Royal HaskoningDHV
Enhancing Society Together

REPORT

Strategic Environmental and Social Assessment

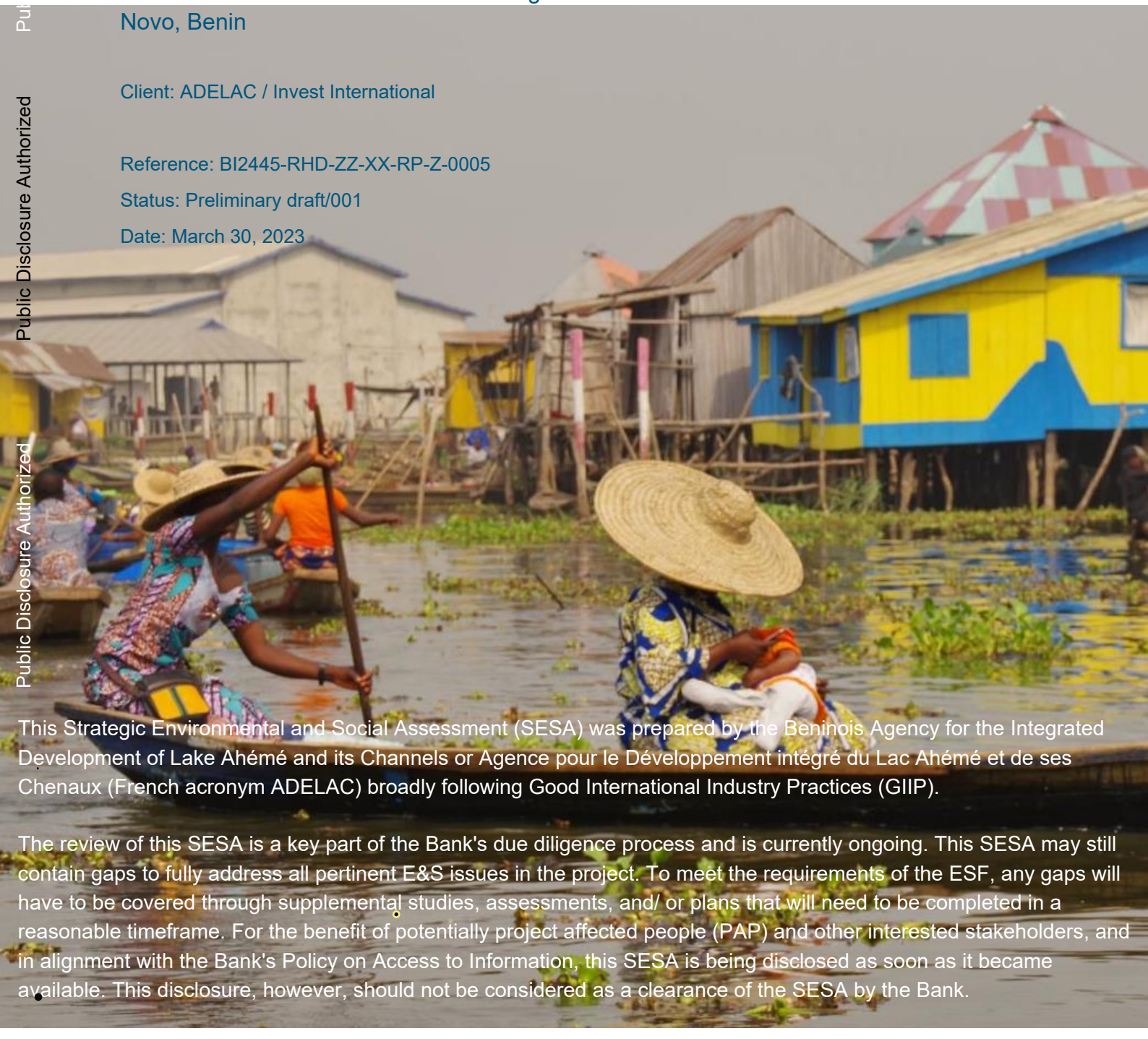
Preparatory studies for the development and rehabilitation of Lake Nokoué and the lagoon of Porto-Novo, Benin

Client: ADELAC / Invest International

Reference: BI2445-RHD-ZZ-XX-RP-Z-0005

Status: Preliminary draft/001

Date: March 30, 2023



This Strategic Environmental and Social Assessment (SESA) was prepared by the Beninois Agency for the Integrated Development of Lake Ahémé and its Channels or Agence pour le Développement intégré du Lac Ahémé et de ses Chenaux (French acronym ADELAC) broadly following Good International Industry Practices (GIIP).

The review of this SESA is a key part of the Bank's due diligence process and is currently ongoing. This SESA may still contain gaps to fully address all pertinent E&S issues in the project. To meet the requirements of the ESF, any gaps will have to be covered through supplemental studies, assessments, and/ or plans that will need to be completed in a reasonable timeframe. For the benefit of potentially project affected people (PAP) and other interested stakeholders, and in alignment with the Bank's Policy on Access to Information, this SESA is being disclosed as soon as it became available. This disclosure, however, should not be considered as a clearance of the SESA by the Bank.

RELATED PROJECTS

Royal HaskoningDHV

HASKONINGDHV NEDERLAND B.V.

Laan 1914 no.35 3818 EX Amersfoort Water &
Maritime Trade register number: 56515154

+31 88 348 20 00 **T**
+31 33 463 36 52 **F**
info@rhdhv.com **E**
royalhaskoningdhv.com **W**

Document Title: Strategic Environmental and Social Assessment

Subtitle: Preparatory studies for the Development and Rehabilitation of Lake Nokoué and the lagoon of Porto-Novo, Benin Reference: BI2445-RHD-ZZ-XX-RP-Z-0005 Status: 001/Preliminary project Date: March 30, 2023

Project name: Benin D2B
Project no.: BI2445 Author:

Marc van Lierde, Michel Tonneijck and Controlled by: Erik Zigterman

Date: 04 April 2023

Approved by: Erik Zigterman

Date: 04 April 2023

Classification
Related projects

Table of Contents

LIST OF ABBREVIATIONS

ABE	Urban Works Execution Agency: Multi-criteria analysis: National Agency for Spatial Planning National Agency for the Promotion of Heritage and Tourism Development: Embassy of the Netherlands: Development and Rehabilitation of Lake Nokoué and the Porto Novo Lagoon: Porto Novo City Rehabilitation Agency: Territorial Agency for Agricultural Development: African Development Bank : European Investment Bank : Biomass Energy Initiative for Africa (World Bank) : World Bank : West African Development Bank : Autonomous Amortisation Fund : National Centre for the Management of Wildlife Reserves : Project Coordination Unit (ARNP) : Steering Committee (ARNP) : Departmental Directorate of Agriculture, Livestock and Fisheries : Directorate General of Urban Development : Directorate General of Water: Directorate General of Environment and Climate: Directorate General of Water, Forests and Hunting: Directorate General of the Republican Police: Directorate of Rural Engineering (MAEP): Directorate of Fisheries Production (MAEP): Strategic Environmental and Social Assessment: Environmental and Social Impact Assessment: Strengths, weaknesses, opportunities, threats: Integrated Water Resources Management: Gesellschaft für Zusammenarbeit (German Cooperation): International Finance Corporation: National Geographic Institute: Invest International Public Programs: National Water Institute: National Institute of Agricultural Research of Benin; National Institute of Statistics and Demography: Institute of Fisheries and Oceanological Research of Benin: Ministry of Agriculture, Livestock and Fisheries Ministry of Development and Coordination of Government Action: Ministry of Living Environment and Sustainable Development: Ministry of Water and Mines: Ministry of Infrastructure and Transport: United Nations: Organisation for Economic Co-operation and Development: Non-Governmental Organization: Government Action Programme: Cotonou Rainwater Sanitation Programme: Secondary Towns Rainwater Drainage Project: National Development Plan
ADELAC	
AFD	
AGETUR	
AMC	
ANAT	
ANPT	
APB	
ARNP	
ARPN	
ATDA	
AFDB BEI	
BEIA BM	
BOAD CAA	
CENAGREF	
CCP CP	
DDAEP	
DGDU	
DGEau	
DGEC	
DGEFC	
DGPR DGR	
DPH EESS	
EIES FFOM	
GIRE GIZ	
IFC IGN	
IIPP INE	
INRAB	
INSTAD	
IRHOB	
MAEP MDC	
MCVDD	
MEM MIT	
NU OECD	
NGO PAG	
PAPC	
PAPVS	
PND: Beninese Environment Agency: Agency for the Integrated Development of Lake Ahémé and its Channels: French Development Agency:	

RELATED PROJECTS

Royal HaskoningDHV

PNDF	WACA: National Programme for the Development of the Sector (for e.g. Aquaculture):
PNVV	Porto Novo Green City: Population-Planet-Profit: Project for the Promotion of
PPP	Sustainable Aquaculture and Competitiveness of Fisheries Value Chains: Inland
PROMAC	Aquaculture Extension Project: Strategic Plan for the Development of the Agricultural Sector: Technical and Financial Partner: Emergency Urban Environmental
PROVAC	Management Project: Royal HaskoningDHV (Consultant): Water Development and
PSDSA	Management Scheme: Municipal Development Master Plan: Beninese Coastal
TFP	Development Master Plan: International Finance Corporation: Road Infrastructure and
PUGEMU	Spatial Planning Company: University of Abomey Calavi: European Union: National
RHDHV	University of Agriculture: West-Africa Coastal Areas Management Program
SAGE	
SDAC	
SDAL	
SFI	
SIRAT	
UAC	
EU	
UNA	

Non-technical executive summary

This report presents the Strategic Environmental and Social Assessment (SESA) of the three areas of action proposed for the project Development and Rehabilitation of Lake Nokoué and the Porto-Novo Lagoon (ARNP).

The report consists of nine chapters describing:

1. The context and vision of the project;
2. The methodology used for the EESS;
3. The environmental, social and strategic diagnosis;
4. The recommended solutions;
5. The public participation process;
6. The Action Plan of the project as well as the areas of action and their resulting measures, subject of the EESS;
7. Multi-criteria analysis of the areas of action and their measures (AMC);
8. The identification of the environmental and social impacts of the areas of action and their measures;
9. A framework plan for environmental and social management.

