water and salinity. Protection through dike rehabilitation will help mitigate one of the village's major concerns, which is flooding. It involves heightening existing dikes and installing flood control infrastructures. This component also includes the building of ridges around the rice plots at Djimsane and providing rice producers with agricultural equipment. The sustainability of the ridges will be secured through vetiver plantation on top of it.

Through Component 2, a management and maintenance plan will be developed for each infrastructure and a management committee will be established to ensure sustainability. Component 2 will ensure strict compliance with the requirements of the Environmental Code, especially regarding environmental and social impact assessments (ESIA) and the development of an environmental and social management plan (ESMP). It will help secure investments made in Component 1 and generate lessons learned that will feed into Component 3.

Component 3 seeks to enhance local development planning and natural resource management, and document lessons learned. It will foster the integration of climate change in the Local Development Plan and promote a local regulatory framework to rationalize the use of natural resources. Component 3 also includes the installation of a meteorological station in the locality to improve weather forecasts for local producers and to better inform local development strategies. Finally, it will draw from lessons learnt from all project activities for documentation and sharing at local, national and international levels.

The project strategy is to take an integrated approach linking up the 3 components.

Component 1: Enhancing resilience for productive sectors on Dionewar Island

Activity 1.1: Development of fish and oyster farms

This activity aims to boost the fisheries sector, which is faced with a scarcity of fish stocks prompting populations to go further out to sea to get worthwhile catches (especially given the amount of time and fuel spent). The project resources will be used to setup 30 fish growing cages. The project will also install 200 spat collectors to develop oyster farming in the mangrove areas. A suspension culture system will also be put in place, above the seabed, with 1000 growing bags that will collect larvae that have reached a fairly large size. Only indigenous species will be used and there will be no introduction of exotic species. The project will also purchase production equipment (ropes, fishing nets, boots, life-jackets…).

The growing cages will have a capacity of $10m^3$ each and be composed of: a galvanized tube frame, four containers as waterline and a net pouch with a volume of $10m^3$ (2.5m x 2.5m x 1.60m). The chosen species will be a local one (Tilapia) and will not be stocked from the wild, but developed in a hatchery by the National Aquaculture

Agency (ANA). ANA will provide the fish fries. These cages will enable production of around 21,375 kg of fish per year. The kilogramme of fish in the market costs around USD 2.6. This activity can therefore bring in around USD 55,575 per year.

This activity will be built on aquaculture experiments now underway in the Saloum Delta. The collection and growth of shells, which are the latest activity, are tested in Missirah, Sandicoly and Betenty with the support of PISA, FAO, ENDA and IRD, as well as WAAME-CIDEAL and ANA.

The oldest experiment remains oyster farming with the GIE (an economic interest grouping) in Joal and Sokone that produce, transport and market fresh oysters to Dakar. The oyster farms implemented will produce around 21,560 kg of mature oysters per year with a price of USD 3 per kg. The oyster farms will bring almost USD 64,680 per year.

This activity is targeted mainly at local women's association (GIE) and assets provided will be community-based. The project will foster the adoption of an agreement between the GIE, the local government unit and the executing agency. This agreement will setup a saving mechanism (fees) from revenues generated by the oyster and fish production activity. The financial resources made available will extend to the establishment of spat collectors and to the renewal of equipment, when required.

The beneficiaries already have a good organizational framework in place and ample experience in sharing such equipment. They already have the appropriate mechanisms and rules for managing and sharing the production and outcomes of the assets provided by the project.

Activity 1.2: At least 6 ha of trees planted (enrichment planting, particularly with coconut and oil palms) and 5 ha of mangrove rehabilitated in Dionewar and its satellite islands to revitalize the main productive sectors

Through activity 1.2, the project resources will be used to increase the density of the stands of coconut and oil palm trees that have long been important sources of income for Dionewar's populations. The enrichment planting will target at least 6 ha (especially coconut and oil palms) and 5 ha of mangrove will be rehabilitated. The population will contribute in terms of human investment.

The main activities include:

- Setup of a tree nursery in close collaboration with the Forestry Service;
- Mobilization sessions to organize populations around tree planting activities;
- Planting of trees;
- Setup of committees tasked with the plantations' surveillance. These committees will be composed of existing committee for natural resources management members, who will be reinforced if required.

Activity 1.3: At least 18 economic interest women's groupings and natural resources management committees trained to improve their technical performance

Activity 1.3 will make it possible to train women oyster farmers and processors on new techniques for better recovery of products. About 270 women will be trained. New production techniques will ensure better quality products and more competitiveness, meaning access to new market and more remunerative prices.

Partnership will be developed with ANA, who has a national mandate to support the development of aquaculture nationwide. They will provide technical support in the selection of performing species, quality of fish larva, biological monitoring and trainings.

For oyster farming, women will be trained in garland-making techniques for capturing spat, transfer of juveniles in pouches for the growth and quality monitoring during their growth period.

For fish farming, they will be trained on the fish feeding and water quality maintenance techniques.

Capacity-building activities will also include linking producer organizations with traders and processors to ensure consistent supply and quality standards, training women groups on entrepreneurship, marketing of products, managing value chains, and accessing financing and credit. Participation of women groups to regional/international commercial fairs will be part of this capacity development activity.

Sustainable management of shellfish other than oysters (*Crassostrea gasar*) will also be taken into account in this component and it concerns the arch (*Anadara senilis*), "yet" (*Cymbium sp.*) and "touffa" (*Murex sp.*). Oyster and shellfish parks will be created around the village to help isolate juveniles until maturity. These parks will operate according to a plan that enables the species to renew.

Activity 1.3 is also designed to build committee capacities for those entrusted with natural resources surveillance and particularly women transformers on the value of non-timber forest products (*Detarium senegalensis*, *Parinari macrophylla,Cocos nucifera and mango tree*). This will help strengthen the achievements already made with the establishment of a natural resource management committee.

The main activities include:

- Identification of trainees, taking into account gender considerations;
- Preparation of training materials;
- Elaboration of a training programme;
- Organization of training sessions, including exchange visits in neighbouring; areas in the Saloum islands where similar programmes took place in the past.

Activity* 1.4: *A management plan is developed for the fish and oyster farms

Intensive fish farming requires constant maintenance and watchfulness. If the management is poor or the funding inadequate, things can go wrong: toxic runoff, introduction of diseased species into populations, food and waste excess affecting population densities and stressed fish stocks. This activity is designed to allow the recipients to benefit from the advantages resulting from the oyster farms without jeopardizing objectives for sustainable and environmental safeguards. In partnership with ANA and target communities, a management plan will be developed and implemented.

Component 2: Protection against flooding and salinization in Dionewar

Activity 2.1*: *Rehabilitation and extension of dikes to protect against flooding

Activity 2.1 seeks the rehabilitation of two dikes and their extension over 2 km to ensure better protection for housing, infrastructures and agricultural lands. With this activity, the project resources will help reduce the vulnerability of Dionewar against rising waters, especially during the rainy season with the start of high tides and storms. Activity 2.1 will be implemented in close collaboration with researchers who focus on coastal management, civil engineers, local extensions, the local government unit and the communities themselves.

The main activities will consist of:

- Social mobilization actions to ensure a fruitful involvement of the population through human investment sessions;
- Heightening of dikes where it seems necessary;
- Extension of dikes.

Activity 2.2*: *Development of ridges around rice plots in Djimsane Island

Through activity 2.2, the project resources will be used to protect rice plots against seawater intrusion. It will help boost rice cultivation in the area, thus enhancing the sustainable livelihoods.

The operating costs will be handled by the project in the first year of operation. A depreciation schedule will be elaborated through consultations with producers in order to amortize the equipment and to recover the operation cost related expenses. Money recovered will flow back into the Fund for Integrated Development of the Islands.

The main activities will be to:

- prepare a “cadastral map” for rice-growing areas;
- organize social mobilization actions to ensure the involvement of the population;
- purchase equipment (ploughing, weeding, harrowing, harvesting, husking and bagging);
- organize consultations with producers to design the appropriate arrangements to be put in place for the amortization of the equipment;

- Realize the ridges.

Activity 2.3: A maintenance plan of coastal infrastructures developed, including key stakeholders

This activity is geared toward creating the conditions for the maintenance, over time, of coastal infrastructures developed by the project. Its execution will include a partnership with the Rural Engineering Directorate, the Directorate of Environment and the Directorate of Civil Defence.

The main activities will be:

- Preparing a maintenance guide for each category of infrastructure;
- Setting up and training a management committee, including the Local Government Unit, the extensions, the main community-based organizations (including women) and the Sub-Prefect;
- Organizing a report back session to present the guide's outlines to members of the management committee.

Component 3: Strategic planning and knowledge management

Activity 3.1: The Local Development Plan (PLD) is reviewed / updated in order to integrate climate change adaptation options & costs benefits.

Dionewar *Local Development Plan (PLD)* will be reviewed and updated to include risks and opportunities associated with long-term climate change and to make community investments more resilient. This revision will also allow incorporation of sustainable fisheries management measures. The different steps for this phase will include: (i) coordination of decision makers and the service provider team selected to revisit the local planning instrument; (ii) sharing tools for mainstreaming climate changes issues; (iii) climate changes vulnerability assessment and costs benefits of adaption options; (iv) revision and adoption of updated plan; (v) identify funding mechanisms for adaptation measures; and (vi) dissemination of revised local development plans.

Activity 3.2: Preparation of a Local Convention to better regulate the use of forest products and the biological rest

Activity 3.2 will allow updating and formalizing of existing rules on the use of forest products (timber and non-timber) and biological rest. To this end, a Local Convention will be prepared in order to promote environmentally appropriate, socially responsible and economically viable use of forests and fisheries resources.

Particular attention will be paid to vulnerable groups. The most relevant negotiating tools will be used in this regard. In particular, participatory mapping of resources will be an important part of this activity, with separate mapping by women and men, followed by each group reporting its findings and decisions in a plenary meeting for joint decision making. During these sessions, efforts will be made towards tackling the causes of the unsustainable practices.

In order to facilitate the enforcement of the new rules, the project will seek the commitments of communities, more specifically through engaging with those who rely mainly on activities that could be targeted by these new rules. The Municipality of Dionewar has already expressed its commitment to accompany the sustainability of the project in the surveillance of each implemented activity. Community leaders, elders and administrative authorities will be involved to help foster acceptance of new rules. In addition, those who could be affected in terms of economic survival would be given priority in the development of alternative livelihoods, for example through the setting up of surveillance committees. As members of these committees, they may be supported by the project in developing bee-keeping activities.

Activity 3.2 will also include a baseline study on land tenure to ensure that land use and land rights issues will not arise.

Activity 3.3: Project's lessons learned documented and shared

Through Activity 3.3, collaborative planning approaches developed will enable multiple stakeholders to share knowledge, develop awareness, improve learning and improve replication.

Activity 3.3 is designed to regularly collect and document lessons learned at each stage of the implementation and integrate these into planning processes and future activities. Through this activity, at least three general reports on lessons learnt will be produced — one every year which is shared regionally and nationally. The information packet will be translated into the appropriate formats and languages to allow dissemination through the community radios or television channels in the national languages. Particular emphasis will be put on strategies that led to improved adaptive capacities and considering gender specificities.

Activity 3.4: Installation of a meteorological station at Dionewar

A standard meteo station will be installed at Dionewar in association with ANACIM[22] to collect climatic data on wind speed, temperature, pluviometry and hygrometry,

As on many islands, transportation to Dionewar is made only by sea. This crossing of the sea exposes people and goods to hazards and recurring accidents. This is exacerbated by the lack of climate information. In fact, low tide crossing is impossible and many canoes find themselves grounded. This lack of climate information is primarily due to the absence of weather stations in the area of Dionewar. The nearest stations are located in Joal and Dioffior (25kms from Dionewar) which are both too far away and have different weather conditions altogether. For an adequate pluviometry data collection the perfect distance between meteorological stations is 5 km.

[22] Agence Nationale de l'Aviation Civile et de la Météorologie (*National Agency for Civil Aviation and Meteorology*)

The implementation of a weather station in the municipality will allow Dionewar and neighbouring islands to have accurate and timely climate information and allow fishermen to have more specific knowledge of the weather conditions that affect their productive activities. This type of station will also be encrypted climatic data - which is often missing in some areas of the country. Such data will be very valuable for local development planning.

The type of station was chosen by ANACIM[23]. The station will integrate the network of this Agency and thus allow it to expand its operation capacity.

Activity 3.4 includes; i) buying a standard automatic meteorological station, ii) laying out the site where the station will be installed, iii) installing the station, iv) securing the station, and v) assuring the maintenance and the monitoring of the station.

B. Project economic, social and environmental benefits

The project will generate economic, social and environmental benefits. It will bring and promote a set of innovations to help improve the livelihoods of the most vulnerable communities through the strengthening of sustainable production means, the use of revolving funds and the improvement of value chains (production, distribution and access to alternative markets). This will facilitate beneficiaries' climate resilience by providing options.

Vulnerable groups who can benefit from this project include:

- ***Fishermen and women oyster farmers and processors***: young men form the bulk of the workforce in fishing, oyster and Cymbium collection activities. They are grouped in the CLPA (Local Artisanal Fisheries Committee). The village of Dionewar has a fleet of 89 canoes, 12 of which have an average three-member crew (36 men) engaged in the oyster farming. They sell fresh fish products to women who are in charge of processing. Considering the technical innovations and training proposed, the project will involve (at the start) about one hundred men, including 75 young people.
- ***Women*** are organized under the the Federation of Local GIE (FELOGIE) which counts 510 members from around 25 groups who run a mutual savings and credit fund. Among these 510 women, 408 (80%) sell cockles ("pagne" in wolof) and the remaining 102 members (20%) are oyster farmers who also manage the processing unit. Apart from women members of the FELOGIE, others (over a hundred) are engaged in the sale of cockles. New production techniques introduced by the project will enable all these actors to increase the productivity of their activities, to maintain their income and to become more resilient to climate change. Their capacity-building training can also help improve the quality of their productions by increasing their value.

[23] National Civil Aviation and Meteorology Agency

- ***Women rice farmers***: the protection of rice plots from salinity will help boost production, reinforce food security and improve their income;
- ***Community-based organizations***: the training (delivered by the project) will improve natural resource-management on the island while generating more income from the exploitation of non-timber forest products;
- ***The State and local government units***: these two actors are the first ones to be called upon by populations whenever they face flooding or other hazards. Securing people and their goods through the protection structures will therefore reduce the level of stress, enabling them to dedicate their resources to other sectors.

The trees planted will help reduce wind erosion and increase populations' income in the medium term. In addition to helping regulate flooding, the mangrove offers other opportunities in the socio-economic plan allowing the diversification of income (eco-tourism, oyster production, seafood production, mangrove honey production, etc.).

To avoid or reduce potentially negative impacts of the project activities, an environmental impact assessment has already been conducted and this study identifies the potential risks and proposes mitigation measures. This study was realized with the purpose to verify the alignment of the project activities with the AF's Environmental and Social Policy and to identify the potential negative impact that might result from these activities.

Land tenure can be a sensitive issue and will therefore receive particular attention. The Saloum estuary is characterized by a multitude of bolons and it is not difficult to find the space to conduct oyster activities without interfering with navigation or other fishing activities. However, expanding oyster farming requires communication across all Saloum islands to identify production areas, while making sure to avoid barriers to seaworthiness.

Oyster farming actors shall inform the Dionewar Municipality Council about the conduct and location of activities. For fish farming and planting of coconut palms, committed groups will file an allocation request to the Council. Indeed, decentralization texts give to that Council the authority to allocate land by authorization under the State-ownership.

Mangrove reforestation will also be performed on the banks of bolons on spaces under the State-ownership of land.

Table 3: Project's benefits

Benefit type	Baseline	At project completion
Social benefits	- Rural exodus due to isolation, scarcity of fish stocks and lack of income-generating activities - Poor response capacities - Lack of mechanisms for disseminating proven strategies to adapt to risks - High exposure to hazards	- Aquaculture development - New capacities acquired by populations on coastal protection and aquaculture Improved food security - Leverage on lessons learnt on coastal management and adaptation to climate change - Decline in rural exodus
Economic benefits	- Housing and infrastructures threatened - Low cost-effectiveness of investments in the main productive sectors - Continuous decline in populations' revenue	- Improved revenue particularly of women, - Revival of the economic activity - Securing investments
Environmental benefits	- Degradation of the mangrove - Degradation of the vegetation - Land salinization	- Replanting the vegetation - Protection of rice fields against salinity

Table 4: Project's economic benefits

Activity	Benefit ($USD)						
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Fish and oyster farming	0	387,164	387,164	774,327	774,327	774,327	116,1491
Reforestation (mangrove, coconut and palm oil trees)	0	0	0	0	8,990	8,990	17,980
Dikes	0	1,699	1,699	1,699	1,699	1,699	1,699
Rice-growing	0	27,605	27,605	55,209	82,814	82,814	110,418

Equitable access to assets financed by the project is a core principle of this project. All members of the women's grouping will benefit from these assets. The assets will not be allocated on an individual basis, but they will be shared and used in rotation. All of the

women will be trained on feeding and maintenance techniques. Backed by the technical staff from ANA, they will undertake feeding and maintenance tasks in turns. When they harvest and market the products, part of the revenues will be used to purchase fish feed and another part will go to the grouping fund. This fund could be used through the grouping's central purchasing in order to extend the shop or to provide loans to its members (revolving fund).

C. Cost-effectiveness of the proposed project

For the design of this project, cost-effectiveness is embedded into the Adaptation Full Cost Approach. This approach makes a distinction between costs directly related to the country's economic development (investment for business as usual), and those relating to the implementation of concrete adaptation measures. While the investment allows the Senegalese Government to improve socioeconomic conditions in the area, AF funds are focused on financing adaptation-related activities. The project will focus on the combination of adaptation options based on communities and ecosystems to better address the specific priorities of local populations. The emphasis is laid on new coastal protection measures that are cheap and more environmentally friendly.

This approach helps avoid duplication, and, moreover, due to a joint use of means for cost-shared staff payment, it allows significant reduction in project management and coordination costs. There are currently several initiatives, with among other objectives, the improved resilience and improvement of sustainable livelihoods and populations in these areas. They are driven by technical services with human resources whose experience and expertise will be a definite asset for the project. This also implicates, for example, shellfish collection and growth techniques already experienced in Missirah, Sandicoly Betenty and with the help of the FAO, PISA Programme, ENDA, IRD and ANA. These achievements will be enhanced to fully use the project resources. Oyster GIEs in Joal and Sokone produce, transport and sell fresh oysters in Dakar (Almadies), in addition to orders placed by hotels in the Saloum islands and Petite Côte. Export opportunities to Africa, Asia and Europe exist, but oyster production remains very low to meet demand. In regards to fish farming, there are still no fish farms in Dionewar, however there has been a success story in Senghor Valley in Sokone where the population showed great interest in fish farming because of their concern over declining fish stocks. The majority of these families depend on fishery resources.

Local stakeholders also benefit from the support of several Non-Governmental Organizations (NGOs) and other multilateral organizations and cooperation agencies across various areas. The project "Women's Entrepreneurship and adaptation" launched by the COLLEGIA Groupe, CEGEP de la Gaspésie des Iles (Quebec-Canada) supported the women from Dionewar village in fish processing by providing the

processing unit which is also serving for storage and office space. They have also organized training in accounting, financial management and organizational development. This project will consolidate these gains by allowing women processors to master new production techniques that will generate added value. In addition, this project will build protective infrastructure, which in turn will be used to secure the facilities established under the COLLEGIA project. In regards to the construction of infrastructures, such as the dikes, several options have been examined through a feasibility study that identifies the best one for protecting the population against hazards.

Option 1: The earthen dike
The selection of the earthen dike is based on two key criteria:
1) ensuring the availability of the material that has the necessary geo-technical qualities to build a dike. According to populations (and after visiting the surrounding area of the village), there is no borrow site that may supply such material (quality earth) in the village or even nearby.
2) having the adequate equipment, such as : a compactor, a grader, etc., for proper stripping and an efficient compaction. Considering the difficulty in having this type of gear in the area, such a choice is then compromised. In regards to the results of the foregoing diagnostic analysis, this option is then not applicable for the three sites of Ndiar, Ndioundiouré and Ecole 2.

Nevertheless, with hand-operated gears (cultivators, harrow and hand-operated compactor), this option is relevant to the Djimsane dike.

The embankment will have a trapezoidal-shaped crown in reinforced concrete.

Option 2: Work with recessed gabions
The establishment of such work would not be well adapted to the area. The village of Dionewar and the island of Djimsane which belong to type III islands (see feasibility study), are vulnerable to encroachment of the sea in high water.

Gabions play a stabilizing or hardening role along the shoreline, which is often affected by erosion. In some way, they play a role of fascine and will more or less leave water penetrate the area to be protected. Such a situation would keep affecting habitats and infrastructure in the village. In regards to the results of the foregoing diagnostic analysis, this option is then not applicable for the four sites.

Option 3: A dike made up of reinforced concretes (RC) plates with a spillway
The option will focus on the RC dike by considering the almost impossibility of building the earthen dike and the irrelevance of the structure in gabion for this type of threat.

A work made up of a RC wall with pre-manufactured plates. The purpose is to build a RC wall (screen) made up of pre-manufactured items to juxtapose those and interconnect them by poles.

This would be the best solution considering the difficulties to apply other systems. Plates can be made at the local level without using a gear, in addition to the basic material (i.e. sand) that may be found on site or near the village.

Carriage of other materials, such as cement, iron, etc., can be done by pirogue without much difficulty. In regards to the results of the foregoing diagnostic analysis, this is the best possible choice for the three sites of Ndiar, Ndioundiouré and Ecole 2.

Through interviews with beneficiaries, the choice meets the aspirations to have operational, solid, easy to maintain works that can be built using local materials and involving the populations in the implementation of the works.
Synergies and supplemental help will be sought wherever the opportunities arise and the project resources will reinforce or value those of various organizations operating in these areas, whenever possible.

The populations of Dionewar will contribute to the realization and the maintenance of infrastructures under activities 2.1, 2.2 and 2.3 in terms of human investment (labor force). This will optimize the project's financial resources.
CSE's administrative and financial management procedures, especially those related to procurement, contribute to cost-effectiveness. Goods and services procurements should be made on a competitive basis between service providers.

D. Project consistency with national or sub-national sustainable development strategies

The project concerns are consistent with the Local Development Plan (PLD) and the Local Plan of Action for the Environment (PLAE) in the commune of Dionewar. These plans are based on the increased revenues with the introduction of technical innovations, the management of fisheries and development of fishery products. These plans also underscore the achievements for the protection and preservation of the village with focus on the mangrove. One of the priority actions of the PLAE of Dionewar relates to the construction and rehabilitation of dikes fighting against coastal erosion and its consequences. The PLD of Dionewar also prioritized the capacity-building of the population on dike construction techniques to address coastal erosion and saline water intrusion. In the Priority Action Programme (PAP) of this PLD, actions considered for the Axis "Environment, Natural Resources Management and Living Environment" include

the realization of dikes against coastal erosion, salinity and tree planting (including fruit-trees).

The project objectives are also in line with the strategic objectives of the 2013-2017 National Strategy for Economic and Social Development (SNDES in French) in terms of employment promotion and integrated development of the rural economy. With respect to the second component, the project will help diversify the production, reduce the vulnerability of agricultural activities and improve production and productivity of fisheries which are addressed in the SNDES (2013-2017). Through Component 1, the project is consistent with the objectives of Policy Statement of the Fisheries and Aquaculture (LPS-PA) Sectors, which aim (among other) to improve the development of inland fisheries and aquaculture.

The implementation of protective measures will contribute to the Priority Axis n°2 ("Human Capital, Social Protection and Sustainable Development") of the Strategic Plan for Senegal's Emergence (PSE). The PSE, which is currently the main development strategic framework, emphasized the improvement of living environments through flood control inter alia, but also on the prevention and management of risks and disasters, mainly in coastal zones. The revival of the main productive sectors and the promotion of local adaptation strategies will contribute to the Priority Axis 1 ("Structural Transformation of the Economy and Growth") of the PSE, and more specifically to the programme on "agriculture, livestock farming, fish and seafood products and agrifood": targeted actions through a programme aim to implement integrated approaches to develop value chains and sector structuring. Aquaculture is one of the six priority areas and 27 flagship projects that can help to drive Senegal towards economic and social emergence.

The project takes into account the objectives of the "2013-2017 Five-year Agricultural Programme" (PAQ in French), which aims to ensure food security and improve rural living conditions by creating conditions that compel rural populations to stay. The PAQ is structured around five major pillars including ''the issue of farmlands'', which this project is looking to protect and preserve.

The project reflects the priorities defined in the National Adaptation Plan of Action (NAPA) to Climate Change which considers that the main environmental concerns (flooding, coastal erosion, water and soil salinization, mangrove degradation and variations of fish stocks) affecting Senegal's coasts, which are directly related to climate factors. The NAPA thus includes a priority programme (Programme 3: "Protection of the littoral") dedicated to coastal protection, reforestation, the construction of protective structures and training/information among the adaptation options selected.

Activities under this project will contribute to the overall objectives No 1 (maintain existing natural and archaeological heritage and restore degraded areas) and especially No. 3 (promote eco-development activities for populations in the RBDS) of the Integrated Management Plan of the Saloum Delta Biosphere Reserve. Expected results of this management plan include: "strengthening conservation and management measures of the RBDS areas", "mitigating natural factors of environmental degradation (drought, salinity)", "strengthening organizational and mobilization capacities of village communities and local institutions" and "improving the living conditions of local populations through the implementation of income-generating projects".

E. Project alignment with relevant national technical standards

The project activities are in compliance with the spirit of the Coastal Act, particularly ‘the maintenance of environmental balances, fight against coastal erosion, preserving site integrity, sea landscapes and heritage’’. Component 2 will be implemented in the spirit of the text.

The project also ensures adherence with the provisions of the Environmental Code, especially Chapter V where Section L48 stipulates that ‘’any development project or activity likely to harm the environment as well as policies, plans, programmes, regional and sectoral studies should be subject to an environmental review’’ that is why the environmental and social impact studies will be an important part of component 2.

The project will also comply with requirements of the National Strategy for Gender Equality (SNEEG 2005-2015) which aims: ‘’(i) to build an institutional, sociocultural, legal and economic environment enabling the achievement of gender equality in Senegal; (ii) and effective gender mainstreaming in development interventions across the sectors. All project components will comply with these principles in their implementation.

The project will observe the provisions of the Fisheries Code, especially regulations on the quality control of fish products. The production and processing of fish products are regulated by the Fisheries Code, Title 5 of which regulates the quality of fish products from installation and operation of fish processing units, to exportation and quality control of fish products. However, there is no regulatory text regarding quality and safety standards. Fish product exporters and the Fishery Department use, as reference, the European Commission regulatory framework in this regard to fill the gaps of the national legislation since nearly 60% of the fish products are exported to Europe. These include 93-48 Guidelines on the safety and quality standards of the food industry and the 178-2002 Regulation on the concept of traceability.

These texts set production techniques, conservation, packaging, storage, import of fish products produced in Senegal. The Guidelines require a health certificate certifying that the products:

1) were caught and handled on board in accordance with established rules of hygiene;
2) were landed, handled and (where appropriate) packaged, prepared, processed, frozen, thawed and stored hygienically. In regards to fish products, they must have been slaughtered under appropriate hygienic conditions. The products must not be soiled with earth, slime or feces;
3) have undergone a health check;
4) are packaged, marked, stored and transported during all stages of production, storage and transportation;
5) do not come from toxic species or contain biotoxins;
6) respect the organoleptic, parasitological, chemical (check the presence of heavy metals and organohalogen substances) and microbiological criteria.

Packaging must be carried out in conditions of hygiene, to avoid product contamination. Regarding the storage and transport conditions, fish products, thawed or cooked should be maintained at the temperature of melting ice. Processed products must be kept at the temperatures specified by the manufacturer or, if required, established under the procedure regulated in the Directive.

Component 1 under the project seeks, among other things, to help women processors comply with the standard defined under this Code and these Directives.

The installation of a meteo-station has to be done according to regulatory measures and directives from the World Meteorological Organization (WMO). In regards to the standards of coverage, the horizontal resolution required according to the standards of the WMO ranges from 10, 50 to 100 km based on the meteorological data to be collected. The installation of the station under this project (Component 3, Activity 3.4) respects these standards and even contributes to reduce the deficit of cover in the zone, because there is no meteorological station in the entire island.

F. Describe if there is duplication of project / programme with other funding sources, if any

The project will strive to avoid potential duplication with other funding sources for similar activities. The design of the project activities is based on complementarity and additionally with existing projects and programmes under development. This will be the case namely with the PAPIL (Support to Local Small scale Irrigation project) operating in the Saloum Islands mainly in the neighbouring islands of Djirnda and Niodior for the

construction of protection dikes and mangrove reforestation. This project will cover the Dionewar Island that was not covered by the PAPIL project.

Initiated by the COLLEGIA Group, CEGEP de la Gaspésie des Iles (Quebec-Canada), the project ‘’Women Entrepreneurship and Adaptation’’ supports women in the village of Dionewar in processing fish products by providing them facilities for processing, storage and offices. This project will consolidate these gains by helping women processors to control new processing and conservation techniques that will generate added value.

The project design has also been informed by The GEF and World Bank project “Integrated Marine and Coastal Resource Management” which aimed at promoting a sustainable management of coastal and marine resources through:

- an ecosystem approach to conservation;
- involving local communities and resource users, including building on local knowledge;
- strengthening local and national institutional capacity to address environmental issues;
- strengthening inter-institutional, and multiple stakeholder forums;
- and strengthening regional networks for conservation and sustainable use of marine biodiversity.

On a smaller scale, lessons drawn from this project have served especially in designing the components 1 and 3. The territorial user rights fisheries (TURF) agreements approach has been explored for the design of Activity 1.4 (Fish and oyster farms management plan developed).

The table below shows the initiatives that took place in Dionewar in past years.

Table 5: Recent initiatives in Dionewar

Type of activity	Activities	Intervention	Partners	Organization in charge locally	Period of intervention
Preservation/Restoration	Mangrove planting	Direct	IUCN/FEM	CLPA	2001-2015 3 Generations
	Preservation activities		WAAME		1995-2008
	Mangrove planting				
	Village forest		PRECEMA		Unknown
	Mangrove planting				
	Mangrove planting		EFA		2013-2015
	Mangrove planting		ADAFYUNGAR		
Training	Capacity building on market gardening and young plant production techniques	Direct	ENDAGRAF	AEED	Unknown
	Literacy			CEED	
	Capacity building on processing of *Detarium senegalensis* (ditakh)			GPF	
	Capacity enhancement	Indirect	ENDA EVE		2012-2013
	Literacy	Direct	WAAME		Unknown
	Capacity building on finance management	Indirect	ADF		
	Capacity enhancement	Indirect	PERACOD		
	Capacity building on processing techniques and ecotourism	Direct	EFA		2013-2015
Popularization	Use of improved woodstoves	Indirect	PERACOD		2012

Type of activity	Activities	Intervention	Partners	Organization in charge locally	Period of intervention
Enhancement	Support for labelling fish products				
	Development of seafood		ADF		Unknown
Land management	Help to identify ecotourism path		PERACOD		2012
Planning	Local environmental plan	Indirect	ENDA EVE		2012-2013
	Local agreement				
	Support to elaborate the local agreement		WULA NAFA		2011
	Elaborate local development plan		PRODDEL		2014
Institutional support	Institutional support	Indirect			
Organizational dynamic	Support to legalize youth organisations	Direct	EFA		2013-2015
Agriculture	Rice cultivation support	Direct	IUCN/FEM	COGER	2013-2015
	Market gardening (fence)				2011
Microfinance	Revolving credit	Direct	Micro FEM	AMP/CADL	2000-2015
			ENDAGRAF		Unknown
Infrastructure	Anti-salt dike building	Direct	Micro FEM	CIVD	2000-2010
	Toilet building			FELOGIE	
	Well building			CIV pour régler les problèmes sociaux	
	Toilet building		WAAME		Unknown
	Building a purchasing office	Indirect	ADF		Unknown

Type of activity	Activities	Intervention	Partners	Organization in charge locally	Period of intervention
	Building a fish products processing plant	Direct	PAPEC		
	Building an equipped fish products processing plant	Direct	EFA		2013-2015
	Building a dike	Indirect	AFDS		2006
	Central purchasing agency				
	Well rehabilitation				
	Chicken coop construction				
	Primary schools rehabilitation		PNDL		2010
	Construction of one of the high school classrooms		Mérignak		Unknown
	Construction of a classroom, administrative block, laboratory and the high school computer class				
	Construction of a classroom		Beau bois		
Equipments	Wain endowment (monkey + equipments)	Direct	IUCN/FEM	ADD	2000-2010
	Equipped dugout canoe endowment			ASC	
	Equipment of the processing plant		ENDAGRAF	CIV	
	Life jacket endowment				
	Motorized dugout canoe endowment				
	Marking access issues	Indirect	ENDA EVE		2012-2013

Type of activity	Activities	Intervention	Partners	Organization in charge locally	Period of intervention
	Life jacket endowment	Indirect			
	Dugout canoe endowment	Direct	ADAFYUNGAR		Unknown
	Incinerator plant endowment				
Oyster farming	Oyster parks	Direct	ENDAGRAF		Unknown
	Sowing oyster				
Food security	Nutrition	Indirect	CHILDFUND		Unknown
	Nutrition				
	Iodized salt				

G. Description of the learning and knowledge management component to capture and disseminate lessons learned

It is important to document and share the lessons learnt from positive experiences resulting from the achievement of the project objectives or the negative ones resulting from these failures. This information is a huge potential to bring crucial knowledge to the design and implementation of strategies enhancing resilience to climate change. To make sure that throughout the project steps, lessons are documented and shared; documentation of lessons learnt will be included in the monitoring-evaluation process. Such approach helps ensure that the project can be reviewed at each stage and the lessons learnt and best practices can be valued in planning the next steps. It also helps record knowledge and enters them into a common reservoir where they can be shared with other stakeholders of the Senegalese coastline and the sub-region.

The process will comprise four major steps:

1. Make an inventory of knowledge: the project managers and the Monitoring-Evaluation Team will collect information through structured or non-structured approaches (interviews and observations) by filling out ‘’lessons learnt’’ cards.
2. Check and summary: the project managers check the accuracy and applicability of knowledge gained in relation with the Monitoring-Evaluation officer. The reports are then forwarded to the project coordinator who will ask experts to determine whether a lesson is specific to a particular component of the project, the entire project or the projects in general.
3. Reporting: the project coordinator will then produce a general report on the lessons learnt for the period under review.
4. Dissemination: the coordinator distributes the report internally (to the steering committee, the project managers and members of the project team) and

externally (on the project website and other electronic forums). By the end of the project, a lessons-learning document will be prepared and published.

The project will work with other projects and programmes to disseminate the information with cost-effectiveness.

The achievements planned under the project, mainly with the introduction of technical innovations in the fishing sector through the involvement of the National Aquaculture Agency (ANA) and the replenishment of local essences, could then be capitalized and shared with other islands in the Saloum Estuary. This experience can be extended in villages located in Lower Casamance which have similar landscape and are also faced with deteriorating living conditions resulting from the depletion of fish stocks, poor environment with aggression of the mangrove and farmland salinization.

Component 3 of the project is designed to document and share all lessons learnt as well as the adaptation strategies identified.

The knowledge management process will be linked to the Monitoring and Evaluation process in order to allow lessons learned to constantly feed into the planning strategy.

H. Description of consultative process

The project itself results from a forum organized on Dionewar Island in May 2009, focusing on its economic and social development and the constraints and adverse effects posed by climate change. This forum gathered the natives of the island, residents and those coming from other cities of Senegal, and even Gambia. This forum was the place to carry out a diagnosis and analysis of key sectors (health, water supply, economic activities, education, environment, sport and culture) and to come up with solutions. An important outcome of this forum has been an action plan, including major issues and possible remedial activities. These activities were later prioritized by the Association for the Development of Dionewar (ADD), leading to a bank of projects. Combining the “environmental management” and the “social” components, the ADD developed this project idea.

The selection of the project idea was also made through a consultative process at the national level. In consultation with the Designated Authority and the National Committee for Climate change (COMNACC), it was agreed to issue an open call for proposals at the national level in order to identify the second proposal to submit from Senegal to the Adaptation Fund. The rationale for such decision was to ensure fairness, transparency and competitiveness. An evaluation committee was then set up, co-chaired by the designated authority and the Chair of the COMNACC. This committee included representatives from various sectors: agriculture, environment, livestock, fisheries, universities, etc. This process led to the selection of this project idea submitted by

CONAF-ADD (National Committee for Literacy and Training and Association for the Development of Dionewar) on behalf of communities in Dionewar.

After this selection, many working sessions were organized with the project initiators to further discuss the issues, objectives, outcomes, etc.

Several consultations were also organized at various levels and with other categories of stakeholders: project sponsors, local elected representatives, women oyster farmers and processors, women rice farmers, fishermen, the civil society, technical services, communities, customary and religious authorities, etc. These consultations have ensured that their concerns and opinions about the project are captured and taken into account in the design of activities. This was successful in securing strong support from these stakeholders, as exemplified by a letter to from the Mayor of Dionewar clearly expressing willingness to participate in the proposed activities.

Figure 12: Meeting with the project's proponents

Figure 13: Meeting with reprsentatives of the womens groups

Field missions were organized to firstly identify aquaculture potentials in the Dionewar village and then explore the sites expected to host the aquaculture infrastructures. This also allowed to better investigate the relevancy of protection measures considered in the project. Some of these missions included two civil engineers and a resource-person who has a breadth of experience in coastal management. The technical design and cost-related aspects of these measures were discussed extensively.

The outcomes of these meetings and visits were captured in the design and planning of the project activities. For instance, the initial option for tree planting (Activity 1.2) was to do this is in forest areas using species such as coconut trees, palm trees, etc. For rehabilitating dikes (Activity 2.1), to help address flooding, the populations suggested an extension of one (of two dikes) to ensure optimum efficiency. Discussions on this topic

took place between the populations and experts (civil engineers), which resulted in an understanding that to make this extension feasible (within the planned budget), the populations will provide the workforce, while the project provides the input and technical backing. The populations also suggested raising the height of the dikes and to include spillways, allowing for better control of the flow of rainwater and seawater. All these concerns have been taken into account, leading to revising the initial budget planned for this activity.

I. Justification for funding requested, focusing on the full cost of adaptation reasoning.

The budget of 1,351,000 US requested from the Adaptation Fund with this project (Adaptation Alternative) is to finance concrete adaptation activities, in response to the vulnerability of the productive ecosystems, the communities and infrastructures in the municipality of Dionewar. It is both a conjectural and structural approach, because aside from solving current problems, which arise with severity, the adaptation options will be mainstreamed into the planning document of Dionewar.

While the protection of Senegal's coast is considered a priority by the current strategies of fight against climate change (Baseline scenario), it has received relatively little financial backing. What is happening in Dionewar weighs heavily on the sustainability and safety of people's livelihoods, and is a major concern for both local and national authorities.

The cost effective use of resources solicited through the project's various components will help reduce constraints and obstacles and build assets to make main productive ecosystems resilient to climate and natural risks.

Direct benefits generated for beneficiaries include an effective reduction of flood losses for 451 households, an increase in incomes for more than 500 persons (most of whom are women), an increase of the resilience and productivity of 6 ha of dry land ecosystem, 5 ha of mangrove, and an increase of awareness of local decision-makers on climate issues.

Ultimately, the Adaptation Fund resources will generate significant benefits at different levels and for various actors, thereby justifying investments made.

Baseline (Without project)

Under the baseline scenario, the fight against climate change's adverse effects in Senegal is essentially made through the programmatic framework of the NAPA in which a number of priority projects are defined. For Senegal, an estimated[24] 700 km of coast

[24] Banque Mondiale, 2005. *Gestion des risques en milieu rural au Sénégal : revue multisectorielle des initiatives en matière de réduction de la vulnérabilité*, 2005.

(with a total cost USD 1,596 million) were deemed in need of protection. These costs were revalued at USD 3,623 million, which is 1.72 % of the GDP's annual cost. Finally, this study estimated 20,600 ha of coastal ecosystems were at risk of becoming salty swamps; 104,100 ha of intertidal zones and 364,300 ha of mangrove swamps. In this scenario, the protection of the coast is certainly a national priority, but due to scarce financial resources, the interventions of the Government of Senegal are limited. Most of these interventions take the form of emergency measures and consist mainly of physical barriers allowing to protecting important human establishments and infrastructures. However, this protection approach integrates "no adaptation" options, which means that in most zones productivity of the surrounding marine and coastal ecosystems keep declining.

Under the same baseline scenario, specifically in the Saloum estuary, Senegal's Government assures the fight against coastal erosion through the management plan of the Delta of the Saloum Biosphere Reserve (RBDS in French acronym). The reach of the interventions in this framework is also strongly limited by the low financial resources, the main part of which is firstly directed to the preservation of the biodiversity. The questions of adaptation to climatic changes and variabilities are marginally addressed.

More specifically at the level of the municipality of Dionewar, the Local Development Plan (PLD in French acronym) and the Local Environmental Action Plan (PLAE in French acronym) are respectively reference frameworks for the socioeconomic development and for the sustainable management of natural resources. In none of these strategic planning documents, the question of adaptation to climate change is considered. The social and economic development activities, as well as those of the environment's sustainable management are typically the ones proposed. This explains why the municipality's populations have difficulties understanding the underlying causes of climatic variations, even though they are directly affected. Most of the time, this leads to population seeking to adopt solutions with a limited reach.

The baseline specific scenarios of the three components of the project are pulled from the preceding analysis:

Component 1: Enhancing resilience for productive ecosystems in Dionewar Island

Populations in the Saloum Islands derive most of their sustainable livelihoods from fishing, agriculture and exploitation of forest products. With the rising sea level and the deterioration of weather conditions (rainfall and temperatures), these populations are vulnerable to several hazards, such as farmland salinization and mangrove regression due to silting and salinity.

Populations have taken many initiatives to cope with these disruptions, namely the construction of rudimentary protection dike, the establishment of natural resource management committees, etc. The Senegalese State has also assisted populations several times during serious flooding that caused the breakdown of the protection dikes.

Among the initiatives implemented in the project area, we can include the financing of a fish processing unit and forest products processing unit given to the GIE. These initiatives allowed the community of Dionewar to design quality products that meet food, health and safety standards. In the development of income-generating activities, a lot of projects carried out mangrove restoration and allowed restoration of natural mangrove ecosystems, such as shellfish and other fish products.

All these interventions, however, had mixed success and were limited in time for lack of financial resources and, particularly, technical resources needed to meet the challenges.

Mangrove reforestation requires a strategic choice of suitable species that are easy to transplant, but it also requires knowledge on the techniques for transport, storage and transplanting seedlings. The most suitable choice for transplanting is also a key element to increase the rate of success of reforestation activities. In terms of aquaculture, weaknesses in the organization and regulation of the operation compromise the resource sustainability.

Component 2: Protection against flooding, coastal erosion and salinization in Dionewar

In Dionewar, populations are at high risk of frequent flooding during heavy rainfalls. These floods pose a constant threat to houses and socioeconomic infrastructures. The damage they cause weigh heavily on the already scarce financial resources of populations. In addition, in many parts the island is facing an advancing sea that is gradually encroaching onto the vegetation and farmland located on the shore, damaging the socioeconomic infrastructures and hindering mobility. Populations are powerless in face of this situation, which requires large financial and technical resources. Financing initiatives conducted by organizations such as Social Development Fund Agency (in French acronym: AFDS), the French Facility for Global Environment (FFEM in French) and the National Program for Local Development (PNDL) have helped fight the recurrent floods in the village during the rainy season — events that cause considerable damage and threaten the village's very existence. These initiatives have contributed to the erection of protective dikes.

Component 3: Strategic Planning and knowledge management

None of the Local Development Plans (PLD) in Dionewar includes strategies, activities and/or options that tackle future climate change. As it appears, when preparing these plans, the council did not have the information nor the tools needed to integrate climate change concerns. Therefore, support for mainstreaming climate change within PDC is needed.

Furthermore, communities are well-organiszed through existing community groups, but there no local convention exists for the regulation of natural resources use. There is no specific climate data on Dionewar available.

Finally, the interventions of various stakeholders to address the adverse effects of climate change generate useful knowledge, but these are rarely documented or shared. In addition, these interventions rarely provide for sustainability measures. Very often, lessons learnt from the implementation of these interventions are lost at project completion.

Adaptation alternative (With project)

Under the adaptation alternative scenario proposed with this project, solutions to reduce the vulnerability of the municipality of Dionewar will be implemented. It is about protective measures of the human establishments and about building infrastructures against the floods and the salinization of lands, including measures to strengthen the resilience of the estuary's ecosystems and measures to strengthen the resilience of the community at the systemic level (mainstreaming of the adaptation in the PDL and the PLAE), at the organizational level (adoption of local convention) and at the individual level (training of the members of the GPF on alternative modes of production). It is about concrete measures of adaptation; on ecosystemic basis and on community basis.

Ecosystem-based adaptation measures are about strengthening the resilience of the main estuary's ecosystems to improve their ecological function and their capacity to supply services to the populations that depend on it. As such, reforestation of the mangrove with salt tolerant species is envisaged, as well as planting tree species in terrestrial forests.

Community-based adaptation aims to strengthen the adaptation capacities of the populations (in particular the women who are most vulnerable) so they can face the negative effects of climate change by adopting alternative modes of production that maintain the production potential of the island's ecosystems. Thus, fish growing cages and cages for oyster farming will be implemented and women will be trained on how to exploit them. These activities will increase food availability and the population's incomes. This increase in financial capacity will enhance their ability to face climate change effects, as it will heavily and positively impact on the community's living conditions, including that of women.

Project resources will also help improve food security for approximately 5,600 persons through the support of alternative modes of production of rice, fish and seafood productions. These alternative modes of production aim at decreasing anthropic pressure on mangroves ecosystems, while contributing to an increase in seafood products. The planting of coconut and oil palm trees will contribute to diversifying and developing local productions which, in turn, will generate incomes for hundreds of people and reduce expenditures on food products.

Both the central and local governments will also draw concrete benefits from the project's investments, as the construction and rehabilitation of protection facilities will

limit spending for emergencies, including flooding and tidal waves. This will allow not only securing government investments for equipment, but also mobilizing more resources for other priority sectors.

More specifically, adaptation alternatives to be implemented through the project components are as follows:

Component 1: Enhancing resilience for productive ecosystems in Dionewar Island

The 'adaptation alternative' to be implemented through this project under Component 1 builds capacity 'on the ground', at the local level, to establish effective approaches and techniques which increase the resilience of vulnerable communities, and of value chains to climate change and climate variability. Component 1 is designed to enhance the resilience of key productive sectors on the Dionewar Island. It builds the capacity of local organizations to support real 'on the ground' impact in order to demonstrate the social and environmental benefits of climate change resilience in a range of local productions systems. Activities build on and partner with a number of important existing initiatives to support the 'additionality' of climate change adaptation in key value chains.

The project resources earmarked for this component (**USD 298,418**) will be used through the revitalization of fish and oyster farming activities, the replenishment of the vegetation, stakeholders' capacity building and product development. It is intended to supplement the former projects, which implemented population support and assistance to provide them with a better living. Indeed, people have a fish processing unit and forest products processing unit operated by women, but they are often faced with two issues: firstly, the availability of fresh fish; and secondly, access to markets for selling processed products. The introduction of new production, processing and storage techniques will help generate added value for local productions. The project also seeks to organize beneficiaries around sustainable farming through local regulation and protection of vulnerable areas, as well as improved recovery. In addition to training the beneficiaries on innovative processing techniques and compliance with international standards in the food sector, the project will also set up income-generating activities, such as fish and oyster farming. Such activities fall in perfect cohesion with existing processing activities. They will allow fresh products to be obtained near processing units and meet necessary health and hygiene standards.

In the same context, the mangrove reforestation will revitalize the ecosystem. Reforestation of coconut and palm oil trees will also develop the sale of products from these species. Populations will acquire strong knowledge on the various techniques of selection, transport, storage and seedling transplantation, but also learn how to select sites for reforestation. Ultimately, the activities implemented under component 1 will

make it possible to improve the sustainable livelihoods of communities and restore natural capital on the island. They will allow higher production of better quality goods and reduce pressure on resources currently used in collection situations.

Component 2: Protection against flooding, coastal erosion and salinization in Dionewar

The project resources for component 2 (**USD 753,957**) will contribute to protecting, socioeconomic infrastructures (high-school, health centre, infrastructure and housing), the vegetation cover and croplands against water and salinity.

The dike built with funding from AFDS was realized in 2005 for an average lifespan of 10 years. Today the dike is in an advanced state of deterioration that exposes people to frequent breaks in the structure. The rehabilitation and extension of dikes by the project will provide security and a better living environment for the Dionewar population. The satellite island of Djimsane was an island where rice growing was once practiced, but due to saltwater intrusion this activity had been abandoned for over two decades. In 2014, the FFEM financed the construction of an earthen anti-salt dike to allow recovery on a part of the land - which the project will complete by developing ridges to facilitate cultivation and prevent water intrusion, and also provide equipment to farmers to boost rice-growing.

The living conditions of populations will be improved and sustainable livelihoods enhanced. People will be trained and involved in the construction of works. They will also be organized to perform simple maintenance tasks.

Component 3: Strategic planning and knowledge management

With resources (**USD 74,496**) mobilized for component 3, the project will provide support for equitable and sustainable use of the project's access and sustainable use of natural resources. The Local Development Plan will be updated to integrate climate changes options and cost benefits, and the local convention on the sustainable use of natural resources will be established. Lessons learned will also be shared to enable replication.

J. Sustainability of the project outcomes at the project design

The first element to ensure the sustainability of the project's results was in the selection of the project idea itself. This was made through an open and competitive call for projects launched by the CSE. The present project was selected because it answers the population's urgent needs and assures the porterage of the project through a federation of community-based organizations (under which CONAF assures leadership). The first

aspect to consider when it comes to sustainability is to ensure the project addresses needs that are expressed by the community.

In the same vein, the implementation of a local project management unit (PMU), based in Dionewar and led by natives of the community, is a sign of appropriation. This will help assure the sustainability of the project beyond its planned three year duration.

Additionally, during the process of negotiating a local convention for the sustainable management of natural resources, it is planned to strengthen the management of various existing financial community mechanisms. Several protection dikes were already built or reconstructed with funds from these mechanisms.

It is also worth noting that the municipality of Dionewar committed, for its next budget, to specifically allocate money to maintain and to protect dikes built by the project.

Moreover, various specific conventions that will be signed between the CSE and certain decentralized (CADL[25]) or specialized (ANA, ANACIM) government structures, aim at assuring technical support of the government to the project, which (as a last resort) assures the project's sustainability.

Furthermore, the project's M&E system includes the development, at an early stage, of a sustainability/exit plan. This will be the main strategy to ensure the sustainability of the project's achievements.

Generally, the project will take an adaptation approach based on sustainable livelihoods by building the basis of human, natural, physical and financial assets. The human capital will be enhanced with improved access to knowledge and practical know-how. Component 1 includes capacity-building activities for recipients.

The Federation of Women's Promotion Groups (GPF) has a lot of experience in organization and management of common equipment, acquired through the intervention of various partners. They will be the main beneficiaries of activities implemented under Component 1 and will be responsible for sustaining the gains and profit sharing. Members of the GPF will be trained for optimal resource management. For equipment maintenance, an amount is paid in a bank account after each sale. Establishment of such mechanisms will be facilitated by women's experience through the management of mutual savings and a credit fund they created. In the past, these women developed their own community projects, such as building a school for the village or the

[25] Local Development Support Center

introduction of a loan scheme to members who repay at a very low interest rate. In this way, they are gradually able to increase their capital.

Through their involvement in Component 2 activities, the population will also gain new capabilities for the maintenance of the realizations and, potentially, their extension.

While the natural capital is developed through adaptation measures based on ecosystems, such as reforestations, the physical capital is strengthened through coastal protection. All these capitals will contribute to enhance the financial asset of fishermen and women transformers contributing to improve the adaptive capacities both in households and the community. The combined effects of the three components will ensure the sustainability of outcomes in the long run.

K. Provide an overview of the environmental and social impacts and risks identified as being relevant to the project / programme.

In 2014, the CSE developed an environmental and social policy which is applied in any project/program the CSE is involved in. This policy defines standards to be considered in the management of environmental and social risks related to projects or programs. These standards are:

- Climate change;
- Hygiene and safety (Efficiency in resource use and pollution prevention; Construction of infrastructure and facilities, Exposure to Disease);
- Biodiversity conservation and sustainable management of natural living resources (Protected Areas, Management of ecosystem services; Management of living resources; Soil conservation, etc.);
- Human rights;
- Workers' rights;
- Cultural heritage;
- Equity and women rights.

Each project activity has been analyzed according to the CSE's Environmental and Social Policy requirements to identify potential risks and appropriate mitigation measures.

Analysis of risks

Compliance with the Law

Though designed to address the adverse effects of climate change, climate variability and build resilience, the activities planned under components 1 and 2 might generate some negative impacts for the natural ecosystems and the communities.

There are a regulatory regime and development strategies relating to mitigating such risks:

- Law N° 2001-01 of 15 January 2001 (Environment Code)
- Law N° 86-4 of 24 January 1984 (Hunting and Nature Protection Code) ;
- Law N° 81-13 of 4 March 1981 (Water Code) which provides for preventing water pollution and requirements in terms of securing drinking water supply and public health, agriculture, biological life of receptor medium, fish fauna…;
- Land legislation: the most relevant section with regard to the project activities are:
    - Land Act N° 64-46 of 17 June 1964 pertaining to the National Domain and creates spaces that are not likely to be owned;
    - Law N° 76-66 of 2 July 1976 (State Domain Code) which organize the public domain and the private domain;
    - Law N°96-06 of 22 March 1996 (Local Government Code) and Law N°96-07 of 22 March 1996 related to transfer of powers to Local Governments, as well as the Decret N°96-1134 of 27 December 1996 defining the powers of the Local Government for managing the environment in its territory.

Access and equity

The revival of rice cultivation will include activities in Ndimsane Island, which is a satellite island of Dionewar. The re-launch of rice growing activity could be source of conflict, if appropriate measures are not identified and implemented.

Marginalized and vulnerable groups

The project takes into account vulnerable groups (especially women) in its approach. Activities such as arches and oyster collection or processing of fish product are exclusively dedicated to this population segment. Furthermore, they are also associated with the implementation of other components, such as tree planting and rice cultivation. However, they could face personal constraints related to having their husband's consent, which the latter may use as a mean to control part of their own income.

The baseline studies and Project Benefit Assessment will include identification of the impact on marginalized and vulnerable groups.

Gender Equity and Women's Empowerment

Women are involved in all project components. In addition, several components, such as the collection of arches and oyster or processing of fish products, are specially dedicated to them while they will get a quota to plant trees, such as oil palms or the

Detarium senegalensis. In some components, such as processing of fish products, they will benefit from capacity-building in dedicated techniques. The environmental monitoring of the project will ensure compliance with these provisions. However, there is a risk these actors may lose control on part of their improved incomes.

The project should comply with the principles of the National Strategy for Gender Equality in this regard.

Core labour rights

Modalities for the project implementation eliminate constraint in its implementation. Populations freely organized to propose the project that they believe is relevant to their community's economic and social development. This is reflected in the project document, which advocates for sharing of benefits generated by the project. Moreover, payments for the work done under this project will be made in strict compliance with the current national standards (Labour Code).

Indigenous people

The population of the Dionewar islands consists mainly of the same ethnic group (Serer Niominka) and two well-established social rules are respect and equity. Therefore, there is no risk related to indigenous people for this project.

Involuntary Resettlement

The project activities do not require the displacement of any community and hence issues of resettlement do not arise.

Protection of natural habitats

The project is planning to rehabilitate natural habitats, namely the mangroves and the forests.

Component 2 of the project includes a ''mangrove planting'' component, which is a vital ecosystem in the reproduction and development of some fish and shellfish species. Mangroves are also a favourite habitat for arches and oysters, which will be used in the project. The tree planting activity is therefore crucial and timely, as the mangrove is facing salinity and deforestation degradation factors. Similarly, the planting of typical trees species on the Island such as oil palm, coconut tree or "ditakh'' (*Detarium senegalensis*), will further contribute to restoring vegetation.

Conservation of Biological Diversity

The project area of intervention, the Saloum Delta, has been classified as biosphere reserve (RBDS) since 1981 by UNESCO and a site of international importance since 1984 by the RAMSAR Convention. This biosphere reserve covers an area of 334,000

ha. In addition, the Saloum Delta has nine protected forests, a natural park (National Park of the Saloum Delta), a Marine Protected Area (Bamboung) and community natural reserves (Mansarinko, Missira, Nema Bah, Same Saroundia, Ndinderling, Baria Valley). A second Marine Protected Area in Sangomar is under preparation and will include the communes of Dionewar and Palmarin and cover an area of 87.437 ha.

In terms of tree planting, as well as fish and oyster farming, only local species will be used. However, equipment used in activities under components 1 and 2 could generate some negative impact for the marine biodiversity.

An assessment of possible impacts will be conducted and mitigation measures will be identified and implemented if there is any risk for the biological diversity.

Climate Change

The island nature of the area of intervention under the project makes it particularly at risk of rising sea levels, one of the major consequences of climate change (increased temperature). Templates that have taken into account the full range of the 35 scenarios forecast an average increase from 0.09 m to 0.88 m of the sea level between 1990 and 2100 (IPCC, 2001). In this context, the project will endeavour to reduce greenhouse gas emissions. This is reflected in the ''tree planting'' component that can contribute to carbon sequestration. At the same time, the development of rice fields will likely not cause logging, given the low rate of recovery on the site.

Pollution Prevention and Resource Efficiency

Some activities under the project, such as processing of fish products or rice cultivation, can be sources of water and soil pollution. The processing of fish products can generate solid and liquid waste, while rice cultivation could use fertilizers that will be thrown through drainage waters. The Environmental and Social Risk Management Plan will suggest a development of plans that manage waste and drainage waters to mitigate site contamination. At the same time, the use of herbicides in rice cultivation will not be promoted.

The project looks for higher resource efficiency for better management of available natural resources, such as fish species, plantation species (locally available), etc.

Public health

In the ''dike construction'' component, the possible and extended presence of workers can foster contact with local populations and cause outbreak of sexually transmitted infections, including HIV/AIDS. It may be the same for the construction of pirogues and banners for garlands for aquaculture.

Physical and cultural heritage

Shellfish beds are a cultural heritage in the Island and often associated with the presence of baobabs, which symbolize former life on the site. Baobabs are also linked to necropolis frequently mounted on shellfish beds. These huge trees often mark sacred places, such as the “Griot Baobab” found in Dioron Boumak.

The baobab gravesite which was a funerary practice has been reported only in the centre-western part of Senegal among the Serers.

In its implementation, the project will make sure not to impact in any way on the integrity and presence of this heritage.

Land and soil conservation

If poorly managed, waste from processed fish products can contribute to land and soil degradation. The same for fertilizers to be used in rice cultivation, as well as in the preparation of rice plots that can destroy soil and foster salt upriver.

Coastal erosion is a reality on the coast, namely upstream where the Arrow protects the commune. The construction of a protection structure here should not simply transfer the problem to another area.

Table 6: Analysis of risks related to project’s activities

Checklist of environmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
Compliance with the Law		Potential risks: - Contamination of the site by construction equipment; - Increased pressure on resources following capacity-building - Changes in drainage patterns Requirement: Environmental and Social Impact Assessment
Access and Equity		Potential risk : - Conflicts on sharing benefits from revival of productive sectors Requirement: - Environmental and Social Impact Assessment

Checklist of environmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
Marginalized and Vulnerable Groups	.	Potential risk: - Loss of control on part of their improved incomes (women oyster farmers or rice growers) Requirement: - Baseline studies and Project Benefit Assessment
Human Rights	No violation of human rights is foreseen through the project implementation.	None
Gender Equity and Women's Empowerment		Potential risk: - Loss of control on part of their improved incomes (women oyster farmers or rice growers) Requirement: - Baseline studies and Project Benefit Assessment - Environmental and Social Impact Assessment
Core Labour Rights	No risk identified with regard to labour rights. Human investments will be used as a contribution of the beneficiaries for the building of the dikes. This will also allow them to receive required capacities for the maintenance of facilities after project completion.	None
Indigenous Peoples	Not relevant for this project	None
Involuntary Resettlement	Not relevant for this project	None
Protection of Natural Habitats	The project activities comply with the requirements in terms of protection of natural habitats.	None

Checklist of environmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
Conservation of Biological Diversity		Potential risks: - Solid and liquid waste generated by the processing of fishery products and fertilizers that could be used in rice cultivation may be thrown through drainage waters and be harmful to the biodiversity. - Poor management of fish and oyster farms could also lead to toxic runoff, introduction of diseased species into populations - Excess of food and waste may influence population densities or stressed out fish. Requirement: Environmental and Social Impact Assessment
Climate Change	The project activities comply with the requirements in regards to climate change.	None
Pollution Prevention and Resource Efficiency		Potential risks: - Solid and liquid waste generated by the processing of fishery products and fertilizers that could be used in rice cultivation may be thrown through drainage waters. Requirement: Environmental and Social Impact Assessment
Public Health		Potential risks : - Outbreak of sexually transmitted infections, including HIV/AIDS Requirement: Sensitization of workers and populations (through the environmental and social management plan)
Physical and Cultural Heritage	In its implementation, the project will make sure not to prejudice the integrity of this heritage.	None

Checklist of environmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
Lands and Soil Conservation		Potential risks - waste from processed fish products can contribute to land and soil degradation, if poorly managed. - fertilisers to be used in rice cultivation as well as in the preparation of rice plots can destroy soil and foster salt upriver. - Transfer of the coastal erosion phenomenon to other parts. Requirement: - the waste management plan proposed by the ESMP will help limit possible soil contamination. - the feasibility study will ensure that the nature of the structure will avoid fostering gullies on other sites.

The project's possible impacts will be addressed through the implementation of the Environmental and Social Management Plan (ESMP), which defines the improvement and mitigation measures to be taken, as well as an environmental oversight and monitoring plan.

All costs associated with the positive impacts are included in the planned activities.

The tables below show the mitigation measures and the associated costs.

Table 7: Mitigation measures and associated costs

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	Cost (USD)
Mitigation measures of negative impacts	**Fish and oyster farming**	➢ Clearing Wetlands ➢ Competition with other water uses ➢ Impoverishment of local wild fish populations ➢ Increased pressure on resources ➢ Poor distribution of income from the marketing of fish and oysters	➢ Restrict wetlands clearing ➢ Choose an adapted site according to use and hydrology ➢ Evaluate the traditional use and demand of water resources ➢ Produce larvae and fry in tanks	ANA PMU	No costs associated (already included in the activity's budget)

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	Cost (USD)
			➢ Avoid exotic species		
		➢ Development of waterborne diseases	➢ Ensure to fight against the development of insect vectors (information and sensitization)	ANA PMU	20,000
	Tree nursery	➢ Over use of fertilizers ➢ Use of pesticides ➢ Groundwater Pollution ➢ Bad management of the packaging ➢ Clearing woodland	➢ Develop an detailed ESMP; ➢ Develop a pest and pesticides management plan ➢ Promote natural fertilizing techniques (composting, organic manure etc.)	PMU Consultant	Included in the ESIA cost Included in the general Pest and Pesticides Management Plan cost
	Dike rehabilitation	<u>Construction phase</u> Disruption of surrounding ecosystems (Rivers, lakes, soils, etc.)	➢ Develop an ESIA	PMU CSE	2000
			➢ Conduct awareness campaign for the risk of accidents	PMU	500
		<u>Operation phase</u> ➢ Use of downstream water issue ➢ Soil salinization ➢ Waterlogging land ➢ Proliferation of invasive plants ➢ Development of insects and other water-related disease vectors ➢ Conflicts because of the use of external workforce ➢ Injury or accidents on site	➢ Establish a Solid Waste Management Plan ➢ Use of local workforce in priority ➢ Take into account the downstream areas in the design of protective infrastructures	Civil engineering company	Included in the works
	Rice-growing	➢ Land degradation due to bad	➢ Restore forest cover;	Civil engineering	Included in the works

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	Cost (USD)
	development	agricultural practices (sensitive habitat, soil, water cycle, woodland ...) ➢ Misuse of fertilizers ➢ Misuse of pesticides can lead to: groundwater pollution, animal contamination, poisoning, residues on products	➢ Avoid slopes, soils subject to erosion; ➢ Develop a pest and pesticide management plan	company PMU	Included in the general Pest and Pesticides Management Plan cost
	Health and safety	➢ Risk of injury and accidents for workers and communities ➢ Dust emission ➢ Noise and vibration emission	➢ Identify potential hazards to workers; ➢ Establish preventive and protective measures, including modification, substitution or elimination of hazardous conditions or substances;	Civil engineering company	Included in the works
	Workforce	➢ Bad working conditions in general ➢ Equal treatment of workers discrimination and inequality of opportunity ➢ Non-compliance with national work standards ➢ Use of minor workers (children) ➢ Bad health and safety conditions	The relevant law must be strictly enforced, in particular concerning: ➢ Health and safety at work. ➢ Working conditions and terms of employment; ➢ workers' organizations; ➢ Non-discrimination and equal opportunities; ➢ Grievance Mechanism; ➢ Workforce	Civil engineering company	Included in the works

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	Cost (USD)
			protection.		
	Social acceptability	➢ Lack of commitment to the project; ➢ Delays in project implementation; ➢ Additional costs which were not initially included ➢ Lower level of social acceptability of the project and protests	➢ Identify interested or affected stakeholders ➢ Communicate and disclose information on the project (risks, impacts and opportunities) with affected the stakeholders ➢ Establish a consultation process with the community	PMU CSE	Included in the project and in the ESIA
	Cultural heritage	Soil movement during the use of shell mounds	The use of shell mounds have to be done in order to take into account the erosion factors and tree destruction	Civil engineering company	Included in the works
	Use of pesticides and fertilizers	➢ Misuse of fertilizers ➢ Misuse of pesticides can lead to: groundwater pollution, animal contamination, poisoning, residues on products,	Develop a pest and pesticide management plan: - Promote natural fertilizing techniques (composting, organic manure etc.) - Consultation with users and sensitization on the practice of an environmentally-friendly agriculture - Endowment	Consultant	30,000

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	Cost (USD)
			for the users		
Total					**52 500**

Categorization

In view of the above, the project is categorized as "Category 2" of the Environment Code of Senegal, which means that it has limited impacts on the environment or the impacts can be mitigated by implementing measures or changes in its development. This category is subject to an initial environmental and social assessment.

With regard to the Adaptation Fund AF categorization, the project can be categorized as Category B, meaning that it has potential adverse impacts, but in small number and scale, not widespread and easily mitigated through an ESMP.

Grievance mechanism

CSE has developed a grievance mechanism policy. That grievance mechanism is the one applicable to the project. The purpose of the policy is to make available a framework for resolving specific grievances in a manner that allows the pursuit of project/program's goals while simultaneously safeguarding the environment and the landscape in line with the expectations of communities. This is how the policy works:

Receiving and recording the complaint: A complaint-resolution staff (CRS) has been created and is part of CSE's "Environmental Assessment and Risk Management" Major Program. The complaint can be sent by electronic mail, fax, post, or hand-delivered. It can be transmitted either directly to the contact point of the CSE or through community leaders, government officials, community organizations, contractors, CSE's staffs or Community Liaison Officers (CLO). Once a complaint has been received, it is recorded in the central register and the CRS will acknowledge receipt of the grievance and inform the complainant about the time frame in which a response can be expected. The CRS then checks the eligibility of the complaint. If the complaint is rejected, the complainant is informed within one week of the decision and the reasons for the rejection. The DEEC is also notified. If eligible, the complainant is also notified, and the grievance is processed. The CRS proceeds to an assessment.

Assessing the grievance: The assessment consists of: identifying the parties, issues, views, and options involved; gathering views of other stakeholders (including those of the project execution team or contractors); determining initial options that parties have considered and exploring various approaches for settlement; classifying the complaint depending its seriousness (high, medium, or low), in collaboration with the DEEC's provincial unit.

Formulating a response: The CRS will prepare a response considering the complainants' views about the process for settlement, and will provide a specific response. The response may suggest an approach for how to settle the issues, or it may offer a preliminary settlement. The response will be reviewed during a meeting with the CRS, the General Manager, the project coordinator and the complainant. If the proposal is a settlement offer and it is accepted, the complaint is resolved amicably. If the case is complex and a resolution time frame cannot be met, an interim response will be provided (oral or written communication) to inform the complainant of the delay, explain the reasons, and liaise with the DEEC in order to offer a revised date for next steps. The grievance is then forwarded to the Directorate of Environment for further action.

Monitoring and reporting: The focal point receives and monitors each grievance case. All complaint cases filed and holding treatments for settlement will be subject to a report, which is shared with relevant stakeholders and CSE's staff.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Arrangements for project implementation

Institutional framework

Several institutions are involved in fighting climate change in Senegal. For the implementation needs of this project, only the main stakeholders in this project will be analyzed.

The **Direction of the Environment and Classified Establishments** (**DEEC**) of the Ministry of the Environment and the Sustainable Development (MEDD) is the Designated National Authority (DNA) of the Adaptation Fund (AF) in Senegal; she has endorsed the current request of financing. (See letter of endorsement)

The **Centre de Suivi Ecologique** (**CSE**) is semi-autonomous body created in 1993 with the long-term mission of contributing to the economic development of Senegal by facilitating the participative management of natural resources and the environment by gathering, treating, analyzing and disseminating data and information about the territory and the resources. The CSE covers a wide range of interventions, including the monitoring of the environment, town and country planning, decentralization, early warning, disasters management, capacity-building, costal area management, etc. Its activities, across all these areas, are based on the use of the geomatics combined with field work. The CSE was accredited as National Implementation Entity (NIE), with the Adaptation Fund (AF) and with the Green Climate Fund (GCF). The CSE successfully led an adaptation project in Senegal's coastal zone (Adaptation to coastal erosion in vulnerable zones). It has also recently — and successfully — submitted to the GCF a project proposal, which is one of the three first projects approved for Africa by the Green Climate Fund.

The **National Council for Functional Literacy** (**CONAF**) was created in October 1993. It was registered as a national Non-Governmental Organization (NGO) under the number 03140 / MFSAEMFMPE / DDC on April 1st, 2010. The CONAF is a NGO that works for the development and the promotion of the Senegalese people's well-being, and particularly the vulnerable ones. CONAF fights to reduce poverty and ignorance through training of vulnerable groups (women and girls), raising awareness and providing tools and economic means through functional community-based organizations. It's in this context that the CONAF, in partnership with the **Association of the Natives for the Development of Dionewar** (**ADD**), actively collaborate in research to protect the village of Dionewar against coastal erosion and floods. The synergy between both structures is visible on the field through mangrove reforestation actions and the installation of dikes that face floods and coastal erosion, which threaten the village of Dionewar.

The **National Agency for Aquaculture** (**ANA**) is an autonomous administrative structure, created by decree 2011-486 of April 8th, 2011 (repealing the decree 2006-766) and placed under the authority of the Ministry of Fisheries and Maritime Economy. As its general mission, ANA seeks to contribute to the development of fish farming by closely assisting professionals in the sector, and by providing the necessary support for the sustainable development of the aqua-cultural exploitations and the realization of the National Program of Development for Fish Farming objectives. It is in charge, and in synergy, with the appropriate structures, to:

- identify and exploit sites favourable to marine and continental fish farming;
- sensitize and supervise entrepreneur project leaders in the various segments of the aqua-cultural sector;
- strengthen management capacities of fish farming professionals, in particular the technical, financial, commercial and organizational aspects;
- support the implementation of aqua-cultural productions farms;
- assure, in partnership with the specialized structures, the required quality monitoring services for the aqua-cultural companies;
- seek national and foreign investments for the aqua-cultural sector.

The **National Agency for Civil Aviation and Meteorology** (**ANACIM**) was created by decree 2011-1055 of July 28th, 2011. It arose from the fusion of the former agencies of the civil aviation and the meteorology service. Through its Directorate of Meteorology, ANACIM is the body in charge with the collection and dissemination of meteorological data on the entire national territory. At a provincial level, ANACIM has standard meteo stations allowing it to collect data and perform the forecasting of several parameters namely: rainfall, wind, humidity, tide. These data are regularly collected and analyzed to produce weather reports that are distributed through various broadcastings channels, among which include the written press, radio, TVs and websites.

Decentralized services (**Sub-Prefecture and CADL**). The municipality of Dionewar is under the administrative authority of the sub-prefecture, which is based in the village of Niodior. As representative of the Government at local level, the sub-prefect has under his authority all government employees and civil agents in the “arrondissement” (third administrative level in Senegal). As such, he coordinates the economic and social development actions within the framework of the local planning strategies. He is also in charge of mobilizing all appropriate means to arouse and to encourage the populations’ participation in development actions. In this respect, he chairs the local development support centre (CADL) among which the attributions, the organization and the functioning are all fixed by order.

The **Local Development Support Centre** (**CADL**) is a decentralized body of the Local Development Support Directorate (DADL). It is charged with instigating and following up on all the development actions at the community level, within the limits of the district’s territory. The CADL agents assure a support function, council and training in diverse domains such as: agriculture, environment, fishing, community-based organizations, the

acts and laws on decentralization etc. In this regard, the municipality's budget is always developed with the support of the CADL.

Project management's bodies

The National Implementing Entity (**NIE**): The Centre de Suivi Ecologique is the implementing entity of the project for the Adaptation Fund and, as such, assures the administrative and financial management of the project. Aside from the project's bookkeeping, the CSE will be in charge of: a) the implementation of a financial accounting system and management of the project's resources, including disbursements; b) drawing up expenditure forecasts for activities planned in the annual work plan and budget (AWB); c) the project account management; d) the account recording for the project operations, the preparation of the annual financial statements and the timeliness of all project documentation relating to financial and accounting management; f) the control of the effectiveness of services; f) providing technical support to the executing agencies; the reporting to the AF, both technical and financial; and g) the programming of the annual audits, the transmission of audit reports to the Government and to the AF, and the implementation of the recommendations of audits. The implementation of the financial management activities will be made correspondingly and in line with the administrative, financial and accounting procedures, such as defined in the CSE's Handbook of Procedures. This latter defines the scoop of work of the project staff and the modalities of appreciation of their performances.

The **National Steering Committee** (**NSC**): the project implementation will be overseen by the NSC, which will be charged with the responsibility of approving the plans, operational and annual reports of the project and for guaranteeing that the project activities are in line with those in the document approved by the AF and with the country's policy framework. The NSC will hold its first meeting during the start-up phase of the project and will meet biannually to perform the project's progress assessment, monitor results, receive other reports for which it can ask for that purpose and get on annual continuous plans of work. The NSC will be composed of the representatives of (i) the Designated Authority for the Adaptation Fund (ii) the Climate Change National Committee, (iii) the decentralized bodies operating in Dionewar, (iv) the community-based organizations, (v) the private sector, (vi) the research institutions, (vii) and the CSE.

The **Project Management Unit** (**PMU**): The Project will be executed by a project team, called Project Management Unit (PMU) that will be based in Dionewar. The PMU will include the following key staff: i) A local project coordinator; ii) a Monitoring and Evaluation specialist; iii) an administrative and financial assistant; and v) two field officers (Members of the CADL). Additionally, staff members of ANA and ANACIM will also be mobilized, when needed and for specific tasks. The PMU will emanate from the main proponent of the project, which is CONAF-ADD and which will provide the coordinator. The PMU will serve as a technical assistance for CONAF-ADD which will ensure CSE's execution of activities on-the-ground. An agreement will be signed between CSE and CONAF-ADD, and this latter will make the recruitment of the PMU

staff using CSE's procedures. Having CONAF-ADD strongly involved in the project management will ensure ownership, strengthen local actors' capacities and, thereby, ensure sustainability.

The CSE will not be directly involved in executing project's activities, but will be supervising the project execution.

The PMU will be responsible for: i) the preparation and the implementation of annual work plans and annual budgets (AWB), ii) relations with administrative authorities and other partners, iii) coherence between the components of the project, iv) the supervision and follow-up execution of all activities promoted by the project. It will establish a synergetic partnership with current projects under implementation in the zone, as well as other projects which are complementary of those of this project. It will contribute to the harmonization of the approaches of intervention (compatibility between the AWB, the harmonization and the alignment of the activities etc.) to facilitate information exchanges, experiences and lessons learned between all stakeholders.

Coordination and implementation modalities

The **Annual Work Program and Budget** (**AWB**): The AWB will be prepared by the PMU on the basis of activities planned under the project's different components. The AWB will contain the activities' details, their unit and global costs, the monitoring indicators as well as the modalities of execution. It will be subject to approval by the NSC and an opinion of non-objection by the CSE before its implementation. The populations will adopt a flexible approach allowing regular revisions of the AWB during the budgetary year and take into account the request formulated and the planned deadlines of execution.

Service providers: The Project will subcontract the execution of some activities to service providers from the associative, public, and private sectors. The PMU will develop specifications and will sign performances contracts with the service providers specifying the activities to be executed, the expected results, the obligations and the rights of each party, the deadlines of execution, the deliverables, the reports and monitoring-evaluation indicators. For information purposes and not restrictive, contracts and procurements for the project activities can be made with the potential service providers below: i) the public institution providers: the institutions of research and the regional and departmental technical services of the relevant Ministries on the subject, in particular for the activities of specialized technical support, supervision or follow-up; ii) associative providers: NGO, GIE, umbrella organizations and local development associations, in particular for advice and training; and iii) private operators: works firms, engineering consulting firms, independents consultants, toilers.

Implementation approach of the components: In a general way, the implementation approach is articulated around three main principles: i) the full and active participation of local populations and their representative institutions in all the stages of the Project

implementation , ii) the contractualization of persons in charge of the execution of the actions promoted by the Project (development of the local offer of service), and iii) the research and the promotion of an operational partnership between the Project, the local actors and the other development partners intervening in the same area. Local communities have already been consulted and involved in the design of the project's activities. They are the main proponent of the project through ADD which will also provide the coordinator of the PMU. Furthermore, the communities will be directly involved in the execution, monitoring and evaluation of the project's activities. In regards to the environmental and social safeguards, public consultations have been conducted in an appropriate way for communities that are directly affected by the project's activities. They will also be involved in the approval of the progress report in the implementation of the environmental and social risk management plan.

Startup activities: Will mainly include the following: i) selection and recruitment of the Project's key staff; ii) elaboration of a AWB; iii) preparation of a monitoring-evaluation (M&E) plan and the implementation of the M&E system; iv) identification of potential service providers, the preparation of the files of calls for tender of the main service providers; v) organization of the inception workshop and starting up of the Project.

B. Measures for financial and project risk management

Table 8: Measures for financial and project risk management

Risks	Level	Proposed mitigation measures
Institutional and political The local elected representatives and the representatives of the State who have already been trained by the project have changed after the local elections in 2017	Low	Training sessions are organized every year by the project and the new elected representatives or officials appointed by the government can benefit from trainings
Climatic Extreme weather events affect the realizations of the project	Low to medium	The technical specifications for constructions of dikes, ridges, fish ponds, spat collector and grow out bags, take into account the most extreme events having affected the project's zone

Risks	Level	Proposed mitigation measures
Financial The implementation of alternative options of production (fish farming, oyster farming, etc.) will generate important financial resources, which can be sources of conflict between stakeholders or subject to embezzlement. This might compromise the financial sustainability of the project achievements.	Medium	Management committees are put in place and their members trained on transparent and fair management of the generated funds. Businesses plan are also developed for purposes of production efficiency.
Social The arrival of a foreign workforce and the establishment of protective infrastructure and income-generating activities in a single village in the municipality (which counts three villages) can be a source of conflict and tension between the villagers.	Low	Conduct awareness sessions and inform the municipality. It is also important to explain early on that the project was initiated by Dionewar nationals, which is essentially why the village was chosen for these activities and infrastructure. When the building starts, it is also essential to inform foreign workers on local cultural settings to help avoid conflict with villagers.

C. Measures for environmental and social risk management, in line with the Adaptation Fund's Environmental and Social Policy

In regards to compliance with the regulatory framework, the project must enforce the relevant provisions provided through regulations and strategies.

Pursuant to the Senegalese Environmental Code, the project was subject to an environmental and social evaluation and an environmental and social management plan was developed.

The project will further comply with other legal texts, such as the Mining Code which requests career clearance to meet the needs to construct infrastructures (dikes, basins, etc.). The Forest Code will support the project activities on tree planting, namely in regards to implementation and evaluation techniques and standards. The project will also comply with the Fisheries Code governing the modalities for capture and resource management: the equipment used for aquaculture development shall be certified by the competent services of the Ministry of Fisheries.

At the international level, the Convention on Biodiversity will be invoked to bolster efforts for species conservation on the Island, while the Convention on Persistent Organic Pollutants will be in force to monitor the use and management of chemicals in aquaculture and rice cultivation. At the same time, the use of herbicides in rice cultivation will not be promoted.

The population and workers will be systematically sensitized on health risks — and mainly HIV/AIDS-related risks.

To anticipate potential land tenure related issues, a “cadastral map” for rice-growing areas will be developed. This will help clarify the land status before any intervention and will guide the distribution of lands at the end of the realizations.

The structures chosen to protect from coastal erosion were carefully chosen to protect against upwelling in Colbassy, for example, and to avoid fostering erosion in other sites.

CSE’s Environmental and Social Policy and the Adaptation Fund’s Environmental and Social Policy will be made available to project stakeholders. They will also be promoted through training and dialogue with implementing agencies to build a common understanding of the principles and practices that have been adopted. Essentially this is to help enhance development benefits and avoid unnecessary harm to the environment and the communities.

D. Monitoring and evaluation arrangements and budgeted M&E plan

The Monitoring and Evaluation of the project will be made according to the procedures established by the CSE and by the AF. The Results framework gives the performance indicators against which the project will be evaluated and specifies the baseline as well the objectives to be achieved. The M&E system proposed describes the main planned activities to be executed in the M&E, reporting and project analysis system (MERAS).

The M&E plan (MEP) is the main element for the Monitoring and Evaluation activities, reporting and analysis System (MERAS) and will play a key role for the planning, management and implementation of project activities. The MERAS is designed to play three main roles: 1) Coordinate the M&E activities of the project; 2) Provide data collected in the appropriate formats for the various stakeholders; and, 3) Store this data / information as well as the other relevant data / information in a computerized system. The total cost of the MEP is estimated at 83,539 USD among which 30,039 USD will be financed by the CSE with its management fees.

The table below shows a list of potential products of the MERAS, with an indicative calendar for the publication of the diverse products, and corresponding budget. The project will have to produce and circulate several documents during the first months of implementation. Thereafter certain documents will be produced periodically while the others will be on demand.

Table 9 : Budgeted Monitoring and Evaluation plan

Outputs	Main responsible	Timeframe	Budget ($ us)	Destination
Inception workshop's report	Project team CSE	During the first month following the start of project	15,539 (9,500 + 6,039)	CSE, AF
M&E Plan	Project team CSE	During the first month following the start of project	-	CSE, AF
National Steering committee meeting reports	Project team CSE	Every 6 months	6,000	CSE, AF
CSE supervision field mission reports	CSE	Monthly in year 1 Quaterly from year 2 to completion	24,000	National Steering committee (NSC), CSE
Final M&E Plan (Including baseline)	Project team	At the beginning of the project (1st month)	-	National Steering committee (NSC) CSE, AF
Monthly progress report	Project team	The 5th of each month	-	National Steering committee (NSC)
Quarterly report	Project team Task Manager CSE	End of each quarter	-	NSC, CSE, AF
Mid-term evaluation report	Consultants	At the mid-term of the project	3,000	NSC, CSE, AF
Final evaluation report	Consultants	At project completion	7,500	NSC, CSE, AF
Audit Report	External auditors	At the end of the project	10,000	NSC, CSE, AF
Maps, posters, videos, photos, etc.	Project team	Rolling, upon availability	17,500	Diverse
TOTAL			**83,539**	

E. Results framework for the project proposal

Table 10: Results framework

Title: REDUCING VULNERABILITY AND INCREASING RESILIENCE OF COASTAL COMMUNITIES IN THE SALOUM ISLANDS (DIONEWAR)

Project goal: Reduce the vulnerability of populations in the Saloum Islands to flooding and coastal erosion.

Specific objectives:

1. Improve the resilience of the sectors of fishing, aquaculture and forestry to natural hazards

2. Reduce the vulnerability of populations and natural habitats to hazards through the establishment of structures to better regulate flooding, control coastal erosion and fight against land salinization.

3. Enhance local development planning through integration of climate change, setting up local conventions and documenting lessons learned

	RESULTS CHAIN	*PERFORMANCE INDICATORS*			*MEANS OF VERIFICATION*	*COMMENTS ON INDICATORS*
		Indicator	*Baseline*[26]	*Target*		
OBJECTIVE	Reduced vulnerability of populations in the Saloum Islands to flooding and coastal erosion	Number of risk-exposed coastal households benefiting of adaptation measures	451 households threatened by flooding and coastal erosion	At least 270 households (112 at mid-term)	Progress reports, survey	

[26] Current baseline information derives from documentary review and field missions during project preparation and may need to be updated at the early stage of the project implementation as indicated in the monitoring and evaluation section of this project document.

OUTCOMES	Improved resilience of the main ecosystems of Dionewar Island and sustainable livelihoods of populations	- Are (ha) of mangrove and terrestrial ecosystems restorated - % of increase of income of population involved in alternative income generating activities (breakdown by gender)	0 0	5ha of mangrove (2 ha at mid-term) and 6ha of terrestrial ecosystem (2ha at mid-term) Increase of 25% at least	Field visit, progress reports Survey	
	Reduced vulnerability of populations and socioeconomic infrastructures in Dionewar to hazards with the construction or rehabilitation of protection structures	Number of dikes and ridges rehabilitated and built to protect households and socioeconomic infrastructures against flooding and coastal erosion	0	2 dikes, 2km of ridges	Field visit, completion report of contractors	
	Strengthened capacity of local institutions to mainstream climate change in local development planning, sustainable natural resources management strategies and to document and disseminate lessons learned.	*Number of persons (including decision makers) aware of local climate issues and adequate measures to be implemented* *Number of local development tools that integrate adaptation measures*	0 0	100 persons (50 at mid-term) (half of them women and half of them men) 2 (PLD and PLAE)	Training Workshop reports (list of participants) Updated PLD and PLAE documents	

OUTPUTS	**Component** 1: Enhancing resilience for productive sectors in Dionewar Island					
	1.1. Alternative Fish and oyster farming production system developed for 18 women associations, including the setup of 30 fish growing cages, 200 spat collectors and 1000 growout bags (USD 81,975)	- Number and type of adaptive production system - Number of fish cages - Number of spat collector - Number of growout bags	0 0 0 0	3 30 200 1000	Progress reports, field visit	Alternative fish and oyster farming includes: growing cages, spat collector and growout bags)
	1.2. At least 6 ha of trees planted (enrichment planting with especially coconut trees and oil palms) and 5 ha of mangrove rehabilitated in Dionewar and its satellite islands in order to revitalize the main productive sectors (USD 35,200)	- Area (ha) of trees planted - Area (ha) of mangrove rehabilitated	0 0	*- 6ha of tree planted (2ha at mid-term)* - 5ha of mangrove rehabilitated (2 ha at mid-term)	Field visit, progress reports	
	1.3. At least 18 women economic interest groupings and natural resources management committee trained to improve their technical performance (USD 40,800)	- Number of women's economic groups trained - Number of member of management commitee of community based organisations trained	0 0	*18 (10 at mid term)* *30 women*	Training sessions reports	
	1.4. *Fish and oyster farms business plan developed (USD 15,400)*	- Number of business plan	0	2	Business plan documents	
	Component 2 : Protection against flooding, coastal erosion and salinization in Dionewar					

	2.1. The 2 dikes to protect against flooding are restaured and extended over 2 km (USD 624,000)	- Number of new dikes built	0	2	Contractor's completion report/Field visit	
	2.2. Ridges are built around rice plots in Dionewar (USD 31,000)	- Area (ha) of rice plot protected by ridges	0	10 ha at least	Contractor's completion report/ Field visit	
	2.3. A maintenance plan developed, involving key stakeholders (USD 21,000)	- Number of dikes' mantenance plan developed	0	1	Maintenance plan document	
	<u>Component 3</u>: Strategic planning and knowledge management					
	3.1. The Local Development Plan (PLD) and the PLAE are reviewed in order to integrate adaptation to climate changes options & costs benefits (USD 21,000)	- Number of planning documents reviewed that integrated adapatation options	0	2	Up dated PLD, updated PLAE	
	3.2. Rules governing the exploitation of timber and non-timber forest products and the biological rest updated and formalized through a Local Convention (USD 7,946)	- Number of local covention on sustainable management of natural ressources adopted	0	1	Municipality delibaration note	

	3.3. Project's lessons learned documented and shared (USD 32,150)	- Number of production of lessons learned - Number *of persons (including decision makers) informed of local climate change issues and adequate measures to be implemented*	0 0	Audio records, video, posters and publications 650 persons (510 adult women, 120 adult men, 20 students (10 girls and 10 boys)	Audio records, video, posters and publications M&E reports, MTE report, Final evaluation Report	Productions includes: audio, video, posters and hard paper publication
	3.4. Automatic meteorological station implemented (USD 29,400)	- Number of meteorological station implemented	0	1	Field visit, contractor's achievement report	
	4. Project Execution (USD 118,290)	- Rate of achievement	0	100%	Progress reports, midterm and final evaluation report	
	5. Project management CSE (USD 105,839)	- Number of reports - Rate of disbursement - Rate of achievement	0 0 0	12 100% 100%	Reports Audit report Final evaluation, field visit, custumer satisfaction survey	9 quaterly reports, 2 annual reports, 1 final report

F. Projects alignment with the Results Framework of the Adaptation Fund

The overall objective of the project ("to reduce the vulnerability of populations in the Saloum Islands to flooding and coastal erosion") contributes to the Adaptation Fund's Outcomes: 1 ("Reduced exposure at national level to climate-related hazards and threats"), 5 ("Increased ecosystem resilience in response to climate change and variability-stress induced"), 6 ("Diversified and strengthened sources of income for vulnerable people in targeted areas livelihoods"), 4 (Increased adaptive capacity within relevant development sector services and infrastructure assets), 3 (Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level), and 7 (Improved policies and regulations that promote and enforce resilience measures). This will be achieved by enhancing the resilience of natural habitats, populations and their activities to the adverse effects of climate change and climate variability.

The first project outcome ("The resilience of the main productive sectors of Dionewar Island is enhanced and sustainable livelihoods of populations are improved") aligns with the Adaptation Output 5 (Vulnerable ecosystem services and natural resource assets strengthened in response to climate change impacts, including variability) and Output 6: "Targeted individual and community livelihood strategies strengthened in relation to climate change impacts, including variability".

The Project Outcome 2 ("The vulnerability of populations in Dionewar to hazards is reduced with the construction or rehabilitation of protection structures") aligns with the Adaptation Fund Output 4: "Vulnerable physical, natural, and social assets strengthened in response to climate impacts, including variability change".

The project Outcome 3 ("Climate change is integrated in local development planning, natural resources are used in a more sustainable way and lessons learned are documented and shared") is aligned with the Adaptation Fund Output 3: Targeted population groups participating in adaptation and risk reduction awareness activities and Output 7: "Improved integration of climate-resilience strategies into country development plans".

Table 11 : Project alignment with the AF's results framework

Project Objective(s)	Project Objective Indicator(s)	Fund Outcome	Fund Outcome Indicator	Grant Amount (USD)

Project Objective(s)	Project Objective Indicator(s)	Fund Outcome	Fund Outcome Indicator	Grant Amount (USD)
Reduce vulnerability of populations in the Saloum Islands to flooding and coastal erosion.	Number of risk-exposed coastal household of Dionewar benefiting of adaptation measures	***Outcome 1:*** *Reduced exposure to climate-related hazards and threats* ***Outcome 5:*** *Increased ecosystem resilience in response to climate change and variability-induced stress* ***Outcome 6:*** *Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas* ***Outcome 4:*** *Increased adaptive capacity within relevant development sector services and infrastructure assets* ***Outcome 3:*** *Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level* ***Outcome 7:*** *Improved policies and*	*1.2.1. Percentage of target population covered by adequate risk-reduction systems* ***5.*** *Ecosystem services and natural resource assets maintained or improved under climate change and variability-induced stress* *6.2. Percentage of targeted population with sustained climate-resilient alternative livelihoods* *4.2. Physical infrastructure improved to withstand climate change and variability-induced stress* ***3.1.*** *Percentage of targeted population aware of predicted adverse impacts of climate change, and of appropriate responses* *7. Climate change priorities are*	

Project Objective(s)	**Project Objective Indicator(s)**	**Fund Outcome**	**Fund Outcome Indicator**	**Grant Amount (USD)**
Project Outcome(s)	Project Outcome Indicator(s)	Fund Output	Fund Output Indicator	Grant Amount (USD)
Outcome 1 : Improved resilience of the main ecosystems of Dionewar Island is enhanced and sustainable livelihoods of populations	*1.1.* Number ha of mangrove and terresterial ecosystems restaurated 1.2. Percentage of increased income for populations involved in alternative generation income activities (desegregated by gender)	***Output 5:*** *Vulnerable ecosystem services and natural resource assets strengthened in response to climate change impacts, including variability* ***Output 6:*** *Targeted individual and community livelihood strategies strengthened in relation to climate change impacts, including variability*	*5.1. No. of natural resource assets created, maintained or improved to withstand conditions resulting from climate variability and change (by type and scale)* *6.2.1. Type of income sources for households generated under climate change scenario*	298,418
Outcome 2: Reduced vulnerability of populations and socioeconomics infrastructures in Dionewar to hazards with the construction or rehabilitation of protection structures	*2.1.* Number of dikes rehabilitated and built to protect household and socioeconomic infrastructures against floding	***Output 4:*** *Vulnerable development sector services and infrastructure assets strengthened in response to climate change impacts, including variability*	*4.1.2. No. of physical assets strengthened or constructed to withstand conditions resulting from climate variability and change (by sector and scale)*	753,957

Project Objective(s)	Project Objective Indicator(s)	Fund Outcome	Fund Outcome Indicator	Grant Amount (USD)
Outcome 3: Strengthened capacity of local institutions to mainstream climate change in local development planning, sustainable natural resource management strategies and to document and disseminate lessons learned.	*3.1. Number of persons (including decision makers) aware of local climate change issues and adequate measures to be implemented* *3.2. Number of local developement tools that integrate adaptation measures*	***Output 3**: Targeted population groups participating in adaptation and risk reduction awareness activities* ***Output 7:** Improved integration of climate-resilience strategies into country development plans*	*3.1 No. of news outlets in the local press and media that have covered the topic* *7.1. No. of policies introduced or adjusted to address climate change risks (by sector)*	74,496

Through its 3 components, the project is in line with 4 out of the 5 Adaptation Fund core impact indicators.

Activities planned under **Components 1** (*Enhancing resilience of main ecosytems in Dionewar island*) and **2** (*Protection against flooding and salinization in Dionewar*) will contribute to measuring impacts in terms of

- "Number of Beneficiaries";
- "Assets Produced, developed, Improved or strengthened" with the rehabilitation of the flood management system;
- "Increased income, or avoided decrease in income": development of fisheries, non-wooded forest products availability and agriculture; and
- "Natural Assets Protected or Rehabilitated": reduction of deforestation, improvement of biodiversity, restoration of mangroves and enhancement of the integrity of ecosystem

Activities planned under **Component 3** (*Strategic planning and knowledge management*) contribute to measuring impacts in terms of "Assets Produced, developed, Improved or strengthened" by the mainstreaming of climate change in local development planning.