The report provides a multidisciplinary and strategic analysis of the action areas and their pre-feasibility measures, to ensure that the potential environmental and social impacts of the action areas and their measures are well defined and taken into account, and serve as a guiding framework for the Environmental and Social Impact Assessment (ESIA) of each feasibility level project arising from the action areas.

This report is drafted for approval and validation by the Benin Environment Agency (EBA), the authority regulating the EESS procedure in Benin.

1 Introduction

This chapter introduces the Project Development and Rehabilitation of Lake Nokoué and the Porto-Novo Lagoon and its context, the Vision for the Future of the project area and the institutional framework of the project.

1.1 The ARNP Project: Development and Rehabilitation of Lake Nokoué and the Porto-Novo Lagoon

As part of its 2021-2026 Action Program, the Government of the Republic of Benin intends to develop and rehabilitate Lake Nokoué and the Porto-Novo lagoon. This action is led by the Ministry of Living Environment and Sustainable Development (MCVDD) through its Agency for the Integrated Development of Lake Ahémé and its Channels (ADELAC), whose area of intervention has been extended to Greater Nokoué [1]. A framework document was drawn up for this purpose in 2019. On this basis, a grant agreement was signed on September 7, 2020 between the Government of Benin and the Government of the Netherlands for the realization of the study "Development and Rehabilitation of Lake Nokoué and the Porto-Novo Lagoon" (ARNP).

Following an international call for tenders, the study was entrusted to the Royal HaskoningDHV/COWI/NETICS consortium. This study, which started in December 2021, includes three phases: (i) Start-up; (ii) Action Plan and pre-feasibility of development options; (iii) The development of tender documents for the implementation of a priority project to be started in 2024. For the development of this priority project, an Environmental and Social Impact Assessment (ESIA) will be required.

It is agreed, as it should be, that the Action Plan of Phase 2 of the ARNP[2] project, with its three areas of action, be accompanied by a Strategic Environmental and Social Assessment (SESA), the subject of this report.

1.1.1 Rationale and Background

Lake Nokoué and the lagoon of Porto-Novo form a lagoon complex located in the center of a highly urbanized area between the cities of Cotonou, Abomey-Calavi, Sèmè-Kpodji and Porto-Novo in southern Benin. This lagoon complex is mainly fed by two rivers, the Ouémé River and the Sô River, which drain a watershed of nearly 50,000 km², and communicate with the Atlantic Ocean through the Cotonou Channel.

Despite Greater Nokoué's important function as the country's main urban centre, the delta's infrastructure is still largely traditional and does not meet current requirements, particularly due to the consequences of climate change and population growth. Lake Nokoué and the lagoon of Porto-Novo are in a very degraded state. The most notable weaknesses are:

- Severe and rapid sedimentation of the system: the rapid sedimentation of the system resulting from intensive agriculture and deforestation upstream in the Ouémé basin is the main cause of sedimentation which leads to a decrease in the storage capacity of water bodies, their transport capacity and their aquatic productivity (fishing);

[1] *Order No. 002/MCVDD/DC/SGM/DGEC/ ADELAC/SA (002SGG21)*
[2] *See: Phase 2 Report, Development and Rehabilitation of Lake Nokoué and the Porto Novo Lagoon (ARNP, Action Plan and Proposal of the First Investments, 202302 RHDHV – BI2445 D2B Benin, March 2023).*

- Water pollution: Water pollution results from the discharge of untreated sewage and hydrocarbons, and many other sources, including household and industrial solid waste that accumulates on the banks of water bodies and in the water;

- Lack of salt and freshwater balance: the man-made connection between the lagoon and the ocean (Cotonou Channel), which is not controlled, has completely changed the salinity levels, which vary according to the seasons, of this original freshwater ecosystem;

- Degraded and polluted banks: the accumulation of solid waste on the banks and the uncontrolled occupation of the banks lead to their degradation;

- Increased flooding: The increase in seasonal flooding is a result of the loss of upstream retention capacity and the impact of climate change on rainfall intensity and ultimately sea level rise. It also results from the lack of infrastructure to protect the many low-lying urban areas and agricultural land around the lake and lagoons and along the rivers (Sô and Ouémé);

- Poorly developed river transport and landing quays: transport by water is very important, especially for the population living around and on the water. Its importance is amplified by population growth and rapid urbanization. Overall, the landing docks are very simple and do not have proper water and sanitation facilities. The Dantokpa market (the largest market in Benin) in Cotonou, is a good example of this situation;

- Overexploitation and loss of fish stocks: the productivity of the ecosystem in recent decades has declined sharply and the number of fish species and fish products (such as shrimp in the past) has declined significantly. Today, there are a few rare mangrove plants in the wetlands to the north and southeast of Lake Nokoué. However, there is a very close relationship between water quality, the presence of mangroves and the diversity and productivity of fishery resources, including those of commercial importance such as fish and shellfish. This is another reason for developing measures that improve water quality and prevent sedimentation while restoring aquatic habitats.

- Acadjas: from a brackish water ecosystem (under RAMSAR site status) that was considered one of the best in West Africa in the past, the lake and lagoon have become an area where acadjas are the main fishing method. Acadjas are locally built fish traps using mangrove wood and palm fronds and other trees and shrubs or even truck tires. With an area of just over 80 ha in 1978, their presence exceeded 1,000 ha in 2006, and continues to increase despite their prohibition by the framework law n°2014-19 of 7 August 2014 on fisheries and aquaculture in the Republic of Benin. The huge amount of acadjas that has developed recently does not only affect the fish stock; They function as sediment traps in the lagoon and should be removed.

- Water hyacinth: river transport routes and fishing areas are invaded by water hyacinth for part of the year. The increase in the areas occupied by acadjas and the proliferation of water hyacinth have led to an increase in the production of organic matter which aggravates eutrophication and also reduces the average transparency of the water of the lake and lagoons.

- Slums in poor condition: several shoals are connected to Lake Nokoué (in particular the "5 fingers") and the Porto-Novo lagoon. Shallow water is a depression in which small streams overflow their beds at higher flows, causing flooding and sediment deposition. Ultimately, this results in a relatively flat valley floor, where vegetation can easily take root. Some of these lowlands were occupied during the urbanization process or even deliberately raised by sand embankments, thus reducing their drainage function. Parts of these lowlands have been used for several decades as solid waste disposal sites. A large part of these lowlands is overgrown and silted.

1.2 Vision for the future

The major challenge of the ARNP project is therefore to slow, stop and reverse the environmental degradation of the Greater Nokoué aquatic area, which is under very strong pressure, to transform it, in terms of long-term vision, into a sanitized, pleasant, socio-economically promising space protected against flooding.

The Vision for Lake Nokoué, the Porto-Novo Lagoon and their related environments are based on two fundamental aspects: rehabilitation (through sanitation) and development (through development).

Figure 1-1: Guiding Aspects of the Project Vision

Rehabilitation
The anthropogenic and climatic threats mentioned above are the basis of the MCVDD's desire to clean up water bodies and, at the same time, to prevent their degradation. Water bodies are under great pressure from population growth, rapid urbanization and economic activities, aggravated by climate change.

Reducing the environmental degradation of such a region and its gradual restoration are long-term and require heavy investments. Actions are already underway and can be amplified through the ARNP project with a view to improving health conditions and creating a favourable socio-economic environment.

Development
The Grand Nokoué has great potential. It has comparative advantages resulting from the presence of land, ocean, fresh water and brackish water with a dense population at the heart of the country's economic activities. Rehabilitation projects that are expensive must go hand in hand with cost-effective development projects. In order to remedy adverse developments, the MCVDD is developing a coherent policy of projects aimed at seizing opportunities to exploit the strengths of the area. The overall ambition for the area is clearly formulated in the National Development Plan (NDP) and the Government's Action Program (PAG 2021-2026), which aim to ensure the economic development of the area but also to significantly improve the quality of life of the population.

1.3 Institutional framework

To ensure that the various interests are taken care of by the project and to ensure the coordination of the project, the Beninese Government, through the Ministry of Living Environment and Sustainable Development, has set up by Order 2021 No 002/MCVDD/DC/SGM/DGEC/ ADELAC/SA (002SGG21) the implementing bodies of the project, namely: a Steering Committee (SC) and a Project Coordination Unit (PCC) whose responsibilities and compositions are presented below. The CP is placed under the authority of the Minister of Living Environment and Sustainable Development.

The responsibilities of the Steering Committee are as follows:

- The SC is the guiding and decision-making body;
- The PC provides political oversight and approval of the general orientations of the ANRP project;
- The CP ensures that the management and impact of the project are taken into account in the State's development policies and strategies as well as the necessary synergy of the project with other sectoral projects.

To ensure the integration of different interests and synergy with other sectoral projects in the lake and lagoon area, the CP is composed of the following partners:

- President: DG Environment and Climate (MCVDD)
- Vice-President: DG Mines (MEM)
- Rapporteur: DG Agency for the Integrated Development of the Economic Zone of Lake Ahémé and its Channels (ADELAC/MCVDD)
- Members (11):
    - DD Agriculture, Livestock, Fisheries - Ouémé (MAEP)
    - DG River-Lagoon Transport (MIT)
    - DG Water (MEM)
    - DG National Agency for the Promotion of Heritage and Tourism Development (Presidency)
    - DG Beninese Environment Agency (MCVDD)
    - DG Agency for the Rehabilitation of the City of Porto-Novo (MCVDD)
    - Director of Sanitation and Urban Roads (MCVDD)
    - Head of the Environmental Monitoring Laboratory (MCVDD)
    - Head of the Legal Unit at the MPD
    - Head of the Netherlands Portfolio at the CAA (MEF)
    - Representative of the Embassy of the Kingdom of the Netherlands.

The CP is the decision-making body that will retain proposals for investment projects, taking into account, among other things, environmental and social issues.

2 Strategic Environmental and Social Assessment

This chapter describes the methodology, objectives and legal framework of the EESS.

2.1 EESS methodology in the context of the ARNP project

The ARNP project has three phases: the first phase focused on the diagnosis of the state of play and trend developments; the second phase, the current phase, has defined a Vision and an Action Plan that includes three areas of action and measures at a pre-feasibility level. The Vision and the three areas of action have been developed on the basis of the diagnosis of the current situation and the consultations and public participation undertaken since the beginning of the project. The third phase will involve the launch of a call for tenders for the implementation of a priority project financed by the Netherlands and Benin. For the development of this priority project, an Environmental and Social Impact Assessment (ESIA) will be required, as well as for any other project resulting from the Action Plan.