G. Detailed budget

a) Summary output budget

Table 12: Output budget

Components	Output	Year-1	Year-2	Year-3	Total
Component 1: Enhancing resilience of main ecosytems in Dionewar island	1.1	41,920	5,895	5,895	53,710
	1.2	87,516	36,783	27,683	151,982
	1.3	13,600	13,600	13,600	40,800
	1.4	0	15,400	0	15,400
	Implementation of the ESMP	12,175	12,175	12,175	36,525
Total Component 1		**155,211**	**83,853**	**59,353**	**298,417**
Component 2: Protection against flooding, coastal erosion and salinization in Dionewar	2.1	624,000	0	0	624,000
	2.2	36,837	0	0	36,837
	2.3	21,000	0	0	21,000
	Implementation of the ESMP	24,040	24,040	24,040	72,120
Total Component 2		**705,877**	**24,040**	**24,040**	**753,957**
Component 3: Strategic planning and knowledge management	3.1	10,000	8,000	3,000	21,000
	3.2	4,400	3,546	0	7,946
	3.3	6,050	5,550	4,550	16,150
	3.4	29,400	0	0	29,400
Total component 3		**49,850**	**17,096**	**7,550**	**74,496**
Project execution		**43,280**	**30,320**	**44,690**	**118,290**
Total Project cost		**954,218**	**155,309**	**135,633**	**1,245,160**
Management fees		**37,239**	**34,200**	**34,400**	**105,839**
TOTAL PROJECT COST		**991,457**	**189,509**	**170,033**	**1,351,000**

b) Detailed budget with budget notes

Table 13: Detailed budget

COMPONENT	OUTPUTS	ACTIVITIES	Year 1	Year 2	Year 3	TOTAL	NOTES
Component 1:	Output 1.1	Fish farming					
Outcome 1	200 spats	Logistic	10,000	-	-	10,000	Motorized speedboat
		Operating expenses	5,895	5,895	5,895	17,685	
		Oyster farming					
		Fixed asset	13,060	-	-	13,060	
		Working capital	12,965	-	-	12,965	
		Total Output 1.1	41,920	5,895	5,895	**53,710**	
	Output 1.2.	Tree Nursery					
	6ha reforestation	Laying out	10,000	-	-	10,000	Cleaning, fencing, digging well
	5ha mangrove	Inputs	2,849	2,449	2,849	8,147	Plastic container, seed, phytosanitary products
		Equipment	49,833	-	-	49,833	Rakes, shovels, wheelbarrows, and other equipment
		Labour	23,734	23,734	23,734	71,202	10 temporary workers for watering, weeding, etc.
		Reforestation					
		Logistic	600	600	600	1,800	Cart rental for young trees transportation
		Social labor	500	500	500	1 500	Allowances, restauration for 100 persons/session
		Ecoguards training	-	5,000	-	5,000	Consultancy services for training 15 eco-guards
		Ecoguards equipment	-	4,500	-	4,500	Uniforms and other equipments
		Total Output 1.2	87,516	36,783	27,683	**151,982**	
	Ouput 1.3.	Organizational management					
	19 GPF trained	Consultancy services	5,000	5,000	5,000	15,000	10H/day x 3 sessions

		Workshop	1,800	1,800	1,800	5,400	30 participants/session of 5days x 3
		Production mgt					
		Consultancy services	5,000	5,000	5,000	15,000	10 P/day x 3 sessions
		Workshop	1,800	1,800	1,800	5,400	30 participants/session of 5 days x 3 sessions
		Total Output 1.3	13,600	13,600	13,600	**40,800**	
	Output 1.4.	Fish farming					
	2 business Plan	Consultancy services	-	7,000	-	7,000	15 P/Day
		Validation workshop	-	700	-	700	One day workshop for 50 participants (Restauration)
		Oyster farming					
		Consultancy services	-	7,000	-	7,000	15 P/day
		Validation workshop	-	700	-	700	One day workshop for 50 participants (Restauration)
		Total output 1.4	-	15,400	-	**15,400**	
	Implementation of the ESMP	**Implementation of the ESMP**	**12,175**	**12,175**	**12,175**	**36,525**	
TOTAL COMPONENT 1:			**155,211**	**83,853**	**59,353**	**298,417**	

COMPONENT	OUTPUTS	ACTIVITIES	Year 1	Year 2	Year 3	TOTAL	Notes
Component 2:	Output 2.1						
	2 dikes	Surveying	35,000	-	-	35,000	Complementary feasibility studies
Outcome 2		Shell storage	527,000	-	-	527,000	Supervision and technical assistance
		Contract services	62,000	-	-	62,000	
		Total Output 2.1	624,000	-	-	**624,000**	
	Output 2.2						
	Ridges	Rice areas mapping	10,000	-	-	10,000	Cadastral map of rice-growing areas

		Purchase of equipment	10,000	-	-	10,000	
		Social mobilization actions	8,000	-	-	8,000	Construction
		Consultation with producers	3,000	-	-	3,000	(use and amortization of material)
		Construction of multipurpose unit	1,699	-	-	1,699	
		Tiller	4,138	-	-	4,138	
		Total Output 2.2	36,837	-	-	**36,837**	
	Output 2.3.						
	Maintenance plan	Maintenance guide	15,000	-	-	15,000	
		Management committee	3,000	-	-	3,000	
		Report back session	3,000	-	-	3,000	
		Total output 2.3	21,000	-	-	**21,000**	
	Implementation of the ESMP	**Implementation of the ESMP**	**24,040**	**24,040**	**24,040**	**72,120**	
TOTAL COMPOSANTE 2:			**705,877**	**24,040**	**24,040**	**753,957**	

COMPONENTS	OUTPUTS	ACTIVITIES	Year 1	Year 2	Year 3	TOTAL	Notes
Component 3:	Output 3.1	_					
	Mainstreaming CC	Update PLD and PLAE	7,000	-	-	7,000	Consultancy services 30 P/Day
		Training (1) local representatives	-	5,000	-	5,000	Consultancy 10 P/Day. “Climate resilient budget”
		Training (2) local representatives	2,600	2,600	2,600	7 800,00	Consultancy 7 P/D x 3 sessions. "CC management”
		Workshops	400	400	400	1,200	25 participants per training session
		Total Output 3.1	10,000	8,000	3,000	**21,000**	

	Output 3.2.						
	Local	Diagnostic RN natural resources	3,000	-	-	3,000	Consultancy services 15 P/day
	convention	Drafting local convention	1,400	-	-	1,400	Consultancy services 10 P/day
	(LC)	Validation workshop	-	600,00	-	600	
		Deliberation session	-	600,00	-	600	Support to municipality
		Edition duplication LC	-	2 346,00	-	2,346	Production of 500 copies
		Total Output 3.2	4,400	3,546	-	**7,946**	
	Ouput 3.3.						
	CC Knowledge	Annual reports production	2,500	2,500	2,500	7,500	Illustrated publication (Edition and impression)
	Management	Audio et television broadcasting	-	1,000	-	1,000	Media mobilization
		Posters production	2,500	-	-	2,500	
		Workshops	1,050	2,050	2,050	5,150	DSA for project's staff
		Total Output 3.3	6,050	5,550	4,550	**16,150**	
	Output 3.4						
	Meteo	Meteo station	22,000	-	-	22,000	
	Station	Identification mission	2,500	-	-	2,500	
		Installation mission	1,000	-	-	1,000	
		Securisation work	2,500	-	-	2,500	
		Maintenance	1,400	-	-	1,400	
		Total Output 3.4	29,400	-	-	**29,400**	
TOTAL COMPONENT 3:			**49,850**	**17,096**	**7,550**	**74,496**	

COMPONENT	ACTIVITIES	Year 1	Year 2	Year 3	TOTAL	NOTES
Project execution	_					

	Staff salaries and allowances					
	M & E specialist salary	7,200	7,200	7,200	21,600	
	Local coordinator salary	6,000	6,000	6,000	18,000	
	Admin and fin assistant salary	3,600	3,600	3,600	10,800	
	Allowances of CADL technical staff	4,800	4,800	4,800	14,400	
	Refection and equipment of office					
	Refection former rural community office	3,290	-	-	3,290	
	Office furniture	900	-	-	900	
	Computing equipment	2,400	-	-	2,400	
	Maintenance	-	200	-	200	
	Office supplies	600	600	600	1,800	
	Commodities	1,200	1,200	1,200	3,600	
	Transportation	1,070	1,000	1,070	3,140	
	Communication	720	720	720	2,160	Estimate. USD 60/month
	Inception workshop	9,500	-	-	9,500	
	Steering committee meeting	2,000	2,000	2,000	6,000	
	Final audit	-	-	10,000	10,000	
	Mid-term evaluation	-	3,000	-	3,000	
	Final evaluation	-	-	7,500	7,500	
	Total Project Execution	43,280	30,320	44,690	**118,290**	

c) Budget on the Implementing Entity management fee (CSE)

Table 1: Budget on NIE fees

COMPONENT	ACTIVITIES	Year 1	Year 2	Year 3	TOTAL	Notes
Management fees						
	CSE staff allowances	14,200	19,200	20,200	**53,600**	
	Field supervisions (contribution to M&E)	10,000	8,000	6,000	**24,000**	
	Control of works	5,000	5,000	5,000	**15,000**	
	Inception workshop (Contribution to execution resources)	6,039	-	-	**6,039**	
	Financial fees	2,000	2,000	3,200	**7,200**	
	Total Project Management	**37,239**	**34,200**	**34,400**	**105,839**	

H. Disbursement schedule

Table 14: Disbursement schedule

	Upon signature of Agreement	**One Year after Project Start**	**Year 2**	**Year 3**	**Total**
Scheduled Date	June 2016	June 2017	June 2018	June 2019	
Project Funds	534,603	534,602	105,516	70,440	1,245,161
Implementing Entity Fees	18,620	18,619	34,200	34,400	105,839
Total	**553,223**	**553,221**	**139,716**	**104,840**	**1,351,000**

PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY

A. Record of endorsement on behalf of the government[2] *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

Mrs. Ndeye Fatou Diaw Guene *Designated National Authority for the Adaptation Fund* *Technical Advisor* *Directorate of Environment and Classified Establishments* *Ministry of Environment and Sustainable Development*	Date: *02/03/2015* 

[6] Each Party shall designate and communicate to the secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

B. Implementing Entity certification *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans (Senegalese National Adaptation programmes of Actions on climate change; Senegalese National Climate Change Adaptation Strategy; National Strategy for Economic and Social Development; Senegalese Five-year Agricultural Programme; Emerging Senegal Plan) and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.
Dr Assize Touré *General Manager* *Centre de Suivi Ecologique* *Implementing Entity Coordinator* 
Date: *02/03/2015* | Tel. and email: +221 338258066 assize@cse.sn
Project Contact Person: Dethie Soumare NDIAYE
Tel. and Email: dethie@cse.sn

BIBLIOGRAPHY

ALHASSANE A., SALACK S., LY M., LONA I., TRAORE S., SARR B. Évolution des risques agroclimatiques associés aux tendances récentes du régime pluviométrique en Afrique de l'Ouest soudano-sahélienne, *Science et changements planétaires / Sécheresse*, 2013.

ANSD, National Strategy for Economic and Social Development (SNDES in French) 2013-2017, 2013.

BLASCO, F., 1983, *Mangroves du Sénégal et de Gambie : Statut écologique-évolution*, Université de Toulouse III, 86 p.

Commune de Dionewar, *Plan Local de Développement 2011-2016*, 2011.

DIEYE E., DIAW A., SANE T. & NDOUR N., « Dynamique de la mangrove de l'estuaire du Saloum (Sénégal) entre 1972 et 2010 », *Cybergeo : European Journal of Geography - Environnement, Nature, Paysage* [online], 2013, document 629, available on : http://cybergeo.revues.org/25671 ; DOI : 10.4000/cybergeo.25671, (visited on December 19th 2015 and January 12th 2016).

DIOP E.S., « *Estuaires holocènes tropicaux. Etude de géographie physique comparée des 'Rivières du Sud' du Saloum à la Méllacorée* », Thèse de doctorat d'Etat, Strasbourg, Université Louis Pasteur, 1986, 498 p.

DIOP, I and al., Phase 1: integrated problem analysis. GEF MSP Sub-Saharan Africa Project (GF/6010-0016): "Development and Protection of the Coastal and Marine Environment in Sub-Saharan Africa", Senegal national report, 2002.

MARIUS C., « Effet de la sécheresse sur l'évolution des mangroves du Sénégal et de Gambie », *Revue Sécheresse,* 1995, No.1, vol. 6, p.123-125.

NIANE, **In** Ndour N., Dieng S. & Fall M. *Rôle des mangroves, modes et perspectives de gestion au Delta du Saloum (Sénégal)*, VertigO – la revue électronique en sciences de l'environnement [**Online**], December 2011, online since February 07 2012, Volume 11 N° 3, available on : http://vertigo.revues.org/11515 ; DOI : 10.4000/vertigo.11515 (visited on June 27 2015)

TRENBERTH K., FASULLO J., An apparent hiatus in global warming? *Earth's future journal, IPCC,* 2013.

ECOWAS, Etude de suivi du trait de côte et Schéma Directeur du Littoral Ouest Africain, 2010

IUCN Report, *Les mangroves au Sénégal: Situation actuelle des ressources, leur exploitation et leur conservation*, 2007.

World Bank, *Gestion des risques en milieu rural au Sénégal : revue multisectorielle des initiatives en matière de réduction de la vulnérabilité,* 2005.

ADAPTATION FUND

0783

REPUBLIQUE DU SENEGAL
Un Peuple - Un But - Une Foi

N° **MEDD/ DEEC. AND/AF**

MINISTERE DE L'ENVIRONNEMENT ET DU DEVELOPPEMENT DURABLE

Date 08 AVR. 2016

Direction de l'Environnement et des Etablissements classés

To: The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

Subject: **Endorsement for Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar)**

In my capacity as designated authority for the Adaptation Fund in Senegal, I confirm that the above national project proposal is in accordance with the government's national priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in Senegal.

Accordingly, I am pleased to endorse the above project proposal with support from the Adaptation Fund. If approved, the project will be implemented by "Centre de Suivi Ecologique (CSE)" and executed by "Comité National pour l'Alphabétisation et la Formation (CONAF), Agence Nationale pour l'Aquaculture (ANA).

Sincerely,

Mrs. Ndèye Fatou Diaw GUENE

Designated National Autority for the Adaptation Fund
Technical Advisor
Directorate of Environment and Classified Establishments

REPUBLIQUE DU SENEGAL
REGION DE FATICK
DEPARTEMENT DE FOUNDIOUGNE
ARRONDISSEMENT DE NIODIOR
COMMUNE DE DIONEWAR

Dionewar, le 15 Janvier 2015

Objet : Lettre d'engagement

Le Conseil Municipal de la Commune de Dionewar à travers son Maire, a été informé et consulté sur l'initiative d'élaboration du projet « ***Réduction de la vulnérabilité et renforcement de la résilience des communautés côtières dans la commune de Dionewar*** » par le Comité National pour l'Alphabétisation et la Formation (CONAF) et l'Agence Nationale pour l'Aquaculture (ANA) avec l'appui du Centre de Suivi Ecologique (CSE), entité nationale d'exécution accréditée par le Fonds d'Adaptation.

A cet effet, le Maire, tout en reconnaissant que le projet est en adéquation avec les objectifs et les priorités du plan de développement de la commune à moyen terme, a eu à exprimer ses besoins et préoccupations de développement local, à donner ses orientations, ses priorités et partager les exigences en matière de gestion transparente, rigoureuse et efficiente des fonds qui seront alloués au dit projet.

Au nom du Conseil Municipal de la commune de Dionewar, le Maire s'engage à apporter une contribution financière ou en nature à hauteur de 5 à 10% du projet en assurant le suivi et la maintenance des ouvrages et infrastructures mis en place, si le projet est approuvé dans le but d'aider et d'accompagner à l'atteinte des résultats attendus dans les composantes du projet et à maintenir la durée de vie des ouvrages.

En foi de quoi, cette lettre d'engagement est établie pour servir et valoir ce que de droit.

Nous souhaitons une bonne réception aux destinataires et prions d'agréer, nos meilleurs sentiments de franche collaboration.

M. Ansoumane SARR

Maire de la commune de Dionewar

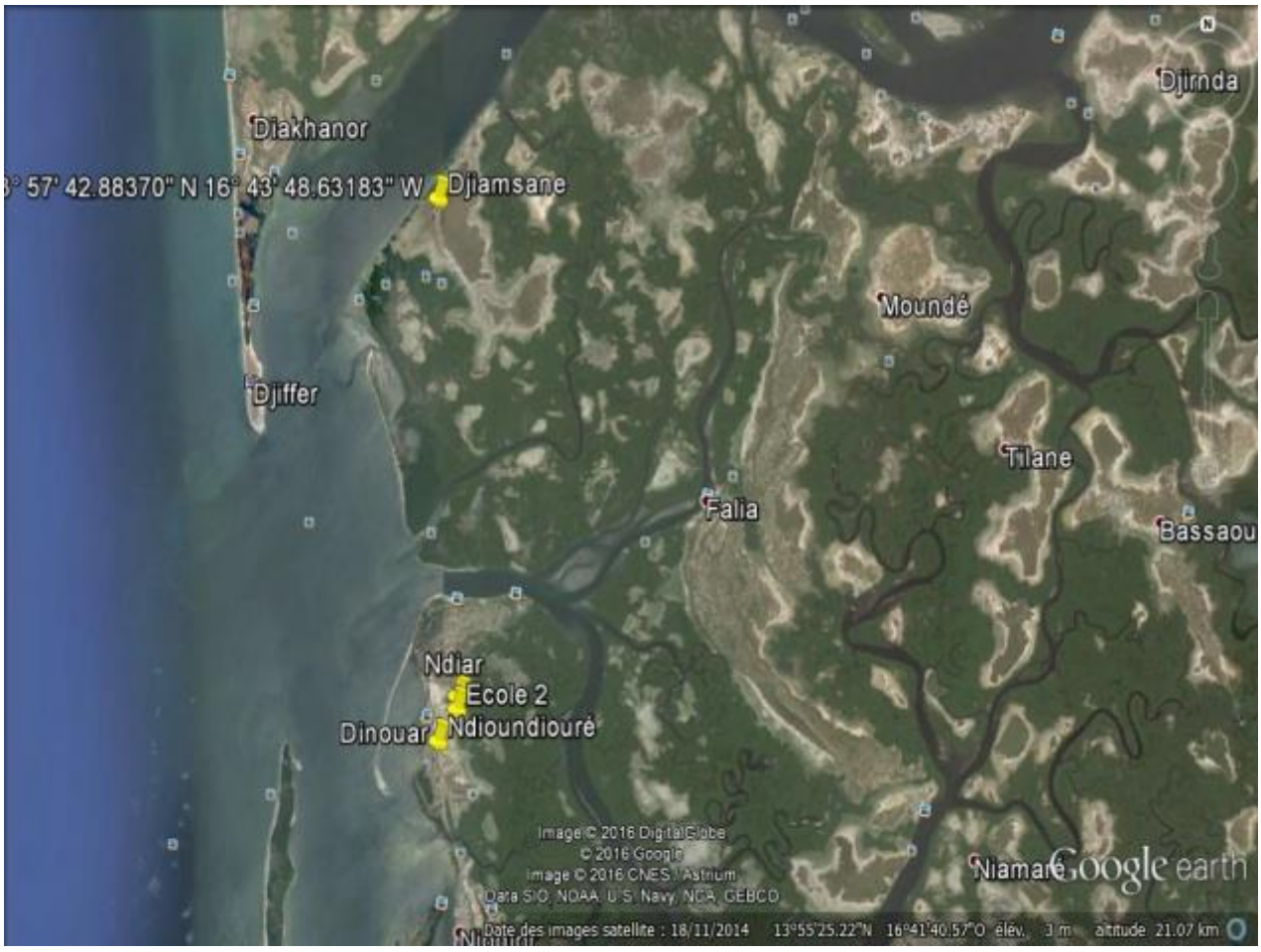
REPUBLIC OF SENEGAL

(One People-One Goal-One Faith)

Centre de Suivi Ecologique

Feasibility Report of the Project entitled "Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar)"

Final/revised version



Saloum Delta Map

February 2016

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LIST OF ACRONYMS AND ABBREVIATIONS

AF : Adaptation Fund

ANA : National Agency for Aquaculture

ANCAR : National Agency for Agricultural Consultancy

ANIDA : National Agency for Professional Integration and Agricultural Development

APD : Detailed Design

BARVAFOR : Water retention and well valuation project

CES/DRS : Water and Soil Conservation and Soil Protection and Restoration

CSE : Centre de Suivi Ecologique

DBRLA : Directorate of Retention Basins and Artificial Lakes

DEEC : Directorate of Environment and Classified Establishments

DH : Height difference between sea level and the highest point of the island

DRDR : Regional Directorate for Rural Development

DREEC : Regional Directorate of Environment and Classified Establishments (Direction de L'Environnement et des Etablissements Classés)

EIA : Environmental Impact Assessment

ESMP : Environmental and Social Management Plan

GDERST : Sustainable Management of Runoff Waters and Land Salinization

INP : Institut National de Pédologie (National Institute of Pedology)

ISRA : Institut Sénégalais de Recherche Agronomique (Senegalese Institute of Agricultural Research)

MAER : Ministry of Agriculture and Rural equipment

NGO : Non-Governmental Organization

PADAER : Agricultural Development and Rural Entrepreneurship Support Program

PADERCA : Rural Development Support Project in Casamance

PAFA : Agricultural Sector Value Chains Support Project

PAPIL : Project to Support Local Small-Scale Irrigation

PAPSEN : Program to Support the National Agricultural Investment Program of Senegal

PNAR : National Program for Rice Self-sufficiency

PNDIL : National Program for Small Irrigation Development

PO : Producers Organization

PRODULAS : Anti-salt Emergency Program

PSE : Plan Senegal Emergent

SNGDERST : National Strategy for Sustainable Management of Runoff Waters and Land Salinization

WFP : World Food Program

Introduction

The Senegalese coastline and low estuary areas including the Saloum Delta islands are very sensitive to climate change impacts, with increased risks of floods and erosion due to the rising sea level and increased aggressiveness of swells. The Saloum Delta is characterized by the confluence of Sine and Saloum rivers and presence of inlets.

This geomorphological situation explains the exposure level of these islands to climate variability and water level rise in particular. The existence of two types of tides (high and low) causing eustatic movements (ebb/flow, high/low tide) is noted. The highest risk periods are those of high tide during the rainy seasons causing the flooding of Saloum Delta island villages.

Faced with the constant threat of advanced marine waters, vulnerable island areas often try to implement control methods at local level but these remain often inappropriate and inadequate. The populations of the village tried to set up sand beads sometimes reinforced with wooden stakes to control flood phenomena. These solutions only served to limit the advance of waters during low water periods and sometimes constituted obstacles to storm water during the rainy season.

The Centre de Suivi Ecologique (CSE), sponsor of this feasibility study is a National Implementing Entity (NIE) of the Adaptation Fund (AF).
As such, CSE supports the formulation and submission of project and program documents to benefit from the Fund's resources. The actions considered by the project will help protect the village against flooding, improve the living environment of populations and, among others, safeguard community assets (public buildings, cultural sites) and dwellings.

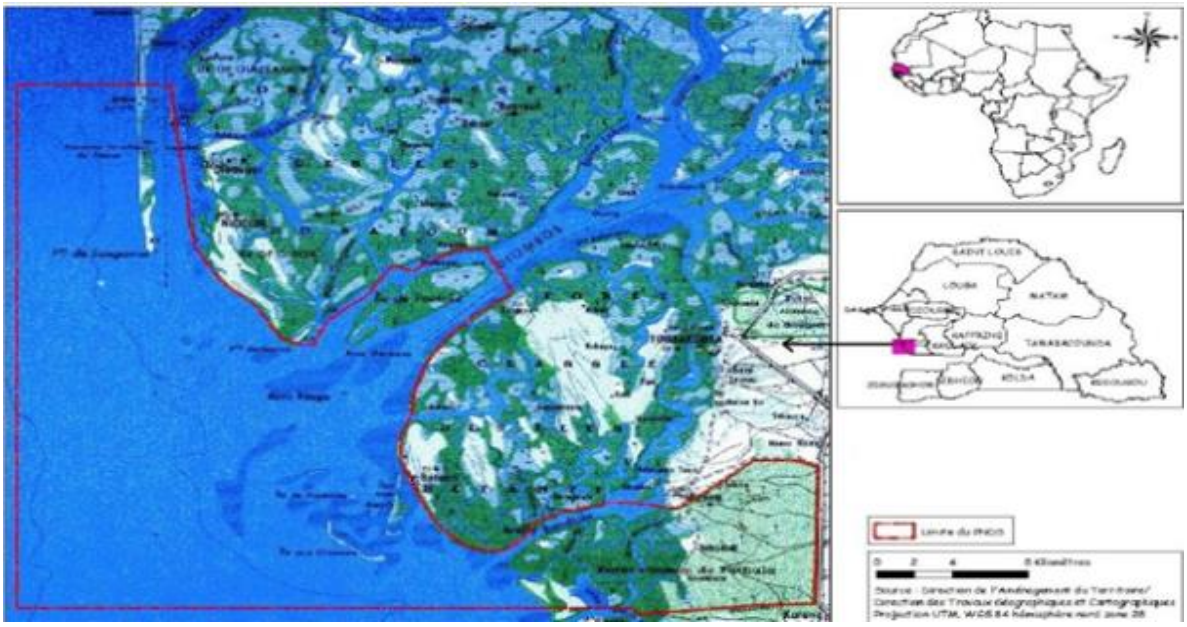


Figure 1: Saloum Delta area localization

The project concept entitled "***Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar)***" was approved by the AF Board at its twenty-sixth meeting held in October 2015. Thus, CSE during the full proposal development

phase decided to engage the services of a civil engineering consultant to conduct a feasibility study of facilities and infrastructures planned under the project.

The reflection requested in the feasibility study focuses on Ndiar, Ndioundiouré and Ecole 2 dikes, all located in the village of Dionewar, and also located on the satellite island of Djimsane. The bulk of the work will deal with the following key items:

- reporting on the current situation of the different above-mentioned dikes;
- conduct of a technical design study for resurfacing, compaction and shaping of existing dikes' structure as well as the finalization of the remaining and not completed structure;
- prospecting of materials;
- development of a program for infrastructure operation and management;
- development of requirements specification;
- proposal of a confidential pricing calculation.

This document is an implementation study report on the technical feasibility of the project for reducing the vulnerability of Dionewar village with regards to flooding and sea encroachment, to which it has been exposed for several years.

I- Resources and Methodology

1.1- Resources

For its smooth running and success according to objectives, the mission mobilized the following resources:

In terms of staff:

- Head of mission: A Rural Engineer;
- A topographer and a surveyor helper;
- Contact for each island
-

In terms of materials:

- A car;
- A rental motorized canoe;
- Materials for topography team
- Total station, Tripods, Rods, Stakes, Hammers, Chisels, Paintbrushes, Iron Stakes, paint buckets, etc.
- 50 m-long Chain
- 100 m-long Rope
- Camera
- GPS unit

1.2- Methodology

The methodology consisted in dividing the available time fifteen days (15 days) into three phases:

✓ A first phase of three (3) days dedicated to literature review of the intervention sites,

✓ A second phase called field work phase, a period of five (5) days, during which resources are mobilized for the collection of data related to the characterization of the sites. These data essentially focused on:

- ***Topographic data:*** It consisted in calculating a random point DTM along and across the structures. With the software Auto-Cad and the GPS, the data will enable to establish longitudinal and transversal profiles of existing dikes and determine the dimensions of the structure along the shoreline. They will also allow resizing the different structures for rainwater drainage into the sea and quantification of backfill recharge volumes, with **COVADIS** software.

- ***Geotechnical data:*** prospecting of existing materials and any quarries in sufficient quantity and quality that will allow building protective structures.

- ***Photographic data:*** A digital camera and **Google Earth** software were used to illustrate and materialize the current situation of the sites.

✓ A third phase of seven (07) days, dedicated, on the one hand, to the data processor of topographic survey using the above-mentioned tools, the geo-hydrological analysis with **DIARPA** software and, on the other hand, to the design of structures using **ORSTOM** method (*RODDIER and AUBREY*) and the writing of progress and draft reports that will be submitted to CSE for review before editing the final report.

II- Monograph of the insular area

2.1 - Presentation of the Saloum Delta

Located in the northern part of the RBDS (Saloum Delta Biosphere Reserve), the Saloum islands (Gandoun islands) have a particular place in the country. Indeed, with an area of 234,000 hectares, the RBDS is a vast estuary, marine and coastal wetland. It consists of mudflats, sand bars, intertidal salty lands, mangrove, sandy islets and seagrass beds.

The Saloum Delta is an archipelago composed of 36 islands of which 21 are inhabited. These 21 inhabited islands are mainly located on the left bank (16 of 21 islands) of the Saloum inlet. This archipelago consists in a geomorphological and geological unit, which "recent" establishment occurs during the Subtropical Quaternary (Holocene period, Upper era of the quaternary period) after a long dynamic process leading to their configuration and current form.

This phenomenon continues to shape them, by constantly changing their shoreline, through the interaction with other hydro geological phenomena such as the different marine currents, including "El Niño" which greatly affect the pace and size of tides. This dynamic and continuous process predisposes the islands to unstable morphology tending towards their possible disappearance or consolidation.

These islands are located in a transition area between the Sudano-Guinean zone in the South and the Sudano-Sahelian zone in the north.

Additionally, they are located in the Saloum Delta, with a singular ecosystem conferred by mangroves (*Avicennia germinans, Rhizophora mangle, etc*.) constituting the main vegetation of submersible areas and their borders.

It provides firewood and construction wood, and is an ideal habitat for many fish species (oysters, crustaceans, ark shells, etc.), some fauna and birds. By contrast, the inland is marked by a Sudanian-type vegetation *Elaeis guineensis* (oil palm trees), *Cocos nucifera* (coconut trees).

The rainfall of the last three years is as follows:

Table 1: Rainfall in Dionewar during the last three years

Year	2013		2014		2015		Inter-annual average	
Stations	Cumulation	NRD	Cumulation	NRD	Cumulation	NRD	Rainfall	NRD
Niodior	977	35	446.3	22	958	36	**860**	**30**

Bassoul	900	15	826	30	1034	32		
Djirnda/Dionewar	**989**	**24**	**649**	**37**	**955**	**38**		

Source: Regional Weather Service of Fatick (2013 – 2015)

2.2- Morphological configuration of Saloum islands

From the perspective of the relief, the islands can be divided into three (03) zones according to DH value representing the *difference between the sea level (0) and the highest point of the island.*

- The first area where the DH value is less than one (01) meter is characteristic of type I islands and is located furthest upstream to the Saloum mouth. This area covers the islands of Fambine, Félir, Rofangué Maya, Vélingara, Djirnda, and Diamniadio.
- The second area relates to type II islands where the DH value is between one (1) meter and three (3) meters. This consists mainly of islands located downstream of Type I islands relative to the mouth. This is essentially composed of Islands such as Bassar, Moundé, Diogane, and Thialane.
- The third area concerns the Type III islands where the DH value is above three (3) meters. This area includes islands as Niodior and Dionewar. In these types of islands, the present formations indicate a mainly marine influence due to the presence of littoral currents that have regulated the coasts. This study focuses specifically on Dionewar Island.

Figure 2: Types of island in the Saloum Delta

2.3 Presentation of Dionewar Island

✓ Geomorphology of Dionewar

Dionewar Island is located on the left bank of the Saloum inlet; it is one of type III islands and is therefore characterized by a DH value above three (3) meters. It is one of the largest islands located on the left bank of the Saloum. The houses are built on a bare and flat area called "tanne," just after the tidal fluctuation area.The vulnerability of the village is due to the following endogenous and exogenous factors:

- The extreme weakness of the height difference between the zero sea level (0 IGN) and the highest point of the village (type 1: DH <1m) and the clay soil nature allowing only a low infiltration of rainwater; the latter follows a gentle slope and flows into the sea.
- The high tides during the rainy season often cause flooding and seawater invasion on most of the village.

The belongingness of Dionewar to type III Island allows it to be protected from any flooding of maritime origin. The presence of sandbars constitutes a natural shield to dissipate marine wave movements during tidal periods in low-water time.

This regulation function is, however, very limited during high water periods.

✓ Vulnerability level

The island is still very vulnerable to eustatic movements whose erosive effects erode and gradually move the sandbars. In addition to these marine erosion phenomena, the succession of sandbars has created depression corridors that encourage the flooding of some parts of the village during high tides. This situation worsens during high water periods coinciding with the rainy season.

Figure 3: Flood-prone areas in Dionewar village

✓ Local initiatives

To cope with tide movements and fight against the coastal erosion of the village, people had undertaken some measures in Ndioundiouré.

Picture 1: Ndioundiouré dike

Thus, in depression areas, an improvised small dike was built to limit seawater intrusions.

The latter could not withstand the water pressure during the rainy season of 2013 and underwent two breaches. For the rehabilitation of the dike of Ndioundiouré, the Directorate of Civil Protection supported local people with plastic bags and PVC pipes to serve as nozzles. In parallel to this initiative, people were also mobilized to close a second gap opened during the rainy season of 2013 and causing inconvenience to residents.

Picture 2: Dike located in front of the village

Thanks to the solidarity of the island inhabitants, the young workers were able to build a protective low wall over a distance of about hundred meters to reduce the pressure of the water on the most sensitive areas.

Picture 3: Low wall located before the village

All these initiatives undertaken by the local community, demonstrate the commitment of the populations to take control of their own destiny. Unfortunately, they do not have the required technical capacity to establish adequate structures for flood risk and coastal erosion reduction. Appropriate works to fight against the encroachment of the sea require, along with technical capacity, a significant financial effort.

2.4- Island protection experiences of some partners

NGOs or projects like PAPIL operated in five (5) island villages of Djirnda commune and Niodior district.

The different types of structures implemented allowed beneficiaries to strengthen their resilience in response to the rising level of marine waters, secure their property, recover lost land and improve their living environment.

Picture 4: Situation of the village of Djirnda before PAPIL intervention

The implementation of a protective infrastructure required the provision of building materials and the mobilization of local workforce.

During the first year of existence of Djirnda earthen dike, PAPIL was supported by the World Food Program (WFP) through its food-for-work program intended for highly labor-intensive (HLI) activities for the realization of the shell embankment. Thus, a strong community mobilization allowed the establishment of a compacted earthen dike with a length of 900 meters which suffered a breakdown after heavy rains. With the help and supervision of a civil engineering company, the surfacing of the dike with reinforced concrete allowed the consolidation.

The rural council was a part of the project, as it provided teams with canoes and fuel for the extraction and transportation of the sand needed for the construction of build parts. The local community also brought shells for the composition of the dike surfacing concrete.

Picture 5: Compacted Earthen Dike Surfaced With Shell Concrete

This single dike was not enough to support the entire part of the village which is exposed to eustatic movements. The construction of a second dike on the whole southern part of the village was needed to protect it properly. The technical characteristics of this second infrastructure were improved to better take into account stability and sustainability aspects. To this end, it was decided, instead of a compacted earthen dike to build a reinforced concrete low wall made of casted plates and poles made on site. The total length of this second dike is 967 meters. The whole low wall was made locally without any machines' intervention. The working equipment and building materials were partly available at locally or easily transported by canoes.

In order to take account of the village socio-cultural realities, ramps allowing each neighborhood to access easily to the sea have been built on the dike. In addition to these social considerations, the dike has been equipped with structures for rainwater drainage during the rainy season. The success of this achievement is due to the commitment of all stakeholders namely the project, water and forestry services, WFP and the community.

Picture 6: Reinforced Concrete dikes and access Ramps

Thus, the reinforced concrete dike (with single or dual screen) with a simple technique, built in other island sites seems to be suitable and ensures good mobilization of local people to carry out useful infrastructures. The immediate effects of the infrastructure on the village were felt from the completion of the work through the recovery and protection of more than 10 ha of land once submerged by sea waters, the protection of public buildings (school, community center, etc.), and the improvement of people's living environment.

III. Diagnostic analysis of existing structures of Dionewar

3.1. Inventory of existing dikes and spillways

Based on following GPS points statements on sites transferred to Google Earth, the actual location of the four Dionewar dikes can be illustrated by the ground plane below.

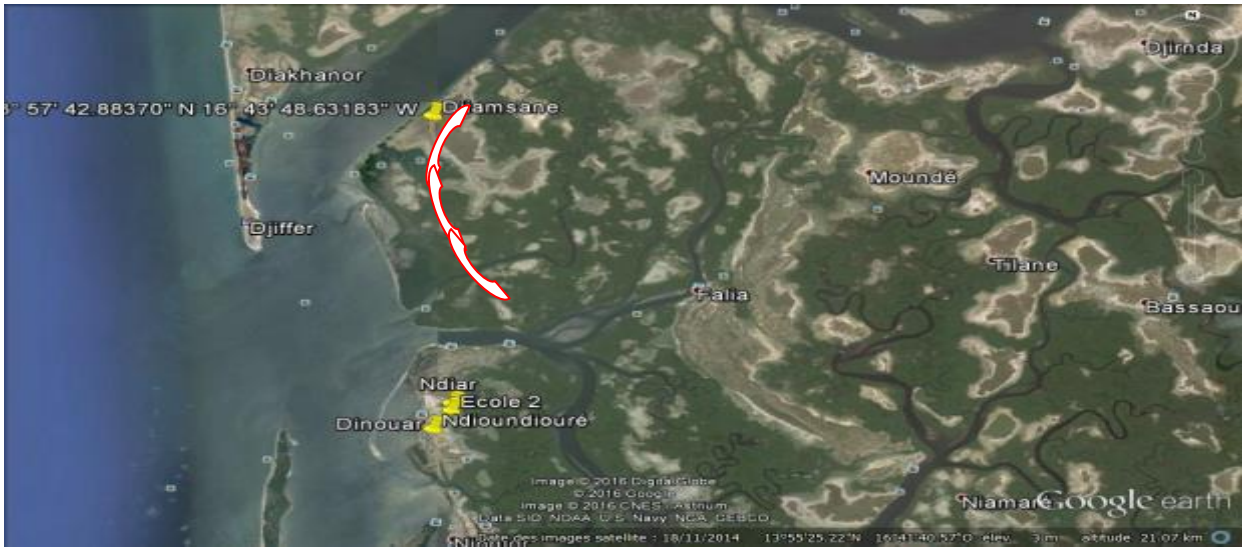


Figure 4: Ground plane of the four dikes of the survey

Based on topographic surveys, field observations and interviews with people (see *Sheet attached to this document)*, the four existing dikes are characterized as follows:

- **Ndiar dike**

The Ndiar dike, with a length of 266.74 meters is degraded, the trapezoidal-shaped shell embankment has collapsed in some places all along the dike and the PVC spillway is at the low point geo-referenced pk10 as follows:

13° 53' 17.49" N; 16° 43' 36.37" W with 19.70 above the sea level.

The foundation depth is less than 30 cm. The building material of the dike consists of still resistant and friable shell. The compactness is low justifying the wooden stakes for support as shown in the pictures below.

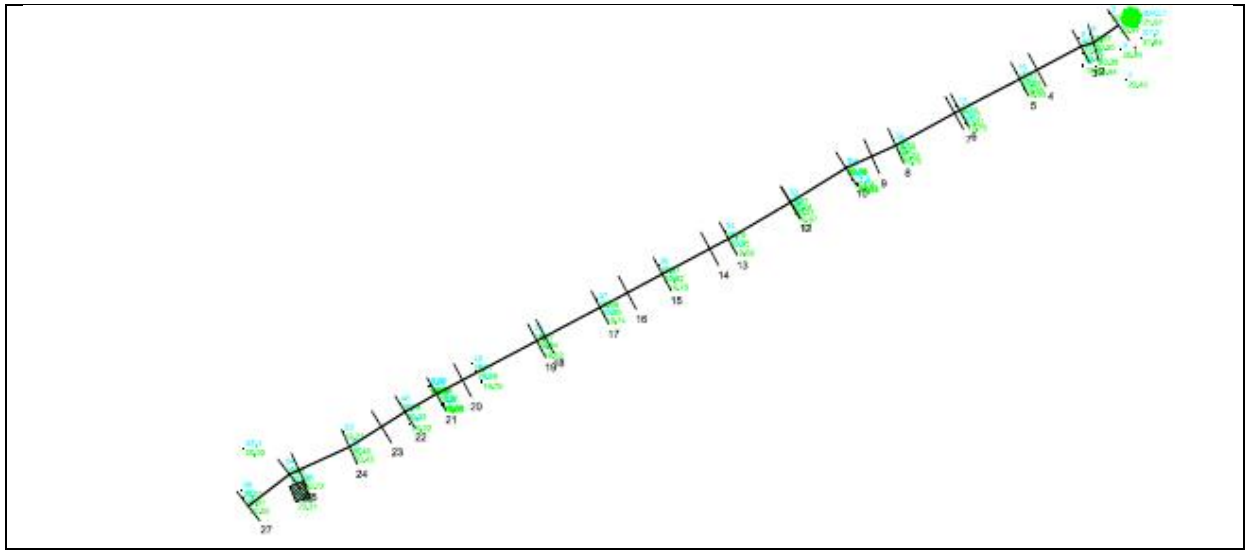

Picture 7: Ndiar dike with a shell embankment


Picture 8: Ndiar dike equipped with discharge nozzles

Ndiar watershed has an estimated surface area of 0.054 km². The dike covers the entire distance of the right-of-way and has a good anchorage on the ridge lines with a natural terrain ground of 20.80 avoiding bypasses. It is not necessary to extend the Ndiar dike.

Figure 5: Ground plane of the three dikes of Dionewar

Longitudinal and transversal profiles, in outliner mode attached hereto are presented as follows:



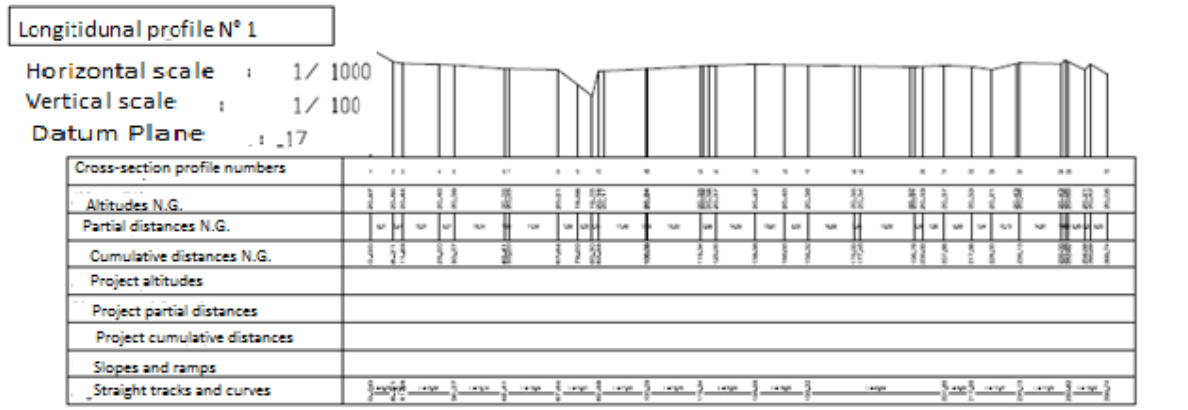


Figure 6: longitudinal profiles of the Ndiar Dike

Upon analysis of the damage level noted on Ndiar compared to appropriate corrective options, it is necessary to (i) reshape the embankment to 2 meters with dual screen reinforced concrete (RC) plates over a length of 266.74 meters on an altitude of 19.90 (ii) backfill with a mixture of seashells and compacted clay to enhance the gauge on a 30 to 40 cm descent (iii) resize and build a rectilinear spillway with 02 fiberglass valves on the flow axis of pk 10.

With years of hydraulic compaction, there is a need to use the surface line of the previous dike as foundation, through the rehabilitation of slumped sections. This scheme will help contain the upwelling of high tides, facilitate rainwater drainage and control upstream washout for the protection of 5.40 ha of land.

The prospecting of materials mainly focuses on local materials, seashells, borrow materials from excavation or shingle spit during the works.

- **Ndioundiouré dike**

The Ndioundiouré dike, with a length of 137.65 meters, is in a very advanced state of degradation with a high hydromorphic level in some places, the embankment consisting of a mixture of sand and trapezoidal shell has completely collapsed with two gaps closed and the PVC 400 spillway is at the low point geo-referenced PK8 as follows:

13° 52’ 5,352,056"N ; **16° 43’ 4,877,735” W** with 19.30 above the sea level.

The foundation depth is less than 50 cm. The building material of the dike consists of smoothed shell system and an embankment composed of a mixture of sand and shell, the compactness is low as illustrated by the pictures below.

Picture 9: Ndioundiouré dike made up with shell wall, left bank

Picture 10: Ndioundiouré dike with two gaps closed with sand bags, right bank

The catchment basin of Ndioundiouré has an estimated surface area of 0.126 km². The dike covers the entire distance of the right of way and has a good anchorage on ridge lines with a natural ground altitude of 20.40 avoiding bypasses. It is not necessary to extend the Ndioundiouré dike. Longitudinal and transversal profiles, in map view attached hereto are presented as follows:

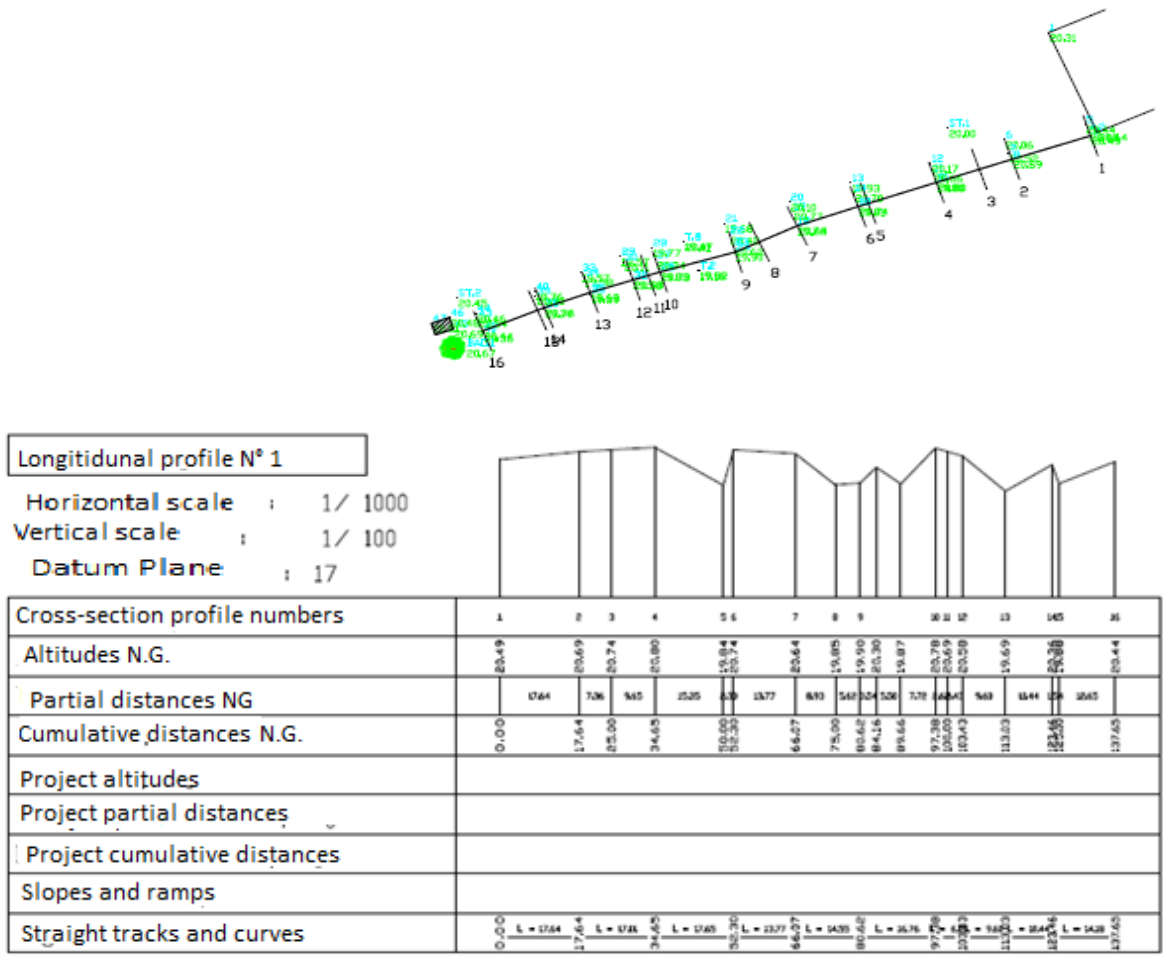


Figure 7: Longitudinal profiles of the Ndioundioure dike

Upon analysis of the damage level noted on Ndioudiouré and soil hydromorphy with regard to the relevant corrective options, it is necessary to (i) reshape the embankment to three (03) meters with dual screen RC plates over a length of 137.65 meters to be anchored on an altitude of 19.50 with demolition of nozzles, bags and the low wall in place, (ii) backfill with a mixture of compacted shell and clay to enhance the gauge on a 30 to 40 cm descent, (iii) resize and build a rectilinear spillway equipped with a fiberglass valve, on the flow axis of pk8.

With years of hydraulic compaction, there is a need to use the surface line of the former dike as foundation through the rehabilitation of the slumped sections. This scheme will help contain the upwelling of high tides, facilitate rain water drainage and control upstream washout for the protection of 12.60 ha of lands.

Prospecting for materials is directed towards local materials mainly shell and borrowed excavations or strings during works.

- **Ecole 2 dike**

Ecole 2 dike, with a length of 767.20 meters, is damaged, the trapezoidal-shaped shell embankment has collapsed on the right bank and the PVC 200 spillway is located in the geo-referenced low point pk28 as follows:

13° 53' 10.78659"N; 16° 43' 36.64871" W with an altitude of 19.81

In high tide period, water bypasses the dike at the level of crest junction. Foundations are 30 cm deep. The building material of the dike is made up of damped shell; compactness is low especially on the right bank as shown by pictures below. It is required to make an extension of Ecole 2 dike on the right bank.