The Strategic Environmental and Social Assessment (SESA), planned in the second phase of the project, focuses on the strategic analysis of the different areas of action and their measures at the pre-feasibility level, in order to ensure that the potential environmental and social effects of the areas of action and their measures are well defined and taken into account, and will serve as a guideline for the ESIA of each project resulting from the Action Plan.

In order to strategically analyse the action areas and their measures, it was decided to conduct a Multi-Criteria Analysis (MCA) of the three action areas as an integral part of the EESS. This tool allows for a simultaneous multidisciplinary and strategic analysis, i.e. an environmental, social, institutional and technical analysis. It is an effective tool perfectly adapted to the context and structure of the ARNP project.

In addition, an assessment of the potential environmental and social impacts of the action areas and their measures is carried out using the IFC's sustainability performance standards, and based on the results of the AMC. This impact assessment provides a preliminary baseline framework for the ESIA of each project in the next planning phase.

Finally, an Environmental and Social Management Framework Plan is presented, including conditions and/or monitoring measures for each project resulting from the Action Plan.

2.2 Sources

This EESS is based on the following documents and sources:

- The EESS Terms of Reference incorporating the EBA's comments (see Annex 1):
- Consultations and public participation undertaken since the beginning of the project (See also references [01] and [02]; During this period, the project consulted with vulnerable groups such as fishmongers, youth, fish farmers and market gardeners.
- Consultation of experts during workshops (April and June 2022);
- Final report (Phase 2) including the Vision, the Action Plan and the areas of action.

In addition, two important sources of guidance, one national and one international (for foreign funding as provided for in the project structure), are taken into account in the drafting of this EHEA:

- Decree No. 2022-390 of 13 July 2022 on the organization of environmental and social assessment procedures in the Republic of Benin and;
- The Organisation for Economic Co-operation and Development (OECD) Guide on the Application of Strategic Environmental Assessments.

Tables 2-1 and Table 2-2 present the main content that these guidance sources require in a SESA.

Table 2-1: Content of an ESSA according to Decree No. 2022-390 and project activities

#	Required content of the EESS (Decree No. 2022-390 Article 14)
1	The non-technical executive summary;
2	Presentation of the methodology used;
3	The presentation of the context and framework for the development, updating or approval of the document concerned in relation to the national orientations of socio-economic development, on the one hand, and sustainable development, on the other hand;
4	The environmental, social and strategic diagnosis presenting the current and past environmental and social situation as well as its likely evolution in time and space in the event of the status quo;
5	The environmental analysis of the guidelines and options provided for in the document, making it possible to verify their compatibility with the legislation in force and the principles of sustainable development adopted by Benin;
6	Identification of key conflicts and potential effects related to the guidance and options selected in the document;
7	The proposal for environmental measures to be included in the document under review, including technical, regulatory, institutional and capacity-building measures;
8	The proposal of a mechanism for monitoring, evaluating and reporting on the implementation of measures and recommendations.

Table 2-2: Stages of a SEA (OECD, 2006) and Project Activities

#	Steps in an ESSA
1	Setting the context for SEA
-	Screening
-	Set goals
-	Stakeholder identification
2	Implementation of SEA
-	Scoping (in dialogue with stakeholders)
-	Baseline Data Collection
-	Identify alternatives
-	Identify potential impacts
-	Identify how to improve opportunities and mitigate impacts
-	Quality assurance
-	Commerce

#	Steps in an ESSA
3	Informing and influencing decision-making
-	Make recommendations (in dialogue with stakeholders)
4	Monitoring and evaluation
-	Follow-up on decisions taken
-	Monitoring implementation
-	Evaluation

2.3 Objectives of the EESS

The general objective of the EESS is to ensure the integration of environmental and social dimensions in the Action Plan of the Project Development and Rehabilitation of Lake Nokoué and the Porto-Novo Lagoon.

In specific terms, this will involve:

- Identify/inventory environmental and social issues;
- To develop an environmental, social and strategic diagnosis of the current and past environmental and social situation, as well as its probable evolution in time and space in the event of the status quo;
- Carry out a strategic environmental and social analysis of the orientations and options provided for in the Action Plan;
- Analyze, at a high level, the potential environmental and social impacts, and propose follow-up measures for the rest of the process.

2.4 Legal framework

2.4.1 National Framework

In Benin, the laws in force applicable to EESS are as follows:

- Constitution of 11 December 1990 of the Republic of Benin which stipulates that "everyone has the right to a healthy, satisfactory and sustainable environment, and has the duty to defend it. The State shall ensure the protection of the environment" (art. 27).

- Law No. 93-009 of 2 July 1993 on the forest regime in the Republic of Benin.

- Law No. 030-98 of 12 February 1999 on the framework law on the environment in the Republic of Benin, which implicitly refers to strategic environmental assessment, particularly in article 3-c, "the protection and enhancement of the environment must be an integral part of the economic and social development plan and the strategy for its implementation". It includes provisions relating to the clarification of concepts, sanctions, the protection and enhancement of receiving environments, the protection and enhancement of the natural and human environment, pollution and nuisances, impact studies, public hearings on the environment, emergency plans and incentives. This law is the basic text of the national environmental policy, in the sense that it covers all aspects from the identification of sources of pollution to their control and enforcement, including environmental assessments (strategic environmental assessment (SEA), environmental impact assessment (EIA), environmental audit (EA), capacity building and environmental information management.

- Law No. 2002-016 of 18 October 2004 on the wildlife regime in the Republic of Benin.
- Decree No. 2005-759 of 8 December 2005 approving the statutes of the Beninese Environment Agency.
- Law No. 2006-17 of 17 October 2006 on the Mining Code and Mining Taxation in the Republic of Benin.
- Law No. 2010-44 of 21 October 2010 on water management in the Republic of Benin, which advocates Integrated Water Resources Management (IWRM) as a basic principle for water management in Benin. Article 1 of this law sets out the constitutional principle that "everyone has the right to a healthy, satisfactory and sustainable environment and has the duty to defend it. The State ensures the protection of the environment and the conservation of natural resources in general, in this case water. »
- Decree No. 2011-281 of 2 April 2011 on the creation, attributions, organization and functioning of environmental units in the Republic of Benin.
- Decree No. 2011 573 of 31 August 2011 establishing the Master Plan for Water Development and Management (SDAGE). It is a document for sustainable water planning and management that sets out the fundamental guidelines for optimal water management and specifies priorities, water quantity and quality objectives as well as the developments to be carried out to achieve them, within a defined perimeter.
- Decree No. 2011 623 of 29 September 2011 laying down the procedure for determining the limits of dependencies in the public water domain. This decree specifies the provisions governing the procedures for determining the boundaries of dependencies in the public water domain – surface water and groundwater.
- Decree No. 2012 227 of 13 August 2012 establishing the Water Development and Management Scheme (SAGE). It is a document for the planning and sustainable management of water setting the general objectives for the use, enhancement and quantitative and qualitative protection of water resources and aquatic ecosystems as well as the preservation of wetlands at the scale of a sub basin or a group of sub basins.
- Law No. 2013-01 of 14 August 2013 on the Land and Property Code in the Republic of Benin.
- Decree No. 2015-029 of 20 January 2015 laying down the terms and conditions for the acquisition of rural land in the Republic of Benin.
- Law No. 2018-10 of 2 July 2018 on the protection, development and development of the coastal zone in the Republic of Benin.
- Decree No. 2022-390 of July 13, 2022 on the organization of environmental and social assessment procedures in the Republic of Benin, which describes in articles 9 to 15 the administrative and technical procedure for strategic environmental and social assessment in Benin.

2.4.1 International Framework

In view of the potential international funding of one or more projects arising from the action areas, it is important that the EESS also complies with international standards. As such, the following international sources are relevant:

- International Finance Corporation (IFC) Performance Standards for Environmental and Social Sustainability (2012);
- OECD Guidance on the Application of Strategic Environmental Assessments (2006).

3 Environmental, social and strategic diagnosis

This chapter presents the environmental, social and strategic diagnosis of the state of play as well as possible trend developments.

3.1 State of play and trends

The major issues related to the ARNP project in the Greater Nokoué area, classified as a RAMSAR site, are:

- Population growth, resulting in more urbanization;
- The effects of climate change on the area;
- The degradation of lakes and lagoons, banks, shallows and the ecosystem;
- The increase in pollution and the deterioration of water quality.

3.1.1 Population growth and climate change

In 2021, the population of Greater Nokoué, including the communes of Abomey-Calavi, Cotonou, Porto Novo, Ouidah and Sèmè-Kpodji, is estimated at 3.7 million, or 30% of Benin's population (12.5 million). According to projections (WB, UN, Benin), the population of the delta will reach 4.7 million in 2030 and 7 million in 2050, i.e. about double the current population. By this time, a large part of the municipalities of the delta will be urbanized.

In addition to demographic pressure, there is the effect of climate change, which will lead to a rise in sea levels and an amplification of extreme events, in particular droughts and rainfall, the latter resulting in an increase in flows from the Ouémé basin. These two situations will accumulate in Greater Nokoué and could cause catastrophic flooding.

In view of these challenges, the infrastructure of the Grand Nokoué lagoon area is still essentially traditional and does not meet current requirements. The most notable weaknesses are the filling of water bodies, water quality, ecosystem loss, overfishing, shoreline degradation and insufficient flood protection measures. These problems are often interconnected, as must the solutions.

3.1.2 Lake and lagoon degradation

3.1.2.1 Filling

The sedimentation rate in the water bodies of Greater Nokoué is very high. Historical bathymetric data from Lake Nokoué reveal an average sedimentation of 2 to 3 cm/year over the last 40 years. This sedimentation leads to a decrease in water storage capacity, which affects the self-cleaning capacity of water bodies and aquatic productivity: shallow water quality decreases water quality, affects fishing and limits river transport.

Figure 3-1: Filling of water bodies

3.1.2.2 Water and bottom quality of water bodies

Seasonal changes in the brackish-freshwater balance in the system are very marked. The low flow of the Ouémé River and the low volume of Lake Nokoué induce a high level of salinization during low water periods, and low to very low salinization during flood periods. These variations, which significantly affect aquatic, plant and animal life, pose a challenge in terms of development.
Water pollution results from the discharge of untreated sewage and hydrocarbons, household solid waste and many other types of waste, including industrial waste, which are dumped in and near cities and disembarkation sites for boats involved in lagoon transport. In addition, there is the pollution resulting from the use of chemical fertilizers and pesticides for upstream agricultural activities. Over the years, pollution accumulates in the muddy bottom of the lake, especially heavy metals.

3.1.2.3 Ecosystem degradation and overfishing

The ecological system is overexploited and loses its natural wealth, which affects biodiversity. Traditional fishing has reached its limits: it can no longer meet the protein needs of the population The productivity of the ecosystem in recent decades has declined and the number of fish species and fish products (such as shrimp in the past) has decreased considerably. Today, a few rare mangrove plants are still found in the northern and southeastern parts of Lake Nokoué at the level of the banks. However, there is a very close relationship between water quality, the presence of mangroves and the diversity and productivity of fishery resources, including commercially important fish and shellfish. It is therefore necessary to develop measures that improve water quality, prevent sedimentation and restore aquatic habitats.

From a brackish water ecosystem (under RAMSAR site status) that was considered one of the best sites in West Africa in the past, the lake has become an area where acadjas are the main method of fishing. With an area of just over 80 ha in 1978, their presence exceeded 1,000 ha in 2006 and has increased considerably over the last ten years. The huge amount of acadjas that have been put in place does not only affect the fish stock; They function as sediment traps and plant debris accentuates the degradation of the aquatic environment. They have been banned since 2014 and should be removed. The 2016-2020 PAG recognized these problems and proposed solutions that are part of the

flagship projects 30 and 31 (Development of the Cotonou lagoon and banks of the Porto-Novo lagoon).

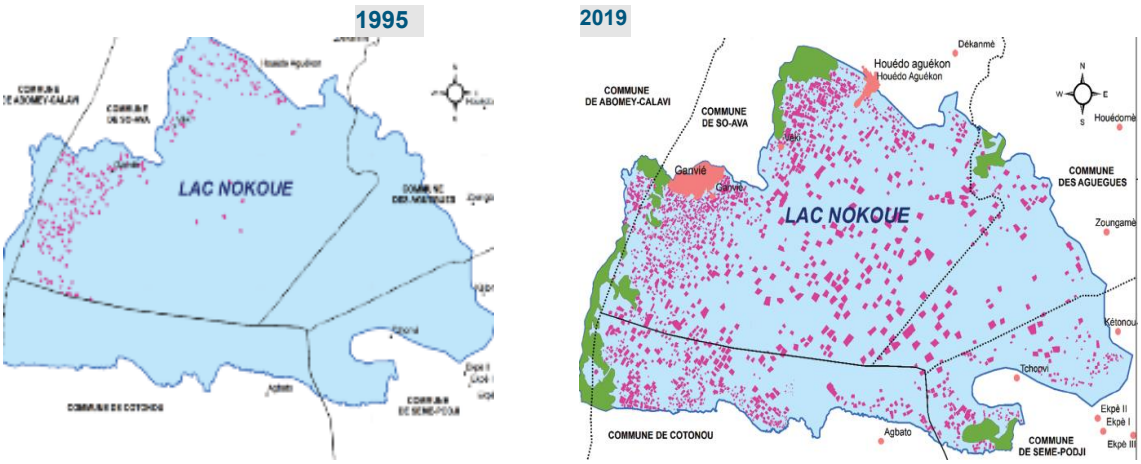


Figure 3-2: Increase in the presence of acadjas

In addition, fishing areas, as well as river transport routes, are invaded by water hyacinth for a large part of the year. Water hyacinth decomposes as the water becomes brackish again during the dry season and thus contributes to the filling of water bodies. The proliferation of water hyacinth as well as the extension of the acadjas have led to an increase in the production of organic matter which aggravates eutrophication and reduces the average transparency of the lake water.

3.1.3 Shoreline degradation

3.1.3.1 Shoreline Pollution

The anarchic occupation of the banks, the accumulation of solid waste brought in during the rainy season by uncleaned collectors, or piled up in the form of illegal deposits or as backfill materials for access roads or the construction of houses, as well as the rise of lake waters during flood periods are all causes that contribute to the degradation of the banks and the ecosystem, as well as water pollution and sedimentation in lakes and lagoons.

Figure 3-3: Shoreline Pollution

3.1.3.2 Storm and lake flooding

Flooding in the rainy season results from higher flows from the upstream of the basin and the lack of protective infrastructure in low-lying urban areas and riparian areas of lakes and lagoons where urban stormwater discharge is blocked by high lake and lagoon levels.

The measures recommended by the PAPC and PAPVS programmes greatly improve drainage systems in urban areas. The development of the shores of lakes and lagoons and the measures to protect against the risk of lake flooding must complement them, because in the long term, the rise in sea and lake levels due to climate change will slow down the evacuation of rainwater and aggravate flooding. The expected damage will be more significant in the context of a growing economy.

Storm flooding

Figure 3-4: Storm Flooding

Drains in poor condition that are being improved in the PAPC

Figure 3-5: Drains

3.1.4 Degradation of the shallows

The lowlands around Porto Novo, in the commune of Sèmè Kpodji and those of Linhouindji, Djissou and Djonou between the Toho lagoon and Godomey are located in an increasingly dense urban environment. The marshy nature of their land has so far limited the construction of housing, but this tends to develop more and more under the effect of urban pressure. Agriculture or fish farming is also practiced in some places. The natural drainage function of the shallows is blocked by sediment and vegetation. However, because of this situation, the lowlands can have very important ecological values.

There is hardly any documentation on the problems and challenges of these lowlands, although they should have development potential for agriculture and aquaculture, ecology, recreation and tourism.

Figure 3-6: Lowlands

4 Top Solutions for Problem Solving

This chapter presents solutions that respond to the current situation presented in the previous chapter. Indeed, on the basis of the social and strategic environmental diagnosis, six major issues have been identified in Figure 4-1 below. In response to the six major challenges, solutions including measures for rehabilitation and development have been developed. The measurements are shown in Figure 4-2. Rehabilitation measures, or structuring measures, form the basis for a healthy environment that can lead to planning measures aimed at sustainable socio-economic development.

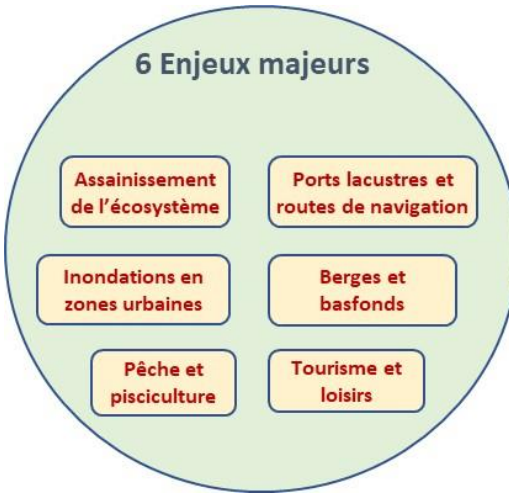


Figure 4-1: The six major issues

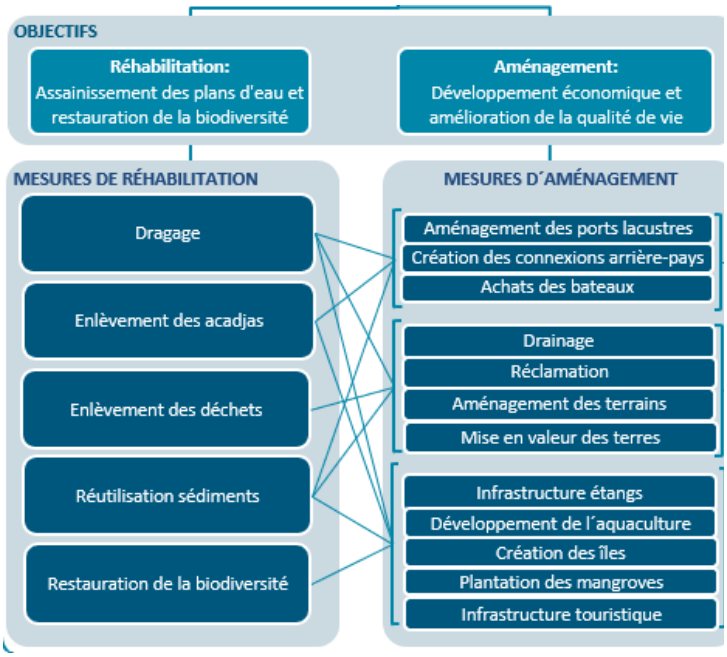


Figure 4-2: Design for the creation of a database to build a sustainable economy

In order to better highlight the specifically environmental and social issues, the six major issues have been grouped below into four main themes:

(i) dredging as a key solution for sanitation and reclamation;
(ii) the replacement of acadjas by fish farming that promotes the ecosystem and food security;

(iii) the rehabilitation and development of the banks;
(iv) dikes, storage and pumping contributing in the long term to flood protection.

4.1 Dredging as a key solution for remediation and reclamation

The main and structural solutions to solve the problems of remediation of water bodies must all be based on the reduction of their filling. The latter is the basis for their rehabilitation and, at the same time, it creates a

structural basis for socio-economic development. The dredging concerns Lake Nokoué and the Porto-Novo lagoon but also the Totchè canal as well as the secondary lagoons.

Dredging can meet several sanitation and recovery objectives:

- Dredging of the lake, lagoon to increase water volume and self-cleaning capacity;
- Extension of the banks by embankment from the dredged material to create space for applicants in the riparian areas for different uses;
- Dredging of channels for transport on the water and the local extension of the banks by embankments to create lake ports;
- Creation of artificial islands from dredged materials, mainly clays, for the rehabilitation of mangrove ecosystems that contribute to the values of RAMSAR status

This approach of solving the problem of filling by adding economic added value introduces an innovative element that cannot be a single solution because it introduces new challenges, particularly for the environment, the private sector, regulations and governance. At this level, dredging and the reuse of dredged materials involve many actors who must assume their responsibilities and interact with each other in order to harmonize the tasks and contributions of each party.