Picture 11 : Ecole 2 dike in damaged shell embankment, left bank

Picture 12 : Ecole 2 dike in shell embankment, right bank, with exhaust nozzles

The watershed of Ecole 2 has a area estimated at 0.051 km². The dike covers the distance of the right-of-way and has a good anchoring on the right crest line with an altitude of 20.85, contrary to the left side with water circumventing. It is necessary to make an extension of

Ecole 2 dike over a 50 meters distance. Its total length will be 830 m. The appended lengthwise and crosswise profiles, in map view are outlined as follows:

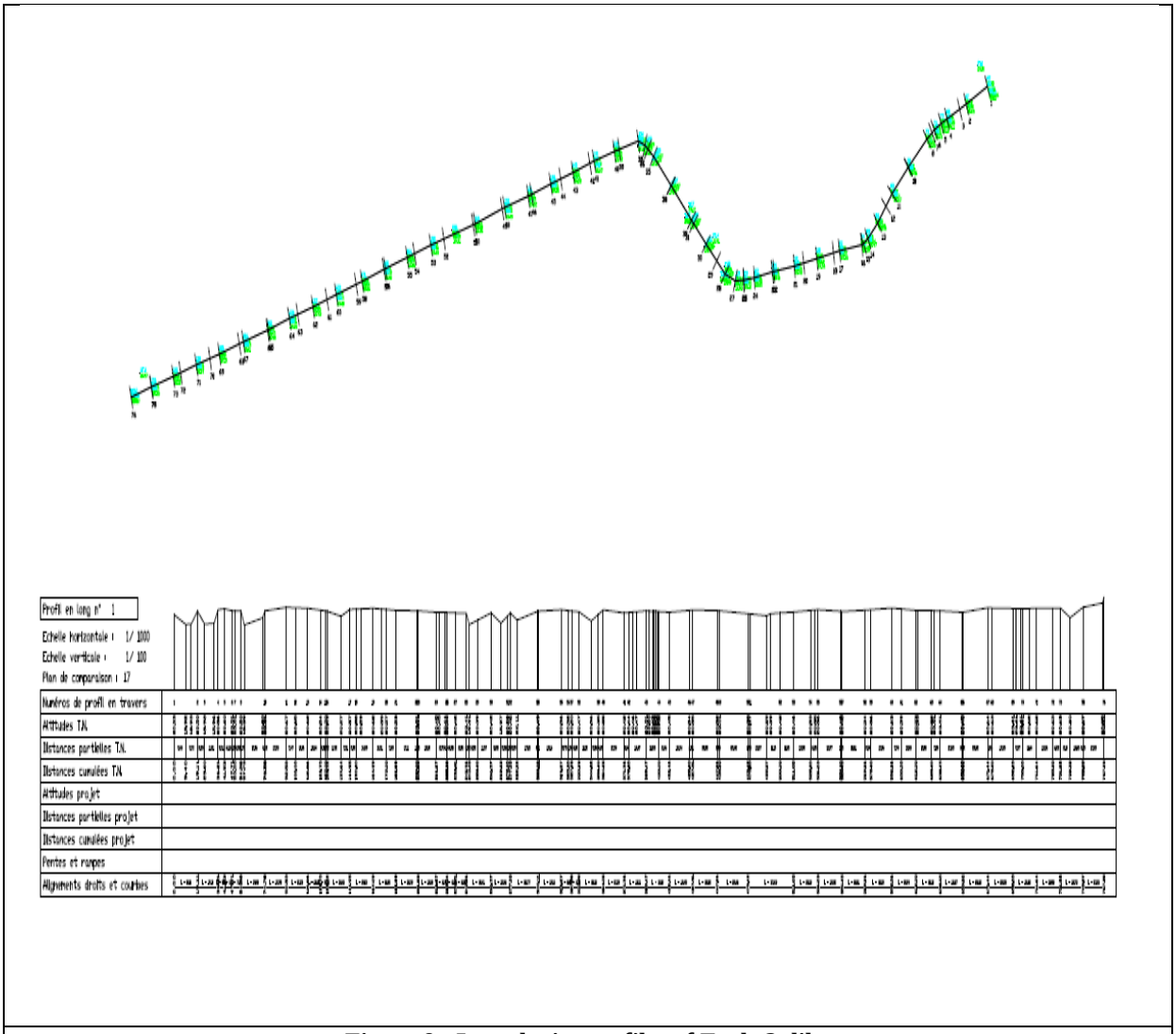


Figure 8 : Lengthwise profiles of Ecole 2 dike

Upon analysis of the level of damage noted on Ecole 2 with regard to the relevant corrective options, it is necessary to (i) reshape the embankment by 2 meters framed with dual screen RC plates with a length of 780 meters anchored on an altitude of 19.95 with demolition of nozzles, (ii) backfill with a mixture of compacted shell and clay to enhance the gauge with a 30 to 40 cm descent, (iii) resize and build a rectilinear spillway equipped with 01 fiberglass valve, on the flow axis of pk28.

With years of hydraulic compaction, there is a need to use the surface line of the former dike as foundation through the rehabilitation of the slumped sections. This scheme will help contain the upwelling of high tides, facilitate rain water drainage and control upstream washout for the protection of 5.60 ha of lands.

- **Djimsane island dike**

The Djimsane dike, with a length of 1754.00 meters, is damaged, the trapezoidal-shaped clay embankment starts collapsing, being eroded and the rectilinear spillway in RC is beginning to be deteriorated, the rusty valve is located in the low geo-referenced point *pk28* as follows:

13° 57' 42.88370" N; 16° 43' 48.63183" W with an altitude of 19.85

Foundations are 20 cm deep. The building material of the dike is made of clay; the compactness is relatively acceptable as shown by the pictures hereinafter.

The catchment of Djimsane, the biggest one, has a surface estimated at 11.84 km². The dike covers all the distance of the right-of way and has a good anchoring with the crest lines of the natural field on an altitude of 20.90 avoiding bypasses.

Picture 13 : Djimsane dike, clay backfill in left bank without crown, eroded

Picture 14 : Djimsane dike, clay backfill in right bank, without crown, and washouts at the base of the spillway

Picture 15 : Djimsane dike, which rudimentary spillway, equipped with a rusty metal valve, without rockfill makes it prone to washouts

The lengthwise and crosswise profiles, detailed herein, are outlined as follows:

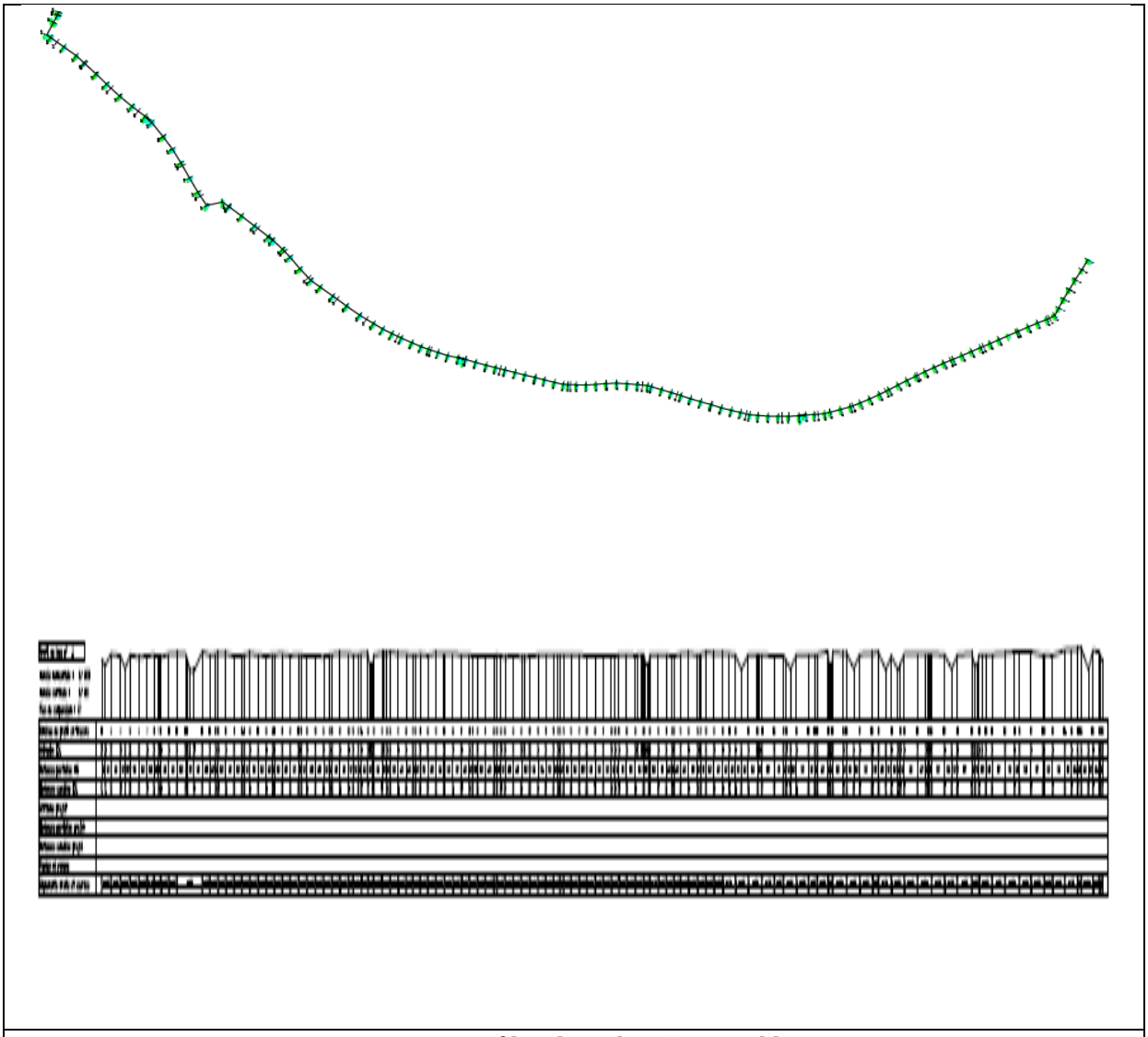


Figure 9 : Profiles along the Djimsane dike

Upon analysis of the level of damage noted on Ecole 2 with regard to the relevant corrective options, it is necessary to (i) consolidate the coating of the spillway, (ii) build upstream/downstream rockfills and walled connection rip-rap, (iii) replace the metal valve by glass fiber, (iv) reshape over the stretch of 1754.00 meters and reload clay backfills to two (02) meters with a RC trapezoidal-shaped crown for a crest on an altitude of 21.10 for a 60 to 70 cm descent.

Let us specify that contrary to the three other dikes, the clay embankment of the existing dike records gullying of the upstream slope which shall be subject to filling in compacted clay prior to the establishment of the crown in RC.

With years of hydraulic compaction, there is a need to use the surface line of the former dike as foundation through the rehabilitation of the slumped sections. This scheme will help contain the upwelling of high tides, to facilitate rain water drainage and control upstream washout for the protection of 118.40 ha of lands.

3.2. Descriptive analysis of options and types of insular protection scheme

Considering the geomorphology of the island, eustatic movements, the different threats and socio-economic realities, the protection system which seems to be more efficient must be the combination of different types of works. Thus, according to specificities of the relevant sections, two types of works will be necessary. Their choice is guided by the simplicity of the building technique, their stability, the easy management and maintenance by beneficiaries and above all it addresses the accessibility of islands.

Working out a sustainable solution would mean also selecting a type of protection relevant to the identified threats. Following the particularity of the area which is located in a hard to access environment but also where finding the material that can be part of the erection of works can turn out to be a difficult task we might choose either:

- An earthen dike;
- A work with recessed gabions;
- A simple or dual screen RC slabs dike.

✓ **The earthen dike**

The selection of the earthen dike is based on two key criteria;

1) ensuring the availability of the material with the geo-technical qualities capable of building a dike. According to populations and after visiting the surrounding area of the village, there is no borrow site that may supply such a material in the village and even beyond in the immediate area.

2) having the adequate equipment such as : a compactor, a grader, etc., for a good stripping and a good compaction of the infrastructure. Considering the difficulty to have this type of gear in this area, such a choice is then compromised. With regard to the results of the foregoing diagnostic analysis, **this option is then not applicable for the three sites of Ndiar, Ndioundiouré and Ecole 2.**

Nevertheless, with hand-operated gears (cultivators, harrow and hand-operated compactor), this option is **relevant to the Djimsane dike**.

The embankment will have a trapezoidal-shaped crown in reinforced concrete.

✓ **A work with recessed gabions**

The establishment of such a work would not be well adapted to the area. The village of Dionewar and the island of Djimsane which belong to type III are vulnerable to see progress in high water.

Gabions play a stabilizing or hardening role of the shoreline often affected by more or less significant erosion. In some way, they will play a role of fascine and will more or less leave water penetrate in the area to protected. Such a situation would keep affecting housings and infrastructure in the village. With regard to the results of the foregoing diagnostic analysis, **this option is then not applicable for the four sites.**

- ✓ **A dike made up of RC plates with a spillway**

The option will focus on the RC dike by considering the almost impossibility to build physically the earthen dike and the irrelevance of the structure in gabion for this type of threat.

A work made up of a RC wall with pre-manufactured slabs. The purpose is to build a RC wall (screen) made up of pre-manufactured items juxtaposed the ones after the others and interconnected between them by poles.

This would be the best solution considering the difficulties to apply other systems. Slabs can be made at locally without using a gear, in addition to the basic material such as sand that may be found on site or not far from the village.

Carriage of other materials such as cement, iron rods, etc., can be done by pirogue without too much difficulty. With regard to the results of the foregoing diagnostic analysis, **this is the best possible choice for the three sites of Ndiar, Ndioundiouré and Ecole 2.**

Through interviews with beneficiaries, the choice meets the aspirations to have operational, solid, easy to maintain works that can be built using local materials and involving the populations in the implementation of the works.

IV- Technical design study for the resizing of existing dikes

The type of works and development patterns to be established will be realistic, easy to maintain and having proven their worth in similar contexts allowing limiting the flood phenomena, marine erosion, the intrusion of high tides while facilitating the mobility of populations throughout the whole island.

4.1- Hydrological estimates

The study is based on ORSTOM method (or Rodier and Auvray) as well as the findings of the studies of streaming in the area. For the respective watershed surfaces, the results of the ten-year floods are as follows:

Table 2: Result of runoff studies

Dimensions / settings	**Dikes**	**Ndiar**	**Ndioundiouré**	**Ecole**	**Djimsane**
Watershed Surface		0.054	0.126	0.051	11.84
The ten-year daily rainfall P10 in mm.		130	130	130	130
An inter-annual rainfall of P in mm		860	860	860	860
The gradient of rainfalls **Ca = 1 - (9 - 42. 10(-3) P + 152) 10(-3) log S**		**0.9**	**0.8**	**0.8**	**1.1**
The average rainfall = **P10 x Ca**		**117**	**104**	**104**	**143**
Soils are predominantly made of clay with **Class P2** shell.		-	-	-	-
Slopes in the thalweg are below 0.4 of the **R2 index**		-	-	-	-

Dimensions / settings	Dikes	Ndiar	Ndioundioure	Ecole	Djimsane
estimation of the value of **Kr** at 40%		40%	40%	40%	40%
the volume that drains off : **Vr (m3) = S x Kr x Ca x P10**		**252,720**	**524,160**	**212,160**	**6 772 480**
the base time is **Tb (h)**		15	15	15	15
the rise time **Tm (h)**		5	5	5	5
the Coefficient **a** for a constant value		2.6	2.6	2.6	2.6
the average flow of the ten-year flood: **Q moy = Vr / Tb en m^3 / s**		4.68	9.71	3.93	12.542
The maximum flow of the ten-year flood **Q max = a x Q moyen m^3 / s**		**12.17**	**25.24**	**10.22**	**32.60**

4.2- Calculation of the length of spillways

To allow the drainage of streaming waters (storm waters) that may cause floods, spillways are projected in specific locations (low points). Considering the extreme climate events such as exceptional rainfalls; the spillway will be sized so as to be able to evacuate the maximum flow of the ten-year flood.

The calculation of the L length will be done without taking into account the laminating effect given the ebb and flow in insular area, the length of the spillway is established as follows:

Table 3: Calculation of the length of spillways

Dimensions / parameters	dikes	Ndiar	Ndioundioure	Ecole	Djimsane
with : m=0,4 ; H=0,8 ; g=9,82 **L = Qmax / (m x (2g)^0,5 x H^3/2) in ml**		9.48	19.67	7.96	25,41or two of 10 m and 15 m

4.3- Sizing of slab units and dual screen slabs

The RC wall structure shows a better resistance in a transition environment between sea waters and storm waters.
Its installation is also easy; with a fairly simple slab building system, the whole work is done on site and requires less heavy machinery for its implementation.

The unit slab has the following characteristics:

- Slab thickness : **8 cm**
- Height: **90 m**.
- Length : **2 m**

Figure 10: Section of the RC wall of a dike

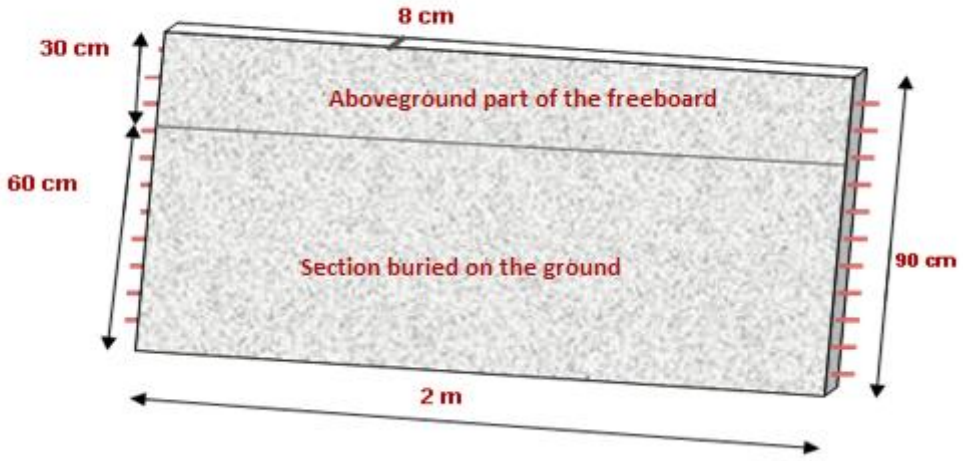


Figure 11: Simple screen plate

Length of plates (2 m) consolidated by bollards.

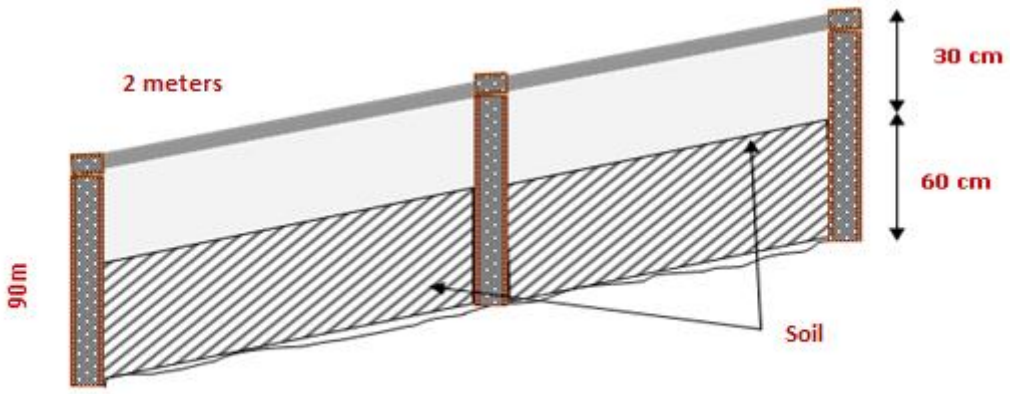


Figure 12: Perspective view of an installed plate width 8 cm

For the three dikes of Ndiar, Ndioundiouré and Ecole 2, the principle will consist in establishing a RC dual screen along the dike axis and fill it in with material from the shell remains pit mixed with clay and borrow excavations (shell and clay), to make a compacted embankment with a hand-operated Bomag 350.

Let us make it clear that the making of the material in shell mixed with clay and its implementation will be borne by the enterprise which will use valuable local labor force otherwise as a contribution of beneficiaries. Screens will be 8cm thick, be 2m long, will have a 90 cm height and will be buried at least 50 m in the ground and offer 50 to 50 cm freeboards. As for their height, it will take into account the anchor score of each profile mentioned above.

At low point (location of nozzles or existing spillways) of each section of the dike, will be built one (or two) spilling work which will be set at a safety elevation to avoid the flooding of neighboring houses.

4.4- Evaluation of pressure forces on the dike with RC plate

For the thickness e = 08 cm, we know that it depends on the compression undergone on the structure in this case, the forces applied are essentially the Q water pressure. This active horizontal pressure requires the establishment of a well-anchored and waterproof RC structure. The thickness must be the minimum possible but by ensuring a good coating of steels in the concrete for this marine environment. The coating must be between 2.5 and 3 cm. For the height of the wall of 1 = 90 cm, corresponding to the total height of a plate. The objective is:

- to have a good anchoring to resist to slides following the water pressure. An anchoring of **60 cm** would largely be enough;
- to have a resistant screen to stop high tide effusion in the village. With a relatively flat land, water sheet at this level cannot in any case go beyond **15 cm** in high tide, low waters and maximum of **25 cm** in exceptional tide, high waters;
- From these **25 cm**, a margin of **05 cm** is expected to take into account the freeboard, what leads to a total of 3**0 cm** for the protective screen combined with the spillway will play a regulation role of rainwater speed so as to avoid the fairly strong water erosion in the village.

The sum of backfill heights **60 cm** plus 30 cm of screen equals **90 cm**, corresponding to the total height of the slab for the simple screen after its installation.

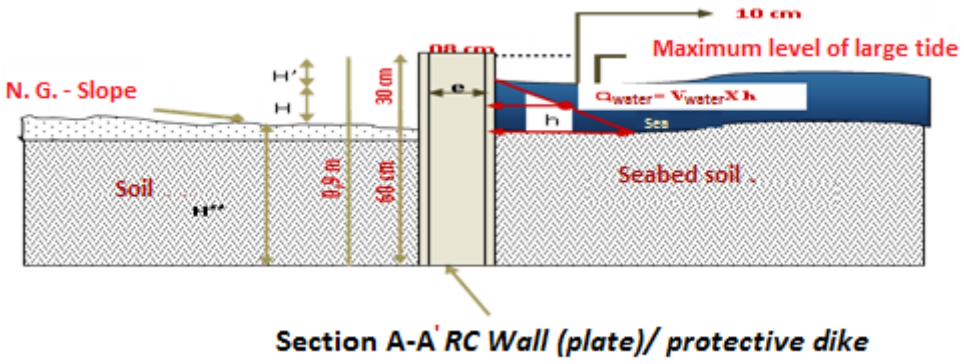


Figure 13: Section of the RC wall of a protection dike

Water action appears through the pressure it exercised directly on the flange downstream the work (in front of the sea). At a depth ***h***, the hydrostatic pressure is:

Active earth pressure $P = \frac{1}{2}\, d\, h^2\, tg^2\left(45 - \frac{\emptyset}{2}\right)$: Passive earth pressure $R = \frac{1}{2}\, d\, f^2\, tg^2\left(45 + \frac{\emptyset}{2}\right)$

by stating : and :

$K = tg^2\left(45 - \frac{\emptyset}{2}\right)$ $K' = tg^2\left(45 + \frac{\phi}{2}\right)$

$\lambda = dk$ $\lambda' = dk'$

$b = \lambda h$ $b' = \lambda' f$

We finally have:

$p = \frac{1}{2}\, bh$ and: $R = \frac{1}{2}\, b'f$

(Active pressure on the free height h) (Passive earth pressure on the height of card f)

The active and passive earth pressure can then be represented by rectangular triangles with h and F height and b and b' base. K and K' are called active and passive earth pressure coefficients.

If the ground slab is full (dual screen), we replace the height h by a fictitious height H such as:

$$H = h + \frac{\text{surchage}}{d}$$

''Active and passive earth pressure deducted from Coulomb and Rankine theories''

P / B = 1.27 < 1.61

P / B is very low on the wall ; the active pressure on the abutment provides an almost null pressure ; the resistance of the RC screen is very high compared to the water pressure which is very low, by considering a water sheet of a maximum f 20 cm.

V- Scope of Work

5.1- General requirements specification

- ✓ **For the Ndiar dike**

The catchment of Ndiar has a surface area estimated at 0.054 km² (5.4 ha; 144x380 m; p 1048 m). The dike covers all the distance of the right-of-way and has a good anchoring on the ridge line on an altitude of 20.80 of the natural ground facing circumventions.

The works to be done are: (i) reshape the embankment to 2 meters framed with dual screen RC plates measuring 266.74 meters anchored to the score (ii) backfill with a mixture of compacted shell and clay to enhance the gauge with a 30 to 40 cm descent, (iii) resize and build a rectilinear spillway equipped with 02 fiberglass valves, on the flow axis of the pk8 on an altitude of 19.70.

- ✓ **For the Ndioundiouré dike**

The works to be done are: 0.126 km² (267x475 m; p 1484 m). The dike covers all the distance of the right-of-way and has a good anchoring on the ridge line on an altitude of 20.40 of the natural ground facing circumventions.

The works to be done are: (i) reshape the embankment to 3 meters framed with Dual screen RC plates measuring 137.65 meters anchored on an altitude of 19.50 with demolition of nozzles, bags and of the low wall in place, (ii) backfill with a mixture of compacted shell and clay to enhance the gauge with a 30 to 40 cm descent, (iii) resize and build a rectilinear spillway equipped with a fiberglass valve, on the flow axis of the pk8 at an altitude of 19.30.

- ✓ **For the Ecole 2 dike**

The catchment of Ndiar has a surface area estimated at 0.051 km² (206x248; p 908 m). The dike covers all the distance of the right-of-way and has a good anchoring on the ridge line at the score of 20.85 of the natural ground facing circumventions.

The works to be done are : (i) reshape the embankment to 2 meters framed with Dual screen RC plates measuring 780 meters anchored on an altitude of 19.95 with demolition of nozzles, bags and of the low wall in place, (ii) backfill with a mixture of compacted shell and clay to enhance the gauge with a 30 to 40 cm descent, (iii) resize and build a rectilinear spillway equipped with a fiberglass valve, on the flow axis of the *pk28* at an altitude of 19.81 and *pk67* at a score of 19.96.

- ✓ **For the Djimsane dike**

The catchment of Ndiar has a surface area estimated at 11.84 km² (3200 x 3700; p 13800 m). The dike covers all the distance of the right-of-way and has a good anchoring on the ridge line on an altitude of 19.40 of the natural ground facing circumventions.

The works to be done are: (i) consolidate the spillway coating, (ii) build upstream/downstream rockfills and walled connection rip-rap, (iii) replace the metal valve by glass fiber, (iv) reshape over the stretch of 1754.00 meters and backfill clay embankments in two meters with a RC trapezoidal-shaped crown for a crest on an altitude of 21.10 for a 60 to 70 cm descent.

5.2 Statements of works and implementing procedures

The statement of works aims to establish technical standards and methods specific to the works. It sets the conditions for the implementation of works and specifies the techniques, supplies and means to use.

✓ **Characteristics of the four insular protective infrastructures**

Characteristics	Ndiar	Ndioundioure	Ecole	Djimsane
Total length of the dike in meter	266.74	137.65	830	1754
width in ridge of the dike in meter	2	3	2	2
Altitude of the ridge of dual screen plates	20.80	20.40	20.85	20.90
Maximum height of the dike in meter	1.10	1.10	1.05	1.05
Altitude of the invert section of the spillway	19.70	19.30	19.81	19.85
Height of the rectilinear spillway	0.80	0.80	0.80	0.80
Freeboard of the spillway	0.30	0.30	0.30	0.30
Maximum flow of the ten-year flood in m2/s	**12.17**	**25.24**	**10.22**	**32.60**
Volume of the impoundment in m3	**252,720**	**524,160**	**212,160**	**6 772 480**
Number of fiber glass valves and locations	02 ; pk10 and pk23	01 ; pk8	01 ; pk28	02
Length of the spillway in meter	**9.48**	**19.67**	**7.96**	**25,41 or two of 10 m and 15 m**

➢ **Building services**

The whole works necessary for the construction of structures will include the following building services:

✓ **Earthwork:** works consisting in making strip excavations on plots for the installation of plates and poles for a depth of 50 to 60 centimeters on dike lines. The natural ground will be excavated whenever necessary, along the plot, according to the specifications of longitudinal and traverse profiles, and one will be projected over a width of 50 cm on each side of the longitudinal alignment. The excavation bottom will then be compacted until a dry density is obtained of at least 90% of OPM.

The obtained elevations shall not differ by more than 01 cm from the project ones.
If, during excavation or compaction operations, there is a water film through the ground, these operations would be stopped. At least a 10 cm thick buffer layer from a material approved by the Consultant Engineer will be applied and compacted until we get a dry density at least equal to 90% of the OPM.

✓ **Reinforcement (steel) :**

- For plates, will be aligned 8 cm iron rods in longitudinal direction with extensions on both sides serving to make interdependent the frame of plates with connecting poles. In the width direction, will be aligned iron rods of 10. The crossing of these iron rods will produce 15 cm x 15 cm meshes.
- For poles, iron rods of 10 will be aligned with iron stirrups of 6.

✓ **Structural work**

- Evacuators : it is the building of straight-lined spillways with passes
- Compacted shell embankments mixed with clay in the right-of-way of the dual screen dike.

✓ **Making of poles**

The building of walls requires connecting poles between pre-manufactured plates.

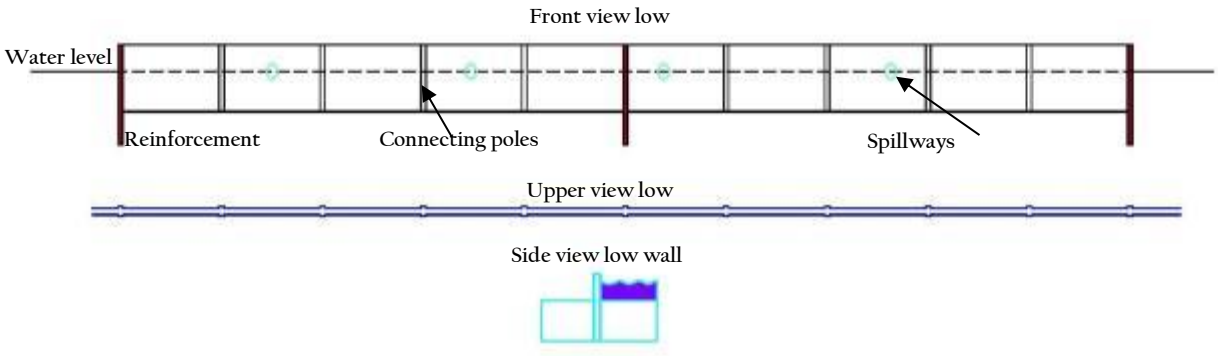
Considering the water pressure on walls that may bring about washouts and / or a swing; two types of poles are planned:

- Reinforcement or fastening poles against swing; these poles will at the same time serve as connecting device between plates. The proposed dimensions are: 150x15x10 cm.
- Connecting poles between plates; the proposed dimensions are: 100x15x10 cm.

Poles will be sized according to the thickness of plates (e = 0.8 cm) and according to the partition between plates (c = 10 cm) meaning 0.8 x 10.

The reinforcement of poles will follow the preceding scheme with posts or vertical iron rods of 10 and stirrups of 0.8 with a 10 cm track what gives: 0.8x10 / 10.

	Height (cm)	**Length (cm)**	**Thickness (cm)**
Reinforcement poles	150	10	15
Connecting poles	100	10	15



Upper view dual screen

- ✓ **Dosage of reinforced concrete**

An appropriate dosage of **400 kg/m^3** of gravel, cement, iron rods, sand, additives and water) to take into account the insular environment will be agreed, with **basaltic** gravel from the ground.

It is needed to reinforce the cohesion with additives such as **Sika** or **water stop** in the concrete dosage.

Considering the nature and complexity of the insular area, the costs and various fees related to transportation and other inputs are included in the pricing items of the different headings of the estimated cost.

a- Steel

Reinforcement / for a plate of **L = 2 m; H = 0.9 m ; e = 0.08 m**

- to the longitudinal direction (horizontal iron rods) will be aligned iron rods of 8 which will presented on a 10 cm length on both sides which will serve to make interdependent the frame of plates with connecting poles.

In the width direction, will be aligned iron rods of 10. The crossing of these iron rods will produce 15 cm x 15 cm meshes.

- ➢ **Quality of materials and special provisions**
  - ✓ The concrete must be perfectly homogeneous, carefully molded and well mixed. The mixing place must be as close as possible to the molding place of plates and casting of poles.
  - ✓ A very good quality sand must be used and without any plant residues.
  - ✓ A very good quality basaltic nature gravel must also be used.
  - ✓ For the mixing water: water used in the making of concrete must not contain substances dissolved, suspended particles, sediments likely to alter the hardening and resistance of the concrete.
  - ✓ The verticality and horizontality of works must be complied with so as to make it pleasant to see.
  - ✓ Finished angles will be perfectly squared.
  - ✓ The works must be built according to the code of practice.

A good quality of building will require the application of a call for tender procedure so as to hire a qualified construction company having a similar experience and monitored by a mission or consultant to ensure the technical control in collaboration with beneficiaries.

The works will then have on average 30 years of civil engineering duration.

5.3- Plans and sketches of developments to be made

The building plans and sketches are as follows:

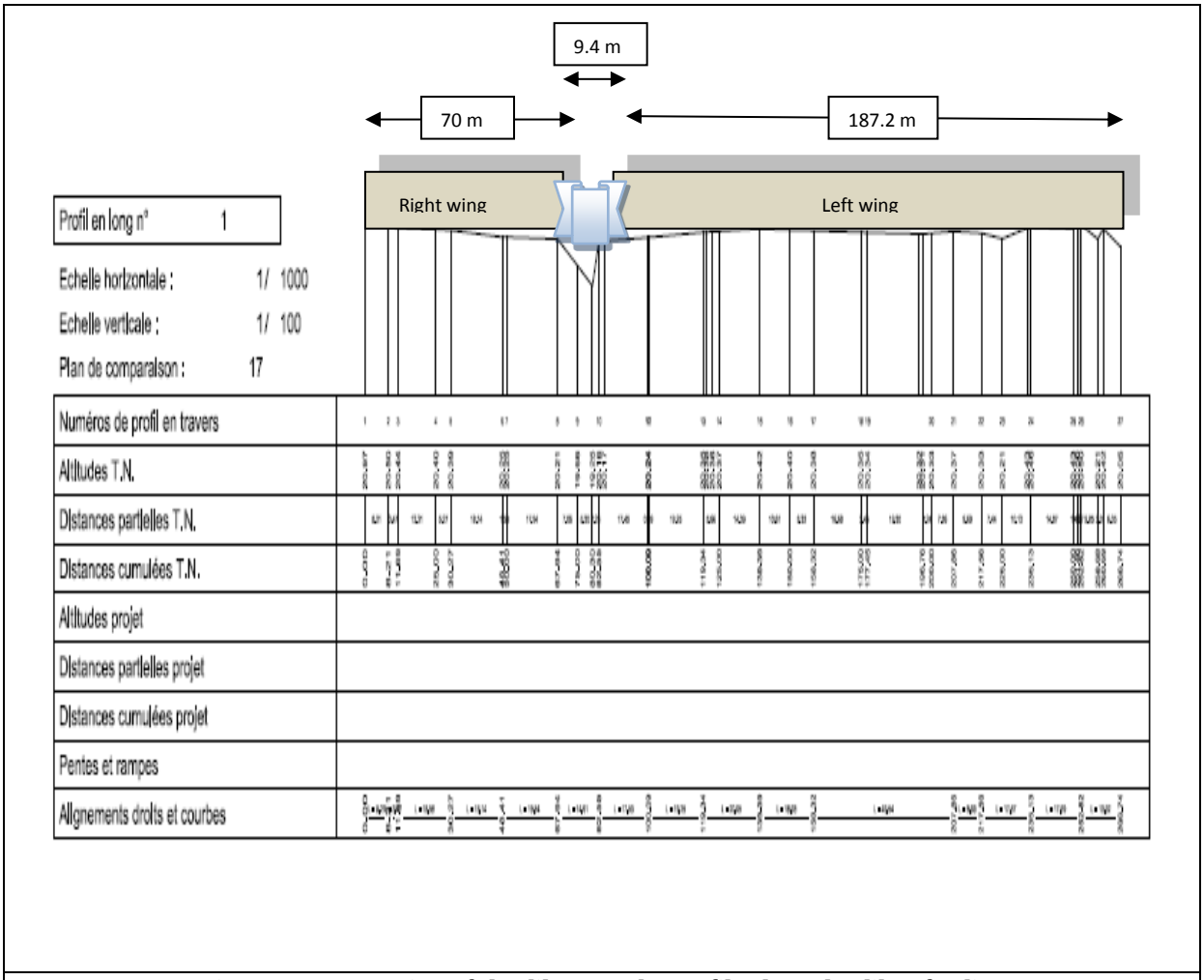


Figure 14 : Front view of the dike over the profile along the dike of Ndiar

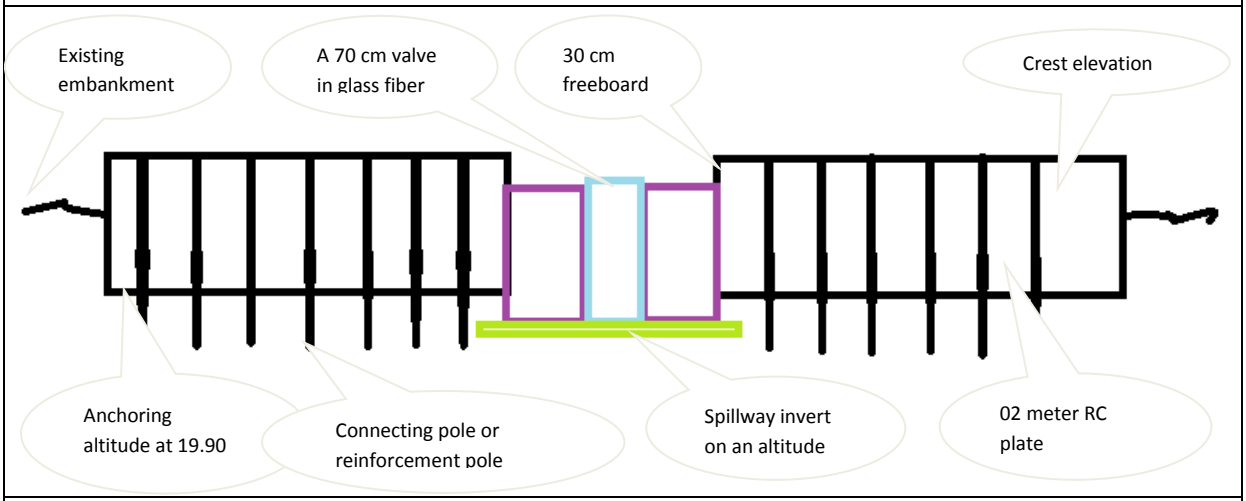


Figure 15 : Front view sketch of the development of the Ndiar dike

These sketches illustrate the operational arrangements meant to be made to build the dikes of Ndiar, Ndioundiouré and Ecole 2.

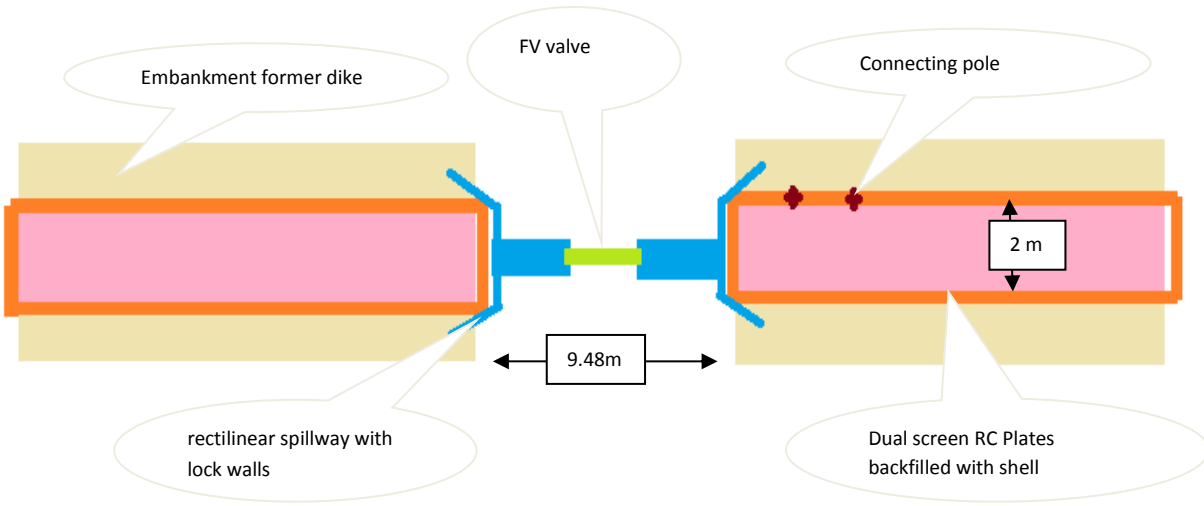


Figure 16 : Upper view sketch of the development of the Ndiar dike

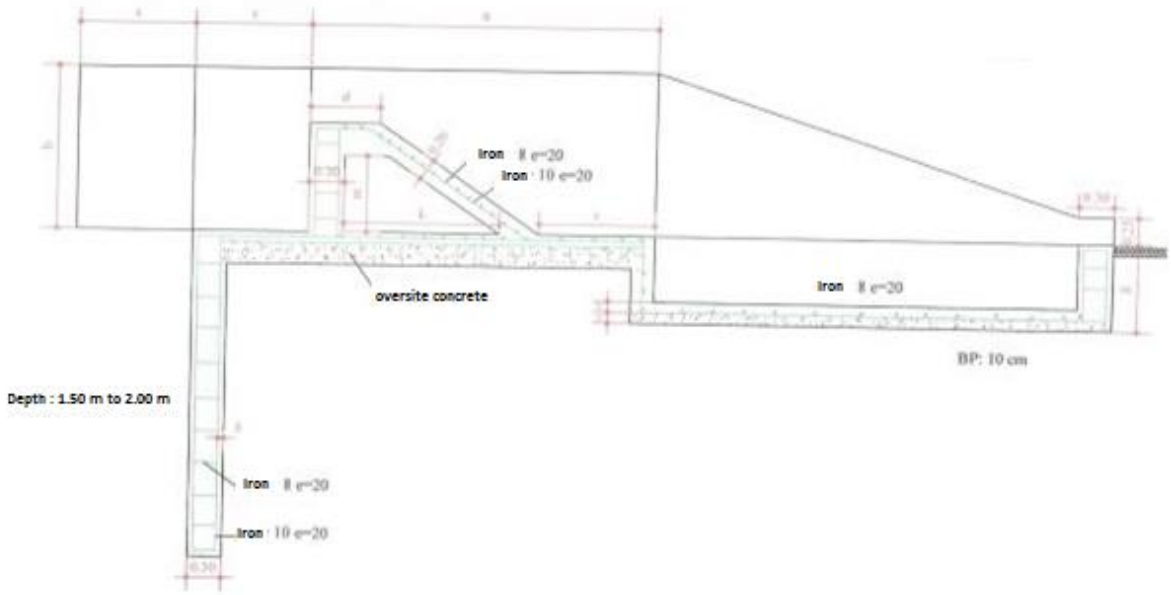


Figure 17 : Evacuator

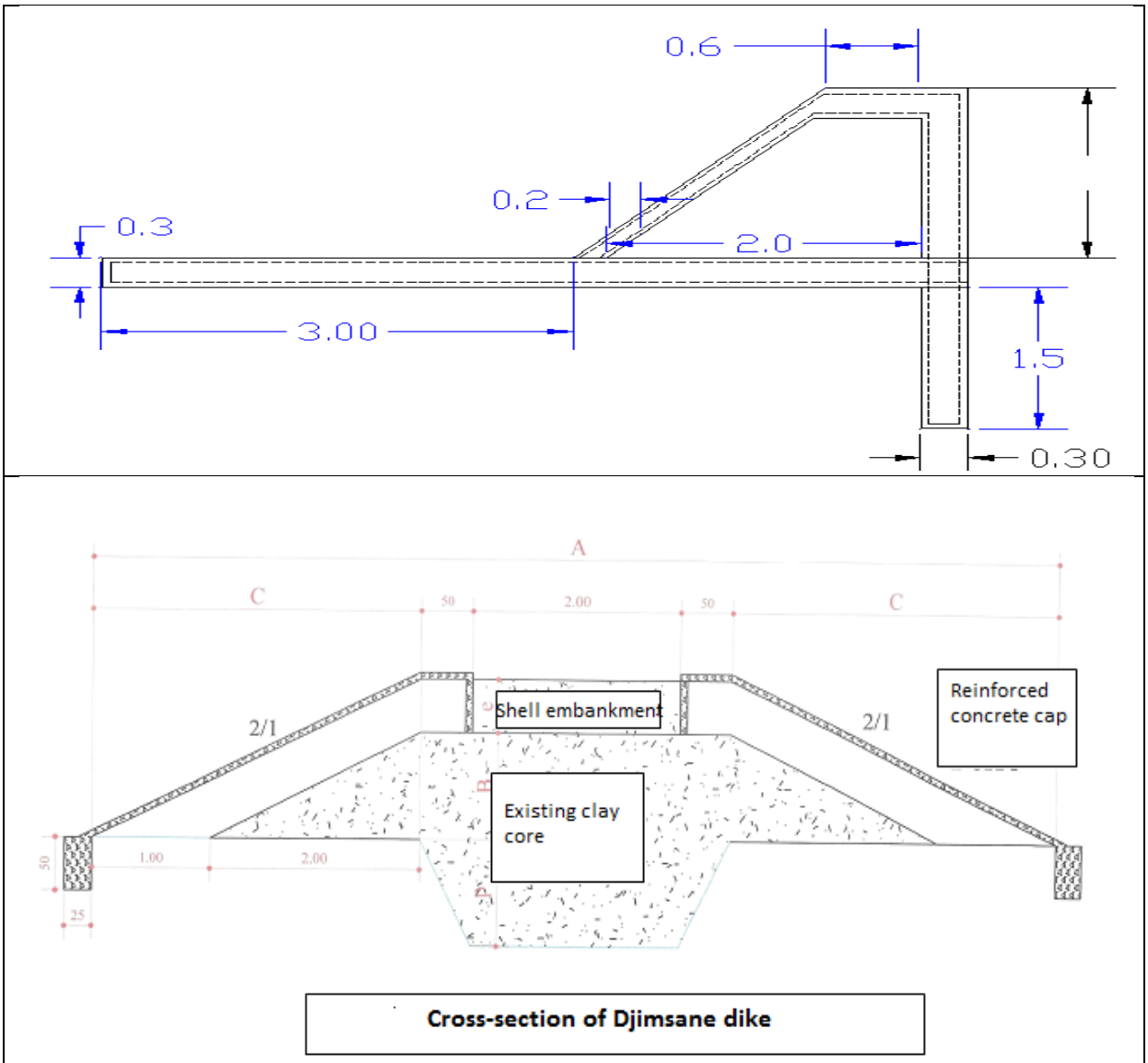


Figure 18 : Shape of the Djimsane dike

5.4- Bill of quantities and estimated costs

Ndiar dike

DESCRIPTION WORKS	Unit	Qty	UP	Total Price (XOF)	Total Price (USD)
Site preparation	FF	FF	500000	500000	
Strip excavation on the dike	ml	520	1000	520000	
Excavation for spillway	m3	13.5	1000	13500	
Oversite concrete calibrated at 150 kg/m3	m3	20	90000	1800000	
Reinforced concrete calibrated at 350 kg/m3 for spillway	m3	30	165000	4950000	

Plates calibrated at 400 kg/m3	U	260	70000	18200000	
Reinforcement poles calibrated at 400 kg/m3	U	260	25000	6500000	
Shell and clay embankment on dual screens	m^3	312	3500	1092000	
Glass fiber valve	u	2	200000	400000	
TOTAL				**33 975 500**	

- **Ndioundiouré dike**

DESCRIPTION OF WORKS	**Unit**	**Qty**	**UP**	**Total Price**
Site preparation	FF	FF	500000	500000
Strip excavations on the dike	ml	260	1000	260000
Excavation for spillway	m3	28.5	1000	28500
Oversite concrete calibrated at 150 kg/m3	m3	40	90000	3600000
Reinforced concrete calibrated at 350 kg/m3 for spillway	m3	50	165000	8250000
Plates calibrated at 400 kg/m3	U	130	70000	9100000
Reinforcement poles calibrated at 400 kg/m3	U	130	25000	3250000
Shell and clay embankments on dual screens	m^3	234	3500	819000
Glass fiber valve	u	1	200000	200000
TOTAL				**26 007 500**

- **Ecole 2 dike**

DESCRIPTION OF WORKS	**Unit**	**Qty**	**UP**	**Total Price**
Site preparation	FF	FF	500000	500000
Strip excavations on the dike	ml	1540	1000	1540000
Excavation for spillway	m3	12	1000	12000
Oversite concrete calibrated at 150 kg/m3	m3	25	90000	2250000
Reinforced concrete calibrated at 350 kg/m3 for 02 spillways	m3	40	165000	5775000
Plates calibrated at 400 kg/m3	U	770	70000	53900000
Reinforcement poles calibrated at 400 kg/m3	U	770	25000	19250000
Shell and clay embankments on dual screens	m^3	1386	3500	4851000
Vanne en fibre de verre	u	2	200000	400000
TOTAL				89 959250

- **Djimsane dike**

DESCRIPTION OF WORKS	Unit	Qty	UP	Total Price
Site preparation	FF	FF	500000	500000
Strip excavations on the dike	ml	3460	1000	3460000
Stabilization clay embankment	m3	865	12000	10380000
Oversite concrete calibrated at 150 kg/m3	m3	50	75000	3750000
Mortar calibrated at 250 kg/m3 for renovation of spillway	m3	10	130000	1300000
Reinforced concrete calibrated at 350 kg/m3 for crown	U	1141.8	150000	171270000
Masoned rip-raps	m2	10	30000	300000
Rip-rap upstream/downstream the spillway	m^3	15	15000	225000
Fiber glass valve	u	1	200000	200000
TOTAL				**191385000**

5.5- Prospecting materials

The needed volume of compacted shell embankments mixed with clay is **8 411 m^3**. The prospecting of materials is directed towards local ones essentially in the form of shell mixed with clay and excavation borrows or strings during works to evaluate at 5 834 m^3. The **2 577 m^3** gap is available in the shell quarry in Ndiar and Ecole 2 which qualities go beyond 10 000 m^3 with a valuable quality.

5.6- Organizational Aspects

The establishment of an organization fits into local stakeholders involvement process, particularly in the coordination and supervision of all activities carried out on site. Thus, its establishment requires the compliance with four major steps:

- Information and awareness raising of stakeholders;
- Support to the selection of representatives for the management committee;
- Support to the development of a draft by-law;
- Support to the organization of statutory meetings.

A management committee will be established for each structure. It will be responsible for:

- the upkeep and maintenance of the infrastructure;
- the application of the local agreement;
- the interaction with shallow users;
- the direct monitoring of some environmental parameters;
- the management of water spaces;
- the management of conflicts;
- the management of funds, etc.

This committee shall work under the supervision of the municipal council, whose tasks is to manage the natural resources of community lands. The municipal council is supported by a proximity operator. The management committee must be trained and monitored at least during the first two years on infrastructure management.

Other accompanying measures will include, among others:

- the development and application of a local agreement for each site to reduce the different conflicts related to the exploitation of natural resources on that area, particularly those caused by stray livestock ;
- the establishment of a dynamic management committee ;
- the establishment of a fund to upkeep and maintain infrastructures ;
- the fight against the proliferation of aquatic plants in thalwegs;
- the facilitation of tillage for newly conquered lands ;
- the enhancement of the technical and organizational capacity of operators ;
- the support to the marketing of products ;
- the conservation and transformation of products ;
- etc.

5.3- Environmental aspects

In accordance with Senegal regulatory requirements, particularly in Article L48 of the Environmental Code, "*any development or activity likely to affect the environment as well as policies, plans, programs, regional and sector-based studies will require an environmental assessment before any authorization for their completion.*

Environmental assessment is a systematic process to assess the possibilities, capabilities and functions of resources, natural and human systems to facilitate sustainable development planning and decision making in general, as well as to provide and manage the negative impacts and consequences of particular development proposals; it includes environmental impact studies, strategic environmental assessment and environmental audits".

As part of this project, a diagnostic study of environmental and social impacts has been performed. This study takes into account all the positive and negative environmental and social impacts resulting from the implementation of certain activities of the project.

In summary, these developments should allow:

- Protecting the islands (dwellings, cults and agricultural lands) against sea encroachment and floods,
- Recovering salty lands and improving water management by building anti-salt dikes and water storage facilities to secure and increase agricultural and livestock production and replenish the water table,
- Defending and restoring soil through erosion control measures, Rehabilitating the vegetation cover,
- Restoring degraded ecosystems and improving biodiversity,
- Building the technical capacity of users,
- Increasing the income of people concerned,
- Changing the behaviors of operators for a good management of low lands,
- Improving social cohesion, users' organization and the institutional framework.

Conclusion

This study conducted as part of the project entitled "***Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar)*"** reflects a detailed project proposal and demonstrates that the implementation of the four dikes is feasible and will induce significant positive impact in Dionewar and its satellite island of Djimsane.

The different types of structures and facilities offered will enable beneficiaries to enhance their resilience in response to the rising level of marine waters, to secure their assets, recover lost land areas and improve their living conditions.

With years of hydraulic compaction, there is a need to use the surface line of the previous dike as foundation, by rehabilitating slumped sections. This development will help contain the upwelling of high tides, facilitate rainwater drainage and control upstream for the protection of at least **1,206.5 ha** of salty lands.

For agricultural uses upstream of the structures after washout, the amount of stored water that can be mobilized is **7,761,520 m^3**.Given the nature and complexity of the island area, the different transportation costs and fees and other inputs are included in price items under the various headings of the cost estimate. The overall cost for the building of the four dikes is 341 327 250F.

A good quality of execution will require a bidding documents preparation process to recruit a qualified construction company with similar experience, monitored by a mission or consultant for technical control in collaboration with the beneficiaries.

The proposed technical option of the island protection facility has considerable impacts at lower cost and is easy to replicate in other sites, considering (ii) the availability of the materials and equipment for the realization of dikes, (iii) the facility to convince other technical and financial partners on the feasibility and (iv) the commitment of local authorities to support the local community.

ANNEXES:

1- Interview guide

Other information to be collected on the ground/sites

Four dikes: Ndiar, Ndioundiouré, Ecole 2 and Djimsane

1. GPS coordinates…….
2. Current situation of the various dikes: **.....**
3. Current lengths of the dikes: ……..
4. Assessing dike construction materials:……
5. Assessing their consistency: …….
6. Shaping existing dike stretch: **.....**
7. Foundation depth…….
8. Identifying and characterizing existing spillways: **.....**
9. Distance of the degradations to be backfilled: ……..
10. Level of compaction:……..
11. Remaining and non-executed stretches, if applicable: **.....**
12. Finalization of the remaining and non-executed stretch:…….
13. Prospecting of materials:……..
14. Other observations or problems found: **.....**
15. Recommendations from populations:……..

2- Topographic surveys and profiles (see attached documents)

3. Topographic data (see attached documents)

EXPLANATORY NOTE

As part of the project to reduce the vulnerability and enhance the resilience of coastal communities, an economic analysis has been conducted in order to have a better understanding of the economic impacts on populations and of the project profitability.

In this document, the costs are equivalent to the expected budget, which are the investments that will be made and the benefits are equivalent to revenues taken from the production activities (e.g. Fish farming or oyster farming, revenues taken from the coconuts sales, etc.). The benefits are also corresponding to the avoided costs (such as rehabilitation or repairs cost, etc.).

The project budget is $ 1,351,000 of which $ 1,024,584 for the first year, $ 170,136 the second year and $ 156,279 the last year of activity.

The first component of the project requires $ 261,893, the component 2 requires $ 681,837 and the third component requires a budget of $ 74,496.

1. COMPONENT 1: ENHANCING RESILIENCE FOR PRODUCTIVE SECTORS IN DIONEWAR ISLAND

1.1. ACTIVITY 1.1: DEVELOPMENT OF FISH AND OYSTER FARMS

The project seeks to develop fish and oyster farms. Those farms will improve the populations' livelihoods. The tables below can show the annual production during the fish and oyster farms exploitation.

Table 1: Annual expected production from the fish farms

Annual production in kgs	21,375	
Cost price of the kg of fish	950 XOF	$1.9
Sell price of the kg of fish	1300 XOF	$ 2.6
Gain	27,787,500	$ 55,575

Table 2: Annual expected production from the oyster farms

Annual production per kg	21,560	
Sell price of the dozen of oyster	1500 XOF	$ 3
Gain	32,340,000 XOF	$ 64,680

1.2. ACTIVITY 1.2: ENRICHMENT PLANTING WITH 6 HA OF TREES AND 5 HA OF MANGROVE

The second activity is reforestation. The planned reforestation will be made using coconut trees, palm oil trees and mangrove.

1.2.1. Coconut trees and palm oil trees

It is planned the reforestation of 6ha with coconut trees and palm oil trees. The coconut tree is the most profitable of the two species in the village. To this end, 4 hectares of coconut trees and 2 hectares of palm oil trees will be planted.

The table below shows the technical parameters and costs for planting the two species.

Table 3: Costs and parameters

Species	Cost of the young plant		Production start	Density (plant/ha)	Annual production	Selling price		Lifespan (year)
	(XOF)	($)				(XOF)	($)	
Coconut tree	15.000	30	After 3 or 4 years	100 - 124	40 – 60 nuts	100/nut	0.2/nut	30
Palm oil tree (nuts)	2,000	4	Between 2 or 4 years (but at the 3rd year the production can start)	120 – 140	8 – 14 tons	-	-	30
Palm oil					4 – 5 tons[1]	1.100/liter	2.2/liter	

The reforestation of these species will require the use of phytosanitary products. Its estimated costs are around 100.000 XOF/year ($200 per year) for the entire 6 hectares.

A staff responsible of the maintenance of the plantation will be needed. The maintenance is mainly made of the following activities:

- Application of fertilizers and pesticides;
- Weeding and pruning after the rainy season especially;
- Watering for 2 years:
  - 20 persons during 8 months (salary: $80 per month per person);
  - 1 safeguard (salary: $100 per month).

Young plant transportation : $1000

For the maintenance Investment :

- *Small equipment :*

Naming	Quantity	Lifespan (year)	Unit price (XOF)	Unit price ($)
12 litres watering can	40	5	7000	14
Wheelbarrow	5	10	12.000	24
Rake	20	2	2.000	4
Hoe	20	2	3.000	6
Bucket + rope	20	1	1.000	2
Secateurs	10	10	2.500	5
Spray	10	5	45.000	90

[1] Density of palm oil : 0.91kg/l

- *Large equipment :*

Naming	Quantity	Lifespan (year)	Unit price (XOF)	Unit price ($)
Well (2 wells per ha)	12	15	500.000	1000
Fence (400m/ha) + pickets	2400 m	10	6000/m	12/m

1.2.2. Mangrove

For the mangrove restoration, the community can be mobilized. This activity mainly concerns the collection and planting of propagules. A flat fee of $500 per year can be used to organize meals for example, the gasoil for the canoe used during the collection of propagules.

After three years, the oysters' production can start.

The working capital will be necessary at least for four years, the time it takes to get the production started.

2. COMPONENT 2: PROTECTION AGAINST FLOODING AND SALINIZATION IN DIONEWAR

2.1. ACTIVITY 2.1: REHABILITATION AND EXTENSION OF DIKES TO PROTECT AGAINST FLOODING

The dikes will be rehabilitated in order to protect housing and buildings against flooding.

In the area exposed to the rising floodwaters in case of dike failure, there are about a hundred buildings (houses, schools, etc.). The cost considered is the one for rehabilitating these buildings after a flood during the rainy season.

The estimated cost is $ 100 per building. The number of buildings damaged or requiring rehabilitation is estimated at 20 per year.

2.2. ACTIVITY 2.2: DEVELOPMENT OF RIDGES AROUND RICE PLOTS IN THE SATELLITE ISLAND OF DJIMSANE

In the Djimsane Island where the rice fields are located, there is an anti-salt dike built by a GEF funded project. Thanks to this dike, Dionewar's women have been able to grow rice during the last rainy season (2015) and generate about 500 kg of rice.

Given the remoteness of houses compared to the growing areas, a multipurpose warehouse will be built to store the equipment and the crops. A tiller will also be purchased in order to fully take advantage of the land areas reclaimed or protected.

Investissements pour la riziculture

Naming	Quantity	Lifespan (year)	Unit price (XOF)	Unit price ($)
Multipurpose warehouse (storage capacity 30 to 40t)	01	20	1.000.000	2.000
Husker	01	15	3.600.000	7.200
Tiller and harrow	01	15	2.436.052	4.872

The efficiency of the rice production is around 2.5t per hectare.

Profitability analysis

The working capital, the operating expenses and the others costs assess the profitability of the project. During the first 6 years, the revenues taken from the activities are estimated between 25 and 75% of the production capacity and the cruising speed will be reached at the 7^{th} year.

COMPONENTS/ OUTPUTS	ACTIVITIES	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15
Component 1: Enhancing resilience of main ecosytems in Dionewar island																
Output 1.1: Development of fish and oyster farms																
Logistic		10 000														
Fixed asset		13 060														
Working capital		12 965														
Investment cost		36 025	0	0												
Operating expenses		5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895
Oyster farming																
Production cost		5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895	5 895
Benefits			387164	387164	774327	774327	774327	1161491	1161491	1548654	1548654	1548654	1548654	1548654	1548654	1548654
Output 1.2: Reforestation of 6 ha of trees and 5 ha of mangrove																
Tree Nursery																
Laying out		10 000														
Equipments		49 833														
Ecoguards training			5 000													
Ecoguards equipments			4 500													
Investment cost		59 833	9 500													
Inputs		2 849	2 449	2 849	2 849	2 849	2 849	2 849	2 849	2 849	2 849	2 849	2 849	2 849	2 849	2 849
Labour		23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734	23 734
Reforestation																
Logistic		600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
Social labor		500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Production cost		27 683	27 283	27 683	27 683	27 683	27 683	27 683	27 683	27 683	27 683	27 683	27 683	27 683	27 683	
Benefits		0	0	0	0	8 990	8 990	17 980	17 980	17 980	17 980	17 980	17 980	17 980	17 980	17 980
Output 1.3: At least 18 women economic interest groupings and natural resources management committee trained to improve their technical performance																
Organizational mgt																
Consultancy services		5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000

Workshop	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800
Production mgt															
Consultancy services	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000	5 000
Workshop	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800	1 800
Output 1.4: A management plan is developed for the fish and oyster farms															
Fish farming															
Consultancy services		7 000													
Validation workshop		700													
Oyster farming															
Consultancy services		7 000													
Validation workshop		700													
Benefit Component 2	0	387 164	387 164	774 327	783 317	783 317	1 179 471	1 179 471	1 566 634	1 566 634	1 566 634	1 566 634	1 566 634	1 566 634	1 566 634
Production cost Component 2	47 178	62 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	19 495
Investment cost Component 2	95 858	9 500	0	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow component 2	-143036	315485	339985	727149	736139	736139	1132292	1132292	1519456	1519456	1519456	1519456	1519456	1519456	1547139
Component 2: Protection against flooding, coastal erosion and salinization in Dionewar															
Output 2.1: Rehabilitation and extension of dikes to protect against flooding															
Surveying	35 000														
Shell storage	527 000														
Contract services	62 000														
Investment cost	624 000														
Production cost															
Benefits (coûts évitées)		1 699	1 699	1 699	1 699	1 699	1 699	1 699	1 699	1 699	1 699	1 699	1 699	1 699	1 699
Output 2.2: Development of ridges around rice plots in satellite island of Djimsane															
Rice areas mapping	10 000														
Purchase of equipment	10 000														
Social mobilization actions	8 000														

Construction de Batiment à Usages Multiples (BUM)	1 699						1 699								
Equipement en matériel lourd (Motoculteur)	4 138										4 138				
Consultation producers	3 000														
Investment cost	36 837	0	0	0	0	0	1 699	0	0	0	4 138	0	0	0	0
Benefits		27 605	27 605	55 209	82 814	82 814	110 418	110 418	110 418	110 418	110 418	110 418	110 418	110 418	110 418
Output 2.3: A maintenance plan of coastal infrastructures developed, including key stakeholders															
Maintenance guide	15 000														
Management comitee	3 000														
Report back session	3 000														
Investment cost	21 000														
Benefit Component 3	0	29 303	29 303	56 908	84 512	84 512	112 117	112 117	112 117	112 117	112 117	112 117	112 117	112 117	112 117
Production cost Component 3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investment cost Component 3	681 837	0	0	0	0	0	1 699	0	0	0	4 138	0	0	0	0
Cash Flow component 3	-681 837	29 303	29 303	56 908	84 512	84 512	110 418	112 117	112 117	112 117	107 979	112 117	112 117	112 117	112 117
Component 3: Strategic planning and knowledge management															
Output 3.1: The Local Development Plan (PLD) is reviewed / updated in order to integrate climate change adaptation options & costs benefits.															
Up date PLD and PLAE	7 000														
Training (1) local representatives		5 000													
Training (2) local representatives	2 600	2 600	2 600												
Workshops	400	400	400												
Output 3.2: Preparation of a Local Convention to better regulate the use of forest products and the biological rest															
Diagnostic RN natural resources	3 000														
Drafting local convention	1 400														
Validation workshop		600													
Delibaration session		600													
Edition duplication LC		2 346													

Output 3.3: Project's lessons learned documented and shared															
Annual reports production	2 500	2 500	2 500												
Audio et television braodcasting		1 000													
Posters production	2 500														
Video production		0													
Workshop participation	1 050	2 050	2 050												
Output 3.4: Installation of a meteorological station at Dionewar															
Meteo station	22 000														
Identification mission	2 500														
Installation mission	1 000														
Securisation work	2 500														
Maintenance	1 400														
Investment cost Component 4	49 850	17 096	7 550	0	0	0	0	0	0	0	0	0	0	0	0
Cash Flow component 4	-49 850	-17 096	-7 550	0	0	0	0	0	0	0	0	0	0	0	0
Project execution															
Staff salaries and allowances															
M&E specialist salary	7 200	7 200	7 200												
Local coordinator salary	6 000	6 000	6 000												
Admin and fin assistant salary	3 600	3 600	3 600												
Allowances of CADL technical staff	4 800	4 800	4 800												
Refection and equipment of office															
Refection of former rural commuty premices	3 290														
Office furniture	900														
Computing equipement	2 400														
Maintenance		200													
Office supplies	600	600	600												
Commodities	1 200	1 200	1 200												
Transportation	1 070	1 000	1 070												

Communication	720	720	720													
Inception workshop	9 500															
Steering committee meeting	2 000	2 000	2 000													
Final audit			10 000													
Mid-term evalutaion		3 000														
Final evaluation			7 500													
Management fees																
CSE staff allowances	14 200	19 200	20 200													
Consultant	5 000	5 000	5 000													
Field supervisions (Contribution to M&E activities)	10 000	8 000	6 000													
Inception workshop Contribution to execution resources)	6 039															
Financial fees	2 000	2 000	3 200													
ESMP Implementation																
Implementation of mitigations measures	17 500	17 500	17 500													
Oversight	3 852	3 852	3 851													
Environmental and social monitoring	14 863	14 863	14 864													
Total Benefit	0	416467	416467	831235	867829	867829	1291588	1291588	1678751	1678751	1678751	1678751	1678751	1678751	1678751	
Total Production cost	47 178	62 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	47 178	19 495	
Total Investment cost	827 544	26 596	7 550	0	0	0	1 699	0	0	0	4 138	0	0	0	0	
EXECUTION COST	116 734	100 735	115 305	0	0	0	0	0	0	0	0	0	0	0	0	
Total Cash Flow	-991457	226957	246433	784056	820651	820651	1242711	1244409	1631573	1631573	1627435	1631573	1631573	1631573	1659256	
BUDGET	**991 457**	**189 509**	**170 033**	**1 351 000**												
Investment Return Rate (IRR)	**54%**															
Net Present Value (NPV)	**4 926 774**															

The 54% Investment Return Rate (IRR) allows to make the investment. Indeed, the project's IRR is higher than the bank rates.

The actual IRR is higher that the discount rate (which is at 12%), the net present value of the project is positive (USD 4 926 774), meaning that the project is profitable.

Centre de Suivi Ecologique

National Implementing Entity (NIE) of the Adaptation Fund (AF) and the Green Climate Fund (GCF)

"REDUCING VULNERABILITY AND INCREASING RESILIENCE OF COASTAL COMMUNITIES IN DIONEWAR"

ENVIRONMENTAL AND SOCIAL DIAGNOSTIC STUDY

FINAL REPORT

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March 2016

DEFINITIONS

For a common understanding, we recall the following definitions of certain key concepts. These definitions are for the most part taken from the Environmental Code of the Republic of Senegal and various official documents of the United Nations.

Adaption to climate change: All initiatives and measures to reduce the vulnerability of natural and human systems to the actual or expected impacts of climate change (IPCC 2007: 1). The adjustment of natural or human systems in response to actual or expected climatic conditions or their impacts to mitigate harmful effects or exploit beneficial opportunities. Adaptation is also understood as the efforts by social groups, individuals and countries to adapt to the current and potential impacts of climate change.

Climate change: Slow variations of climate characteristics in a given location over time. Climate change may cause significant damage: rising sea levels, accentuation of extreme weather events (droughts, floods, cyclones, etc.), destabilization of forests, threats to freshwater resources, agricultural problems, desertification, biodiversity reduction, etc.

Waste: Any solid, liquid, gaseous substance or residue from a process of production, processing, or use of other substances disposed, meant to be disposed or disposed of under the laws and regulations in force.

Ecological damage: Ecological damage: Any damage to the natural environment, people and property that affects the ecological balance. This may be:

- Pollution damage caused by man and suffered by identifiable assets and individuals;
- Damage suffered by inappropriate elements of the natural environment;
- Damage to crops and property by game.

Ecological balance: The relatively stable relationship between man, fauna and flora, and their interaction with the conditions of the natural environment in which they live.

Environmental issue: Refers to the importance of a use, function, territory or natural environment in terms of environmental concerns, heritage, landscape, sociological, health considerations or quality of life.

Environment: All natural and artificial elements as well as economic, social and cultural factors that promote the existence, transformation and development of the natural world, living organisms and human activities.

Human settlements: All urban and rural areas, regardless of their types and sizes and all the facilities they must have in order to ensure that their inhabitants enjoy a healthy and decent life.

Environmental impact: Refers to the set of qualitative, quantitative and functional changes in the environment caused by a project, process, method, one or more organizations and one or more products from design to "end of life".

Public participation: The involvement of the populations in decision making. Public participation involves three stages, namely, information, consultation and public hearing.

Pollution: Any contamination or direct or indirect modification of the environment caused by any act:

- likely to adversely affect a use of the environment that is beneficial to man;
- that causes or is likely to cause a situation prejudicial to the health, safety, well-being of people, flora, fauna, atmosphere, water and collective and individual property.

Atmospheric pollution: The emission in the atmosphere of gases, smoke or substances likely to inconvenience the people, endanger public health or safety or harm agricultural production, preservation of buildings and monuments or alter the nature of natural sites and ecosystems.

Water pollution: The introduction into the aquatic environment of any substance that can modify the physical, chemical and biological characteristics of the water and jeopardize human health, harm the aquatic flora and fauna, affecting facilities or interfering with any other normal water use.

Resilience: In ecology, resilience is the ability of an ecosystem to recover its functions after a disturbance. Applied to human systems, factors that build resilience may include diversification of resources and agricultural production systems, disaster management systems, insurance schemes, food and monetary reserves or wise infrastructure investments, etc.

Environmental sensitivity: The degree of the impact of climate variability on assets of recognized value. It may be considered as the extent to which national and local economies depend on a given sector and are, therefore, sensitive to any changes in that sector.

Sustainable use: The use of the components of biological diversity in a way and at a rate that does not lead to their long-term decline, thereby maintaining their potential to meet the needs and aspirations of present and future generations.

Vulnerability: The impact level where humans and/or natural systems are sensitive to or unable to cope with the adverse effects of climate change. It depends on the magnitude of the variation in climate, exposure, sensitivity and adaptive capacity.

ABBREVIATIONS AND ACRONYMS

ADF: African Development Fund

AF: Adaptation Fund

AFDS: Agence du Fonds de Développement Social

ANA: National Agency for Aquaculture

ANSD: Agence Nationale de la Statistique et de la Démographie

ARD: Agence Régionale de Développement

CADL: Centre d'Appui au Développement Local

CC: Climate change

CEM: Collège d'Enseignement Moyen

COGER: Comité de Gestion des Ressources naturelles

CONAF: Comité National pour l'Alphabétisation Fonctionnelle

CSE: Centre de Suivi Ecologique

DAMP: Direction des Aires Marines Protégées

DRDR: Direction Régionale du Développement Local

DREEC: Division Régionale de l'Environnement et des Etablissements Classés

DRP: Direction Régionale des Pêches

EDF: Environmental Development Fund (EDF)

EFA: Education for All

EIG: Economic Interest Group

EVE: Eau Vie Environnement

FELOGIE: Fédération Locale des GIE

GPF: Groupement de Promotion Féminine

IGA: Income Generating Activity

IREF: Inspection Régionale des Eaux et Forêts

IUCN: International Union for Conservation of Nature and Natural Resources

LA: Local authorities

NRM: Natural resources management

PAPA-SUD: Programme d'Appui à la Pêche Artisanale dans le Sud du Sénégal

PERACOD: Programme pour la promotion des énergies renouvelables, de l'électrification rurale et de l'approvisionnement durable en combustibles domestiques

PLD: Plan Local de Développement

PNAT: Plan National d'Aménagement du Territoire

PNDL: Programme National de Développement Local

PODES: Plan d'Orientation pour le Développement Economique et Social

PRECEMA: Projet de Restauration et de Conservation de l'Ecosystème Mangrove dans la Réserve de Biosphère du Delta du Saloum

PRODDEL: Programme d'Appui à la Décentralisation et au Développement Local

SEF: Secteur des Eaux et Forêts

SRP: Service Régional des Pêches

STD: Sexually Transmitted Disease

WAAME: West African Association for Marine Environment

WULA NAFA: Agriculture Programme/Natural resources management

EXECUTIVE SUMMARY

Dionewar communities have suffered for decades from the adverse effects of climate change, triggered most significantly by the widening of the passage in the narrow sandpit called 'la Pointe de Sangomar' in February 1987 following an exceptionally strong swell. This mainly affected the productive systems.

The major environmental problems encountered by the population of Dionewar are: (i) the coastal erosion that threatens the existence of some settlements of the island; (ii) recurrent floods; (iii) the degradation of plant cover; (iv) the threat of salinization of the Djimsane rice fields; (v) the mangrove degradation and loss of fisheries resources. These environmental problems have, among other effects on populations, caused a decline in the income of the population derived from the exploitation of fisheries and forest resources.

In the face of these challenges, the adaptation strategy developed by the population is to create conditions that ensure the protection of the island through the building of dykes, sustainable management of forest resources and the development of fisheries resources through processing.

The village people have welcomed the project with great hope in the many opportunities it can provide. This is the case for rice farming, a cultural activity that women want to revive. The rehabilitation of the dykes will better protect the village against floods, but also help reclaim dozens of hectares of land affected by salinization. Reforestation through tree planting, beyond the restoration of forest ecosystems, will provide many non-timber forest products which when processed will contribute to local development. The promotion of aquaculture will generate additional income through the development of fisheries products.

The environmental and social diagnosis helped identify the impacts the implementation of the project will have.

The impact analysis shows that the activities envisaged in the project to reduce the vulnerability and enhance the resilience of the coastal communities of Dionewar are generally positive in that they have the potential to: (i) reverse the current trends of the degradation of natural resources and biodiversity (erosion and salinization); (ii) revitalize the mangroves, coconut and oil palm trees; (iii) increase the potential of the arable lands; (iv) enhance the quality of the landscape; (v) improve the nutritional status by ensuring the availability of forest fruits, fish and oysters for most of the year; (vi) create jobs in order to curb the rural exodus and increase the income of the populations, particularly young people and women; (vii) promote the establishment of organizations capable of managing the facilities.

However, some activities are associated with negative effects that should be prevented or mitigated in order to maximize the benefits of the project. That is the case of the earthworks including the Djimsane dyke, the extraction of shells from shell middens used as building materials, the excavations for the low protection walls planned for the dykes of Ndiar, Ecole 2 and Ndioundioure, the mining and transportation of materials, moving of machinery, the presence of laborers on project sites, and finally the presence of dams and their use.

❖ Thus, *during the project implementation phase*, these activities will affect:

The biophysical environment by generating: dust, gases and noise; oil product spill risks on the sites; solid wastes consisting of construction material residues and other materials (plastic bags, packaging); a reduction of plant cover and wildlife habitat, erosion risk at the extraction sites of the different building materials (shell middens) and soil degradation through compaction.

These disruptions will have a low impact on air quality because they are very localized and temporary. For the plant cover, the effects will be minor because they are largely preventable. As for the soil, the disruptions will somewhat worsen the erosion, at least temporarily.

Regarding the human environment, the project's impacts will consist of: the generation of dust and noise in the project site as well as in the nearby human settlements; social tensions related to the recruitment of workers; the risk of the spreading of STDs due to the arrival in the village of people from diverse backgrounds. All these risks can be controlled by establishing an environmental monitoring and surveillance programme.

❖ *During the operation phase*

Regarding the biophysical environment, the activities of intensification of agricultural production, fish farming, oyster farming and the construction of a plant nursery could cause potential contamination of water resources and wildlife (aquatic and avian) by chemical inputs.

For the human environment, there is a risk of the impact of diseases transmitted or facilitated by the presence of water bodies as well as the adverse effects of the possible misuse of pesticides on the health of farmers.

Specific mitigation measures have been proposed to protect the most sensitive elements of the environment, reduce the negative impacts and enhance the positive impacts of the project and compensate for the residual impacts due to the implementation of the project.

❖ *During the construction phase*, appropriate environmental management and project organization measures will help mitigate the negative impacts resulting from various construction works. Thus, the harmful effects and risks caused by the project construction activities will be addressed in special technical requirements to be respected by those who will conduct the work. These will generally cover site management measures (sensitizing workers about the need to protect the environment respect for hygiene and safety regulations, site restoration, etc.).

❖ *During the operation phase*, mitigation measures will consist of: preventing water pollution by chemical inputs, training farmers in the proper use of chemical fertilizers and pesticides. The incidence of waterborne diseases will be mitigated by health education, dissemination of the concepts of prophylaxis and environmental health in the communities living near the facilities. Conflicts between farmers and herders over use of the space will be avoided by the development of integrated management plans in the relevant developed areas.

Regarding the specific measures for enhancing the impacts, the project provides genuine opportunities for the development of the site, but the latter's fragility calls for the rational use of integrated facilities with environmental protection in mind. The environmental and social management plan for the site must contribute to the protection of the ecosystems and the integration of both traditional activities and those induced or enhanced by the project.

The following measures are proposed to ensure more enhanced and effective site development, conservation of the environment and ecosystems, and integration of the project site:

- watershed protection against erosion and silting;
- restoration of mangrove ecosystems;
- training management committees in water management techniques, pesticide use and maintenance of the facilities;
- organizational and material capacity building for the facility management committees;
- improving the living conditions of the beneficiary populations by promoting the creation of favourable conditions for women's access to appropriate knowledge and technology such as the processing of fishery products and fruits; capacity building for the facility management committees.

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INTRODUCTION

Dionewar Island (13° 54'N, 16° 44'W) is located between the Diomboss and Saloum inlets in Niodior borough in the district of Foundiougne (Fatick region). Its population is composed of Serere Niominka Muslims, numbering about 5,000 inhabitants and mainly engaged in maritime activities (fishing, fish processing).

In February 1987, following an exceptional swell the foremost tip of the Sangomar sandspit opened, causing considerable disruption of the hydrodynamic and ecological balance of the archipelago, particularly on the island of Dionewar. The populations, now exposed to the effects of the tides and floods, are adopting measures to not only protect the village with dykes, but also diversify their sources of income by processing fish and forest fruits.

It is with a view to supporting these community efforts that the ecosystem-based adaptation project was initiated to help reduce the vulnerability and enhance the resilience of these coastal communities.

This document, an environmental and social diagnosis of the project entitled "Reducing the Vulnerability and Improving the Resilience of the Coastal Communities of Dionewar", is outlined as follows:

- A description of the project and its different components;
- The scope and objectives of the environmental and social diagnosis;
- The main environmental and social issues of the project.
- The environmental and social diagnosis;
- The main findings and measures proposed.

I. PROJECT RATIONALE

Dionewar Island has in recent decades encountered a number of problems related to climate change. Following the widening of the gap in the Sangomar sandspit, the island has become exposed to the combined problems of coastal erosion and silting along its coastline. This is compounded by the now recurrent floods. Meanwhile, the mangrove ecosystem is subjected to the effects of climate hazards as well as the wasteful cutting by the population for their energy and construction needs.

Indeed, with the combined effects of climate change and (anthropogenic) economic activities, the mangrove ecosystems in the Saloum estuary have markedly deteriorated in recent years resulting in a significant decline in ecological and economic functions, notably including the widening of the passage at the tip of the Sangomar sandspit. The Dionewar communities are thus exposed to the disappearance of their settlements in the long term. They have become vulnerable.

Indeed, the studies[1] conducted on the coastline and the Saloum estuary indicate that recent climate variations (from 1971 to 2010) are reflected in many ways in the mangrove ecosystem of the Saloum estuary and that rainfall has been the critical factor. The succession of dry years has significantly pushed back the tidal limits, and the salinity fronts have moved at times far upstream. Thus, borderline cases of hypersalinity have been reported in the Saloum estuaries, while it is established that salinity has a major effect on the metabolic efficiency of plant species, particularly on mangrove productivity which decreases as salinity increases. These hydrological and ecological conditions explain the small size of the mangrove in the Saloum estuary, but also its density, species composition and productivity.

The mangrove is also subject to intensive economic exploitation by the communities: oyster harvesting, firewood, timber, among others.

The receding of the mangrove has a direct influence on the sediment dynamics that ensures the stability of the sandspit commonly known as the "pointe de Sangomar". Indeed, when the mangrove recedes, it leads to reduced sediment supply. Thus, in 1987, a gap was created in 'pointe de Sangomar', causing major ecological upheavals due to the acceleration and worsening of the marine coastal erosion.

The stimulus package for rice farming in Senegal was hailed by the women of Dionewar. They pledged in 2015 to resume rice production on the island of Djimsane, jointly with the

[1] UEMOA, IUCN, 2010: Programme de lutte contre l'érosion côtière de l'UEMOA. "**Etude régionale pour le suivi du trait de côte et l'élaboration d'un schema directeur du littoral de l'Afrique de l'Ouest;** Schéma directeur, prescriptions générales".
EL Hadji Balla Dieye, Amadou Tahirou Diaw, Tidiane Sané et Ngor Ndour, **« Dynamique de la mangrove de l'estuaire du Saloum (Sénégal)** entre 1972 et 2010 », *Cybergeo : European Journal of Geography* [Online], Environment, Nature, Landscape, Document 629, posted January 9, 2013, accessed 19 December 2015. URL : http://cybergeo.revues.org/25671 ; DOI : 10.4000/cybergeo.25671

population of the nearby village of Niodior. The resumption of rice farming in Djimsane was facilitated in 2014 by GEF/SGP support for the construction of a 1.5 km long dyke to stop the salt front.

With the difficulties in the fisheries sector (declining landings in particular) in recent years, the populations have developed other income generating activities. The women of the Local EIG Federation (*Fédération Locale des GIE*, or FELOGIE) of Dionewar have thus started processing forest fruits (*Detarium senegalensis, Tamarindus indica, Adansonia digitata* etc.). These activities have been added to the processing of fishery products and the commitment and performance of the womenfolk in this area have resulted in the construction of a modern processing centre.

These initiatives, while laudable, are unfortunately not enough to fully address the island's vulnerability issues. Floods have become recurrent and cause a lot of damage. Meanwhile the sea continues to advance, threatening each year all infrastructure along the coast.

It is in this context of vulnerability of coastal communities, including those of Dionewar who are the most vulnerable, that the project was initiated as a response to:

- the declining ecological and economic functions of the mangrove due to climate variations. This is significantly reflected in the dwindling productivity of the estuary ecosystems on which the livelihoods of the populations largely depend;
- the recurrent floods;
- the risks that coastal erosion poses to human settlements and ecosystems of the estuary;
- the climate data gap, which hampers the establishment of good local development policies and strategies, which results in a rather weak legal and regulatory framework, notably characterized by the poor integration of climate change issues into local development strategies.

Faced with this situation, the local people have undertaken a number of initiatives, the most important of which are the protection of the island against the tides and floods by a system of dykes.

It is in this context that the islanders, through the Dionewar Development Association (*l'Association pour le Développement de Dionewar*, or ADD) and the national literacy and training committee (*Comité National pour l'Alphabétisation et la Formation*, or CONAF), proposed the idea of a project to address the numerous climate change challenges.

The concept that arose from this project idea entitled ***"Reducing vulnerability and Increasing Resilience of Coastal Communities in the Saloum islands (Dionewar)"*** was submitted and approved by the Board of the Adaptation Fund at the end of its 26th meeting held from 8 to 9 October 2015. It is in this context that the project entitled ***"Reducing vulnerability and improving the resilience of coastal communities in Dionewar"*** which is the subject of this social and environmental diagnostic study was initiated.

The purpose of this diagnosis at this stage of the project formulation is to help its promoters to conduct an early identification of the environmental and social issues in the various implementation phases. It is not intended to replace an Environmental and Social Management Plan following an environmental assessment whose format will be determined by the competent national authority depending on the category in which it will classify the project. This report seeks to clarify the issues as comprehensively as possible.

II. THE PROJECT DESIGN AND FORMULATION CONTEXT

2.1. The institutional background

The idea of the project emanated from the Dionewar Forum held in November 2009. The purpose of the forum, which brought together all the social classes of the village, was to conduct a diagnosis of the socio-economic and environmental issues of the island in order to identify concrete rehabilitation or restoration measures and actions. One of the key players of the forum was the Association for the Development of Dionewar (ADD) established by the inhabitants of Dionewar to promote the economic and social development of the island. The association provides support in different areas: education (school supplies, renovation of class rooms, etc.), health (supply of medicines to the community pharmacy and medical equipment). At the end of this forum, several priorities were identified, each of which were expected to end up as projects to be promoted mainly by the ADD. Thus, in response to a call for proposals issued by the CSE and the designated authority of Senegal for the Adaptation Fund, ADD, in collaboration with CONAF, submitted a concept note based on the priorities identified by the Dionewar forum.

In the project development phase, the CSE and promoters agreed to involve the National Aquaculture Agency (*Agence Nationale pour l'Aquaculture*, or ANA) to provide support on aspects related to aquaculture. The aim of this institutional arrangement is to involve, as early as the project development phase, a national institution duly mandated to promote aquaculture. This will facilitate the maintenance and management of the facilities in the post-project stage.

The collaboration between ADD, CONAF, ANA and CSE thus led to the formulation of the project entitled "Reducing vulnerability and improving the resilience of coastal communities in Dionewar".

2.2. The geographic and administrative context

The project intervention area is the village of Dionewar which is also the provincial capital of the municipality of the same name. Together with the villages of Niodior and Falia, they form three localities that make up the municipality of Dionewar.

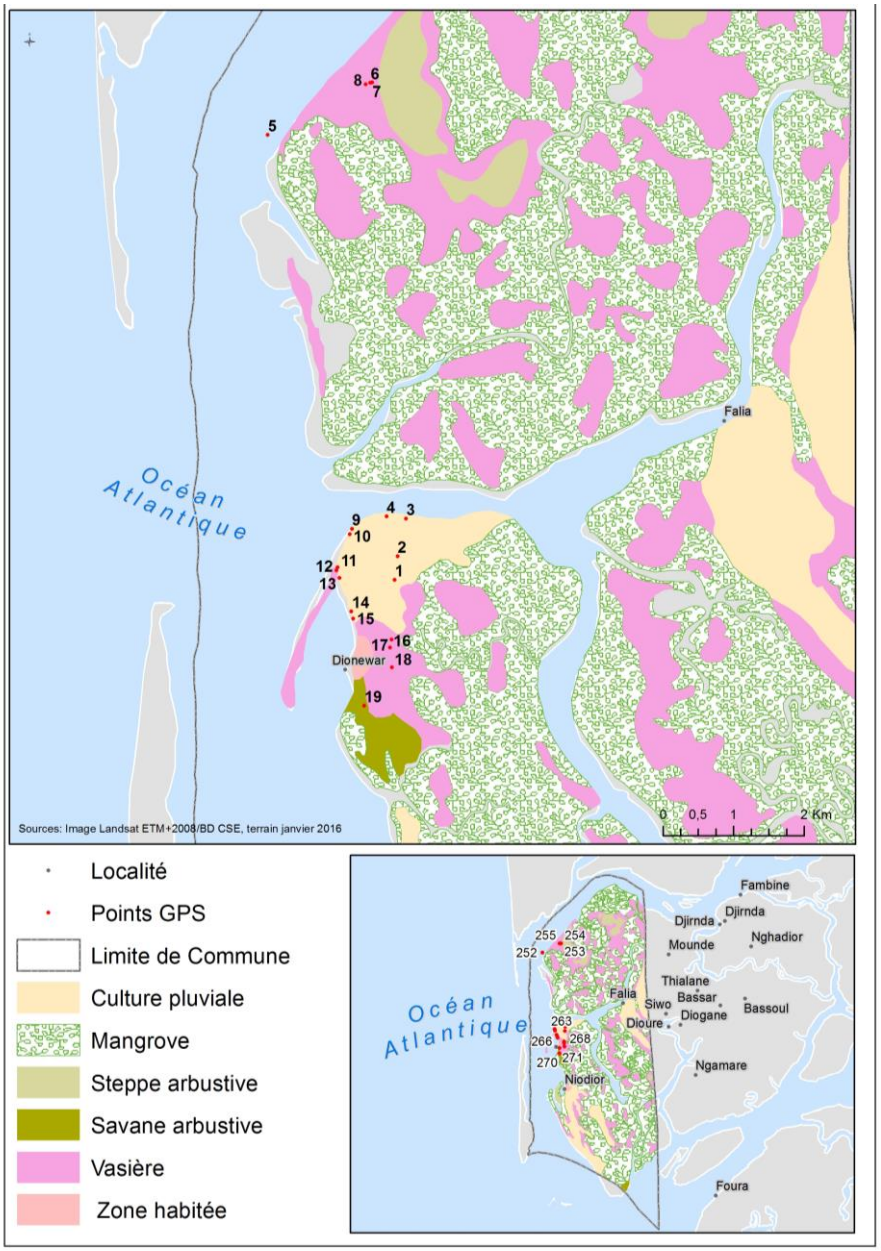
Geographically, the municipality of Dionewar is located in the western part of Senegal, in the coastal area of Sine-Saloum and covers an area of 316 km². In the North, the nearest municipality is Fimela, and in the south, Toubacouta. In the west the municipality of Dionewar is bounded by the Atlantic Ocean and in the east the closest municipalities are Djirnda and Bassoul.

Administratively, Dionewar is located in the borough of Niodior in the district of Foundiougne in the Fatick region.

The population of the municipality was estimated at 12,988 inhabitants in 2011, and is

expected to reach 14,525 by 2015 according to estimates by the National Demography and Statistics Agency (*Agence Nationale de la Démographie et de la Statistique*, or ANSD).

Dionewar village is part of the archipelago of the *Saloum* islands whose geographical area is bounded by the *Diombos* and *Saloum* inlets. These *Niominka*, islands, historically referred to as *Gandoun*, are characterized by a strong presence of mangroves, tributaries and swamps. They are composed of nineteen (19) islands some of which are uninhabited. The uninhabited islands are often used for rice farming by the inhabitants of nearby islands. This is the case of the island of Djimsane farmed by the villages of Dionewar and Niodior.



Graph 1: The village of Dionewar and surroundings (CSE, 2015)

The climate of the locality is oceanic, strongly characterized by the maritime trade wind. It has two seasons: a dry season of eight (8) months from October to June and a rainy season of four (4) months from July to September. During the dry season, the regular combination of

maritime trade winds and harmattan helps maintain a relatively cool climate with an average temperature of 27° C. The extremes are 17° C in January and 37° C in June.

Rainfall is irregular, though it has increased marginally in the last two decades. Indeed, the ten-year average from 2001 - 2010 in the district of Dionewar was 756.94 mm of rain for 42 days, while that of 2006 to 2015 is 870.24 mm for 38 days. These two averages are greater than that of the isohyet of the area, which is 400 to 600mm.

The rainfall irregularity has implications for the agro-pastoral sector, which depends mainly on rainfall, and increases the vulnerability of the island. The islanders are increasing aware of the evidence of climate change. This perception of the population is physically supported on the ground by environmental changes such as the progress of the salt intrusion and coastal erosion.

2.3. The project

2.3.1. The objectives of the project

The general objective of the project for reducing the vulnerability and improving the resilience of the coastal communities of Dionewar is to reduce the vulnerability of the populations in the Saloum islands in the face of the harmful effects of climate change: floods, coastal erosion and food insecurity.

More specifically, the project aims to: (i) enhance the resilience of the fisheries, aquaculture and forestry sectors to natural disasters; (ii) reduce the vulnerability of the populations and natural habitats through the construction of protective devices against floods, coastal erosion and land salinization; (iii) improve local development planning by mainstreaming climate change issues in policies, developing local agreements and taking advantage of the lessons learned.

2.3.2. The project components

The main activities of the project are listed in the following table.

Table 1: Summary of the project activities

<table>
<tr><th colspan="5">PROJECT ACTIVITIES</th></tr>
<tr><td colspan="5">COMPONENT 1: Increasing the resilience of the productive sectors in Dionewar island</td></tr>
<tr><td></td><td><u>Activities 1.</u>
Development of fish and oyster farms</td><td><u>Activities 2.</u>
Reforestation</td><td><u>Activities 3.</u>
training and improving the technical skills of 19 women's groups and management committees</td><td><u>Activities 4.</u>
developing a management plan for fish and oyster farms</td></tr>
<tr><td rowspan="3">Sub-activities</td><td>Development of fish and oyster farms</td><td>Establishment of a nursery for forest species.</td><td>Training 270 women in new oyster and fish farming techniques (making garlands, transferring juveniles, quality monitoring, fish feeding techniques and water quality maintenance)</td><td rowspan="3">Facility management plan: maintenance, monitoring, etc.</td></tr>
<tr><td>Installation of 20 floating cages for fish production</td><td>Protective measures</td><td>Construction of parks around the villages for the management of fishery resources such as cymbium, etc.</td></tr>
<tr><td>Installing 200 spat collectors</td><td>Planting of 6 ha (enrichment) of coconut and oil palm trees and 5 ha of mangrove
The establishment of committees to monitor tree planting</td><td>Capacity building for the monitoring committee and women processors on the assessment of non-wood forest products</td></tr>
<tr><td colspan="5">COMPONENT 2: Protection against floods, coastal erosion and soil salinization</td></tr>
<tr><td></td><td><u>Activity 3.</u>
Protection of the village against floods</td><td><u>Activity 2.</u>
Rehabilitation and extension of dykes (against flooding)</td><td><u>Activity 3.</u>
Development of rice farming plots around Dionewar</td><td><u>Activity 4.</u>
Setting up a maintenance plan for all the facilities</td></tr>
<tr><td rowspan="2">Sub-activities</td><td rowspan="2">Rehabilitation and extension of the dykes in Ndiar, Ndioundioure, Ecole 2 and Djimsane</td><td rowspan="2"></td><td rowspan="2">Ridging the rice farms in the island of Djimsane
Rehabilitation of the anti-salt dam in Djimsane</td><td>Preparation of a maintenance guide for all categories of infrastructure</td></tr>
<tr><td>Setting up a management committee</td></tr>
<tr><td colspan="5">COMPONENT 3: STRATEGIC PLANNING AND KNOWLEDGE MANAGEMENT</td></tr>
</table>

PROJECT ACTIVITIES				
	Activity 1. Reviewing and updating the LDP for mainstreaming CC	**Activity 2.** Preparing a local agreement for better regulation and use of forest products and observance of the biological rest period.	**Activity 3.** Documenting and sharing the lessons learned from the project	

2.3.2.1. Component 1: Increasing the resilience of the productive sectors in Dionewar island

This component aims to boost the fisheries sector currently affected by dwindling fishery products. Fishermen are forced to travel long distances to catch quality fish, implying an increase in the fishing effort. The project will therefore help enhance income-generating activities undertaken by the populations in order to cope with increasingly difficult living conditions. These activities are: (i) aquaculture, particularly fish and oyster farming and the development of the relevant management plans; (ii) the establishment of a village forest nursery, reforestation, coconut, oil palm trees and mangrove; (iii) training and improving the technical skills of 19 women's promotion groups (*Groupements de Promotion Féminine*, or GPF).

The project will draw on the success stories of Missirah, Sandicoly and Betenty supported by PISA, FAO, IRD, ENDA, as well as WAAME-CIADEL and ANA. The oldest experience in oyster farming is that of the women of Joal and Sokone organised in the form of EIGs. For several years now, they have been producing, processing and selling fresh oysters up to Dakar.

2.3.2.1.1. Fish farming

- **Installation sites**

Four sites with high aquaculture potential were identified and selected by specialists of the National Aquaculture Agency (*Agence Nationale de l'Aquaculture*, or ANA) following several field missions. They are the Dionewar bolong between the village of Dionewar itself and Niodior near the bridge connecting the two villages; the site of Ndiar located between the dyke and the middle school of the village; the site of Ndioundiouré in the southwest of the village, and salt flats of Djimsane island located 1 hour 30 minutes away from the village by canoe.

Photo 1: Dionewar Bridge - Niodior, close to the future site of the fish farm.

(Photo CSE, January 2016)

Photo 2: Tilapia

The species selected species for the development of fish farming in the island of Dionewar. This fish is locally caught. (Photo CSE, January 2016)

The project involves growing to size the brackish water tilapia (*Sarotherodon melanotheron)* in floating cages in the water in the vicinity of the Dionewar-Niodior bridge. This activity could contribute eventually to the emergence of several projects that promote food self-sufficiency and fight against poverty in the area. The project's core activities are mainly tilapia farming, training producers in fish farming techniques and marketing of their annual production.

- **Technical characteristics of the installations**

The fish are cultured in floating cages. A floating cage is a form of cubic device whose top is protected by a cover (fishing net) to facilitate the monitoring of the fish and guard against the introduction of undesirable species. It is immersed in the water at a depth of at least 1.5 m and has a volume of 10 m^3 (2.5 x 2.5 x 2m). The pockets are made of 14 mm diameter Nortene net and held rigid by a 26/34 galvanized steel frame tube. The device is held afloat in the water by floats consisting of 4 160l plastic containers per cage. Weights are used to keep the cage floating upright.

Regarding production, each cage can hold up to 3,000 fish and produce at least 900 kg of fish in 6 months. 20g fry provided by the ANA will be transported and placed in the cages. It is expected that the fish will be grown to size for a period of six months in 30 10 m^3 size cages. The stocking density is 300 fish per m^3 and the harvest weight will be 250g. The fish will be fed 3 times a day with food containing at least 30% protein (artificial granules composed of agro-industrial by-products amounting to 4% of their biomass).

For the 30 floating cages, the estimated budget is 6,792,750 CFA francs, and the operating costs 14,737,850 CFA francs, or a total investment of 21,530,600 CFA francs.

2.3.2.1.2. Oyster farming

The selected species is the mangrove oyster *Crassostera gassar* farmed by the population and thus already quite plentiful in the project area. The oyster culture will be in four stages: collection with garlands, growing to size in lantern nets, conditioning and marketing.