However, there are limits to added value: the types of sediments, their useful use, the exploitation rate, the ratio between usable and non-usable sediments and, in any case, the large volumes of sediment to be dredged determine the costs and impacts. The redevelopment of land and water surfaces also poses many challenges for stakeholders.

4.2 Replacing the acadjas with fish farming that promotes the ecosystem and food security

The removal of acadjas contributes to the improvement of water quality and biodiversity

Fishing, which is largely traditional (nets and acadjas) and increasingly practiced (1826 fish farmers in 2017 compared to 874 in 2010) is causing an invasion of water bodies. Lake Nokoué alone provides more than 50% of the national fish production, but in a context of overfishing that is causing the scarcity of fish products. Sea fishing is growing but remains limited.

The proliferation of acadjas is clear, their production contributes to food security, but because of their negative impacts on water bodies and their influence on biodiversity, they have been banned since 2014.

The removal of the acadjas alone can provide space for the rehabilitation of traditional fishing, but little research is available on this subject. It also contributes to the improvement of water quality.

As a replacement for the acadjas, the development of aquaculture is seen as the way forward to ensure fish production that provides Beninese with the food proteins they need.

The dredging in this ARNP project aims to create navigation channels or to provide materials for the construction of embankments. The funds that will be dredged will be the first for the suppression of the acadjas.

Aquaculture

The Directorate of Fisheries Production (DPH) of the APRM is clear in its Vision for the Future of Fisheries. The largest proportion of protein in the diet of Beninese must come from the consumption of fish. Fish production can no longer come from traditional fishing, which has reached its limits, but from domestic fish farming. The DPH does not expect a significant growth in marine fishing, which is still artisanal and marginal in its contribution to meeting needs. The ARNP project can contribute to this development by creating better ecological conditions in the lake and lagoon, by providing useful services at lake ports and by supplying construction material (clay) for fish ponds.

The DPH's Vision is based on three pillars:

- For small-scale fisheries, in the short term, current catch levels can be optimised through better management of the post-harvest phase to minimise post-harvest losses, and facilitate the processing, processing and marketing of products. In the medium term, the management of the entire chain can be improved, but the recovery of the fish stock and the possibilities for recovery depend on the strong reduction of pollution, which will be a long-term challenge. To make a real difference in the trade balance in the field of fisheries production, Benin will have to attract additional producers.

- The development of fish farming is at the centre of the policy in terms of fish production. For fish farming to be competitive, a series of constraints hindering the development of the sector must be removed. They are mainly related to the security of land tenure, the quality and availability of food, access to quality fingerlings, and the technical and entrepreneurial capacities of the actors. The APRM/DPH considers the lakes, lagoons and lowlands of the littoral zone and their riparian areas as areas with comparative advantages for the development of fish farming, especially in ponds. These ponds will have a production that will exceed the production of the acadjas by 10 to 20 times and in a more sustainable way. The development of these ponds could greatly contribute to the replacement of the acadjas.

- "The return of shrimp" in Lake Nokoué and the lagoon of Porto Novo can be considered as the third axis of the policy. This sector was the flagship of production until 2003, with good export revenues. Since then, exports have struggled to recover, despite strong international demand for shrimp. The revival of Beninese shrimp will require a sustained commitment from the State and the support of the private sector, the development of landing sites for products allowing their control as well as the good management of the fishing sector as a whole. Even more than traditional fishing and fish farming, shrimp farming must benefit from clean and unpolluted water, a challenge that requires time and perseverance.

It should be noted that sea fishing is also experiencing some development. The Port of Cotonou sea fishing port will be moved to the mouth of the Cotonou Channel with modernized storage and auction facilities. Sea fishing can be important for Benin in the search for its own production of fish feed for fish farming.

4.3 Shoreline rehabilitation and development

In the diagnostic analysis, the observation relates to the degraded situation of the banks. Their rehabilitation first leads to intensive sanitation by removing the hard waste that pollutes the banks and bodies of water everywhere, not to mention that they form an unhealthy living environment.

The development of the banks is complex: it leads to difficult procedures because of multiple "space seekers" in an area that is most often already occupied. Evictions, such as near the Dantokpa market, create some space, but this is hardly enough to develop activities with added value.

The recommended approach is to artificially widen the banks, which can create space for activities that need it: piers and small lake ports, shops and terminals around these ports, green areas for entertainment and recreation, the Northern Bypass and other transport routes, flood protection (dikes, ponds, pumping stations). An extension of the banks can avoid rehousing or offer space for rehousing, either for homes or for shops.

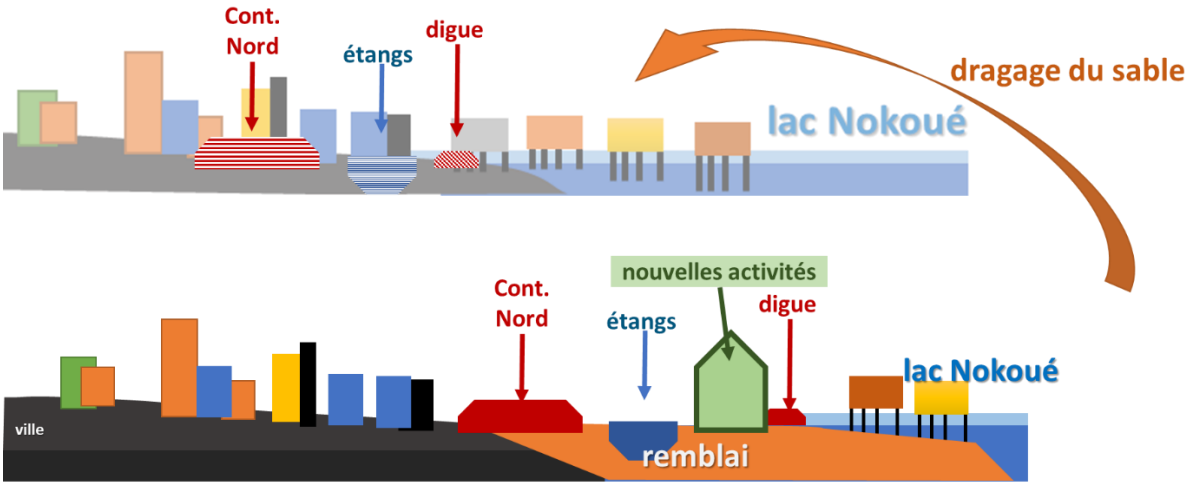


Figure 4-3: Seekers of space such as the North Bypass, retention basins, dikes, new activities. The dredging of the lake and lagoons, and the extension of banks in the form of embankments (tens or hundreds of metres along the banks) make it possible to create the desired space

4.4 Dikes, storage and pumping contributing to long-term flood protection

The approach to reducing the risks associated with urban flooding caused by precipitation and flooding from the lake during periods of high water cannot be solely sectoral. Following the PUGEMU, various projects contributing to the reduction of rainwater flooding have been undertaken by the MCVDD: drainage project, asphalting project, rehabilitation of banks, etc. The Cotonou Rainwater Sanitation Programme (PAPC) and the Secondary Towns Rainwater Sanitation Project (PAPVS) are helping to solve many of the problems of rainwater flooding in cities.

However, rising sea levels due to climate change (up to 50 cm in 2050) will exacerbate the problems caused by lake flooding in the low-lying riparian areas of the lake. The approach for the reclamation of the banks, in combination with the remediation of the banks and the lake (solid waste) opens up prospects for the establishment of embankments that can create the necessary space for the resolution of flooding problems in riparian areas, structurally and in the long term.

One approach could be to combine the transport function and flood protection. Taking into account the Northern Bypass which runs along the edges of the lake and involves the restructuring of a long and wide strip of land to the south and west of Lake Nokoué, as an element that can structurally contribute to the reduction of the risk of lake flooding.

4.5 Summary of solutions and recommended measures

In the previous section, the 6 major issues grouped into four main themes were presented and solutions and measures were described. A summary of the issues, as well as the structural solutions and measures for the development and rehabilitation of water bodies and their banks is presented in Figure 4-4 below.

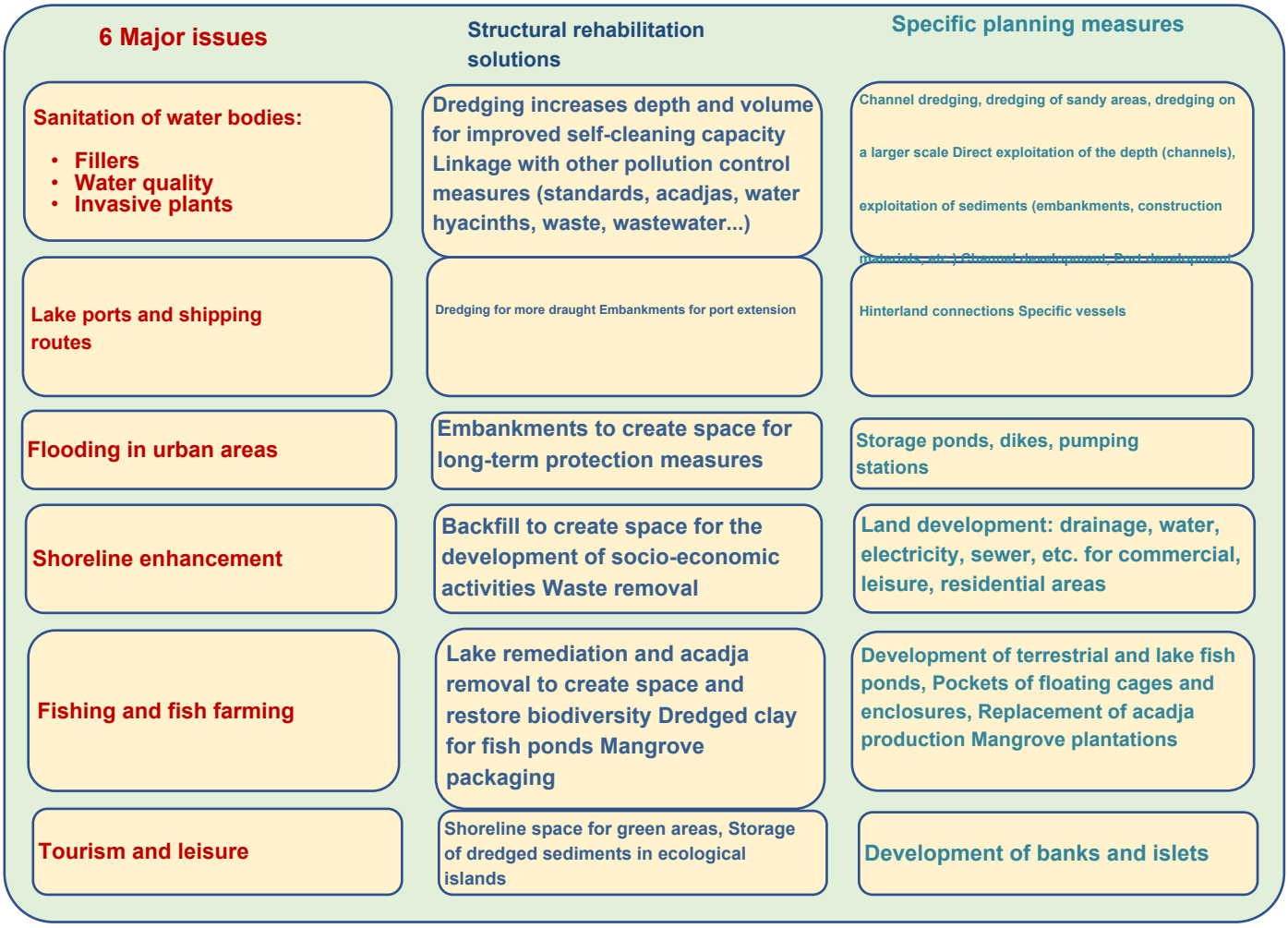


Figure 4-4: Environmental, Social and Strategic Diagnosis Summary, Issues and Solutions

5 Public Participation

Dialogue with all relevant stakeholders throughout the EESS process is fundamental and required by the applicable national and international laws regulating the EESS process. This is a question of public and transparent participation.

In parallel with the meetings with the Steering Committee, the identified stakeholders were consulted on a regular basis from the beginning of the project:

- During phase 1, a consultation tour with the populations living around Lake Nokoué and the Porto-Novo lagoon was undertaken as a first step during the month of January 2022. Following the tour, two consultation workshops were organized with stakeholder representatives in Cotonou during the month of February 2022. These workshops were preceded by targeted interviews with key stakeholders.

- Then, during Phase 2, there were many meetings with state actors, including the agencies and ministries concerned. In this context, in April and June 2022, eight workshops were organized with participants from various sectors (state, grassroots, NGOs, dredging/sand companies), as well as meetings with experts and meetings with potential technical and financial partners (TFPs).

These processes were carried out with the aim of informing, collecting opinions and positions taken and contextualizing the themes related to the project.

5.1 Steering Committee

Meetings with the Steering Committee, the Project Coordination Unit, and the Consultant team took place in February, October and December 2022. At each meeting, a progress report was made, exchanges took place on the reports and proposals and led to orientations and decisions for the continuation of the process.

5.2 First phase of the ARNP project

5.2.1 Touring around the lake and lagoon

The tour of Lake Nokoué and the Porto-Novo lagoon is the very first step in the consultation process implemented within the framework of the ARNP project. The objective of this approach was to inform the stakeholders about the project, to collect their assent and proposals in order to assess, already at the start, the environmental and social issues that the project's choices are likely to generate in order to anticipate their mitigation. This tour identified the main stakeholders, which are local communities, civil society organizations and groups, and communal and governmental authorities.

The various stakeholders identified around Lake Nokoué and the Porto-Novo lagoon, grouped into three categories of actors, are presented in Figure 5-1 below.

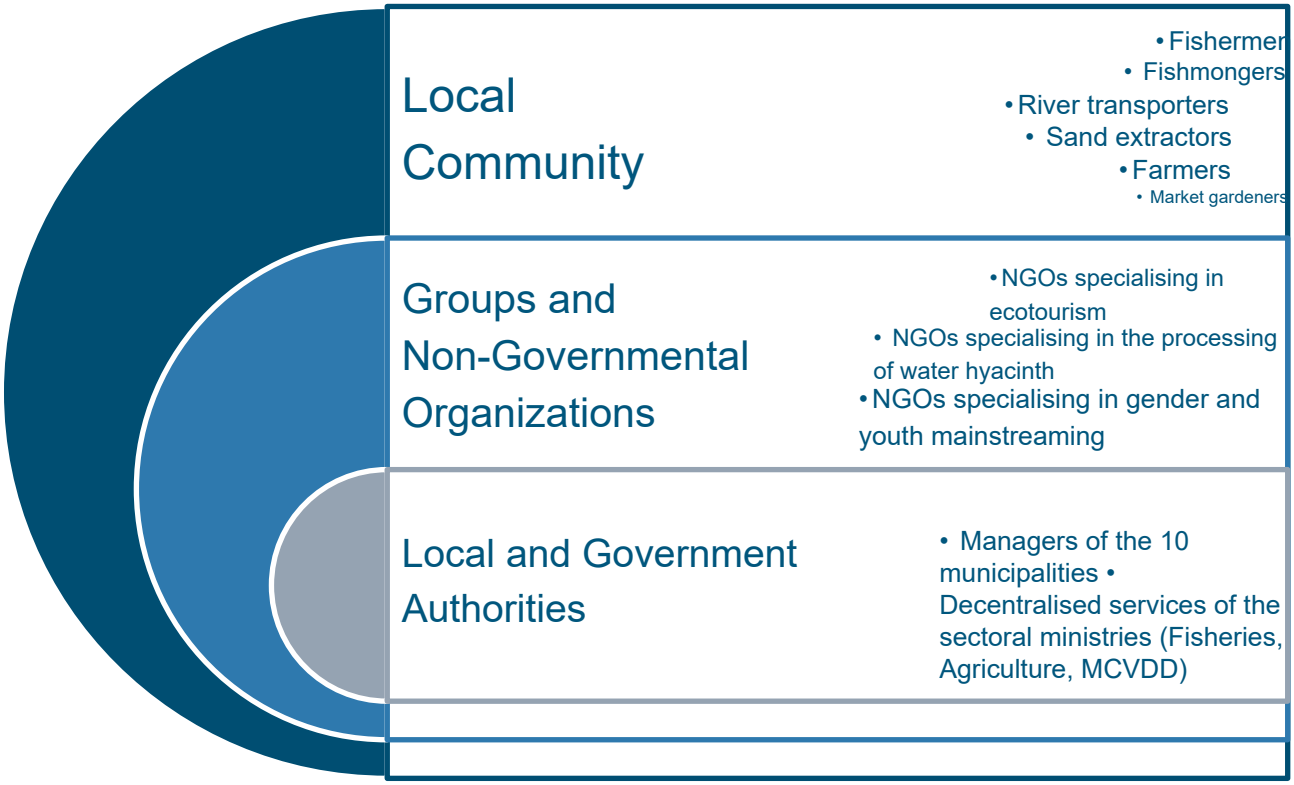


Figure 5-1: Categories and Stakeholder Groups in the ARNP Project Area

5.2.2 Targeted Interviews

In order to consolidate the achievements of the tour of Lake Nokoué and the Porto-Novo lagoon, meetings were organized with sectoral ministries, structures in charge of PAG projects, specialized companies and technical partners in the project area. These meetings also served as a framework to explain the issues at stake in the consultation workshop of state actors and to invite these different structures to be represented.

Table 5-1 summarizes the interviews conducted in this first phase of the project.

Table 5-1: Focus on Targeted Interviews Conducted During Phase 1 of the Project

Number	Categories	Structures
1	**Sector Ministries**	• Directorate-General for River-Lagoon Transport • Directorate General of Mines • Fisheries Production Department • Ministry of Finance
2	**PAG**	• National Agency for the Promotion of Tourism (ANPT) • Northern Bypass Project • Agency for the Rehabilitation of the City of Porto-Novo
3	**Specialized companies**	• Boskalis • INE Laboratory
4	**TFP**	• APB • EU

5.2.3 Stakeholder consultation

Two group consultations were held in February 2022 with stakeholders (grassroots and state actors) in a participatory and inclusive manner. Among other things, it was a question of sharing with these actors the summary of the conclusions of the tour of Lake Nokoué and the Porto-Novo lagoon and of exchanging on the coherent solutions proposed by the project team. It should be noted that the conclusions of the consultation of the actors at the grassroots level were presented to the group of state actors (Table 5-2).

Table 5-2: Stakeholders mobilized for the group consultations.

Type of consultation	Category of actors	Stakeholder groups/structures
Consultation with grassroots stakeholders	**Local community**	• Fishermen (7) • Fishmongers (6) • River transporters (3) • Fish farmers (9) • Market gardeners (4) • Sand Operator and Dredging Companies (2)
	Groups and Non-Governmental Organizations	• Bees ONG (1) • Green Keeper (1) • Jevev NGO (1)
Consultation with state actors	**Municipal administration**	• Cotonou City Hall (3) • Porto-Novo City Hall (1)
	Central government	• ANPT (1) • APRM (1) • MOC (1) • DGEau (1) • ATDA (7) • DDAEP Littoral (1) • DDAEP Ouémé (2) • MIT 1 • ARPN/MCVDD (1)
	TFP	• APB (1)

5.3 Second phase of the ARNP project

5.3.1 Solution Package Information Workshops

The second phase of the ARNP project started with the holding of information workshops in April 2022 on the three areas of action. In short, four workshops were organized to discuss the areas of action with the resource persons identified among the stakeholders.