- **Collection**

Collection involves installing the spat collectors or cultches in order to have the maximum quantity of seed. These cultches will be made by the women with garlands.
Garlands are strings of empty oyster shells that allow the spat to cling to the shells and grow directly on them.

- **Growing to size**

To grow them out in lanterns, the oysters extracted from the cultches will be sorted and enclosed in lantern nets hanging from primary lines. The growing lanterns provide better quality oysters, thus reducing siltation and predation. Moreover, the yield is higher because the losses are limited.

- **Conditioning**

Conditioning is putting the oysters in conditioning devices to harden them, giving them a healthier quality and better taste. Areas of very clear water that will serve as conditioning points have been identified in the mangrove where the oysters ready for market are kept in crates.

- **Marketing**

The marketing of the products will be performed by the village women who have had experience for many years. They will be supported by ANA to sell these products in local markets, hotels and restaurants. The oysters will be sold fresh. The dried, cooked, or smoked form is not recommended because it devalues the product.
The investment necessary for the implementation of the oyster farming component of the project is estimated at 18,012,600 CFA francs.

For each of the oyster and fish farming project components, the populations will be supported to establish a management committee. The committee will be responsible, among other things, for surveillance and infrastructure maintenance to ensure sustainability. Infrastructure management plans will be developed for this purpose. Committee members will receive the training necessary to better perform their duties.

The necessary equipment (boots, gloves, fishing gear, life jackets, etc.) will be purchased by the project and made available to the beneficiaries.

2.3.2.1.3. Reforestation

The following activities are planned as part of the reforestation component of the project: (i) creating a nursery of forest species; (ii) the planting of 6 ha of coconut palm trees (*Cocos nucifera*) and oil palm trees (*Elaeis guineensis*) as a form of enrichment; and (iii) the planting

of 5 ha of mangrove. It should be noted that at this stage the actual sites of these activities have not yet been identified.

Photo 3: Some oil palm trees near the beach in Dionewar.

(Photo CSE, January 2016)

Photo 4: Mangrove and its many uses.

Bundles of mangrove firewood. (Photo CSE, January 2016)

Consultations with the populations and stakeholders in Dionewar village have shown the relevance of these activities. However, they made a number of comments. In the case of the mangroves, because of the multiplicity of actors in this area, people overwhelmingly prefer that the resources available for this activity be used to improve the planting of *Detarium senegalensis* (Ditakh) and other species with high economic value that currently provide them with significant income.

Our observations allow us to confirm that their proposals are relevant and deserve to be supported. Regarding coconut and oil palm trees, people are now developing interesting initiatives by planting them in their homes. The project would benefit from moving in this direction in addition to establishing village woodlots.

For the mangrove, it is advisable to ensure its protection through a special agreement. Ecosystems upstream of the Ndiar and Ndioundiouré dykes could be used as the starting point for such an initiative.

2.3.2.1.4. Training and improving the technical skills of 18 women's groups and management committees

The women of Dionewar village are very active in the processing of fish and forest fruits (ditakh, tamarind, bouy, etc.). For fishery products, they now have an operational centre for

processing these products with modern facilities. This centre was funded by PAPASUD and inaugurated in 2002. Ovens for smoking fish are under construction in the centre. The processors have requested for assistance to build their capacity for the efficient management of the centre and marketing of the processed products.

Therefore, the measures taken by the project to improve their technical skills are highly appreciated; 270 women will benefit from capacity building in the fields of processing, packaging and marketing of fishery and forest products.

Photo 5: From left to right, top to bottom, the fishery product processing centre, drying ovens and some processed forest and fishery products.

(Photo CSE, January 2016)

2.3.2.1.5. Development of a management plan for the fish and oyster farms

To secure, make profitable and enhance the value of all these initiatives, it is expected that fish and oyster farm management plans will be developed. Under the leadership of the ANA, the development of these plans will be conducted in a participatory manner and include aspects relating to the maintenance of the facilities and infrastructure, governance and monitoring of the physico-chemical parameters of the water. For each of the farms, a management committee will be set up and tasked with:

- managing the facilities;
- mobilizing the people for the maintenance work;
- managing potential conflicts relating to the facilities;
- developing regulations for the sustainable management of the resources;
- serving as an interface with the authorities and partners;
- providing more training;
- setting up funds for the upkeep and maintenance of the farms.

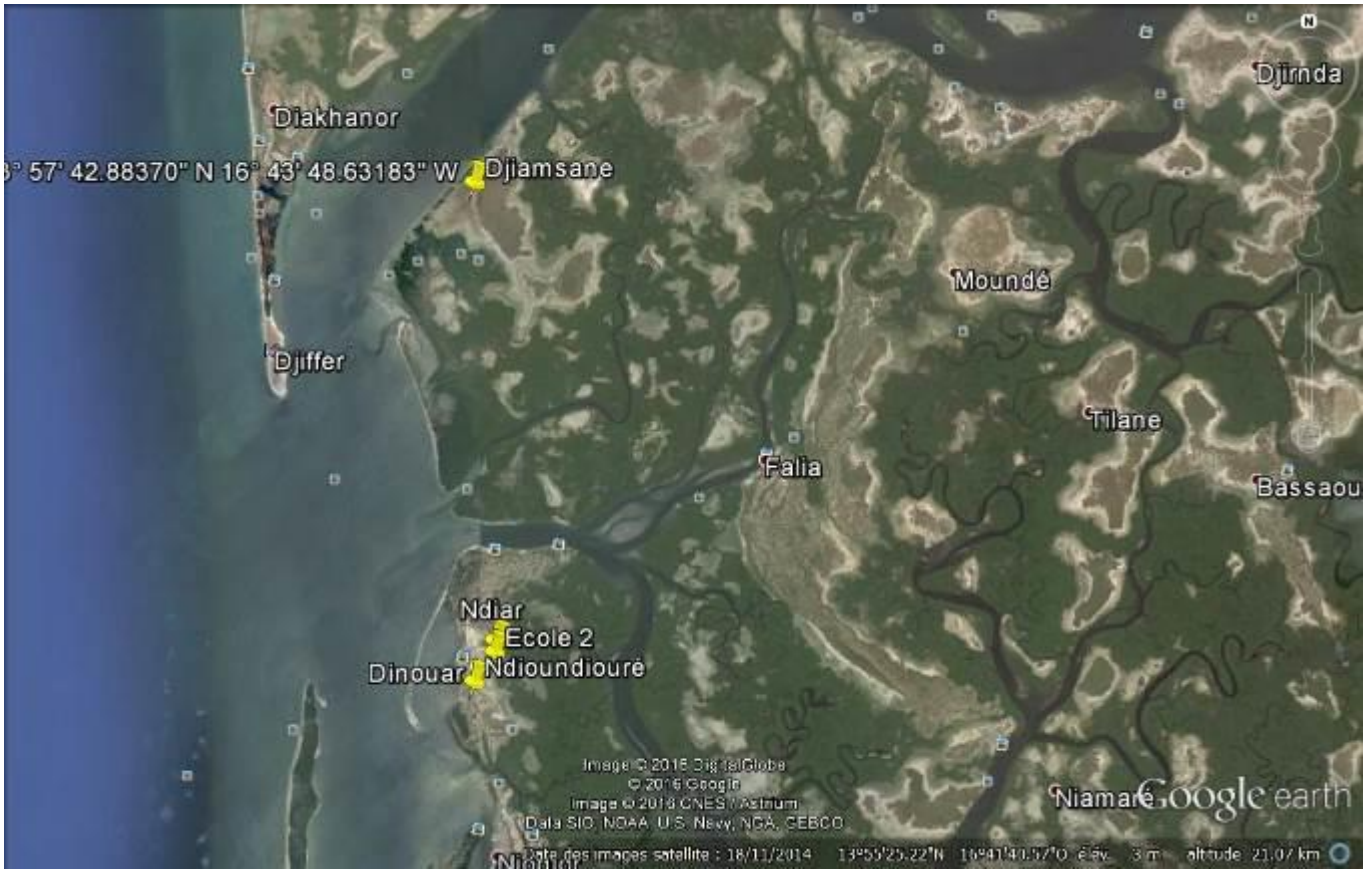
To maintain the farms, the populations will have to invest their time and labour and work with the management committees. Maintenance involves replacing the floating cages or garlands for oyster farming. The costs will be borne by the population (through funds set up for this purpose) and municipal council (financial contribution from its budget).

2.3.2.2. Component 2: Protection against coastal erosion, floods and land salinization.

This component aims to protect the island against coastal erosion and floods by building dykes.

2.3.2.2.1. Rehabilitation and extension of dykes to fight against floods (Ndiar, Ecole 2 and Ndioundiouré dykes)

Following the recurrent floods and very high tides, people have built dykes to protect the village with the support of partners such as the Social Development Fund Agency (*Agence du Fonds de Développement Sociale*, or AFDS), the National Local Development Programme (*Programme National de Développement Loca*l, or PNDL). A dyke was also completed in 2014 with GEF/SGP support in front of the village and facing the sea.



Graph 2: Location of the four dykes (Source: Etude de faisabilité technique du projet, February 2016)

a. <u>Status of the dykes</u>

- **The Ndioundiouré dyke**

The Ndioundiouré dyke, located south-west of the village, is 137.65 meters long. It is in a very poor state of repair, the hydromorphic level being high in places. The backfill mixture of sand and trapezoidal shells has completely collapsed and has two sealed gaps. The dyke construction material consists of a rough fill seashell structure and a sand and shell mix dyke. Its compactness is low. The Ndioundiouré watershed covers an estimated area of 0,126 km² [2].

[2] Camara, M., Etude de faisabilité technique du projet de réduction de la vulnérabilité des communautés côtières à Dionewar, February 2016

Photo 6: Partial views of the Ndioundiouré dyke.

On the left is the low protection wall made with cement and shells that helped maintain the dyke. The unprotected opposite side is being eroded by the water. On the right, the spillway has collapsed under strong water pressure during the floods. (Photos CSE, January 2016)

Photo 7: Partial view of the Ndiar dyke east of the village, built with the support of the AFDS in 2005.

One can see the crumbling and collapse of the top of the dyke even though its main structure remains strong. Garbage is disposed on both sides of the dyke. (Photo CSE, January 2016)

Photo 8: View of a spillway

The spillways used are PVC pipes whose sizes are generally small given the flow rates during the floods. (Photo CSE, January 2016)

The Ndiar dyke

With a length of 266.74 meters, the dyke is in a fairly advanced state of disrepair. The trapezoidal shell embankment has collapsed along the length of the dyke. The dyke is made of seashell material that is still resistant and crumbly. Compactness is low, hence the wooden

support stakes that can be seen in some parts of the dyke. The watershed covers an area of 0,054 km².

- **The Ecole 2 dyke**

The Ecole 2 dyke has a length of 767.20 meters. It is in a poor state of repair. The trapezoidal shell embankment has collapsed, especially on the right side. During high tides, the water bypasses the dyke at the highest connection points. Its extension is therefore necessary.

The dyke construction material consists of a rough fill seashell structure of low compactness, especially on the right bank. The watershed area is estimated at 0,051 km².

b. Status of the spillways

For the Ndiar, Ecole 2 and Ndioundioure dykes, the spillways are PVC pipes with diameters so small that they cannot handle the high flows during floods, resulting in the destruction of the dykes at those points. Under the Project, the spillways will be designed to address this situation. The structure that will be proposed will be equipped with an opening/closing device that can be easily operated by the populations and be able to fulfill its water management functions. The openings (passes) should be adequately sized to cope with the large water flows observed during the floods of recent years.

The main observation is that all these dykes are in a very poor state of repair. The main causes of their poor state are the recurrent flooding, the runoff and the weakness of the material used (clay and seashell).

It is in response to these many problems that the project will intervene in the rehabilitation of the dykes.

2.3.2.2.2. Development of rice farming plots around Dionewar

In the past, the population of Dionewar cultivated rice in the village and surrounding islands. However, following the drought of the 1970s, this activity was virtually abandoned.

Under the programme aimed at enhancing and accelerating the pace of agricultural development in Senegal (*Programme de Renforcement et d'Accélération de la Cadence de l'Agriculture Sénégalaise*, or PRACAS), rice self-sufficiency is considered a priority. As part of this effort, the GEF/SGP in 2014 supported Dionewar in building a dyke to fight against land salinization on the island of Djimsane. This made it possible to cultivate rice on the island in 2015 with an estimated production of 20 tonnes (Public consultation of January 17, 2016).

- **The Djimsane dyke**

The Djimsane dyke is 1,754 meters long and damaged. The trapezoidal clay backfill has begun to sag, is being eroded and its straight reinforced concrete weir has started to deteriorate. The valve that allows the closing and opening of the spillway is rusty.

The dyke is made of clay with a relatively acceptable compactness. The watershed of the dyke covers an estimated area of 11,84 km².

Photo 9: The Djimsane dyke

On the left, the clay dyke with the rice farms on the grassy side. On the right, the spillway structure. (Photos CSE, January 2016).

Photo 10: Rice fields on the island of Djimsane.

Over 20 tons of rice was produced there during the 2015 rainy season. (Photo CSE, January 2016)

The project will involve the following activities: (i) the rehabilitation of the dyke; (ii) the ridging and preparation of a cadastral map for the rice plots; (iii) the purchase of harvesting and post-harvesting equipment (plowing, weeding, harvesting, shelling and bagging).

2.3.2.2.3. The borrow areas of the building materials

Two shell midden sites have been identified. There is a shell midden a few meters from the Ndiar dyke. However, the largest midden is located about 500 meters north of the village. According to the village head, this midden is 150m by 200m with a depth of 10 meters. On this basis, its volume can be estimated at roughly 150 000 m^3 .

Photo 11: Shell middens in operation

The shells from these middens are used for most of the construction work in the village: housing, dykes, etc. This extraction will contribute to the destruction of the plant cover consisting of trees of different species. (Photos CSE, January 2016).

These shell middens are the borrow sites of the materials used in the rehabilitation work on the dykes. However, the extraction could contribute to the degradation of the environment. Indeed, these sites are home to several species of trees such as baobab, tamarind, etc. Any excessive extraction may also cause soil erosion in addition to the destruction of the cultural heritage. Special measures will therefore have to be taken to preserve the environment.

2.3.2.2.4. The dyke management committees

The dykes to be rehabilitated should be maintained in order to ensure their sustainability. Therefore, the project will support the setting up of a committee responsible for the management, servicing and maintenance of the dykes. The role of the committee will be to:

- manage the dykes;
- mobilize the people for the maintenance work;
- serve as an interface with the authorities and partners;
- provide more training;
- set up a fund for the upkeep and maintenance of the dykes.

The maintenance costs of the dykes are generally low. These maintenance costs require an investment in terms of time and labour on the part of the populations working with the management committees. The maintenance involves raising the parts collapsed or eroded by rainwater with small earthmoving equipment or jute bags filled with sand. These jute bags are necessary only in case of breaks in the dykes due to poor management. Every 5 years, a machine (loading shovel or bulldozer) could be used for 1-2 days to repair any damaged parts. The costs are borne by the population (through the fund set up for this purpose) and the municipal council (financial contribution from its budget).

2.3.2.3. Component 3: Strategic planning and knowledge management

This component of the project summarizes all the activities related to knowledge management. It presents the support of the Communal council to: (i) review the Local Development Plan (LDP) while incorporating the adaptation options to climate change; (ii) prepare a local agreement to support the communities to sustainably manage the natural resources in their environment (timber, non-timber forest products) including the observation of a biological rest period throughout Dionewar and its territory; and, (iii) prepare the capitalization of the project activities to enable the populations and partners to make the most of the lessons learned as part of its implementation.

2.3.2.3.1. Review and update of the Local Development Plan (LDP) for mainstreaming climate change

The LDP of Dionewar was developed for 2011-2016. Among the weaknesses identified in this document, is the low level of consideration of issues related to climate change. Thus, the future Communal Development Plan (CDP) should incorporate the forecasting of the risks related to climate change and the strategies to make the communities more resilient.

The municipal development plan should analyze the following issues in order to assess the risks they may entail. These are: (i) environmental fragility (location and infrastructure, unprotected buildings); (ii) fragility of the local economy characterized by a modest living environment and livelihoods, and the low level of income; (iii) social vulnerability reflected by the weakness of social institutions; and, (iv) public action in the context of the lack of disaster preparedness, for example.

The main risks to be considered may include submersion, groundwater salinization, floods, deforestation and reduction of soil fertility.

2.3.2.3.2. Preparation of a local agreement for better regulation and use of forest products and observance of the biological rest period.

The advanced state of degradation of the natural resources in and around Dionewar is sufficient motivation to support the local populations to develop a local agreement on the sustainable management of natural resources. The objective is to ensure conservation and sustainable use of the environment and natural resources with a view to production of goods and services to meet the growing diverse and changing needs of the population, while preserving their productive, ecological and cultural functions for the benefit of society.

More specifically, the local agreement should help:

- consensually regulate the access and use of the natural resources of the community's territory;
- involve the populations in the sustainable management of the resources in their territory;
- cause the villagers to have a responsible attitude toward the use of natural resources;
- bring each actor (without exception) of the village to access natural resources to satisfy their essential needs without compromising the interests of others and without jeopardizing the existing potential;
- establish coordination mechanisms between the different stakeholders and ensure preventive conflict management.

2.3.2.3.3. Documenting and sharing the lessons learned from the project

This sub-component is important. It enables the capitalization of all the achievements of the project. The lessons learned will provide inspiration to the populations and allow future projects to be implemented in the best possible conditions.

Throughout the implementation of the project, data on best practices will be collected and shared at national and international level. The resulting documents will be translated into local languages to make the information accessible to the relevant communities.

III. OPTION ANALYSIS

This section will analyze the project options in relation to each component. It will focus on the key activities that have already been the subject of a feasibility study, for instance aquaculture farms and protective dikes.

The analysis will be structured around the three following fundamental principles:

- Economic efficiency: all resources including financial must be allocated in the most effective way possible;
- Environmental protection: maintaining or reducing a certain level of environmental quality is required;
- Social equity: the impact of decisions must be socially acceptable.

The settings for the location of the home sites are not taken into consideration in the analysis. The main reason is that except for reforestation (mangrove, palm trees, coconut, nurseries), all the implantation sites for infrastructures have already been selected and validated with the populations. For example, the dikes will not be built from the ground up, but rather restored and enhanced. There are no other choices regarding locations.

3.1. Component 1: Strengthening the resilience of productive sectors in Dionewar Island

3.1.1. Developing aquaculture farms

3.1.1.1. The 0 option or « no project » option

The 0 option or no project option relates to leaving the situation as it is, with no intervention in the aquaculture activities of Dionewar.

The fishing industry currently employs almost all of the workforce in the Dionewar community and remains its main source of income. This is why the Serere group (ethnicity) of the Saloum Islands, essentially composed of fishermen are also referred to as «Serere Niominka» meaning « Serere with feet in water ».

The species caught in estuaries and in the sea are by order of importance the Bonga (cobo), the mullet (tanbadiang), sardinella (yaboy), shrimp, octopus and catfish. Fishing is also a seasonal activity. Hence, during the rainy season, it is more geared towards catching shrimp, catfish, sardinella, cuttlefish, gray carp, grouper, trevally and octopus. Fish processing is growing especially through the strong determination of women members of Dionewar FELOGIE who received both in 1996 and 2003, the Head of State Grand Prize for Women Empowerment. The processing mainly concerns shellfish using drying, smoking, and fermentation processes.

The harvest of seafood such as shells is done with rudimentary tools. This activity is mainly carried out by women and done in very difficult conditions and with little security. Women use small non-motorized pirogues to move up the waters in search of richer areas. This is also significantly reducing their production capacity and therefore their revenue.

In regards to the processing of those products, the conditions have improved with the construction of a fish processing center for FELOGIE. However, commercializing processed fish products remains a serious issue for these women processors.

The performance of the fisheries sector is experiencing a downward trend since 1987 following the opening of the Sangomar breach according to the populations. Indeed, the sandy bottoms released by the rupture of the breach block the pirogues' main routes in the estuary. They also invade the biological rest and reproduction areas of fish. The main consequence is the migration to other areas.

In general, the present situation is characterized by:

- The decline of fisheries resources stocks;
- The many constraints regarding fishing activities (financial, technical, security, etc.), conservation of fresh products, processing and especially the commercialization of fishery products;
- The lack of supervision of the fisheries sector's stakeholders;
- The decline in revenues that will impact more and more the quality of life of populations.

In this component, the option analysis will focus on development of the farms (fish farming and oyster farming).

3.1.1.2. « Project » option:

Option 1 consists of the actual project of developing aquaculture in Dionewar through fish farming and oyster farming for which infrastructure building is planned.

For each of these activities, different infrastructure building options, proposed by the feasibility studies will be analyzed based on technical, economic and environmental impacts.

3.1.1.2.1. Multicriteria assessment of aquaculture farms development

a. *Fish Farming*

The project plans to help support development of fish farming in Dionewar. Hence, two technologies are taken into consideration based on lessons learned from past experiences in Fatick and Ziguinchor. They are the construction of fishponds on one hand, and the development and implementation of floating cages on the other. The combination of both technologies is also an option.

- **Option 1: Installation of fish ponds**

The fish pond consist of artificial shallow water of varying size, which depends on the person responsible for drying it, filling it up and installing it in regards to his will to control fish breeding. Regarding this project, ponds will be excavated from natural earth to one meter deep (1m). The excavated soil will be used for the construction of dikes 1.5 meters high when completed. The base of the pond will be spread and compacted in accordance to the longitudinal slope of the bottom which must be between 0.5% and 1.5% to allow good drainage; the talus slopes will be internally 2/1 and 1/1 externally; the ridges and slopes will

be well spread and compacted to make the dike solid hence preventing rainwater infiltration as none will be able to go through the walls of the protective dikes that must be coated with compacted clays to ensure waterproofing. Each pond is provided with a PVC pressure power system of 200 mm diameter that will be simultaneously used for drainage.

The average cost to develop a fish farm with ponds is 28.32 million CFA (USD 56,640).

The operating equipment will consist of:

- 1 150m^3/h diesel water pump and its accessories;
- Fishing Net and its accessories;
- Scale and accessories;
- Anti-bird protection net for ten ponds;
- Small scoops, for larvae;
- Plastic sorters with sieves;
- 20 liters capacity buckets ;
- 10 liters capacity buckets;
- 8 m3 oxygen bottle;
- Packets of 100 transportation bags;
- PH meter;
- Oximeter;
- Portable thermometer;
- Refractometer.

Djimsane Island would be ideal for the installation of fishponds.

Photo 12: Ponds surrounded by dikes

(the photo is from the ANA Office of Fatick)

<u>Advantages of Option 1</u>

- Relatively simple production method, especially at low density, use of the pond's natural resources ;
- Low water renewal, except to compensate evaporation and infiltration ;
- Valorization of humid areas that are of little use to agriculture ;

- Opportunities to enhance natural production through pond fertilization and agricultural subproducts distribution ;
- Does not require regular control of breeding fish when density is low ;
- Biotope close to natural habitat and favorable to reproduction and during early stages of development ;
- Rare illnesses and low mortality ;
- Theft is more difficult than in caged breeding ;
- Low maintenance costs and a relatively long amortization on investment;
- Important revenue generation for populations ;
- Socially accepted : the populations interviewed are in favor of this activity ;
- Local market available to sell the products ;
- Economic gain: ponds can generate important quantities of fish with an improvement of the community's quality of life (nutrition, generation of revenue).

Disadvantages of Option 1

- High investment costs ;
- More complex technology when the breeding density increases and requires artificial feeding ;
- Requires a large area, appropriate topography. It can be challenging to combine different production stages in the same pond, with independent harvesting treatments;
- Overpopulation issues with a majority of younger fish and heterogeneity in the size of fries;
- Poor control of the consumption of artificial food;
- Difficult to control the reproduction and growth of fry (little recalibration);
- Egg and larvae losses during drainage or seine fishing;
- Difficult to control parasital infection and illnesses when they appear;
- High staff costs during drainage, expensive investments ;
- Possible negative impacts on the environment in terms of (i) competition with other water uses; (ii) environmental pollution by water basins ; (iii) Impoverishment of local wild fish populations.

Multi criteria assessment of option 1

We will be using a matrix for the assessment of activity feasibility based on three criteria: (i) technical feasibility; (ii) economic feasibility, and (iii) (negative) environmental impact

A score is given to each criteria in regards based on the matrix below:

Table 2 : Economic and technical feasibility for the assessment of the score matrix

Assessment	Score
Unfavorable	0
Relatively unfavorable	1
Relatively favorable	2
Favorable	3
Very favorable	4

Table 3 : Score matrix for the assessment of impacts (negative) on the environment

Assessment	Score
Relatively unfavorable	-1
Unfavorable	-2
Very unfavorable	-3

Hence, the assessment results of Option 1 are summarized as follows:

Table 4 : Summary of the multicriteria assessment

	Technical feasibility	Economic feasibility	Environmental impact	
Criteria	Relatively simple production method, especially at low density, use of the pond's natural resources ; Low maintenance costs and a relatively long investment amortization; Requires a large area, appropriate topography. It can be challenging to combine different production stages in the same pond, with independent harvesting treatments	High realization costs (USD 42 820) High staff costs during drainage;	Competition with other water uses Environmental pollution by water basins (fertilizers, chemicals) Impoverishment of local wild fish populations	**Result (Scores total)**
Score	**3**	**2**	**-2**	**3**

Option 2 : Realization and installation of the floating cages

The farm will consist of 30 cages, or 3 modules of 10 cages of $10m^3$ each. The frame of each cage should be made of galvanized tubes with a square interior of 2.5m long and a square exterior of 3.5m long, using 160 liter capacity plastic containers as flotation materials belted by 10 φ cords or flat iron with a 20 diameter. The cage pockets are made of plastic mesh nets preferably in Nortene material. These nets must have the same interior dimensions as the tubes with a drop of 1.6 m or (2 x 2.5m, 5m x 1.6m) to form $10m^3$. A wooden handrail step made of distinct boards 30cm apart and attached to the frame by nuts and bolts of 17mm diameter, to facilitate work in the cages.

The entire system is attached to the bottom of the water body (over 2m deep) by a minimum of 4 anchors (at least 20 kg) in addition to an engine block or another anchor over 30 kg that resists salt or water flow to avoid displacement of the module to locations different from the

original location. The welding and frame points will be coated with anti-rust paint and connected to the module by 12mm diameter ropes. The modules bags will be completely covered by a blue or green net of 26mm diameter, which serves as protection against predatory fish or the intrusion of unwanted species in the breeding system.

The total realization cost of a fish farm with 30 floating cages is 16 755 000 CFA (USD 33,510).

The equipment consists of:

- a 6 meter long wood pirogue with 2 paddles;
- 3 life jackets;
- 2 basins;
- 2 buckets;
- 2 large dipnets;
- a scale that can weigh up to 50 kg

Annual production is estimated at 21,375 kg (economic assessment). The sale price is estimated at 1,300 CFA (USD 2.6); annual revenues would reach 27,787 million CFA (USD 55,575). These additional revenues provided by the project will help improve community resilience.

Option 2 Advantages

- Relatively low implementation costs;
- Faster growth of fish because the water quality is superior to the one in the ponds (key factor for growth);
- The infrastructure is easier to manage for locals;
- Easy to move or relocate;
- Higher fish production (eg high density and quality nutrition cause improved growth rates and a reduction in breeding time.);
- Optimal use of artificial food for growth resulting in improved food conversion values;
- Easy monitoring of rivals and predators;
- Daily monitoring of livestock for better management and timely detection of diseases, cost effective treatment of pests and diseases;
- Easy to manage tilapia reproduction, reduced fish handling and fish mortality;
- Easy and manageable fish pond's harvest that can be completed and from an unique product;
- Easy to store and transport live fish;
- Relatively low initial investment;
- Adopted by the locals;
- Economically profitable.

Option 2 Disadvantages

The relative importance of the disadvantages of cage farming varies from one place to another. The main problems are related to the implantation site of fish farming, quality of

water, small fry diet, predation and disease, production cost and lastly, theft. The main disadvantages are listed below:

- Potential environmental impacts: increase of organic matter in the home environment's infrastructure observed in some farming communities;
- Difficult to apply when the water surface is stirred, it's thus restricted to sheltered areas. Requires structures for food storage, processing and incubation, therefore needs a strategic location;
- Adequate water exchange through the cages is necessary to get rid of metabolites and maintain a high level of oxygen. Quick fouling of the cage walls require frequent cleaning;
- Total dependency on artificial diet unless used in sewage ponds. Requires high quality and balanced food portions. Possibility of food losses through the cage walls;
- Local fish populations are potential reservoirs of disease or pests and the likelihood of spreading the disease by introducing livestock is increased;
- More difficulties to treat diseases and parasites.

Multicriteria assessment of Option 2

The same process used for Option 1 will be applied. On this basis, conclusions are presented below:

Table 5: Options summary

	Technical feasibility	**Economic feasibilty**	**Environmental Impact**	
Criteria	Easy infrastructural management Easy to move and relocate infrastructure Fish harvest Easy and manageable fish pond's harvest that can be completed and from an unique product Quick fouling of the cage walls require frequent cleaning	Relatively low realization costs (USD 33 510) Faster growth of fish because the water quality is superior to the one in the ponds (key factor for growth); Optimal use artificial food for growth resulting in improved food conversion values; Relatively low initial costs Econonomically profitable	Increase of organic matter in the home environment's infrastructure observed in some farming communities Noticed in some farming environments More difficulties to treat diseases and parasites.	**Result (Scores total)**
Score	**3**	**4**	**-1**	**6**

Multicriteria assessment of both options

The assessment's results are summarized in the table below:

Table 6 : Summary of the multicriteria assessment of fish farm options

	Option 1: 1000 m^2 fish ponds	Option 2 : 10 m^3 floating cages
Technical feasibility	Important location determination due to need in land surfaces Limited density Difficult control of competitors and predators High mortality due to handling Uncontrolled reproduction hence limiting growth	Reducing the need for earth surfaces hence conflict reduction Movement of livestock if necessary Intensification of fish production (high density and optimal nutrition) Less mortality related to handling Limited breeding hence good growth
Economic feasibility	High human investment costs Relatively heavy maintenance (frequent dike rising, frequent equipment renewal, etc.)	Low infrastructure costs Easy maintenance
Environmental Impact	Water fertilization hence minimal risk of contamination Risk of flooding	On the contrary, attracts a lot of other species therefore beneficial to cqpture fishing
Initial investment	500 000 CFA	2 000 000 CFA
Average production capacity	750 kg annually and per pond	1 000 kg annually per cage
Return on investment	Average	Good
Assessment	Best infrastructure for breeding (reproduction)	Best infrastructure for sprawning

Table 7: Summary of options' assessment for the development of fish farming facilities

	Option 1: Fish ponds	Option 2 : Floating cages
Technical feasibility	3	3
Economic feasibility	2	4
Environmental impact	-2	-1
Assessment	3	6

Based on the multicriteria analysis, Option 2 is preferable. This analysis validates ANA's preference for floating cages over fishing ponds.

b. Oyster farming

Option 0

Option 0 describes the current situation. Oyster farming as practiced currently in the project intervention area consists of harvesting oysters on the *Rhizophora* roots. Oysters live gregarious naturally, on stilts mangrove roots at low tide. Gathering instruments are rudimentary: an old machete and a forked stick are enough. Others prefer to cut the branches out and detach oysters once they are back in the village, by putting them on the fire. Once dried, the oysters can be stored for several months.

This technique is not very productive, and the women who practice it are forced to travel longer distances due to the progressive degradation of the mangroves on which oysters develop. The other drawback is that it contributes to the degradation of mangroves because most oyster farmers cut the mangroves roots.

Option 1

This option corresponds to the project. For this option, only one building option is proposed. The next step will then be to raise oysters on artificial supports.

Technical feasibility

The implementation process of the oyster farm includes the following phases:

Capturing: During this operation, spat collectors will be installed to obtain maximum seed with the help of collectors that will be made by women with ropes and empty oyster shells.

The magnification lantern: oysters detached from collectors will be sorted and enclosed in lanterns hanging from primary lines. The magnification lanterns provide better quality oysters reducing siltation and predation. In addition, performance is good since the losses are limited.

Marketing: With better quality products, there should be a bigger demand from hotels and restaurants, not to mention exportation opportunities. On the other hand, cooking and drying are not recommended as they decrease product quality.

This technique has been practiced for several years in Fatick and Ziguinchor. The last test has been undergoing in Néba Ba for the past two years with significant results.

Economic feasibility (initial investment cost)

Based on a 500 lantern installation plan, the initial investment cost is estimated at 10.3 million FCFA (20 600 USD) by ANA. The expected annual production is 21,560 kg of mature oysters sold at 1 500 CFA francs ($3) per kg. The commercialisation of this production could generate 32.34 million CFA (USD 64680). This additional substantial income will improve the resilience of communities in Dionewar.

Environmental impacts

Oyster farms will be built at the mangrove. Besides potential pruning, mangrove cuts are not planned. The main potential negative environmental impacts are waste material from making garlands (shells, stakes, etc.), and oysters remains during their operation.

3.1.2. Reforestation and improved technical performance of 19 groups

- **Option 0 or « no project » option**

This option refers to the situation described in the analysis section relative to the initial project state. It highlights a gradual degradation of vegetation including trees due to the combined effects of climate change and human activities.

Without intervention, this trend will continue.

- **Option 1**

Option 1 refers to the present project. We will proceed to the reforestation of 2 hectares of palm trees and 4 hectares of coconut trees in Dionewar. Palm trees are high-value species, and could thus contribute to income generation for the populations.

Technical feasibility

Whether it be mangrove or other timber forest species such as palm and coconut trees, reforestation is an activity performed by local populations for several decades, under the supervision of forestry services. Every year, reforestation actions are undertaken in the area. The forestry services have confirmed their support to the project, hence guaranteeing successful reforestation actions.

Economic feasibility

The proposed dwarf coconut trees start producing from the third year of planting at an average annual production rate of 40 nuts per foot. The average density per hectare is 100 feet, the average annual income from these plantations is 1.6 million CFA (USD 3,200) if the coconut is sold at 100 CFA (USD 0.2). For palm trees, the economic analysis predicts an annual output of 4 to 5 tons, or 4395 liters of palm oil. At a 1100 CFA (USD 2.2) rate, annual production could generate an average of 4,834,500 CFA (USD 9,669) from the third year of reforestation.

These data provided by the project economic analysis show that the reforestation of palm and coconut trees, beyond the restoration ecology, contribute to improving the resilience of communities by providing fairly substantial income.

The reforestation of 6 hectares of mangrove is also planned to contribute to rebuilding the ecosystem in different locations. Mangrove plays an important role in the fight against flooding, reproduction, and the development of certain fish species, oyster development, construction wood production (poles) and wood fuel, etc.

Environmental impact

The main potential negative impacts on the environment can be summarized in terms of poor management of packaging and overuse of fertilizers and pesticides for nurseries, production of solid waste (plant residues or propagules). These minor impacts can be avoided by a strategic choice of sites and the implementation of a pest and pesticide management plan.

Overall, planned reforestation actions are technically simple and socially acceptable. In addition to its economic profitability (including coconut and palm tree oil), reforestation has very few significant adverse impacts.

3.2. Component 2: Protection against flooding, coastal erosion and soil salinization

For this component, the project plans the rehabilitation of existing dikes to fight flooding and coastal erosion in Dionewar on one hand, and on the other hand, the protection of Djimsane rice fields against salinization.

The option analysis based on the principles of technical and economic feasibility and environmental impact will focus on the no project choice (option 0) and the project choice (option 1). In option 1, the proposed development of alternatives will be analyzed.

3.2.1. The 0 option or « no project » option

The no project option describes the current situation, meaning no intervention. It focuses on the gradual decay of dikes and water drainage structures in place (see section 2.3.2.2).

This situation led the Dionewar populations to propose this project through the DDA and CONAF.

3.2.2. Option 1

Option 1 is a good match for this project. It aims to rehabilitate existing dikes in order to fight floods in Dionewar and salinization of rice fields in Djimsane.

The technical feasibility study proposed three options for dike management systems. These are: (i) development of compacted earth dikes; (ii) the creation of infrastructure with built-in gabions; and, (iii) the construction of dikes in reinforced concrete plates in single screen or dual screen.

Each of these options is discussed in the following sections. The analysis will focus on different aspects of technical feasibility and environmental impact.

The scale for the assessment of the technical and economic feasibility is as follows:

Table 8: Scale for the assessment of technical and economic feasibility

Criteria	Score
Medium	1
High	2
Very High	3

The appreciation scale of negative environmental impacts is described below:

Table 9: Appreciation scale of negative environmental impacts

Assessment	Score
Minor potential impact	-1
Low potential impact	-2
Medium potential impact	-3

3.2.2.1. Option 1.1: Compacted earth dikes

Technical feasibility

Building a compacted earth dike requires the availability of materials with appropriate geotechnical qualities such as sand. Surveys have shown that this material is not available in the island and its surroundings.

Carrying out the work also requires adequate equipment (compactor, grader) for stripping and compacting the dikes' structure. Dionewar being an island, it will be difficult to carry such heavy machinery there.

Photo 13 : Compacted earth dike

(Photo credit: Camara, M., *Feasibility study report*, February 2016)

The technical feasibility for this type of structure is high.

Economic feasibility

The economic feasibility is based on the following factors:

- Borrow material is available on site (clay, shells) ;
- Job creation through hiring of locals;
- The need to use heavy machinery requiring significant investments for their transportation on the island;
- Mitigation of flooding effects.

Environmental impact

The main environmental impacts relate to: (i) solid (rubble) and liquid (oil and gas may be spilled on the ground and eventually contaminate wetlands) waste generation; (ii) soil erosion as a result of pickling; (iii) pollution related to the noise produced by the machinery; (iv) dust (pickling), unfair labor practices.

With manual gear such as tillers, harrows and manual compactors, this option could be adaptable to the clay dike in Djimsane.

3.2.2.2. Option 1.2: Construction with built-in gabions

Technical feasibility

This built-in gabion technique requires a company and a skilled workforce. Gabions play a stabilizing role and cure shores affected by a more or less significant erosion. In a certain way, they will play a weir role and will more or less let water get into the protected area, and affect habitats and village infrastructure.

Puttin in place such as system is not very appropriate because Dionewar is a village subject to sea encroachment during high waters. The necessary rubble is not available locally. Sindia and Khombole (in the Thies region) are the sites from which we can obtain such materials. Procurement and routing to Dionewar would be very expensive.

Economic feasibility

On the economic front, the adoption of the built-on gabion dike system is not favorable because of the very high investment costs. Indeed, this technique requires on one hand hiring a company and recruiting a skilled workforce, and on the other hand, the procurement and transportation of rubble from the Thies region.

Environmental impact

The main environmental impacts relate to: (i) solid (rubble) and liquid (oil and gas may be spilled on the ground and eventually contaminate wetlands) waste generation; (ii) soil erosion as a result of pickling; (iii) pollution related to the noise produced by the machinery; (iv) dust (pickling), unfair labor practices.

3.2.2.3. Option 1.3: Reinforced concrete dikes

Technical feasibility

A dike made out of reinforced plates is made out of a concrete wall. The wall is constituted by pre-manufactured items juxtaposed one after the other and interconnected by poles.

Photo 14: Dike made of RC plates

(Photo from Technical feasibilty study, January 2016)

Plates can be built locally without using a machine. Moreover, sand which is the base material can be found on site or not too far from the village. The transportation of other materials like cement, steel, etc can be done through pirogues without a lot of difficulty.

Economic feasibility

The investments needed to achieve dikes made out of concrete are less important than the other options. Indeed, the material (sand) is found on site, and the work will be performed by local hire. Cement and iron will be transported by the pirogues.

Environmental impact

The potential environmental impacts are summarized as follows: (i) generation of solid waste (steel reinforcement, rubble); and, (ii) unfair labor practices.

3.2.2.4. Multi criteria analysis of construction options

The summary of the development options in terms of technical, economic and environmental impacts is presented in the table below.

Table 10 : Summary of multicriteria analysis of dike construction options

Criteria	Compacted earth dike	Built-in gabions dike	RC plates dike
Technical feasibility	High: Compacting can be done by locals if they are trained Small manual compactors will be enough Works easily achievable by local masons **High technical feasibility**	Medium : Requires qualified workforce **Medium technical feasibility**	Very high : Easily achievable and does not require qualified workforce Availability of local labor Availability of required materials (cement, steel, etc.) **Very High technical feasibility**
Economic feasibilty	Materials available on site (borrow areas)	Requires a specialized company, hence high	Easy construction

Criteria	Compacted earth dike	Built-in gabions dike	RC plates dike
	Shells are available Job Creation Mitigation of flooding effects **Medium Economic feasibility**	investment costs Rubble is not available onsite (to be obtained in Sindia or Khombole – Thies region) **Low Economic feasibility**	Enhances rainwater drainage trough spillways **High Economic feasibility**
Environmental impact	Solid (rubble) and liquid (oil and gas may be spilled on the ground and eventually contaminate wetlands) waste generation Soil erosion as a result of pickling Pollution (Noise from machinery) Dust (pickling) Unfair labor practices **Medium Environmental impact**	Solid (rubble) and liquid (oil and gas may be spilled on the ground and eventually contaminate wetlands) waste generation Pollution (Noise from machinery) Unfair labor practices **Low Environmental impact**	Solid waste generation (steel reinforcement, rubble) Unfair labor practices **Minor Environmental impact**

Table 11: Options Summary

	Compacted earth dike	Built-in gabions dike	RC plates dike
Technical feasibility	3	2	4
Economic feasibilty	2	1	3
Environmental Impact	-3	-2	-1
Assessment	2	1	6

The results of the multi-criteria analysis show that the reinforced concrete plates option is technically and economically more favorable. It has a lower potential impact on the environment.

Therefore, this option is the most favorable to achieve the rehabilitation of Dionewar dikes. However, given the fact that the material used to develop the Djimsane dike is clay, its rehabilitation can be achieved through compacting using manual compactors.

3.2.2.5. Selected construction option

For the three dikes, Ndiar, Ndioundioure and Ecole 2, the plan is to make a reinforced concrete dual screen on either side of the dike axis in place and fill it up with material from the shell remains quarry mixed with clay and borrow materials from excavations (shell and clay) in order to create a compacted backfill with a manual Bomag 350.

The screens dimensions will be 8 cm, 90 cm and 2 m referring respectively to thickness, length and height. They will be embedded at least 50 cm into the ground and will offer freeboards between 40 to 50 cm. As for the height, it will take into account of the ridge line of each of the profiles mentioned above.

At the lowest point (nozzle location or existing spillways) of each dike section, there will be one or two flood drainage structures set at a level that will ensure safety and prevent flooding of nearby homes.

3.2.2.5.1. Ndiar dike

The selected option is the dike made out of RC Plates. The work will consist of: (i) reshaping the backfill to 2 meters framed with dual screen RC plates for 266.74 meters to be embedded to the 19.90 line (ii) fill dike to increase the gauge by 30 and 40 cm steepness, (iii) resize and build a rectilinear spillway equipped with 02 fiberglass valves, on the flow axis of pk10.

With the years of hydraulic compaction, it is more appropriate to use the vertical surface of the old dike as basis by repairing sunken areas. This will help contain the rise of high tides, evacuate rainwater and upstream runoff for the recovery of 5.40 hectares of saline land.

3.2.2.5.2. Ndioundiouré dike

In regards to the Ndioundiouré dike, the following is required: (i) reshape the backfill to 3 meters framed with dual screen RC plates for 137.65 meters to be embedded to the 19.50 line with demolition of nozzles, bags and of the low wall in place, (ii) fill dike to increase the gauge by 30 to 40 cm steepness, (iii) resize and build a rectilinear spillway equipped with a fiberglass valve, on the flow axis of pk8.

It is more appropriate to use the vertical surface of the old dike as basis by repairing sunken areas, like the Ndiar dike. This will help contain the rise of high tides, evacuate rainwater and upstream runoff for the recovery of 12.60 hectares of saline land.

3.2.2.5.3. Ecole 2 dike

The work will be identical to the 2 previous dikes, namely: (i) reshaping the backfill to 2 meters framed with dual screen RC plates for 780 meters to be embedded to the 19.95 line with nozzle demolition, (ii) filling dike to increase the gauge by 30 to 40 cm steepness, (iii) resizing and building a rectilinear spillway equipped with a fiberglass valve, on the flow axis of pk28

For these three dikes, it will be easier to transport materials (cement, concrete, etc.) to Dionewar than the heavy equipment required for the compacted earth dike. The base material (sand and shells) is available on site.

3.2.2.5.4. Djimsane dike

For the Djimsane dike, the process will be different. Indeed, after an assessment of the degradation levels noticed on the dike with respect to the appropriate corrective options, the following will be necessary: (i) reinforce spillway coating; (ii) build upstream/downstream rockfills and walled connection rip-rap (iii) replacement of the metal valve by fiberglass; (iv) reshape over the stretch of 1754.00 meters and fill clay embankments at two meters with a

RC trapezoidal-shaped crown for a crest on an altitude of 21.10 for a ridge line of 60 to 70 cm steep.

With the years of hydraulic compaction, it is more appropriate to use the vertical surface of the old dike as basis by repairing sunken areas. This will help contain the rise of high tides, evacuate rainwater and upstream runoff for the recovery of 118.40 hectares of saline land.

Table 12: Dikes' characteristics (measurements)

Dike	Linear (m) pre-intervention	Linear (m) with project	Catchment areas (Km^2)	Number of hydraulic structures	Width of dike crest in meters	Crest elevation of dual screen plates	Dike maximum height (m)
Ndiar	266,74	266,74	0,054	2 valves	2	20,80	1,10
Ndioundiouré	137,64	137,65	0,126	1 valves	3	20,40	1,10
Ecole 2	767,20	830	0,051	1 valves	2	20,85	1,05
Djimsane	1.754	1754	11,84	1	2	20,90	1,05

Source: Technical feasibility study report, february 2016

The environmental and social assessment will cover this option.

IV. IMPLEMENTATION SCOPE OF THE ENVIRONMENTAL AND SOCIAL ASSESSMENT

The implementation scope of this assessment refers to all project components. It takes into consideration all the options offered for the works involved with the dike rehabilitation.

The different activities planned by the project are summarized below.

- Development of fish and oyster farms by: i) the installation of floating cages; ii) the installation of twenty spat and streamer collectors in oyster areas; (iii) the development of a culture system with magnification bags;
- Reforestation with the establishment nurseries of forest fruit species, planting for an additional 6 ha of coconut and palm trees and 5 ha of mangroves ;
- Training and technical performance improvement of 18 GPF and management committees including the areas of oyster farming and fish farming, and the development of a management plan for fish and oyster farms;
- Rehabilitation, extension and strengthening of two of the village protective dikes, namely Ndiar in the East side and Ndioundiouré located southeast of the Village;
- Rehabilitation of the anti-salt dike located on Djimsane Island to fight against land salinization and revive rice production in favor of Dionewar and Niodior villages;
- local community support to update the LDP by integrating aspects related to climate change.

These various activities are analyzed in this assessment report.

4.1. Goals of the environmental and social assessment

The proposed assessment is an independent review to verify compliance processes and operations with respect to environmental and social norms and provide data and a baseline for developing preventive and corrective actions to address identified risks and issues.

On this basis, the environmental and social assessment aims to: (i) check the level of compliance of the interventions with national and FA norms; (ii) identify key environmental and social issues for different types of work and the sensitivity of the receiving waters; (iii) propose corrective measures in response to the major environmental and social issues.

4.2. Methodological approach

The methodological approach used includes the following steps:

- Description of the legal and regulatory framework for environmental and social aspects applied in Senegal;
- Description of the initial state of the receiving environment and identification of issues, in other words, the description of the environmental and social context in the study area and the identification of key environmental and social issues;
- Diagnostic analysis of key environmental and social issues of the project;
- Introduction of key environmental and social observations related to management and operations, and presentation of the main measures to address shortcomings observed.

  For the legal and regulatory framework, environmental and social requirements were identified according to the following approach:

- Identification of the national legal requirements: codes (including environmental code), all applicable laws and decrees ;
- The FA's requirements regarding environmental and social matters.

The description of the initial state of the receiver environment was achieved based on:

- *Background research*

The background search focused on the review of the scientific literature, study reports, study papers, action plans etc. based on the coast and the Saloum delta.

Document review has allowed to understand the overall situation of the study area and to detect missing data completed during field visits.

- *Field visits*

A seven-day (7) field mission for the assessment of social and environmental aspects had been organized from January 13 to 20 2016 in the project intervention area. It has allowed the verification of collected data and fill in the shortcomings identified during document review.

The following sites have been visited:

- the dikes present in the Dionewar village, namely Ndiar, Ndioundiouré, Ecole 2 and Ecole arabe ;
- Djimsane island and the anti-salt dike built for rice fields;
- The shell remains located north of the Dionewar village which allowed to simultaneously make observations on the biophysical environment;
- The Dionewar Beach to observe the sand encroachment phenomenon, coastal erosion and degradation of mangroves;
- The mangrove at different locations around the village and on Djimsane island;
- Potential sites to accommodate aquaculture infrastructure (fish farming and oyster farming);
- The fish processing center of Dionewar FELOGIE;

Meetings have been organized with authorities and the following groups:

- The village chief who led the various visits;
- The city council led by the Mayor of the Commune;
- The Sub-Prefect of Niodior;
- The Association for the Development of Dionewar (ADD);
- The population of Dionewar as part of a large public consultation;
- The technical services of the ANA, Water and Forestry (Niodior and Fatick), the Sangomar MPA (Niodior), Environment (Fatick), Fisheries (Fatick and Foundiougne), Rural Development (Fatick and Foundiougne), ARD (Fatick) and mangrove projects (Wetlands International - based in Foundiougne), restoration and conservation of the mangrove ecosystem in the Saloum Delta (PRECEMA - Fatick).

These interviews were designed not only to introduce the project, but also to collect the views, concerns, and project expectations of the beneficiaries who were interviewed. It also helped to identify measures to reduce the adverse effects of the project on one hand, and the enhancement measures of the benefits of the project on the other hand.

4.3. Identification of main challenges

The main environmental and social issues have been identified based on: (i) the detailed analysis of the project; (ii) analysis of existing studies relating to the project; (iii) field visits; and (iv) a description of the initial state.

V. LEGAL AND REGULATORY FRAMEWORK

5.1. Senegal legal and regulatory framework

5.1.1. Environmental code

The most recent version of the legal framework regarding the environment is marked by the adoption of the Environmental Code, in particular Law No. 2001-01 of January 15, 2001 and its implementing decree No. 2001-282 of April 12, 2001.

This code was reinforced by regulations including:

- the Prime Minister circular letter No. 009 PM.SGG / SP of July 2001 reminding all structures, the need to respect the provisions of the Environmental Code which

stipulates in Article L48 that "*any development project or activity likely to damage the environment, as well as policies, plans, programs, regional and sectoral studies should be subject to an environmental assessment*». The completion of an environmental impact study must be done prior to any project and must be conducted in accordance with procedures defined in the implementation decree of the law

- The five orders from November 28, 2001 organizing the implementation modalities of the Environmental Impact Assessment (EIA), which are:
    - Order No. 009468 regulating public participation in the Environmental Impact Assessment;
    - Order No. 009469 regarding the organization and functioning of the Technical Committee;
    - Order No. 009470 establishing the conditions for issuance of the approval for the exercise of EIA activities;
    - Order No. 009 471 regarding TOR content for EIA;
    - Order No. 009 472 regarding EIA report content.

5.1.2. Forestry Code

The Forestry Code (Law No. 98-03 of January 8, 1998 and Decree 98-164 of February 20, 1998) guarantees the integrity of artificial plantations by way of Article L11 which states that "*user rights do not apply to the perimeters of reforestation and restoration, and private forest..*" and Article R2 which classifies areas of reforestation and restoration in the forest area of the State.

Article R5 defines the perimeters of reforestation or restoration as "*non-forested or insufficiently reforested land on which is or may be exercised severe erosion, and whose reforestation and restoration is deemed necessary agronomically or environmentally. These lands are temporarily classified in order to ensure their protection, restoration or reforestation. Once these goals are achieved, they can be developed or removed from the classified forest system.*" This can promote the sustainability of reforestation carried out in the project because the plantations located in the Dionewar of village land within that area.

Senegal has a new forest policy document. It updates the Forest Code, taking into account: (i) strengthening the decentralization process with one hand, the establishment of the local community in the region and on the other hand, the transfer of the management of certain powers to communities including local environment and natural resources; (ii) ensure consistency with the different national planning documents (DSRP, PODES, PNAT, Agro-forestry-pastoral Orientation Law, MDGs, etc..); (iii) at the international level, ratification by Senegal of a number of conventions that affect directly forest management: Biodiversity, Climate Change, Fight against Desertification.

5.1.3. Fisheries code

Law No. 2015-18 from July 13, 2015 regarding the Code of marine fisheries guarantee the conservation of fishery resources and their exploitation in a sustainable and rational way.

Thus, in its L4 article, the code states that "*the management of fisheries resources is a prerogative of the state which defines, for this purpose, a policy to protect, maintain and provide the sustainable use in order to preserve the ecosystem*".

The state promotes the co-management of fisheries with industry professional's organizations, marine fisheries communities and all other stakeholders. The terms and conditions for implementation of fisheries co-management are determined by regulation.

The same code also promotes "*the creation of crop farms, meaning that any installation done in the sea or on the shores of marine waters under Senegalese jurisdiction and that aims conservation, farming or intensive exploitation of marine organisms and resulting in a fairly prolonged occupation of public property or, in the case of installation on private property, is fueled by the sea* "(Art. L62).

Project activities fit well within this framework.

5.2. Conventions, treaties and international agreements

Convention	**Regulated sector and objectives**	**Implementation in the project scope**
African Convention on the conservation of natural environment and its resources *Alger, 1963*	- Improving the protection of the environment, - Promoting the conservation and sustainable use of natural resources, - Harmonize and coordinate policies relates to environment	Implement actions to be undertaken individually and collectively for the conservation, use and development of land resources in waters, flora and fauna.
Stockholm declaration on the environment and sustainable development *Stockholm, 1972*	- Acknowledgment of the need to better manage non-renewable resources, protect the environment and implement national and international governance systems to take into account the environment. - Give priority to capacity building in regards to the vulnerability related to sustainable development.	Component 3 of the project has defined support of the commune in the management of natural resources and plans to ensure the respect of biological rest and all applicable standards related to environmental and social issues. Also, in its second component, the project offers building technical and institutional capacity of beneficiaries to increase their resilience to the effects of climate change.
Ramsar Convention on wetland areas *Ramsar, 1971*	- Stopping the degradation or loss of wetlands now and in the future; - Urges the signatories to take into account the conservation of wetlands in their planning; - Inclusion of sites on the Ramsar List and promoting their conservation; - Preserving wetlands included or not on the Ramsar list, support research, training, management and monitoring in the area of wetlands;	The project, in an effort to limit exploitation of resources such as mangroves initiated a program of reforestation and sustainable management of these resources.

Convention	Regulated sector and objectives	Implementation in the project scope
	- Cooperate with other countries, particularly to preserve or restore the transnational wetlands.	
Rio Declaration on environment and sustainable development *Rio, 1992*	- Provide a clear and comprehensive definition of the concept of sustainable development; - Demonstrate collective ability to manage global problems; - Assert the need for green growth; - Principle 10: "*the best way to address environmental issues is to ensure the participation of all concerned citizens, at the relevant level [...]*"; - Principle 17: "*an environmental impact study [...] shall be undertaken for proposed activities that are likely to have significant adverse effects on the environment [...].*"	The idea of the project is part of a will to reduce the vulnerability of coastal communities and to strengthen their resilience to climate change.
United Nations Framework Convention on Climate Change (CCNUCC) Came into effect in *1994*	- Use appropriate methods, for example impact assessments, formulated and determined nationally; - Minimize adverse effects on the economy, public health and the quality of the environment of projects or measures undertaken by them to mitigate climate change or adaptation.	The project in its initial definition aims to reduce as much as possible the vulnerability of populations to climate change by offering protection and also income-generating activities.
Natural and Cultural World Heritage Convention Came into effect in *1972*	- The deterioration or extinction of any item of cultural and natural heritage constitutes harmful impoverishment; - Are considered cultural heritage: monuments, groups, sites, etc. - Are considered cultural heritage: natural, geological and physiographic monuments, natural sites.	The objective of the assessment study of the environmental and social impacts is to identify the presence of cultural and / or natural heritage to allow the project to ensure its protection.

5.3. Convergence with the Adaptation Fund of the Environmental and Social Policy

The AF's environmental and social policy defines the basic principles that include among others: (i) compliance with national and international legislation; (ii) soil conservation and production capacity; (iii) fair access to project benefits; (iv) integration of vulnerable and marginalized groups; (v) respect of human rights; (vi) inclusion of gender and women's

empowerment; (vii) compliance with basic labor rights; (viii) respect of indigenous rights; (ix) limitation of the involuntary resettlement of populations; (x) protection of natural habitats; (Xi) conservation of biodiversity; (xii) climate change consideration ; (xiii) the fight against pollution; (xiv) public health preservation ; and (xv) protection of the physical and cultural heritage.

The project complies with the climate change Adaptation Fund policy.

VI. DESCRIPTION OF THE RECEIVING ENVIRONMENT

Dionewar village is part of the Saloum islands archipelago whose geographical space is defined by the inlets of Diombos and Saloum. These Niominka islands, historically called Gandoun are composed of nineteen (19) inhabited islands and many others uninhabited islands (some of which serve as rice fields). They are, essentially, in an environment with a strong presence of riverine mangrove, multiple mudflats and bolongs.

6.1. Physical environment

Data and information for the characterization of the biophysical environment Dionewar's village land are drawn essentially from the 2011-2016 Dionewar LPD and the Economic and Social Forum Report of Dionewar.

6.1.1. Topography

The extent of the Dionewar landform is mainly characterized by a flat relief except the bottomlands or basins located mainly in the East and North of the village. Most of the village is located below sea level, which increases its vulnerability to climate change impacts. In particular: (i) coastal erosion in the north of the village following the breakdown of Sangomar boom in 1987; and (ii) the gradual silting of tidal channels threatening mangroves and disturbing pirogue's seaworthability; (iii) floods; and, (iv) salinisation of groundwater.

6.1.2. Climate

6.1.2.1. Temperature

The climate is largely influenced by the maritime trade wind because of the proximity to the Atlantic Ocean and because of its insularity. It is characterized by the existence of two seasons:

- A longer dry season which lasts eight (8) months (October to June) during which a regular combination of maritime trade wind/harmattan results in the constancy of a relatively cool climate with an average temperature of 27 ° C. The maximum temperatures are 17 ° C in January and 37 ° C in June.
- A short rainy season starts after the monsoon. This hot and humid wind that blows from mid-June to mid-October brings rain. The greatest rainfall amounts are recorded during the month of August.

6.1.2.2. Rainfall

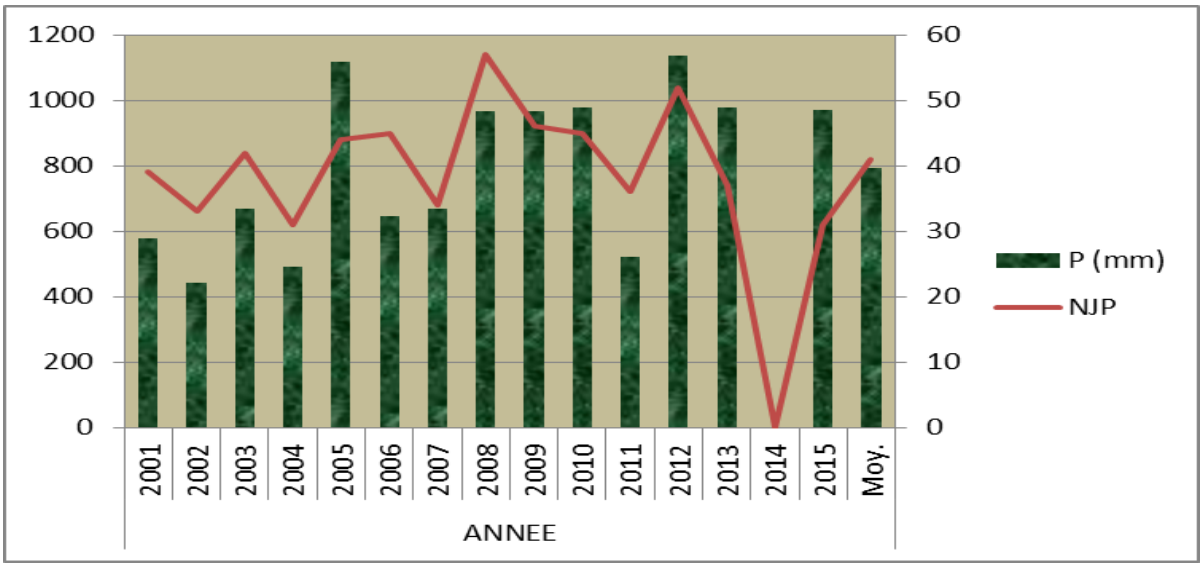
The rainfall evolution over these last fifteen years is presented in the table below.

Table 13: Recorded rainfall at Niodior station 2001-2015

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Moy.
P (mm)	578,5	441	666,9	489,8	1116,7	646,2	666,5	967,7	967,9	978,9	520,3	1136	977,7	ND	971	794,65
NJP	39	33	42	31	44	45	34	57	46	45	36	52	37	ND	31	41,00

Sources: 2011-2016 Dionewar LDP and SD Foundiougne Agriculture , january 2016

Graph 1: Rainfall evolution at Niodior station 2001-2015



Average annual recorded rainfall in the Niodior station is 794.65 mm of rain during 41 days in the last 15 years. This average is above the area's isohyet that is between 400 to 600 mm. The rainiest years are 2005 (1116.7 mm during 44 days) and 2012 (1136 mm during 52 days) while those with less rainfall are 2002 (441 mm during 31 days) and 2011 (520.3 mm during 36 days).

6.1.3. Water resources

6.1.3.1. Hydrography

6.1.3.1.1. Surface water

Surface water in the project area is mainly from the Atlantic Ocean along the entire western part of the island, of the Saloum River that feeds several ponds and mangrove. Thus, the commonly known Bolong inlets of Falia rise at the Saloum River before splitting into two meanderings among the villages of Dionewar and Falia. The Diagne Bolong goes through the eastern part of the Niodior village after taking its source at the Saloum River from its mouth. Despite their importance, these rivers are only used for fishing, gathering of fishery products and shipping.

Temporary ponds on the other hand allow the practice of market gardening and livestock watering.

6.1.3.1.2. Groundwater

Groundwater relates to the shallow groundwater of the Continental terminal captured by numerous wells. The intrusion of sea water makes the water saltier and more polluted.

6.1.3.2. Hydrology

Hydrology refers to groundwater abstraction from the water table. Indeed, fresh water from the commune comes from the Continental terminal groundwater picked up by the village well. The depth of the water varies between 4 and 7 meters. This water is used for all purposes.

6.1.4. Soils

Dionewar village does not have enough land favorable for farming. Most of the available land suitable for agriculture suffered harsh effects of saline incursions and damage linked to intensive monoculture rice and the absence of fallow.

There are:

- The Dior soils or ferruginous tropical leached soil which are soft and permeable soils. Primarily located in the northern part of the island, these soils are suitable for agriculture.
- The Deck-Dior soils or little leached ferruginous soils occupy a small part of the total area. They are very suitable for horticulture, arboriculture and rainfed cultures (LDP 2011 - 2016).
- The lowlands or basins located for the most part in the East and North of the land are predominantly clay and clay loam type. They hence constitute areas suitable for rice and vegetable culture.
- The saline soils are encountered along the mangrove on the back of the mudflat. They are constantly watered by the flow of the tides, and rarely covered by vegetation due to their salty and even acid clay texture. There is currently a gradual extension of this type of soil, which is a threat to arable soils.

6.2. Biological environment

6.2.1. Vegetation

The vegetation of the municipality of Dionewar is essentially composed of three layers: a tree layer, shrub layer and herb layer.

6.2.1.1. Tree layer

The tree layer can be decomposed into coastal forest and land forest. These two sub-strata are relatively well preserved and in clear regeneration (2011-2016 Dionewar PLD).

The coastal forest essentially has mangrove ecosystem tree species that occupies 17% of the total area of the municipality, and consists of *Rhizophora racemosa, Rhizophora mangle and Avicennia africana*. The mangrove is the breeding and development location of certain species of fauna and aquatic flora. Its wealth has raised awareness of the population in favor of its protection.

The land forest is located in the continental area after a big amount of mangrove vegetation. 8.7% of this area is allocated to agricultural and livestock activities. It consists of Sudano-Guinean species such as *Parinari macrofila, Detarium senegalensis, Borassus aethipium, Elaeis guineensis, Adansonia digitata, Cocos nucifera, etc*.

6.2.1.2. Shrub layer

Shrub species in Dionewar are essentially *Daniellia oliveri, the raffia, the solom,* etc.

6.2.1.3. Herb layer

It is essentially composed of seasonal species whose development depends on rainfall. During the winter, the grass cover is well supplied and very varied. The grass that provides this layer is a power source for livestock whose survival depends heavily on the abundance of the latter.

The vegetation of the municipality of Dionewar has been facing these past years a progressive deterioration due to the growing needs of the population mainly in firewood, timber, extension of harvesting areas. The adverse effects of climate change are exacerbating this situation.

A resource management committee (COGER) is set up to raise awareness on the need to preserve natural resources. A local agreement for the sustainable management of natural resources of the community is in place.

Photo 15: Dionewar landscape

(Photo credit: CSE , january 2016)

6.2.2. Wildlife

6.2.2.1. Terrestrial wildlife

If the terrestrial wildlife was rich and varied several decades ago, it has become very rare now. Some species formerly represented in the zone like the lion, the leopard, hyena, the antelope, the jackal, the rabbit and many reptiles and birds are now unknown to the new generation.

For birds, this area which is part of the Saloum Delta National Park constutes an important drop and reproduction point. This is the case especially for migratory birds. Some birds species like the flamingo and the pelican are sometimes seen in the area.

6.2.2.2. Aquatic life

The aquatic life is rich and diverse. It consists of estuarine and marine species (see table below).

The exploitation of fishery resources is the main source of household income. Over the past decade, there has been a reduction in stocks of fish resources due to poor fishing practices and climate change.


Photo 16: Some waterbird species seen on Dionewar island

(Photo credit:CSE , january 2016)

Table 14: Aquatic species caught in estuaries and in the sea

ESTUAIRES	MER
Barracudas (seud)	Trevally (Saaka)
Captain (jum)	White carp (sompat)
Trevally (Saaka)	Black carp (nawrex)
Gray carp (waas)	Red carp (yax)
Black carp (nawrex)	Lobster,
Red carp (yax)	Grouper (Thiof)
Belt (tallar)	Catfish (Kong)
Mackerel (IAI)	Octopus
Shrimp (sipaax)	Shark
Doyene (tapandar)	Sardinellas (yaboy)
Bonga (Cobo)	Seiche (yeuredeu)
Grouper (Thiof)	
Molluscs (Touffa, yet, loincloth, Yokos)	
Mulet (gray)	
Catfish (Kong)	
Skate (rayartar)	
Sardinellas (yaboy)	
Seiche (yeuredeu)	
Soles (SAPAL)	

Source: PLD Dionewar 2011-2016

6.3. Human environment

6.3.1. Demographic context

The Statistics and Demography National Office (ANSD) estimates there were 12,988 inhabitants in Dionewar in 2011, in its 2008-2012 documents, and gives a projection of 14,525 inhabitants in 2015. The same source estimates the population of the village of Dionewar to be 5.395 inhabitants, inluding 2,607 women (48.32%).

The population density is 43 hbts./Km², hence lower than that of the region which is 77 hbts./Km².

Elements that affect the dynamics of the population are fertility, mortality, migration and immigration. For Dionewar, migration relates mainly to external flows. Indeed, the external migratory movement is highlighted by rural migration and seasonal migration which constitute a revenue generation strategy and search for food security. Based on the 2003 LDP data, two kinds of flows are identified. For instance, there are seasonal movements of fishermen relating to some of them moving to other fishing areas both inside the country and in neighboring countries such as Gambia, Guinea Bissau and Mauritania. The exodus of young people in turn corresponds to the movements of the latter due to economic reasons or study to large urban centers. This phenomenon is more pronounced for girls because nearly 80% of them are in urban centers and return only for ceremonies.

6.3.2. Socioeconomic context

Fishing is the dominant activity in Dionewar. Other economic activities relate to agriculture, livestock, small businesses and arts and crafts.

In correlation to the growth of the fishing industry, there is an increase in fish processing activities. This is due to the dedication of Dionewar FELOGIE women. Processing activities mainly concerns shellfish by using drying processes, smoking, soiling and fermentation.

Rainfed agriculture mainly concerns food crops such as rice, millet "souna", sorghum, cowpea (niébé) and hibiscus (bissap). Rice, which is a staple food is also the main food crop. Growing millet is developing because of the existence of the very conducive Dior soils. The sorghum and cowpea crops are part of the millet plots. This is also the case for growing sorrel (hibiscus), of which a portion is grown around the fields to define the limits. It should also be noted that food crops, especially cereals, are often the victims of seed-eating birds.

For horticulture, speculations revolve mainly around the culture of sweet potato and various other vegetables, but its potential is underused because of its rudimentary practice. Arboriculture concerns mainly dwarf coconut trees.

Livestock farming is mainly domestic and is marked by a predominance of poultry and sheep. The presence of horses is very low. The livestock vulnerability is accentuated by the lack of veterinary care which exposes it to various viral and microbial attacks in the region. In addition, it is important to note the poor quality of livestock drinking water especially in the dry season, a period when it is cloudy and unsanitary (LDP 2011 - 2016).

6.3.3. Support to the development of Dionewar

Dionewar village received a lot of support to help people face the many issues caused by insularity of the community. The main areas of support include education (construction / rehabilitation of classrooms, literacy), health (rehabilitation of the health center), sanitation (latrine construction), access to drinking water (well drilling), the fight against flooding (dike construction), agriculture (anti-salt dam), the development of income generating activities (construction of fish processing center and forest fruit, central purchasing unit, revolving credit, etc.) and capacity building in several sectors, etc.

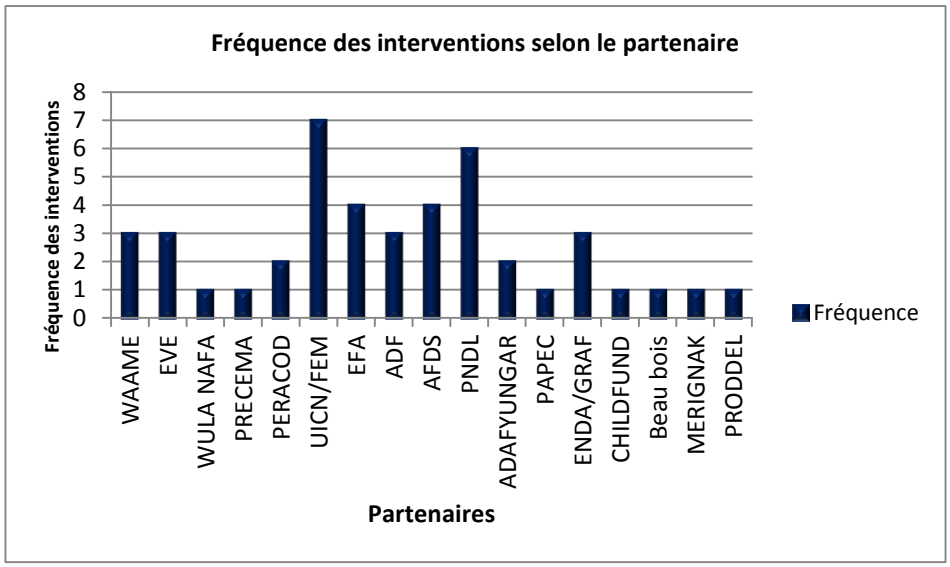
The table below summarizes the key areas of support and relevant partners to Dionewar these past years.

Table 15: List of Dionewar past support partners

Sectors/Activities	Main partners
Natural resource conservation activities (reforestation, wood village, development of local convention for the sustainable management of natural resources, distribution of improved stoves)	WAAME, EVE, WULA NAFA, PRECEMA, PERACOD
Literacy	WAAME, UICN/FEM
Youth group support	EFA
Support for the certification of fishery products and the enhancement of seafood value	EFA, ADF
Construction and central purchasing unit	ADF, AFDS
Sanitation: Construction of latrines, provision of donkeys and carts for garbage collection, incinerator donation)	WAAME, UICN/FEM, PNDL, ADAFYUNGAR
Support for the promotion of income generating activities (henhouse construction, processing units, oyster farming, market gardening, recycling seafood, revolving credit)	AFDS, EFA, PNDL, PAPEC, ENDA/GRAF, UICN/FEM
Support for the fisheries sector (wharf construction, endowment of life jackets, motorized pirogues)	PNDL, ENDA/GRAF, EVE, ADAFYUNGAR, UICN/FEM
Fight against floods and tides (construction of protective dikes)	AFDS
Health (Construction and equipping dental office , salt iodization, nutrition)	PNDL, CHILDFUND
Education (Construction / rehabilitation of classrooms)	Beau bois, Mérignak, PNDL
Local Development : ((Support for the development of PLH of the CR))	PRODDEL, PNDL
Access to drinking water (welldrilling)	AFDS, UICN/FEM
Agriculture (Development of anti-salt dikes, rice)	UICN/FEM
Capacity building in the areas of PFNL, processing, fishery products, administrative and financial management, etc.)...	EVE, PERACOD, ADF, ENDA/GRAF, EFA, UICN/FEM

Source: "Mapping of interventions and beneficiaries in the Saloum Delta" Report, Foundiougne Mangrove Platform Technical Committee, August 2015

Graph 2: Past development support from partners for Dionewar



The table and graph analysis below shows that UICN/FEM and PNDL are first on the Dionewar list of development partners these past years. They work mainly in rice growing, mangrove regeneration, and hygiene, revenue generating activities and capacity building, fisheries, health, local development. AFDS, EFA, WAAME and EVE have had a big impact on the island, especially in capacity building activities, hygiene, promotion of revenue generating activities, etc. ENDA GRAF, Wula Nafa, PRECEMA, PERACOD, ADF, ADAFYOUNGAR, PAPEC, PRODDEL, Child Fund have also worked in Dionewar but in a less important manner.

The situation on the ground shows that although there are various actors and various intervention sectors, the Dionewar village has not been able to address all the issues that challenge its effective development.

VII. PUBLIC CONSULTATION

The consultation mission organized in the project intervention area allowed meeting the different stakeholder categories: local and administrative authorities, devolved state technical services and beneficiary populations. The objectives of these meetings in the form of interviews were to present the project and collect in return the perception and expectations of people and groups met.

The Sub-Prefect of Niodior and the Heads of devolved technical services at regional and departmental levels have been met in their respective services. The representatives of Water, Forestry and Marine Protected Areas services have been grouped in a single interview.

For local authorities, a meeting of the communal council chaired by the Mayor was organized. As for beneficiary populations, they have been consulted through a meeting organized with FELOGIE (local federation of economic interest groups of Niodior) members, on the one hand, and a public meeting involving all social classes of Dionewar, on the other hand.

The main issues focused on: (i) the project implementation opportunity; (ii) the project expectations; (iii) the social-economic impacts expected from the project.

Each of the stakeholder categories met will participate, according to its competence and responsibilities, in the project implementation.

The results of these consultations are summarized in the sections below.

7.1. Administrative authorities: the Sub-Prefect of Niodior

In Senegal, each region is divided into departments and the departments into arrondissements. Arrondissements are divided into communes, which are administered by a Sub-Prefect.

The Commune of Dionewar belongs to the arrondissement of Niodior.

The Sub-prefect considers that Dionewar is very vulnerable to climate change. Every year, the risk incurred is the junction between the river and the sea. Therefore, the project is a godsend, and he will spare no effort to support its implementation.

The activities planned by the project take into account the general concerns of local populations.

The Sub-Prefect also hailed the dynamism of FELOGIE female members, particularly those engaged in the processing of fishery products.

The main recommendations include: (i) the need for strong involvement of people and administrative and local authorities at all levels for their adherence to the project; (ii) the establishment of a steering committee for the monitoring and maintenance of infrastructure to ensure their sustainability; (iii) the need to focus on the results to avoid the despondency of populations.

7.2. The Municipal Council

The main themes discussed during the meeting with the Municipal Council of Dionewar include:

- The environmental issue, which is currently a critical question, because of the geographical configuration of Dionewar, as an island village faced with floods, sea encroachment and coastal erosion. The means to tackle them are out of populations' reach;
- The importance of the need to rehabilitate the dikes "*The studies previously carried out report that the dike located at the entrance of the village must be rehabilitated over 3 km for a total cost of about F CFA 5 million. As for the dike located at the river side, the length is about 1 km for a cost approximating F CFA 100 million. Currently, about 4 km of dike must be rehabilitated*" according to one of the commune councilors.
- *"The reforestation of coconut trees is a very good initiative, because currently dead coconuts are not replaced"*.
- The importance of forest fruits in the local economy was highlighted. Indeed, the exploitation of ditakh (*Detarium senegalensis*) brings to Dionewar "about F CFA 3 million per year and F CFA 10 million FCFA to Niodior. *These benefits allowed restoring the mosque of Dionewar with up to CFA 10 million*" according to one of COGER members.

As a result of these numerous questions of clarification, following recommendations have been made:

- Include ditakh reforestation in reforestation components, because this species brings a lot of income contributing to the local economy enhancement. "*Currently, there are only old plants that will not be renewed once dead*."
- Build access ramps for canoes if the dike at the village entrance is rehabilitated (ocean side);
- For mangroves, in addition to their reforestation, think about alternative energies such as improved stoves. Indeed "*the commune has a population of about 15,000 inhabitants with approximately 700 households that only use mangrove wood as firewood, representing thus a strong pressure on mangroves*";
- Share intervention resources and strategies with the Directorate of Marine Protected areas as part of Sangomar MPA which also includes Dionewar;
- Involve municipal councilors and community-based organizations (CBOs) in the training and technical capacity building component;
- Establish a participatory monitoring and evaluation mechanism to ensure the project sustainability.

7.3. State Technical Services

Interviews with the various state technical services can be summarized in terms of:

Vulnerability of the village

All technical services met have pointed out the vulnerability of the commune of Dionewar due to its sandy coast. They stressed on the urgent need to rehabilitate the dikes. Indeed, according to them "*The populations in these islands are often confronted with the difficulty for navigation, due to the silting of tidal reservoirs and bolongs (channels)*".

Partnership with the MPA of Sangomar

The MPA of Sangomar recently created aims at managing protected areas in the region. Today, the MPA of Sangomar has developed a management and action plan whose activities are in line with those planned under this project. In this context, the establishment of a partnership with the MPA of Sangomar is necessary to share resources and strategies particularly with respect to dike rehabilitation, reforestation, agroforestry development, income-generating activities development, etc.

Fishing

The sector is marked by a decline in productivity. This decline in productivity has been confirmed by the heads of regional and departmental fishing services met. Fish farming and aquaculture activities planned by the project are in line with the policy developed by the State for the restoration of marine ecosystems and the problem of pressure on resources can be reduced through aquaculture. The potential for aquaculture is quite important. It appeared that the conflicts recorded in the area are generally related to fishing practices.

"*In Dionewar, women are very active in the processing of fishery products and the project will enable them to better prepare for climate change, and thanks to the support, find a suitable adaptation strategy"* according to the head of the departmental fishing service of Foundiougne.

Reforestation and natural resource management

Despite the absence of statistics on degraded mangrove areas, the overall remark is the decline of palm trees, coconut trees and mangroves. This is mainly due to illegal logging, decreasing rainfall and soil salinization. Islands are generally hostile to reforestation and species diversification. Reforestation is therefore essential to avoid sea encroachment. This activity must be supported by the Water and Forestry service for an important success rate.

There is an agreement for the management of natural resources. The COGER which supports the implementation of this agreement is doing a good job in the area. However, it shall comply with the Forestry Code regarding forest fruits owned by the state. The Water and Forestry Services recommend an agreement between the project and these services for continuous follow up and support of reforestation activities and identification of the sites and species to be reforested.

Rice cultivation

Rice cultivation helps improve people's income, because oyster farming is difficult to perform, so it allows the reconversion and diversification of the activities.

There is an abandonment of rice cropping because of the increasing salinity of soil and rainfall reduction. "*Generally, the inputs (seed, fertilizer, etc.) are subsidized and given to the commune, but island communes do not benefit from it*" according to the head of the rural development department of Foundiougne.

To know the species adapted to Dionewar area, a soil survey must be undertaken. The agricultural service that must support the population is faced with a lack of financial and human resources. Thus "*it is difficult to reach insular areas that are hardly accessible. These communes do not benefit from the agricultural inputs granted by the State, because it is difficult to transport them in such areas*".

As a result of the strong demand of Dionewar populations, the project for the recovery of saline lands was funded in 2013. But the problem that may be faced by people growing rice is the presence of grain-eating birds.

7.4. Beneficiary populations

FELOGIE

The local federation of economic interest groups is composed of 25 groups. The size of these groups ranges between 25 and 80 members.

Women welcome the project because all the activities planned therein are covered by FELOGIE: the processing of fishery products and forest fruits, the reforestation of casuarinas and coconut trees in 2003 and mangrove planting almost every year in August, the farming of oyster even if their first experience was not successful.

Dionewar populations

The public consultation with Dionewar populations allowed collecting the following expectations, perceptions and concerns:

- The vulnerability of the village to recurrent flooding, coastal erosion and silting of a portion of the coast. Thus, during the rainy season, the village is faced with the difficulty to drain stormwater.
- The need to extend the dike of Ndioundiouré to Niodior to ensure a certain security and prevent water—during the rainy season—from bypassing the village and causing damage elsewhere.
- The importance of the environmental issue considering the island vulnerability:
- *"The village mosque has been rehabilitated partly thanks to the revenues from ditakh sales (almost FCFA 25 million)";*
- The importance of boosting rice cultivation through the rehabilitation of Djimsane dike. Indeed, 20 years ago, the village was self-sufficient in rice. In 2015, FELOGIE piloted a project funded by the GEF (Global Environment Facility) to revitalize rice cultivation on Djimsane island with the construction of an anti-salt dike;

- The importance of monitoring reforested sites. With JAD (Active Youth of Dionewar) association, "several reforestation actions of casuarinas, coconut trees and eucalyptus have been carried out, but the problem is that there has been no follow-up, thus most of the plants reforested are dead";
- The need to develop reception sites in Djimsane to actually boost rice cultivation on this island. *"Before, when rice cultivation was performed in Djimsane, there were available huts on site and people returned to Dionewar once a week for a day on average. They stayed there the whole season (about 90 days). Things have changed. People cannot carry cropping equipment every night to Dionewar.*

  Before 2015, rice fields were no longer used since 1961. The resumption of activities in Djimsane also requires additional resources: canoes, available huts on site, etc."
- The consideration of "freshwater issue in Djimsane as there is no well."

7.5. Summary of the perceptions and expectations of Project beneficiaries and partners

7.5.1. Perception of beneficiaries

During the environmental and social impact assessment mission in the field, consultation sessions with beneficiaries, administrative and local authorities and other stakeholders, were organized at different institution levels in the villages of Dionewar and Niodior arrondissement, but also in Foundiougne and Fatick. Thus, meetings with beneficiaries were organized, while administration officers (prefect), municipal councilors and devolved state services were consulted through meetings restricted to officials. The community of Dionewar has also been met as part of a forum, which brought together all social classes of the island including the project proponents. These consultations have been extended to other projects and programs whose missions cover the issues addressed in the project "Reducing vulnerability and increasing resilience of coastal communities in Dionewar".

Photo 17: Partial view of the room during the public consultation of Dionewar on January 17, 2016.

(Photo CSE, January 2016)

Photo 18: Partial view of the room during the public consultation of Dionewar on January 17, 2016.

Here some ADD members, proponents of the project and the consultants

Photo 19: Partial view of the room during the public consultation of Dionewar on January 17, 2016.

(Photo CSE, January 2016)

Photo 20: Interview with the Sub-Prefect of Niodior

(Photo CSE, January 2016)

The reactions recorded at the end of this consultation activity can be divided into two categories: expectations and concerns.

In general, all interviewees have accepted the project, and looked forward to its implementation, considering the numerous issues it is supposed to address.

7.5.2. Expectations of beneficiaries and project partners

People's expectations revolve around the resolution of recurrent flooding and coastal erosion issues, the revitalization of rice cultivation, the restoration of mangrove ecosystems and the increase of their revenues through income generating activities. This can be summarized in a

strong desire to see their island cope with its current vulnerability and record improved resilience of communities.

These expectations and possible solutions are summarized in the table below.

Table 16: Summary of the expectations of the populations and project partners as well as the possible solutions

Expectations of populations and	Possible solutions
Effective start-up of the project	All the arrangements are made by stakeholders for the effective start-up of the project
Protection of the island against recurrent flooding	➢ Rehabilitation and extension of existing dikes ➢ Rehabilitation of the mangrove ecosystem (reforestation)
Protection of the island against coastal erosion	➢ Reforestation along the coastline mainland with adapted plant species such as the Niaouli (Melaleuca quinquenervia)
Resolution of the food insecurity issue	➢ Support to fish farming and oyster farming ➢ Support to the processing, packaging and marketing of forest fruits ➢ Support to the processing, packaging and marketing of fishery products
Conservation and valuation of forest fruits to increase people's income	➢ Enhancement and implementation of the local convention on the management of natural resources including the actual observance of a biological rest period and the regulation of forest fruits exploitation ➢ Agroforestry development through the planting of forest fruit trees of high economic value (ditakh, tamarind, etc.) ➢ Regeneration of oil palm trees ➢ Regeneration of coconut trees by supporting ongoing family initiatives (development of coconut clumps in family compounds) ➢ Capacity building for women engaged in forest fruit processing, with respect to the processing, packaging and marketing of processed products and administrative and financial management
Resolution of Djimsane land salinization problems	➢ Rehabilitation of Djimsane dike to curb the saline front
Development of rice production activities particularly in Djimsane island.	➢ Rehabilitation and extension of Djimsane dike to stop the saline front and protect the rice lands from the effects of salt. ➢ Development of Djimsane rice fields (fragmentation into plots and ridging) ➢ Support to producers with agricultural and logistical equipment (canoes) for advantageous use of rice fields ➢ Capacity building for producers on good agricultural practices and post-harvest techniques ➢ Support to the rice sector

7.5.3. Beneficiaries and project partners' concerns

The beneficiaries and project partners have expressed a certain number of concerns, revolving around: (i) the insularity and climate change which is increasingly putting pressure on people's mind; (ii) the delay observed in the actual start of the project; (iii) the management, monitoring and maintenance of the infrastructure to be implemented; (iv) the aging of coconut populations which raises fear about their disappearance from the island in a near future; (v)

the degradation of the mangrove ecosystem, especially due to its abusive logging for firewood and timber purposes.

These concerns reveal the relevance of the project. In fact, most of the concerns of the populations and partners are taken into account by the project: fight against flooding and coastal erosion through the refurbishment of dikes, support rice production with the refurbishment of Djimsane dike and ridging rice plots and provision of equipments, management of natural resources, support for the processing of forest fruits, training and capacity building of actors in the fields of management and maintenance of infrastructure, aquaculture farms, etc. Regarding the facilities that will be put in place, a plan of management and maintenance will be developed for this purpose.

For aging coconut tree stands, the project provides reforestation enrichment of these two species on an area of 6 acres. Laudable family initiatives (coconut plantation in households) are underway in Dionewar regarding coconut tree. They deserve to be supported.

VIII. PROJECT ACTIVITIES MAIN ENVIRONMENTAL AND SOCIAL IMPACTS

8.1. The physical environment

The key issues at stakes with the project would include the use of construction site machinery (manual compactor, tillers, harrows, etc.), which require the use and handling of hydrocarbons that could contaminate the soil and surface waters if it happens to spill into the environment. These risks will be noticed at all stages of the construction site (maintenance of the equipment, supply, storage and distribution of diesel, leakages, etc.).

The earthworks, embankment reshaping, recovery of hydraulic work (drainage) and bank stabilization can also have a negative effect on the physical environment, mainly because of their interaction with surface water (accelerated erosion, increased turbidity in the mangroves and water bodies, etc.). It is worth to be noted that the renewal of many equipments can potentially be an environmental issue due to environmental contamination and visual impact in case of mismanagement of obsolete equipment. This includes mainly non-functional PVC pipes, rubble, wooden posts, etc.

8.1.1. Negative impacts

The nature of the project, which is to rehabilitate existing dikes in their existing easements, significantly reduced physical issues and their importance. Indeed, the sources of impact of this project are limited in scope and circumscribed in an already existing easement, and have a relatively short duration for each intervention site. The other activities (fish farming, oyster farming, nursery, rice growing, etc.) are likely to generate negative small-scale impacts.

In the following sections, the negative impacts of each of the activities planned in the project are analyzed.

8.1.1.1. Dikes rehabilitation activities, developments and rice plots shared impacts

8.1.1.1.1. Disintegration of the soil and erosion

- **During the construction phase**

The risk of soil disintegration occurs whenever the rehabilitation activities require the creation or reopening of access roads to construction sites and temporary storage of materials. This disintegration of soil may be accompanied by erosion when these areas are subject to a vegetation loss that compromises the soil retention by the vegetation cover.

Any change in topography which was not previously weighed up is likely to significantly change the natural drainage courses (stagnation and siltation, or acceleration of flows) and can have a significant impact on soil quality, plans nutrition, stream water and on water-bearings.

Flows from areas that have experienced earth movements and / or vegetation loss are also likely to generate a supply of turbid water in the plans and streams, thus affecting the quality of the water which becomes harmful to aquatic ecosystems.

These impacts are, however, very unlikely or minor because the easements of implantation sites were for the most part already released in previous work.

- **During the operational phase**

There is no predictable negative impact during this phase.

8.1.1.1.2. Contamination by products that are toxic for the environment

- **During the construction phase**

Soil and water contamination occurs when there is handling of liquid or solid substances that are toxic for the environment, which may occur during rehabilitation of dikes and during the exploitation of rice farms. In general, the possible sources of pollution recurring in all activities / projects undertaken on site are the following ones:

- Use of rolling stock and construction site machinery: the main risk comes from the presence of hydrocarbons. These hydrocarbons are either fuels (mainly diesel) or mineral oil used in engines or hydraulic units of construction site machineries. Soil contamination risks can occur at several stages of the use of the equipment:
- during their refueling;
- during maintenance (oil changes, lubrication, washing);
- during the carriage of these hydrocarbons to the areas of activity;
- when in use and leaking;
- during any incident leading to a loss of hydrocarbons into the environment.
- Handling and use of toxic products (degreasers, additives, resins, etc.).

- **During the operational phase**

The main negative impacts can be summarized as follows:

- Pollution of the environment by pesticides and fertilizers used in rice farming.
- Pollution of the environment by fertilizers and other chemicals used in the context of the development of nurseries.

8.1.1.2. Soil and water contamination

8.1.1.2.1. Rehabilitation of existing dikes

- **During the construction phase**

Most of the activities involved in the rehabilitation of unstable areas and of hydraulic work are essentially subject to the risk of disintegration of soil and erosion, and to the risk of oil spillage. These risks of disintegration and soil erosion will be particularly present during the rehabilitation of dikes' banks to the extent that this work will be a major operation requiring significant earthwork for the Djimsane dike. For the other dikes, the excavations for the installation of reinforced concrete plates on the low walls can have similar consequences.

For the drainage, the ripraps and the arrangement of culverts at the water crossings will be held close to sensitive receptors such as mangroves (Ndiar and Ndioundiouré dikes). They

involve earthwork and significant handling, and use of machinery. There is a risk of disintegration of the soil and a temporary increase in turbidity in relation to the activities, as well as a contamination of soil and water by hydrocarbons.

- **During the operational phase**

The reservoirs created by dikes can produce negative impacts such as congestion of soil, submersion of plant species at water sites, water-borne diseases.

8.1.1.2.2. Fish and oyster farm implementation

- **During the construction phase**

A very unlikely but possible impact is the increase in water turbidity at the cages implantation site. These impacts are of a very small scale and last only for the infrastructure establishment time.

- **During the operational phase**

For fish farming, the main impacts are competition with other uses of water, depletion of local wild fish populations, and the risk to native species if the settlement was made with exotic species, the development of water-borne human diseases.

For oyster farming, the few reported cases are about the increase of the organic matter of the water at the cages implantation sites. Increase in the organic matter could favor the development of some species, especially plants and the eutrophication of the environment.

8.1.1.2.3. Nursery implementation

The exact site where the nursery will be implanted is not yet defined. In all cases, the main possible environmental impacts can be summarized as follows:

- **Construction phase:**

Minor impacts may come from the arrangement of the nursery's implantation area through the breakdown of soil and erosion. However, careful site selection can help avoid these impacts.

- **Operation phase**

The main possible impacts can be summarized as follows: (i) improper use of fertilizers and pesticides, which may cause pollution of groundwater; (ii) intoxication due to bad use of pesticides; (iii) poor management of fertilizer and pesticide containers; (iv) destruction of non-targets.

8.1.1.2.4. Development of rice fields

The creation of ridges is envisioned during the Rice farming development in Djimsane. Ridge farming is an agricultural technique used to limit the effects of a significant rainfall or humidity or to allow crops on clay soils.

The main environmental impacts related to this activity mainly occur during the operational phase and mostly include: (i) land degradation due to poor agricultural practices (sensitive habitat, soil, hydrological cycle, forest areas etc.); land erosion due to furrows created while ridging; (Iii) misuse of fertilizers and pesticides that can pollute adjacent aquatic areas, groundwater and residues in products.

8.1.1.3. Waste generation

Waste can have a significant impact on the natural environment (soil contamination, surface and ground water, atmosphere) if they are not subject to strict management while eliminating them through appropriate channels. All dikes rehabilitation activities, nursery developments, development of floating cages and oyster farms are likely to generate waste. However, their nature and amount vary. The main sources of waste identified during the construction phase are:

- ***Waste generated from field activities:***

- Vegetal waste from vegetation loss and clearing;
- Wastes from earthworks and sanitation (mixture of soil and building materials)

- ***Waste from the replacement of equipment and existing materials***

- Non-functional materials such as PVC pipes

- ***Construction related waste***

- Rubble, iron framework, various packaging and containers, fouled water from cleaning equipment (concrete mixers, various tools), etc.

- ***Waste from equipment maintenance***

- Used oil, damaged parts, hazardous waste (detergents, cleansers, and various chemical residues), industrial wastewater (cleaning of equipment, water from retention areas, etc.

8.1.1.4. Atmospheric emissions

The construction site machineries will constitute the main source of air pollution during the construction phase in particular during the rehabilitation of the Djimsane dike. These devices are typically equipped with diesel engines, which emit combustion products, nitrogen oxides (NOx), particles in suspension (PS) and carbon dioxide (CO2) which is a greenhouse gas.

The second source of degradation of the quality of air will come from the local emission of dust during the earthwork phase. This deterioration is only noticeable during the dry season while dust generation is virtually null or quickly cut back during the rainy season.

During the operation phase, these atmospheric emissions are not expected.

8.1.1.5. Noise and vibration

The nuisance generated by noise and vibration during the construction phase are caused by two types of situations that can be combined:

The appearance of a noisy activity and / or increasing its intensity in an area devoid of human activity;

Increase of the frequency of these sources of noise and vibration, due to the construction phase.

Noise sources are mainly from construction machinery during all the phases requiring the use of hydropower such as manual compactors. Some of these activities such as earthworks can generate additional noise and vibrations.

8.1.2. Positive impacts

In general, the positive environmental and social impacts are far greater than the negative ones.

Indeed, the rehabilitation of dikes will:

- Fight effectively against recurrent floods causing extensive damage to people every year (including destruction of properties);
- Gradually recover dozens of hectares of saline land and thus promote the development of agricultural activities;
- Fight effectively against the salty line and thus promote rice production in the island of Djimsane. This rice farming will contribute to the fight against food insecurity and enable the diversification of income among the populations.
- Generate jobs during construction phases.

In the same order of thought, the creation of drainage to allow passages for water has two positive sides. It allows, on the one hand, better water management during floods (management of large water flows), and, on the other hand, serves as crossing points for local populations.

The replanting of coconut trees, palm oil trees and other forest fruit tree species contribute to the reforestation of the environment and the recovery of forest ecosystems, to soil stabilization in relation to plants' root systems, to the fight against water and wind erosion, and to banks silting. Moreover, forest products will constitute significant sources of income for the population.

8.2. Biological Environment

8.2.1. Negative Impacts

The impacts on the biological components are relatively low because of the limited scope of sites which will mostly be located near the dams and paths to reach construction sites. It has to be noted that in most cases, transport by cart or dugout (for this specific case of Djimsane) will enable transportation of staff, equipment and materials on construction sites. The small size and relatively tight deadlines for completion are other factors minimizing the potential effects on wildlife and plants.

In this low worrying context, the main impacts on wildlife and plants mainly concern the planned work on the dikes, due to their potential impact on aquatic wildlife and plants.

All considerations of the main risks on the rehabilitation of dikes, the development of fish farms and reforestation on the biological component are presented in the following paragraphs.

Moreover, once the works are completed during the operational phase, the risks will be largely reduced.

8.2.1.1. Disruption of natural habitats

Most dikes rehabilitation activities will not cause a reduction of terrestrial and aquatic habitats as infrastructure subject to rehabilitation already exists.

To ensure regular maintenance of way and access routes of fish and oyster farms, it may be necessary to use means for cutting vegetation and use of herbicides as a method of struggle against fast-growing vegetation on construction sites. In this unlikely event, it is recommended to consider the precautions that are described in the Environmental and Social Management Plan (ESMP).

Some reductions of natural habitats could be caused by materials removal activities such as shells in the pit areas.

The impacts on wildlife include the destruction of houses of animals and birds niches due to the felling of trees (specially in pit area), the passing of machines, although most sites will be limited in space and time.

8.2.1.2. Impacts due to soil contamination

Soil contamination risk (especially by hydrocarbons) exists when there is handling of toxic liquids or solid substances on the environment during the rehabilitation and construction work (use and maintenance of construction equipment, human concentration). All these activities can have negative consequences on the components of wildlife and plants if adequate measures are not taken to avoid soil contamination. One of the direct consequences of contamination could be the poisoning and death of animals and plants, an indirect result can be a loss of regenerative capacity and a general degradation of ecosystem functions (including mangroves).