Table 5-3: Profile of Contacts and Structures of Origin

Information workshops	Profile of the Contacts	Provenance structures
River transport	• Expert in mobility in lagoon systems • Water and Forestry Inspectorate • Expert in natural resources and living environment • Dock managers • Manager of a company specialising in inland waterway transport	• ADELAC • General Directorate of the Republican Police • River transport company (Only God) • Porto-Novo Town Halls • Abomey-Calavi City Hall • Ministry of Infrastructure and Transport • Fisheries Production Department • University of Abomey-Calavi
Dredging/Construction	• Specialist in environmental regulation and control • Civil Engineering Engineer • Expert in sedimentology	• Agency for the Rehabilitation of the City of Porto-Novo • Porto-Novo City Hall • University of Abomey-Calavi • UNA • ADELAC • EBA (MCVDD)
Fishing and fish farming	• Fisheries and aquaculture expert • Fish species specialist • Aquaculture Technician • Expert in local governance	• BEIA • DPH • UAC • ATDA • EBA • Porto-Novo City Hall • ARNP
Protected Area Management	• Specialist in biological and ecological monitoring of water bodies • Wetland Specialist • Expert planner • Specialist in Planning and Infrastructure	• UAC • DPH • CENAGREF/MCVDD • UNA • DGEFC • DGR • ATDA • EBA • ARNP

5.3.2 Technical Workshops

During this second round of Phase 2 workshops in June 2022, each of the following aspects was addressed: institutional, economic and financial, environmental and social. In addition to these three workshops, it was necessary to deepen the theme of the banks and shallows following the conclusions of the information workshops. A total of four technical workshops were held.

Table 5-4: Categories of actors and structures represented

Technical workshops	Categories of actors	Structures represented
Workshop on the banks and shallows	• Sector ministries • Municipal administration • Researchers	• DGEC • CENAGREF • EBA • ARPN • UAC • Abomey-Calavi City Hall • DGDU • ANAT • IGN • UNA • Porto-Novo City Hall
Workshop on economic and financial aspects	• Sector ministries • Municipal administration • Academics • Businesses	• Adjarra Town Hall • Tonon et fils fishing companies • DGPR • Only God transport company • Sô-Ava City Hall • INSTAD (INSAE) • Company Horse Sarl • DPH/APRM • EBA • ANAT/MCVDD • UAC • INRAB • ARPN • CENAGREF • Company Transport and logistics
Workshop on institutional aspects	• Sector ministries • Academics • Civil society organization	• EBA • ANAT/MCVDD • Directorate General of Mines • UAC • BEES-ONG • INRAB • ARPN • DPH

Technical workshops	Categories of actors	Structures represented
		• CENAGREF • DGPR • CAA
Environmental, Social and Safety Workshop	• Academics • Sector ministries	• EBA • ANAT/MCVDD • UNA • UAC • INRAB • ARPN

5.3.3 Briefings and working sessions with TFPs, technical meetings

In this second phase, exchanges and meetings continued throughout 2022 with donors and technical partners, including AFD, the Dutch Embassy, the local consortium of laboratories, the municipalities of Porto-Novo and Cotonou, and the ministries and agencies concerned to enrich the reflections and obtain new commitments on the project.

In October and December 2022, 2 working sessions with the Steering Committee were organized to discuss the holistic vision on Greater Nokoué.

5.4 Summary of actions carried out

Table 5-5: Summary of actions carried out and methodological approach

Actions	Methodological approach	Implementation period
Lake Tour	• Focus groups with a special focus on women • Team meeting at the municipal level	January 2022
Meeting with state structures, PAG projects and private companies	• Individual interview • Team meeting	February
Consultation workshop for grassroots stakeholders	• Communications on the context of the project, the synthesis of the conclusions of the tour of the Lake, coherent solutions • Work in mixed professional social groups with a circle reserved exclusively for women; • Plenary exchanges of the results of group reflections	February
Consultation workshop of state actors	• Communications on the context of the project, the synthesis of the conclusions of the tour of the Lake, coherent solutions • Plenary exchanges	February

Actions	Methodological approach	Implementation period
Information workshop on coherent solutions	• Communication • Exchanges	April
Thematic workshops on areas of action	• Communication • Exchanges	June
CoP Working Sessions	• Meeting	October
Meetings with the town halls of Porto-Novo and Cotonou	• Meeting and visit to possible sites for lake ports	December 2022
Working sessions with CoP	• Meeting	October and December 2022

5.5 Results of actions carried out in connection with the EESS

Table 5-6: Results of the SEA process

No.	Process	Results
1	Lake Tour	− Information for local communities − Information for the municipal administration and decentralised services − Collection and exchanges on the environmental and social impacts of the project − Taking into account the opinions of stakeholders in the formulation of options
2	Individual interviews with state structures, PAG projects and private companies	− Information of sectoral ministries and agencies − Establishment of a synergy of actions around the project
3	Consultation workshop for grassroots stakeholders	− Taking into account the different points of view of stakeholders − Free exchanges on sensitive topics such as acadjas − Taking into account the specific concerns of women in the framework of the project
4	Consultation workshop of state actors	
5	Information workshop on coherent solutions	− Collection of the opinions of experts in fishing, transport, dredging and development of the banks − Obtaining the opinion of local and governmental authorities − Collection of the opinion of specialized companies

6	Thematic workshops on areas of action	- Advice of technical experts in economics, institutionalization, environmental and social assessment, etc.
7	Working sessions and field visits for lake ports	− Good understanding of the local situation − Potential sites with investment opportunities for lake ports
8	Working sessions with the PC	− Adaptation of the holistic vision of the ARNP project in line with national policy.

6 ARNP Action Plan

This chapter describes the Action Plan for the ARNP[3] project, as well as these three areas of action and their resulting measures. These areas of action each represent a specific objective for the development and rehabilitation of Lake Nokoué and the Porto-Novo lagoon. In addition, these areas of action each represent an indicative formulation of potential implementation projects.

6.1 Development Process

The process of developing the Action Plan is led by the MCVDD through ADELAC and the ARNP Project Steering Committee.

During phase 1 of the ARNP project, five different areas of action for the development and rehabilitation of the water bodies of Greater Nokoué were presented[4]:

1. Development of river-lake transport;
2. Development of the shores of lakes and lagoons;
3. Modernization of fishing and development of fish farming;
4. Protection of ecosystems and development of tourism;
5. Development of the Cotonou channel to improve water circulation in Lake Nokoué.

During phase 2 of the ARNP project, three areas of action constituting the Action Plan were discussed and selected. Indeed, on May 3, 2022, the Steering Committee agreed that the study should develop an Action Plan based on the first four areas by combining areas 3 and 4 as follows:

Domain no.1. Development of river-lake transport; Development of banks and
Domain no.2. shallows; Promotion of fish production, ecology and tourism.
Domain no.3.

The in-depth development of the areas of action was based on the following components:

- The environmental, social and strategic diagnosis, including the state of play and trend developments;
- The six major challenges;
- The recommended solutions, including structuring measures and enhancement measures;
- Public participation.

Towards an ARNP Investment Program

The preparation in the second phase of the study goes as far as the preparation of indicative projects.
It is planned that all these projects will be combined in an Investment Program for the development and rehabilitation of Lake Nokoué and the Porto-Novo lagoon (ARNP Investment Program).

While the primary focus of the projects arising from each area is defined by area, the development of the areas showed that:

- An approach that combines remediation (or rehabilitation) with development may find its main objectives in one area, but the secondary objectives and mitigation of

[3] *For a detailed explanation of the Action Plan, see Phase 2 Report, Development and Rehabilitation of Lake Nokoué and the Porto Novo Lagoon (ARNP, Action Plan and Proposal of the First Investments, 202302 RHDHV – BI2445 D2B Benin, February 2023.*

[4] *Inception and Progress Report, 25 May 2022, RHDHV/COWI/Netics*

The impacts of each project go beyond the scope of the domain as some activities belong to other domains and will require measures that go beyond the domain as well.

- Dredging is a structuring and cross-cutting activity. The destination of the dredged sediments also facilitates the implementation of structuring measures in the three areas. It should be noted, however, that the analysis of the complete results of the study of the sediments of the lake and lagoons has not yet been finalized, so the analysis of the cost-effectiveness of measures based on dredging is still limited.
- Planning, which goes beyond structural rehabilitation alone, needs measures that accelerate socio-economic development.
- The coherence of projects within the ARNP domains, the interfaces between them and their interfaces and coordination with other projects in the area will also require policy and technical coherence.

The

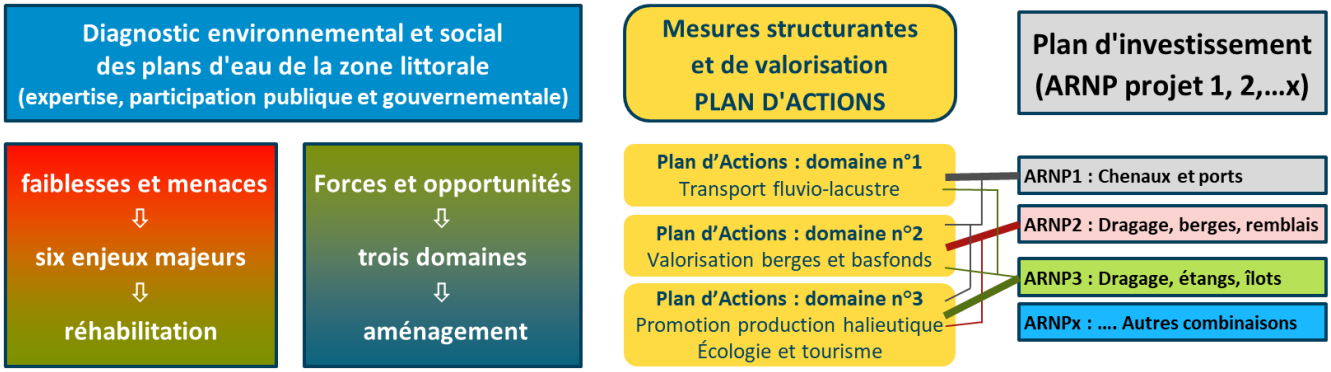


Figure 6-1 below illustrates the entire process.