In fact, soil pollution, particularly by hydrocarbons, alters the composition and richness of the invertebrate population. The toxicity of contaminants can also affect a part of the food chain through bioaccumulation phenomenon and thus affect many classes of predators.

8.2.1.3. Biological issues due to contamination of surface and groundwater

The same activities described for soil contamination can also affect surface water and groundwater. The toxic and organic waste can seep directly into streams or be washed out by the rain.

All the rehabilitation actions taken on the dikes (riprap banks, drainage and design of spillways access) may generate a risk to surface water that can directly impact on aquatic life. Any leakage of toxic substances in water (runoff or in bodies of water and inlets), if it is not immediately contained, can promptly spread and affect aquatic systems downstream of the spill, including biological environment. The nutrients (nitrogen and phosphorus in particular) present in chemicals and organic substance may cause eutrophication of waterways. The consequences of such a provision may result in a radical change in the natural habitat that could affect many species of the flora and fauna.

8.2.1.4. Biological issues due to the alteration of streams

The increase in turbidity due to the scouring of rivers during excavation work on the banks can cause disruption and qualitative impairment of aquatic environments if protective measures are not taken during the work. The removal of vegetation may also increase shoreline erosion and enhance or increase the salting out through runoff of sediment into streams.

The suspension of mineral substances can be likened to pollution if the phenomenon is recurrent because increased turbidity reduces light penetration in water and degrades photosynthesis. Suspended solids can cause abrasion of gills and affect breathing of fish. They may also, when deposited, cause silting beds of inlets and so alter natural habitats, block streams, depriving fish eggs of their oxygen supply.

An increase in turbidity changes the caloric intake of water and may cause a warming of the water, which will reduce the quality of habitat for cold water organisms which may result in changes of existing species.

As part of this project, these impacts are very unlikely to happen since the facilities that will be rehabilitated are located in the village quite far from *bolongs* and are flooded only during periods of high water.

8.2.1.5. Biological issues due to atmospheric emissions

Atmospheric emissions will come from all activities carried out on site mainly during the rehabilitation of dikes by machinery. Emissions of exhaust gases and dust from the activity of machines on construction sites are also sources of impacts to the biological environment. Indeed, these emissions can affect the quality of the ambient air, dust and gases emitted may settle on the leaves and the trunks of trees, blocking plants photosynthesis mechanisms.

8.2.1.6. Wildlife disturbance by noise and vibrations

Noise sources are basically the equipment used on construction sites. Some of these activities can also generate vibrations, such as creation of the spillways at the dam or the simultaneous use of multiple machines.

Noise and vibration can affect wildlife and impact particularly on the presence of certain species, reducing mating and reproduction or disturbing their tranquility especially with birds. However, this impact is limited both in time and in space because the sites requiring the use of machinery are mostly located outside of natural habitats.

8.2.1.7. Biological impacts due to the generation of waste

All dikes rehabilitation activities, construction of fish and oyster farms are likely to generate solid and liquid waste. Their nature and amount are, however, variables.

The absence or inadequate management of waste generated during all phases of rehabilitation of dikes can have significant consequences on animal and plant components. Poor management of solid and liquid waste is a significant pollution risk factor of water resources and soil.

During the operational phase of fish and oyster farms, it should be noted that poor management of organic waste (fish remains, oysters) can attract opportunistic species that find it a food source.

8.2.2. Positive impacts

The project aims basically to refurbish existing infrastructure (dikes), to reforest, to develop aquaculture farms, the biological habitat will therefore be not significantly changed.

8.3 Human Environment

8.3.1. Negative impacts

The nature of the project, which is to refurbish the existing infrastructure in an existing area, replanting coconut palms, oil palms and mangroves, developing aquaculture farms, significantly reduce the social issues and their importance. Indeed, the impacts of this project are limited geographically, restricted in an already existing area of relatively short duration for each intervention site and require a relatively small labor force.

The most important issues of the project are health and safety of workers and surrounding communities.

In terms of health and safety, issues concern mainly the risk of injury and accidents of workers and surrounding communities during the work, the risk of transmission of infectious diseases and sexually transmitted (STDs) such as HIV / AIDS. Other significant issues can be identified outside of these two key issues. These issues, though relatively minor, however, are subject to mitigation measures to ensure that they become important during the project.

8.3.1.1. Health and safety of workers and communities

Several rehabilitation works under the project will affect the health and safety of workers and the surrounding population.

In fact, the rehabilitation works can represent risks of accidents and injuries to workers if they do not have adequate protective equipment, if there is no established health and safety procedures and / or if there are no efforts to educate workers about safety and health risks related to their tasks.

Moreover, these risks can also reach the surrounding communities if construction sites are not properly secured.

8.3.1.2. Life quality and social balance

Workers' quality of life and surrounding communities as well as social balance could be affected by the project activities particularly in the context of the rehabilitation of dikes.

Indeed, the dikes rehabilitation phase works will generate dust, especially in the dry season. This dust, if not controlled properly, can not only have a negative impact on health but also on the quality of life of the surrounding population. In addition to dust, noise may also be generated by the construction equipment and the work performed. Regular noise control measures must be taken to prevent discomfort and nuisance which may be caused by these activities.

The rehabilitation works will certainly appeal to local and internal labor. Foreign labor presence could, on the other hand, trigger ethnic and social tensions with local people.

The fabric and the social balance could be affected by the arrival of workers in search of jobs that could increase the pressure on social services, and reveal situations of non-compliance with local customs by newcomers.

However, the project context and the nature of the work indicate that the number of foreign workers may be relatively minimal. This remains a risk to deal with so as to manage it from the start of the project activities.

During the operational phase, the main risks could be the choice of members of the management committees in particular as regards the gender dimension.

8.3.1.3. Labor and working conditions

Any project involving the recruitment of permanent or contracted workers by the promoter, by his sub-contractors and by his primary suppliers may carry risks related to fair treatment of workers and their working conditions if a policy is not established for that matter. Also on equal skills, the employer must give priority to candidates from the town - and when the skills required are not available on site – he can recruit from outside the municipality or department. Risks associated with labor and working conditions can be related to:

- injuries and accidents of workers and communities;
- a dust emission;
- choice of external workforce whereas skills are available locally;
- unfair treatment of workers;
- discrimination and inequality of opportunity;
- bad relations between workers and management;
- non-compliance of national labor law and employment;
- use of underage labor (children);
- poor conditions of hygiene and safety.

8.3.1.4. Social acceptability

Social acceptability is essential to successfully carry out the project. Though they are unexpected, the risks linked to poor relationships with stakeholders should be pointed out. They may be disagreement regarding the project, missed deadlines for activities that required the support of stakeholders, extra costs, lower social acceptability level of the project and protests.

If stakeholders are unidentified and their consultation plan is not developed and implemented, then, the project may experience significant financial and calendar risks. In addition, the desired level of social acceptability will probably be unfulfilled. Moreover, if social and environmental impacts of the project are not monitored and adequately managed over its implementation, this may also endanger the social acceptability of stakeholders particularly populations that are directly affected.

8.3.1.5. Archeological and cultural heritage

All works requiring generally to dig the ground or to move it may endanger the natural, archeological or cultural heritage like in the case of shell heaps. These sites are placed where lots of domestic or technical wastes were thrown over long periods. They are mainly hallowed ark shells, oyster, limpet, and murex shells stemming from the exploitation of former mollusks. The most ancient is that of Ndiamo-Badat, in Dionewar which started its edification by 420 BC (MBOW, 2000). By using shell heaps as base material, rehabilitation works of dike will degrade these sites. Consequently, these rehabilitations have a link with the degradation of shell heaps. The impact on cultural heritage is significant. Dionewar being an insular place, if other materials are not used, it is recommended to use moderately shell heaps.

8.3.2. Positive impacts

8.3.2.1. Economic activities

The dike operation, the exploitation of aquaculture farm and reforestation will have many positive economic effects:

- Job creation (processing and marketing of processed forest fruit for instance)

- Creation of business opportunity for service and goods suppliers

- Significant increase of available income, better life quality and living conditions for families.
- Development of related economic activities (for example sale of cement for dikes rehabilitation);
- Less rural exodus thanks to temporary job creation for young people
- Food self-sufficiency, rice growing being more dynamic.

8.3.2.2. Life quality

The project activities improve populations' life quality thanks to better food and security conditions. Indeed, the equipment would enable to face up with floods and costal erosion that cause important damage on populations' lifestyle and environment.

The reforestation of coconut trees, palm oil trees and other forest fruits trees will favor an increase of incomes for populations which will contribute to the improvement of their quality life. Sea products from aquaculture farms will have the same impact as well.

Populations will meet their basic needs thanks to incomes generated by the sale of aquaculture products from oyster and fish farming activities, processing and sale of forest fruits (from reforestation of palm oil and coconut trees and aquaculture farms).

8.3.2.3. Landscape

Since the project essentially consists in rehabilitating equipment, reforesting, converting aquaculture farms and cutting up rice lots, the landscape will not be modified significantly. However, a relative improvement of the landscape is to be expected thanks to reforestation activities.

8.4. Associated issues with cumulative impacts

The cumulative impacts can be defined as impacts resulting of successive and / or combined effects of an action, a project or an activity when they are cumulated to other actions, projects or activities that are considered in future, existing and /or reasonably predictable perspectives. Other people define them as impacts that are considered to be important on the basis of scientific and / or particular concerns regarding affected communities.

In the framework of the project, potential impacts of this kind are not identified so far. In the current context of Dionewar, there is no other project in the short term.

8.5. Synthesis of environment and social issues

The works of environment and social diagnosis carried out through different reports and books on the one hand, field work and basic investigation such as meetings, interviews and exchange with different actors on the other, enable to identify environment and social issues and impacts in the project's sphere of influence. They are summarized in the table below.

Table 17: Summary presentation of the project activities and related stakes

	Stakes related to the physical environment					**Stakes related to the biological environment**							**Stakes related to the human environment**				
Project activities	Soil instability	Soil and water contamination	Waste generation	Atmospheric emissions	Noises and vibrations	Reduction of natural habitats	Biological stakes due to soil contamination	Biological stakes due to water contamination	Biological stakes due to watercourse disturbances	Biological stakes due to atmospheric emissions	Disturbances due to noises and winds	Biological stakes due to emissions of waste	Health and safety	Life quality and social balance	Labor force and working conditions	Social acceptability	Cultural patrimony
Development of fish farms	x	x	x			x	x	x	x			x	x	x	x		
Development of oyster farms	x	x	x			x	x	x	x			x	x	x	x		
Coconut palm tree Reforestation	x												x	Palm oil tree reforestation			
Oil palm tree reforestation	x																

	Stakes related to the physical environment					**Stakes related to the biological environment**							**Stakes related to the human environment**				
Project activities	Soil instability	Soil and water contamination	Waste generation	Atmospheric emissions	Noises and vibrations	Reduction of natural habitats	Biological stakes due to soil contamination	Biological stakes due to water contamination	Biological stakes due to watercourse disturbances	Biological stakes due to atmospheric emissions	Disturbances due to noises and winds	Biological stakes due to emissions of waste	Health and safety	Life quality and social balance	Labor force and working conditions	Social acceptability	Cultural patrimony
Forest fruit tree reforestation	x												x	x			
Establishment of nurseries	x	x	x				x	x				x	x	Mangrove reforestation			
Mangrove reforestation	x												x	x			
Rehabilitation and extension of dikes against floods	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

	Stakes related to the physical environment					**Stakes related to the biological environment**							**Stakes related to the human environment**				
Project activities	Soil instability	Soil and water contamination	Waste generation	Atmospheric emissions	Noises and vibrations	Reduction of natural habitats	Biological stakes due to soil contamination	Biological stakes due to water contamination	Biological stakes due to watercourse disturbances	Biological stakes due to atmospheric emissions	Disturbances due to noises and winds	Biological stakes due to emissions of waste	Health and safety	Life quality and social balance	Labor force and working conditions	Social acceptability	Cultural patrimony
Development of rice plots (ridging) in Djimsane	x	x										x		x	x	x	
Other items																	
Existence of labor force		x	x				x	x			x	x					

IX. FINDINGS AND PROPOSED ACTIONS

The table below lists the whole recommendations which shall be applied to implement the Project.

Table 18: Result of the environmental and social diagnosis of the Project for the reduction of vulnerability and improvement of the resilience of coastal communities in Dionewar

Stakes	Nature of the environmental or social stake	Recommendations in this area
Physical environment		
Soil destruction and erosion	All works generating soil movements or the modification of the soil drainage network as well as the creation of potential access roads to sites (namely rehabilitation of dikes, nurseries)	➢ Carrying out effective actions for the stabilization of dike slopes, reduction of sediments and control of washout, until we are in a position to apply long term measures for the operational phase. ➢ Establishing adequate drainage systems to minimize and control infiltrations.
Contamination by toxic products for the environment	Use of pesticides and fertilizers in nurseries and rice fields	➢ Development of a hazardous materials management plan (works and infrastructure operation phase)
Soil and water contamination	➢ Diesel storage, distribution, ➢ Generation of used oils ➢ Maintenance of site machinery	➢ Development of a hazardous materials management plan. The hazardous materials management plan must cover the relevant and essential aspects of hygiene management and safety in the working place. It must be developed according to formulated recommendations. ➢ Installing in sites adequate secondary confinement devices for fuel tanks, and for the storage devices of various fluids (lubricating oil and hydraulic fluids). ➢ Using waterproof surfaces in areas for the refueling and transfer of other fluids. ➢ Training workers on good stripping and handling of fuels and chemical products, and on actions in case of accidental spill.
Emission of waste	➢ Building of box culverts ➢ Stripping works of dikes for reshaping ➢ Development of nurseries ➢ Exploitation of mollusk farms	➢ Defining priorities in waste management as early as the start of activities, on the basis of the awareness of risks and potential impacts on the environment, health and safety, and the review of waste production and its consequences; ➢ Establishing an adequate waste collection system ➢ Establishing a hierarchy in waste management addressing the prevention, reduction, re-use, collection, recycling, disposal and, finally, elimination of waste; ➢ Preventing and minimizing waste production, as much as possible.
Atmospheric emissions	➢ Earthworks during rehabilitation (stripping) of dikes ➢ Exploitation of borrow sites	The storage and transfer of fuel or volatile chemical products may lead to fugitive releases. The recommended measures to prevent, limit and control atmospheric emissions consist namely in reducing the consumption of fuel/ and increasing energy efficiency. Ensuring the use of machinery in good condition and generating fewer emissions.

Stakes	Nature of the environmental or social stake	Recommendations in this area
Noises and vibrations	Set of activities requiring the use of site and threshing equipments. ➢ Earthworks during rehabilitation (stripping) of dikes ➢ Exploitation of borrow sites	Among the reduction options we may consider, one will indicate the following ones : ➢ Selecting equipments which noise levels are consistent with noise regulations ➢ Limiting hours of operation for some equipments or some applications, especially mobile sources
Biological environment		
Disturbance of natural habitats	The development of oyster farms may lead to the reduction of natural habitats (especially birds) generate impacts on the biological environment in terms of reduction and disturbance of natural habitats. The reduction of natural habitats may be linked to stripping activities in borrow areas of building materials (shell heaps)	➢ Taking all measures to protect natural habitats namely during the development of oyster farms with regard to the mangrove ecosystem ➢ Avoiding the destruction of critical land and aquatic habitats whenever possible; ➢ Reducing to a maximum the destruction of streambank vegetation ; ➢ Avoiding or reducing to a maximum maintenance clearing in riparian areas ;
Soil contamination	There is a risk of soil contamination when there is a handling of liquid or solid toxic substances for the environment. All dike rehabilitation activities with machinery, the exploitation of aquaculture farms, the exploitation of rice fields through the use of fertilizers and pesticides may have adverse consequences on the components of the fauna and flora if adequate measures are not taken to avoid any soil contamination.	➢ Restricting the duration and activity periods in water bodies at low water periods ;
Surface and ground water contamination	The toxic products and organic waste may infiltrate directly the groundwater table and watercourses or be washed off by rain. Any leak of toxic substances in water (runoff waters or in water bodies and watercourses), if it is not promptly contained, may promptly spread and affect aquatic systems downstream the	➢ Ensuring the management of liquid and solid wastes during the exploitation of aquaculture farms, the rehabilitation of dikes (stripping, embankment, box culverts, etc.) ➢ Establishing a waste collection system ➢ Informing and raising the awareness of workers on the impacts of wastes with regard to ground and surface waters

Stakes	Nature of the environmental or social stake	Recommendations in this area
	spill, including the biological environment.	
Atmospheric emission	Atmospheric emissions, by laying on leaves and tree trunks may block plant photosynthesis mechanisms. These stakes will be particularly felt in the mangrove ecosystem during dike rehabilitation works	➢ Spraying water to reduce loose materials on sites which are sources of emissions. ➢ Applying dust reduction techniques, such as the use of water or non-toxic chemical products to minimize dust raised by gears ➢ Using machinery in good condition to minimize emissions
Waste emission	The lack or absence of management of waste generated during all dike rehabilitation phases, the development of fish basins and nurseries may have significant consequences on animal and plant components.	Facilities producing and storing wastes must apply the following methods : ➢ Defining waste management priorities as early as the start of activities, on the basis of knowledge on risks and potential impacts on the environment, health and safety, and the review of the waste production and its consequences ; ➢ Establishing a hierarchy in waste management addressing the prevention, reduction, reuse, collection, recycling, disposal, and finally elimination of wastes ; ➢ Preventing or minimizing waste production as much as possible.
Disturbance of the fauna by noises and vibrations	Noise and vibrations can affect animals and influence particularly the presence of some species, thus reducing mating and reproduction	➢ Selecting equipments which noise levels are lower. ➢ Installing appropriate soundproofing devices on engines exhaust pipes and components of compressors. ➢ Installing vibration insulators for mechanical equipments ➢ Limiting the operating hours for some equipments.
Human environment		
Health and safety of workers and communities	The health and safety stakes for workers and communities relate essentially to : ➢ risk of injuries and accidents for workers and communities ➢ Dust emission ➢ Noise and vibration emissions	The site supervisor of works planned in the project will provide his workers with a safe and healthy working environment, addressing risks inherent to his activity area and specific hazards of his working spaces, namely physical chemical, biological hazards, specific hazards to which are exposed women. The client will take measures intended to prevent accidents, injuries, and diseases resulting from the work, associated with the work or happening as part of the work by minimizing as much as reasonably practical the causes of these hazards.
Life quality and social balance	The stakes on life quality and social balance are : ➢ Dust emission ; ➢ Noise emission ; ➢ Vibration emission , ➢ Social and inter-ethnic tensions between local residents and non-	The mitigation measures defined in the ESMP shall be implemented during the lifespan of the project so as to avoid some risks.

Stakes	Nature of the environmental or social stake	Recommendations in this area
	indigenous immigrants ➢ Fragilized social balance because of the influx of various populations in the area looking for job, increased pressure on social services ; ➢ Non-compliance with local customs by newcomers	
Labor force and working conditions	The stakes related to the labor force and working conditions are : ➢ bad working conditions in general ➢ unfair treatment of workers, discrimination and inequality of opportunities ➢ bad relations between workers and the management ➢ non-compliance with the national labor and employment right ➢ use of underage labor (children) ➢ bad hygiene and safety conditions at work	The client must provide information to workers, backed by clear and easy to understand documents on their rights by virtue of the national labor and employment right and any applicable collective agreement , including on their rights in terms of working time, salary, overtime, remuneration social benefits in the start of the labor relation and when a significant change happens. The provisions of the labor force and its implementing decrees shall be complied with.
Social acceptability	The stakes of social acceptability are : ➢ Lack of acceptance of the project ; ➢ Delays in the implementation of the project ; ➢ Unexpected additional costs ➢ Drop of the social acceptability of the project and protests	➢ Formulating and implementing a stakeholders engagement plan adapted to the risks and impacts of the project and to its development stage and which shall address the characteristics and interests of the relevant communities. ➢ Disclosing relevant information about the project (risks, impacts and opportunities) with stakeholders ➢ Establishing consultation processes with communities so as to identify, with them, the risks, impacts and mitigation actions that may be envisaged for the project
Cultural and archeological heritage	Digging or displacing the soil may have an impact on the cultural patrimony, namely shell heaps.	➢ Implementing an exploitation plan of shell heaps. ➢ In all cases, the promoter will be responsible for the establishment and design of the project so as to avoid considerable adverse impacts on cultural heritage. The identification process of risks and impacts
Other stakes		
Training of members of women's associations	➢ Selection of beneficiaries of training ➢ Mainstreaming gender dimension	The selection of beneficiaries must be as fair as possible so as to avoid suspicions and avoid undermining group cohesion.

Stakes	Nature of the environmental or social stake	Recommendations in this area
Establishment of management committees (infrastructures)	Selection of committee members	The selection of members must be as fair as possible so as to avoid suspicions and avoid undermining group cohesion. Gender dimension must be mainstreamed if traditions and customs allow it.

The activities of the project may have potential risks on environment, soil, water and aquifer with a risk of contamination, but also on the atmosphere. These risks have also social and sanitary impacts when there is a human receiving environment. These risks are however low. The following table reviews the impacts noted in the different matrices and depending on considered activities and installations.

Table 19: Summary of the main adverse impacts of the project and litigation actions

Planned activity	Potential impact	Proposed mitigation action
Fish farming and oyster farming	➢ Wetlands clearing ➢ Alteration of water flow ➢ Flood risk ➢ Competition with other water uses ➢ Impoverishment of local wild fish populations ➢ Risk for indigenous species if peopling with exotics ➢ Apparition of water-borne human diseases ➢ Increase of pressure on the resource ➢ Bad distribution of income generated by the sale of fish and oysters	➢ Restriction of clearing ➢ Selection of the site depending on uses and the hydrology ➢ Evaluating the traditional use and water resource demand ➢ Producing larvae and fry in fishponds ➢ Avoiding exotics except if risks are low and confirmed ➢ Ensuring the development of vector insects and prevention measures
Nursery	➢ Overuse of fertilizers ➢ Use of pesticides ➢ Intoxication in case of bad ➢ use ➢ Bad management of fertilizers and pesticides packages ➢ Destruction of non-targets	➢ ESM Plan ➢ Pests and Pesticides Management Plan
Dike rehabilitation	<u>Site phase</u> Disturbance of neighboring ecosystems (water course, water bodies, soils, etc.) <u>Exploitation phase</u> ➢ Problem of use of water downstream ➢ Salinization of soils ➢ Water-logging of lands ➢ Proliferation of invasive plants ➢ Submersion of plant species ➢ Accidents on sites ➢ Conflicts linked to employment and external labor force ➢ Development of insects and other water-borne disease vectors	➢ Environmental impact assessment ➢ Solid waste management (excavated material, demolition, etc.) ➢ Employment of local labor force as a priority ➢ Awareness on accident risks and workers protection ➢ Taking into consideration areas located downstream in the design of protection works
Rice farming schemes	➢ Land degradation due to bad farming practices (sensitive habitat, soil, hydrological cycle, woody areas...) ➢ Bad fertilizer use ➢ Bad pesticide use ➢ which may lead to : pollution of groundwater, livestock contamination, intoxication, residues on products, destruction of non-targets	➢ Reestablishing adequately the relevant forest cover ➢ Avoiding slopes, erosion-prone soils ➢ Rational choice of site ➢ Developing an Environmental and Social Management Plan ➢ Developing a Pests and Pesticides Management Plan
Health and safety	➢ Risk of injuries and accidents for workers and communities	➢ Identifying potential hazards for workers, namely those likely to threaten their lives ;

Planned activity	Potential impact	Proposed mitigation action
	➢ Dust emissions ➢ Noise and vibration emissions	➢ Establishing prevention and protection measures including the modification, substitution or elimination of situations or hazardous substances ; ➢ Providing workers with collective and individual protective equipments
Labor force	➢ Bad working conditions in general ➢ unfair treatment of workers, discrimination and inequality of opportunities ➢ bad relations between workers and management ➢ no respect of national employment and labor right ➢ use of underage labor (children) bad hygiene conditions and occupational safety	The law must be rigorously applied, namely as regards : ➢ Working conditions and employment terms ; ➢ Workers unions ; ➢ Non-discrimination and equal changes ; ➢ Grievance settlement mechanism ➢ Labor force protection ➢ Occupational hygiene and safety
Social acceptability	➢ Lack of support to the project ; ➢ Delays in the project implementation ; ➢ Unexpected additional costs ➢ Decrease in the social acceptability of the project and protests	➢ Identifying stakeholders potentially interested or affected by the project ➢ Disclosing relevant information about the project (risks, impacts and opportunities) with affected communities and other stakeholders. ➢ Establishing a consultation process with affected communities so as to identify, with them, the impacts and mitigation measures considered for the project.
Cultural heritage	Soil displacement during the exploitation of shell heaps	The use of shell heaps must be done while taking into account erosion and tree destruction factors.

Tableau 20: Summarized Mitigation measures with the associated costs

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	**Cost (USD)**
Mitigation measures of negative impacts	**Fish and oyster farming**	➢ Clearing Wetlands ➢ Competition with other water uses ➢ Impoverishment of local wild fish populations ➢ Increased pressure on resources ➢ Poor distribution of income from the marketing of fish and oysters	➢ Restrict wetlands clearing ➢ Choose an adapted site according to use and hydrology ➢ Evaluate the traditional use and demand of water resources ➢ Produce larvae and fry in tanks ➢ Avoid exotic species	ANA PMU	No costs associated (already included in the activity's budget)
		➢ Development of waterborne diseases	➢ Ensure to fight against the development of insect vectors (information and sensitization)	ANA PMU	20,000
	Tree nursery	➢ Over use of fertilizers ➢ Use of pesticides ➢ Groundwater Pollution ➢ Bad management of the packaging ➢ Clearing woodland	➢ Develop an detailed ESMP; ➢ Develop a pest and pesticides management plan ➢ Promote natural fertilizing techniques (composting, organic manure etc.)	PMU Consultant	Included in the ESIA cost Included in the general Pest and Pesticides Management Plan cost
	Dike rehabilitation	<u>Construction phase</u> Disruption of surrounding ecosystems (Rivers, lakes, soils, etc.)	➢ Develop an ESIA	PMU CSE	2000
			➢ Conduct awareness campaign for the risk of accidents	PMU	500

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	**Cost (USD)**
		<u>Operation phase</u> ➢ Use of downstream water issue ➢ Soil salinization ➢ Waterlogging land ➢ Proliferation of invasive plants ➢ Development of insects and other water-related disease vectors ➢ Conflicts because of the use of external workforce ➢ Injury or accidents on site	➢ Establish a Solid Waste Management Plan ➢ Use of local workforce in priority ➢ Take into account the downstream areas in the design of protective infrastructures	Civil engineering company	Included in the works
	Rice-growing development	➢ Land degradation due to bad agricultural practices (sensitive habitat, soil, water cycle, woodland ...) ➢ Misuse of fertilizers ➢ Misuse of pesticides can lead to: groundwater pollution, animal contamination, poisoning, residues on products	➢ Restore forest cover; ➢ Avoid slopes, soils subject to erosion; ➢ Develop a pest and pesticide management plan	Civil engineering company PMU	Included in the works Included in the general Pest and Pesticides Management Plan cost
	Health and safety	➢ Risk of injury and accidents for workers and communities ➢ Dust emission ➢ Noise and vibration emission	➢ Identify potential hazards to workers; ➢ Establish preventive and protective measures, including modification, substitution or elimination of hazardous conditions or substances;	Civil engineering company	Included in the works
	Workforce	➢ Bad working conditions in general ➢ Equal treatment of workers discrimination and inequality of opportunity	The relevant law must be strictly enforced, in particular	Civil engineering company	Included in the works

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	**Cost (USD)**
		➢ Non-compliance with national work standards ➢ Use of minor workers (children) ➢ Bad health and safety conditions	concerning: ➢ Health and safety at work. ➢ Working conditions and terms of employment; ➢ workers' organizations; ➢ Non-discrimination and equal opportunities; ➢ Grievance Mechanism; ➢ Workforce protection.		
	Social acceptability	➢ Lack of commitment to the project; ➢ Delays in project implementation; ➢ Additional costs which were not initially included ➢ Lower level of social acceptability of the project and protests	➢ Identify interested or affected stakeholders ➢ Communicate and disclose information on the project (risks, impacts and opportunities) with affected the stakeholders ➢ Establish a consultation process with the community	PMU CSE	Included in the project and in the ESIA
	Cultural heritage	Soil movement during the use of shell mounds	The use of shell mounds have to be done in order to take into account the erosion factors and tree destruction	Civil engineering company	Included in the works
	Use of pesticides and fertilizers	➢ Misuse of fertilizers ➢ Misuse of pesticides can lead to: groundwater pollution, animal contamination, poisoning, residues on products,	Develop a pest and pesticide management plan: - Promote natural fertilizing techniques (composting, organic manure etc.) - Consultation with users and sensitization on the practice of an environmentally-	Consultant	30,000

Area of activity	Activity	Potential impact	Mitigation measures	Implementing the mitigation measures	
				Responsible	**Cost (USD)**
			friendly agriculture - Endowment for the users		
Total					**52 500**

X. ENVIRONMENTAL MONITORING AND SURVEILLANCE

The following sections deal briefly with aspects linked to environmental monitoring and surveillance

The necessary arrangements will be made under the project to ensure the follow-up of environmental and social factors likely to be affected by project activities. Monitoring will be done in relation with the relevant authority in this respect, the Environment and Classified Establishment Directorate (DEEC) and technical services, members of the regional technical committee.

Environmental surveillance as for it will essentially focus on sites with a view to ensure the compliance with environmental terms.

The table below presents the summary of environmental surveillance and monitoring.

Table 21 : Environmental surveillance

COMPONENT	ACTIVITY	OUTPUTS	ELEMENT TO OVERSEE	RESPONSIBLE	COSTS(USD)
COMPONENT 1	Aquaculture	Implementation of an oyster farm	Ensure proper waste management for each phase	ENVIRONMENT DEPARTMENT, ANA, CC, CSE, PMU	3 575
		Implementation of a fish farm with floating cages	Ensure proper waste management for each phase	ENVIRONMENT DEPARTMENT, ANA, CC, CSE, PMU	
		Strengthen the actors' capacities on fish and oyster farming techniques	Ensure the application of the environmental clauses	ENVIRONMENT DEPARTMENT, ANA, CC, CSE, PMU	
			Check the effectiveness of the training sessions	ENVIRONMENT DEPARTMENT, ANA, CC, CSE, PMU	
		Implement farm management plan	Ensure the effectiveness of the management plan	ENVIRONMENT DEPARTMENT, ANA, CC, CSE, PMU	
		Endowment (boots, gloves, safety jacket, etc.)	Check the effectiveness of the endowment	ENVIRONMENT DEPARTMENT, ANA, CC, CSE, PMU	

COMPONENT	ACTIVITY	OUTPUTS	ELEMENT TO OVERSEE	RESPONSIBLE	COSTS(USD)
COMPONENT 2	Extension and rehabilitation of the dikes to fight against flooding	Rehabilitation and extension of the dikes	Check the efficiency of the works	ENVIRONMENT DEPARTMENT, Water Management Department, CC, CSE, PMU	1050
	Reforestation	Reforestation of 6 ha of palm oil and coconut trees	Ensure the involvement of the forestry department	ENVIRONMENT DEPARTMENT, FORESTRY DEPARTMENT, CC, CSE, PMU	4 480
		Reforestation of 5ha of mangrove	Ensure the involvement of the forestry department	ENVIRONMENT DEPARTMENT, FORESTRY DEPARTMENT, CC, CSE, PMU	
		Preparation of a maintenance guide	Check the efficiency of the guide's use	ENVIRONMENT DEPARTMENT, Water Management Department, DRDR, ANA, CC, CSE, PMU	Included in the activity's budget
	Development of rice plots at Djimsane	Rehabilitation of the dike	Check the efficiency of the works	ENVIRONMENT DEPARTMENT, Water Management Department, CC, CSE, PMU	2 450
		Development of rice plots	Ensure the respect and application of environmental clauses	ENVIRONMENT DEPARTMENT, Agriculture Department, CC, CSE, PMU	
		Implement a management committee	Ensure that the committee includes gender aspect	ENVIRONMENT DEPARTMENT, CC, CSE, PMU	
COMPONENT 3	Review and update of the PLD	Integrate climate change aspects into the PLD	Ensure effectiveness of the PLD	ENVIRONMENT DEPARTMENT, CC, CSE, PMU	Included in the activity's budget
	Preparation of a local convention for natural resources management	Implement a local convention to better regulate the use of forest products and to respect the biological recovery period of the fish	Ensure the implementation of the local convention	ENVIRONMENT DEPARTMENT, CC, CSE, PMU	Included in the activity's budget

COMPONENT	ACTIVITY	OUTPUTS	ELEMENT TO OVERSEE	RESPONSIBLE	COSTS(USD)
		products			
	Sharing the lessons learned from the project	Sharing the project's activities	Check the existence of a lessons learned sharing report	ENVIRONMENT DEPARTMENT, CC, CSE, PMU	Included in the activity's budget
Total					**11,555**

The pro forma budget for the implementation of the environmental surveillance plan amounts to 5 775 000 CFA F (11 555 USD). This budget corresponds to the mission's expenses and dsa of technical staff involved in the implementation of the surveillance plan.

Table 22 : Environmental monitoring

COMPONENT	ACTIVITY	OUTPUT	MONITORING PARAMETERS	TIMETABLE	RESPONSIBLE	COSTS (USD)
COMPONENT 1	Aquaculture	Implementation of an oyster farm	Monitoring of the physicochemical and bacteriological parameters of the oyster farm's site	Before the works and every 3 months after installing	DEEC, ANA, CC, CSE, PMU	5,250
		Implementation of a fish farm with floating cages	Monitoring of the physicochemical and bacteriological parameters of the fish farm's site	Before the works and every 3 months after installing	DEEC, ANA, CC, CSE, PMU	5,250
		Strengthen the actors' capacities on fish and oyster farming techniques	Monitoring the selection of beneficiaries taking into account gender aspects	At the time of planning, and during the implementation of the capacity building plan	DEEC, ANA, CC, CSE, PMU	FTR
		Implement farm management plan	Monitoring the implementation of the farm management plan	Throughout the project	DEEC, ANA, CC, CSE, PMU	2 450

COMPONENT	ACTIVITY	OUTPUT	MONITORING PARAMETERS	TIMETABLE	RESPONSIBLE	COSTS (USD)
		Endowment (boots, gloves, safety jacket, etc.)	Check of the technical specifications of the equipment	Upon receipt of the equipment	DEEC, ANA, CC, CSE, PMU	FTR[3]
COMPONENT 2	Extension and rehabilitation of the dikes to fight against flooding in Dionewar	Rehabilitation and extension of the dikes	Monitoring the effectiveness of protective structures	After each rainy season	DEEC, WATER MANAGEMENT DEPARTMENT, CC, CSE, PMU	2,680
	Reforestation	Reforestation of 6 ha of palm oil and coconut trees	Monitoring the implementation rate, survival rate and success rate of the reforested Area	Annual	DEEC, FORESTRY DEPARTMENT, CC, CSE, PMU	3,220
		Reforestation of 5ha of mangrove	Monitoring the implementation rate, survival rate and success rate of the reforested Area	Annual	DEEC, FORESTRY DEPARTMENT, CC, CSE, PMU	
	Infrastructure management	Preparation of a maintenance guide	Monitoring the implementation guide	Quaterly	DEEC, WATER MANAGEMENT DEPARTMENT, DRDR, ANA, CC, CSE, PMU	FTR
	Development of rice plots at Djimsane	Rehabilitation of the dike	Monitoring the water quality (drain water): physicochemical parameters such as pH, temperature, conductivity) Monitoring soil quality upstream and downstream of the dike (pH, salinity and sodium	Twice yearly (right after the rainy season and after dry season)	DEEC, WATER MANAGEMENT DEPARTMENT, CC, CSE, PMU	25,740

[3] FTR : For The Record

COMPONENT	ACTIVITY	OUTPUT	MONITORING PARAMETERS	TIMETABLE	RESPONSIBLE	COSTS (USD)
			concentrations, etc.)			
		Development of rice plots	Monitoring of physicochemical parameters of drainage water	Before and after the rainy season	DEEC, DRDR, CC, CSE, PMU	
		Implement a management committee	Monitoring of the Management Committees' activities	Quaterly	DEEC, CC, CSE, PMU	FTR
COMPONENT 3	Review and update of the PLD	Integrate climate change aspects into the PLD	Monitoring the implementation of the PLD with the climate change aspects	Quaterly	DEEC, CC, CSE, PMU	FTR
	Preparation of a local convention for natural resources management	Implement a local convention to better regulate the use of forest products and to respect the biological recovery period of the fish products	Monitoring the implementation of the local convention	Quaterly	DEEC, CC, CSE, PMU	FTR
	Sharing the lessons learned from the project	Sharing the project's activities	Monitoring the process of sharing the project's activities	Mid-term and at the last semester of the project	DEEC, CC, CSE, PMU	FTR
Total						**44,590**

The environmental monitoring budget which includes the mission expenses and dsa of technical staff involved, the costs for the collection and analysis of physical-chemical parameters of waters and soils, amounts to USD 44,590. Memorandums of understanding will be signed with those services (namely ANA, DREEC, Water & Forestry) for the implementation of the environmental and social monitoring plan.

The overall cost of the environmental monitoring and surveillance amounts to USD 56,145.

CONCLUSION

The project entitled ‘‘***Reducing vulnerability and increasing the resilience of Dionewar coastal communities’’*** has a strategic role for the economic development of the village. It has an economic and social impact on the population.

This environment and social diagnosis is based on document research and field observations conducted within a week.

The project interventions aim at improving global living conditions of Dionewar population and reducing their vulnerability as to climate change effects. They also aim at improving the following social and environmental conditions:

- The protection of populations against recurrent floods and coastal erosion;
- The rehabilitation of natural ecosystems particularly the mangrove, forest fruit trees through reforestation. This will improve the landscape and will have a positive effect on the fauna;
- Food insecurity through the boosting of aquaculture activities such as fish farming and oyster farming ;
- Populations build more their capacity to manage their natural resources through the ratification of local convention including the period of biological rest for fish species;
- Quality life improvement for populations through different adopted measures;
- Job and business opportunity creation.

As regards negative issues, taking into account the nature of the project which aims at rehabilitating existing equipments in a given area, there are not major negative effects on social and environmental components. Indeed the sources of impact have a limited range, are confined in an existing area and the duration is relatively reduced for each site of intervention.

The main environment concerns of the rehabilitation project are the following:

- Hydrocarbon use and handling that may contaminate the grounds and surface water in case of accidental spillage in the natural milieu;
- Interaction with surface water for leveling works, bank reshaping, resumption of hydraulic works and riverbank stabilization. This interaction will be particularly visible for reshaping work of Djimsane dike;
- Workers and neighboring communities health: the issues mainly concern injury and accident risks for workers and neighboring populations during works, the risk of

communicable disease transmission, the risk of poisoning when handling creosoted sleepers;

Except from these two major concerns other potential concerns are identified:

- The risk of temporary degradation of life quality and social balance for workers and populations that may be affected by dike rehabilitation activities (dust generation and noise nuisance);
- Risks linked to the workforce and working conditions in the case of inappropriate staff management;
- Possible impacts on cultural heritage associated with works requiring the exploitation of shell heaps.

All these constraints can be removed through the implementation of an appropriate social and environment management.

BIBLIOGRAPHY

Camara, M., Technical feasibility Report of the Project entitled « Reducing vulnerability and increasing resilience of coastal communities in the Saloum Islands (Dionewar) », February 2016, 46 p.

Rural Community of Dionewar, Environmental Local Action Plan (PLAE), May 2013, 32p.

CSE, Study of the vulnerability to climate change of Dionewar, March 2015, 24 p.

Diop, M., *Contribution à la gestion durable et participative de la Réserve de Biosphère du Delta du Saloum (RBDS) : Diagnostic et analyse des conflits liés aux ressources naturelles*, Internship report, November 2005-April 2006.

Dièye E.B., Diaw A. T., Sané T., Ndour N. *« Dynamique de la mangrove de l'estuaire du Saloum (Sénégal) entre 1972 et 2010 »,* [Online], Cybergeo : European Journal of Geography, Environnement, Nature, Available on <http://cybergeo.revues.org/25671;DOI:10:4000/cybergeo.25671>

Faye D., *Etude de la vulnérabilité écologique et socioéconomique de la mangrove dans la zone de Foundiougne et proposition de mesures d'adaptation.* Master degree document, ISFAR Bambey, 2012, 71 p.

Ministry of Environment and Sustainable Development, National Strategy for Protected Areas Management of Senegal, 2011, 42 p.

National Program for Local Development (PNDL), Local Development Plan (2011-2016, August 2011, 108 p.

West African Economic and Monetary Union, IUCN, WAEMU program to fight against coastal erosion, « *Etude régionale pour le suivi du trait de côte et l'élaboration d'un schéma directeur du littoral de l'Afrique de l'Ouest »***,** Blueprint, General prescriptions, 2010

UICN, Natural and Coastal resources management in Senegal, Goree Workshop, 27-29 juillet 1992

Wetlands international, *Simple Mangrove management plan of the polarized areas of the Marine Protected Area of Abéné,* August 2015, 65 p.

Wetlands international, *Simple Mangrove management plan of the polarized areas of the Marine Protected Area of Joal Fadiouth,* August 2015, 63 p.

Wetlands international, *Simple Mangrove management plan of the polarized areas of the Marine Protected Area of Foundiougne,* August 2015, 66 p.

WWF, *Ecological and Socioeconomic vulnerability of the Saloum Delta and Casamance*, October 2013, 72 p.

ANNEX : LIST OF PERSONS AND INSTITUTIONS MET

N°	Name	Position	Contact
Niodior Prefecture, January 15 2016			
1	Amadou Lamine SY	Sub-prefect	77 529 06 73
Municipal Council of Dionewar, January 15 2016			
2	Ansoumana SARR	Mayor	77 318 01 84
3	Abdoulaye NDIAYE	Secretary	77 525 99 35
4	Lamine THIARE	Mayor's 1st assistant	77 412 43 37
5	Abdou FAYE	Municipal Councillor	77 113 55 10
6	Mata DIENE	Municipal Councillor	77 604 37 61
7	Fatou BAKHOUM	Municipal Councillor	77 329 61 20
8	Aminata NDONG	Municipal Councillor	77 268 77 13
9	El H Ismaïla SARR	Municipal Councillor	77 921 66 62
10	Sophie SARR	Municipal Councillor	77 893 47 39
11	Lamine SARR	Municipal Councillor	77 316 22 64
12	Ibrahima NDIAYE	Municipal Councillor	77 507 11 08
13	Ibrahima DIOP	Municipal Councillor	77 518 90 32
14	Marie SARR	Municipal Councillor	77 316 23 92
15	Faback SALL	Municipal Councillor	77 415 84 96
Local federation of the Economic Interested Groups (FELOGIE) de Dionewar, January 16 2016			
16	Moussa SARR	Association for the Development of Dionewar (ADD)	77 566 21 85
17	Mariama THIOR	FELOGIE	77 521 61 38
18	Fatou NDONG	FELOGIE	
19	Fatou SARR	FELOGIE	77 449 35 42
20	Assane SARR	ADD	77 563 64 88
21	Djibril DIOP	ADD	77 552 33 95
22	Mahamadou Lamine NDONG	Village Chairman	77 521 54 28
Public consultation of Dionewar, January 17 2016			
23	Lamine THIARE	Mayor's 1st assistant	77 412 43 37
24	Arfang NDOUR	Fisherman	77 202 02 00
25	Adama NDIAYE	Fisherman	77 358 23 01
26	Mamadou DIOUF	Fisherman	77 320 83 23
27	Djibril SARR	Teacher	77 457 17 60
28	Aïcha DIOP	Housewife	77 903 29 72
29	Assane SARR	Health Committee President	77 309 47 22
30	Fatou SARR	GIE President	77 449 35 42
31	Salimata SARR	Midewife	77 375 28 37
32	Fatou NDONG	Housewife	
33	Gnima DIOUF	Housewife	
34	Mary SARR	Municipal Councillor	77 316 23 92
35	Ndèye Doko SENGHOR	Housewife	77 876 02 50
36	Mariama THIOR	GPF President	77 522 62 38

N°	Name	Position	Contact
37	Mariama SARR	Housewife	77 191 64 47
38	Idrissa DIOP	Fisherman	77 734 48 94
39	Mouhamadou S SARR	Student	77 066 44 51
40	Bakary SARR	Student	78 315 88 79
41	Astou NDIAYE	Student	77 737 04 41
42	Khady NDIAYE	Student	78 397 04 96
43	Fodé SARR	Fisherman	77 784 29 68
44	Boubacar DIENG	Fisherman	77 520 99 15
45	Sékou NDIAYE	Fisherman	77 453 57 23
46	Faback SARR	Retiree Sailor/Fisherman	77 363 61 55
47	El H NDIAYE	Retiree Sailor/Fisherman	77 433 36 99
48	Birama NDONG	Fisherman	77 045 36 83
49	Abdou DIOUF	Fisherman	77 179 21 90
50	Ousmane NDONG	Retiree Sailor/Fisherman	
51	Babacar SARR	Carpenter	77 255 53 05
52	Omar NDONG	Fisherman	77 785 48 77
53	Moustapha NDOUR	Retiree	77 127 02 11
54	Mamadou SOW	Student	78 230 66 73
55	Mbagnick NGOM	Student	77 994 33 25
56	Abdou SENGHOR	Student	78 215 50 08
57	Abdou DIOUF	Teacher	77 443 11 58
58	Lamine DIOP	Fisherman	77 425 65 06
59	Assane DIOP	Fisherman	77 798 47 41
60	Mamadou NDOUR	Fisherman	77 229 82 94
61	Abdou NDIAYE	Fisherman	77 666 27 17
62	Yamaty MANE	Housewife	77 609 92 44
63	Sophie SARR	Municipal Councillor	77 893 47 39
64	Aminata NDONG	Municipal Councillor	77 268 77 13
65	Seynabou DIENE	Teacher	77 237 12 46
66	Sophie DIOUF	Post officer	77 428 52 43
67	Rokhy DIOUF	Housewife	77 030 79 86
68	Abdou SARR	Mason	77 316 24 46
69	Mama Lamine NDIAYE	Eco tour guide	77 370 55 09
70	Mamadou NDIAYE	Student	78 358 14 16
71	Bakary NDONG	Student	77 378 51 30
72	Abdoulaye DIOP	Teacher	77 378 51 30
73	Ansou DIOUF	Teacher	77 456 61 87
74	Soumaïla NDIAYE	Carpenter	77 367 09 46
75	Mady SARR	Teacher	77 532 17 34
76	Ibrahima NDIAYE	Municipal Councillor	77 507 11 08
77	El H Faby DIOUF	Teacher	77 435 87 85
78	Mamadou THIAW	Merchant	77 906 94 28
79	Lamine Séla FAYE	Fisherman	77 989 78 29
80	Ibrahima DIOP	Municipal Councillor	77 518 90 32

N°	Name	Position	Contact
81	Mamady DIOUF	Fisherman	77 438 78 99
82	Djibril Passy NDONG	Teacher	77 451 71 58
83	Lamine DIOUF	Local development agent	77 406 31 82
84	Ousmane THIOR	Carpenter	77 105 56 67
85	Assane NDIAYE	Retiree	77 534 47 10
86	Haby NDONG	Housewife	
87	Babacar NDIAYE	Carpenter	77 646 75 47
88	Aliou NDIAYE	Fishmonger	77 605 76 37
89	Ousmane SARR	Carpenter	77 916 90 27
90	Mouhamadou Lamine NDONG	Chef de village	77 521 54 18
91	Diatou DIOUF	Housewife	
92	Maïmouna DIAME	Housewife	
93	Bakary SARR	Carpenter	77 570 97 50
94	Dioba SARR	Maçon	77 986 88 00
95	Lamine TOURE	Maçon	77 230 18 98
96	Adama NDIAYE	Fisherman	77 678 53 97
97	Bineta DIOUF	Housewife	77 820 21 51
98	Djibril DIOP	ADD	77 566 21 85
99	Birama SARR	ADD	77 649 21 49
100	Souleymane DIOUF	Fisherman	77 175 57 92
101	Adama Sy SARR	Teacher	77 241 21 24
Technical services, January 18 and 19 2016			
102	Mamadou WADE	Foundiougne fishery department, Head of office	77 737 59 51
103	Victor Toupane	Foundiougne Rural development, Head of office	77 572 20 74
104	Papa Diogomaye DIOUF	APIL Coordinator	77 362 53 98
105	Ousseynou DIOUF	APIL leader	77 573 21 79
106	Adama DIALLO	Foundiougne Forestry Department Assistant Director	77 209 03 35
107	Abdallah L. CAMARA	Fatick Environment and Classified Establishments Department Head of Office	77 671 82 97
108	Omar BADIANE	Fatick Environment and Classified Establishments Department Head of Office's Assistant	77 441 51 70
109	Ousmane FALL	Fatick Forestry Department Head of Office	77 630 75 43
110	Mamadou Hamdiatou BA	Regional development Agency of Fatick's M&E Officer	77 657 77 33
111	Boubacar DIALLO	Fatick Rural Development Director	77 363 67 45
112	Ibrahima LO	Fatick Fishery Department Head of Office	77 649 01 45