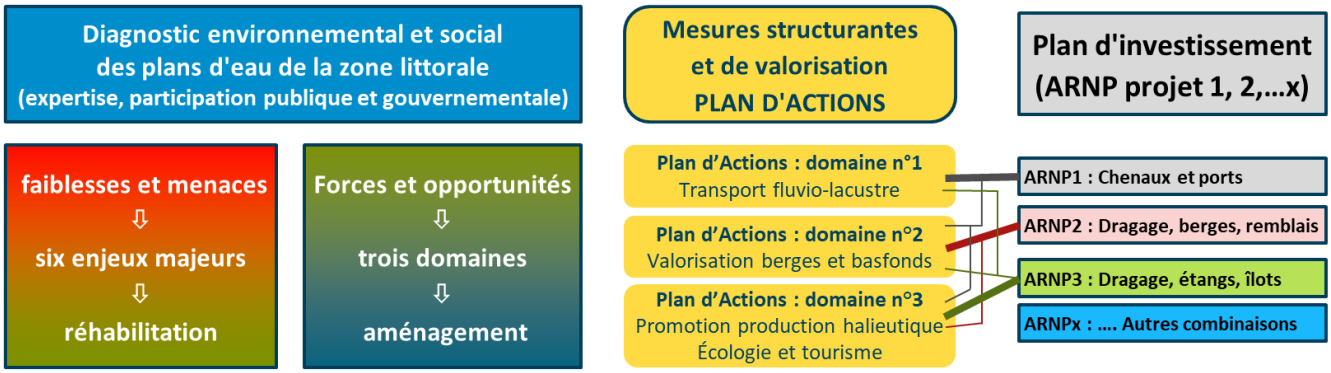


Figure 6-1: Action Plan Development Process

Each area of action is composed of a set of measures responding to the major challenges to varying degrees. The areas of action and their measures are detailed below and are the subject of this EESS.

6.2 Area of action n°1: River-lake transport

Area No. 1 focuses on a set of measures aimed at providing a solution to the current limitations of water transport, which is considered one of the main challenges for Greater Nokoué. Navigable roads on the lake

and lagoon connect production and sales centers, residential areas, and labor. It is therefore a question of developing and modernizing river-lake transport in Greater Nokoué in order to facilitate the transport of people and goods, which will contribute to the socio-economic development of the metropolitan area.

Passenger transport by shuttle will reduce travel time and traffic congestion on the roads. There are various examples around the world where passenger transport on water is a viable alternative to land transport. The system of Lake Nokoué and the lagoon of Porto-Novo provides a suitable basis for this. Port facilities are needed as well as navigation channels of sufficient depth.

The main constraints affecting river-lake transport are the following:

- The poor state of the facilities at the piers: absence of services and limited connection to the hinterland;
- The insufficient draught for high-capacity waterways in the lake and lagoon that are filled due to siltation and invasion of water bodies by water hyacinth and acadjas;
- The vertical clearance at the level of the bridges, particularly the old bridge and the current bridge in Porto Novo.

6.2.1 Creation, rehabilitation and improvement of lake harbours

Ports and terminals need to be able to accommodate much more and larger vessels and facilitate efficient and fast loading and unloading. In addition, there must be room for related activities such as passenger waiting areas, fishing-related storage and marketing activities, the transfer of goods to land transport or neighbouring markets and processing industries. These associated facilities need to be tailored to the needs of local stakeholders, with particular attention to the interests of women who carry out a large part of the activities associated with ports and terminals. Secondary piers can be considered at specific points between larger ports.

6.2.2 Connecting lake ports with the hinterland

When creating, rehabilitating and improving key ports and terminals, the physical connection to the hinterland must also be considered. This means the possible creation and/or extension of the road network and parking lots for public transport connections as well as other public services such as electricity and wastewater treatment.

6.2.3 Dredging of navigation channels

Navigation on the lake and lagoon is severely hampered by obstacles on the direct routes between ports. The shallow water bodies and the acadjas are the main obstacles. To facilitate transport on water, these obstacles must be removed or kept out of the way. Dredging is the first step. Attention will be paid to the particular situations of fishers exploiting acadjas in relation to alternative means of subsistence. Subsequent maintenance is also complex; Siltation of navigation channels is likely to recur.

6.2.4 Maintenance Dredging

Sand extraction combined with channel maintenance dredging would create a financial basis for channel maintenance. However, this will depend on the composition of the soil layer and the depth at which the sand is available. For construction and maintenance, dredging boats adapted to the characteristics of the lakes

and lagoons of Greater Nokoué are planned. The most economical options are to be chosen by private dredgers.

Figure 6-2: Technical concept of Action Area 1

6.3 Action area 2a: Shoreline development

Action Area No. 2a aims to restore the function of the banks, a transitional space between water bodies and the terrestrial environment, by integrating urban development into the development of the banks and by developing protection against lake flooding along the banks. The urbanized perimeter of the lake or lagoon will provide a buffer zone between urban activities and lake development, as seen in many modern cities located along bodies of water.

The underlying causes of flooding and a degraded living environment along the shorelines include:

- Insufficient urban drainage infrastructure, clogging, lack of maintenance of drains and low level of solid waste collection, leading to its discharge into drains;
- High water levels in the lake during the flood season reducing the discharge capacity of drains; lack of storage capacity in water bodies due to siltation, tidal influence and sea level rise that amplify water levels in the lake;
- Uncontrolled urbanization leading to the occupation of flood-prone areas and the reduction of storage and infiltration capacity due to surface hardening;
- Lack of infrastructure to protect against flooding caused by high water levels in rivers, lakes and lagoons.

6.3.1 Land Reclamation to Create Space for Urban Development

As the shores of Lake Nokoué and the Porto Novo Lagoon are shallow, they can be rehabilitated and provide opportunities for urban development such as recreation, transport, trade, ecological zones, lake and port facilities, and housing (including resettlement opportunities for internally displaced persons). In planning

measures, drainage and flood protection must be considered and guidelines developed and adhered to to ensure that land rehabilitation also contributes to the socio-economic development of communities, especially low-income communities. Land reclamation can be done using feedstock materials from the lake (e.g., reuse of dredged materials) or provided from another location. It also depends heavily on the types and quality of sediments available in the lake.

The sanitation of the banks with their accumulation of solid waste is a basic measure to create a healthy living environment.

6.3.2 Dredging

Dredging is a basic measure in this area. The starting point for this area is indeed the option of large-scale dredging for the construction of embankments offering space that will make it possible to enhance the banks. This approach is particularly applicable for the riparian area of Cotonou. As sand will be the basic material for these embankments, the areas east of Lake Nokoué are qualified for this use. The channels of Domaine n°1 are essential for the transport of sand.

Apart from sand, dredging will certainly produce clay and sediments that are not very exploitable and will have various uses: clay for the construction of dikes and fish ponds, the manufacture of bricks and for any other building material; less exploitable sediments (clayey) for the construction of islands (Domain n°3).

6.3.3 Sediment reclamation and infrastructure construction

The reclamation of land outside the banks offers important opportunities for the use of dredged sediments (possibly after treatment) and for the construction of infrastructure. Indeed, the construction of infrastructure can be facilitated by the recovery of dredged sediments in the form of construction materials, which will contribute to urban development near the banks. In addition, economic synergies should be sought with ongoing dredging projects or new dredging initiatives in order to increase the possibilities of valorization of dredged sediments.

Figure 6-3: Technical concept Action area 2

6.4 Action area 2b: Lowland development

The development of the lowlands remains uncertain for the moment. These spaces will at least remain "green lungs" in a predominantly urban area, providing opportunities for recreation and entertainment, and for water drainage and storage as part of the urban drainage system. In theory, the restoration of an old situation, with more open valleys with an unfilled watercourse, could open up a perspective in terms of water transport to Lake Nokoué. The lowlands also have potential for agriculture and aquaculture. Currently, these areas are largely so overgrown and silted that these options can only be far away. Nevertheless, these areas already function as green areas with their own ecosystems that need to be integrated as much as possible into all future plans.

This results in a very strong desire to map the problems and opportunities for solutions in order to formulate a vision of the territory and develop an action plan. The implementation of the development of the lowlands is the subject of studies within the framework of the PNVV project with the participation of the Municipality of Porto Novo and the Rehabilitation Agency of the city of Porto Novo.

6.5 Action Area 3: Promotion of Fish Production, Ecology and Tourism

The Action Area n°3 aims to restore the productive function of Lake Nokoué and the Porto-Novo lagoon and their ecological value (RAMSAR site). It focuses on:

- The protection and enhancement of existing ecosystems;
- The strengthening of their ecosystem services such as fisheries (with shrimp as an example) and aquaculture, but also tourism, flood protection and a pleasant living environment.

This package of measures is strongly linked to the vision of the DPH which seeks to flourish the fisheries and aquaculture sector and to benefit recreation and tourism from the intrinsic value of the coast, the lake, its culture, wetlands and other ecological areas. Even though the ecosystem is under multiple pressures, Lake Nokoué and the Porto Novo Lagoon still contain multiple sites of significant ecological importance. These values must be protected and enhanced to enhance the ecosystem services they provide.

The main constraints affecting the existing ecological values are the following:

- Overfishing due to high demand;
- Eutrophication and low dissolved oxygen levels due to the high influx of nutrients and minerals from human activities and water hyacinths;
- The storage of nutrients and minerals in the siltation layers on the lake and lagoon bottom;
- Loss of self-cleaning capacity due to continuous filling;
- Changes in the ecosystem caused by the excessive use of acadjas;
- The loss of spawning grounds and nurseries under human pressure;
- Encroachment on protected areas;
- In general, because of all the degradation, the decrease in biodiversity.

6.5.1 Development of fisheries production

Acadjas have been officially banned by law since 2014 but have not yet been systematically removed from Lake Nokoué. Their elimination will benefit the ecosystem and is necessary for the implementation of several proposed measures in action areas 1 and 2.

The transition to a sustainable type of aquaculture is not simple. Eligible farmers of the acadjas should be offered alternative livelihoods. In the PROMAC program, the DPH (and AfDB) foresees the possibility of providing an alternative livelihood by establishing sustainable aquaculture farms in areas specifically designated for this purpose. This policy focuses mainly on fish ponds.

What the ARNP project can provide is the dredged equipment for the construction of fish ponds. Dredging for shipping channels and for sand from embankments will help to end the use of acadja for fish production and replace it with sustainable fish farming methods. The options proposed by the ARNP project therefore strengthen the DPH's desire to develop the entire fisheries production chain.

A thorough knowledge of current dependencies on acadjas is needed to determine who would be eligible for livelihood support. The design of a sustainable aquaculture system (locations, types, ownership, etc.) will be a complex and iterative process, which will require detailed information on the environmental and social factors influencing the success of such a design as well as extensive stakeholder participation.

6.5.2 Valorization of clay sediments: fish ponds and ecological islands

In terms of volumes of commercial value, the main purpose of dredging is the production of sand. The by-product of this activity is clay of different qualities, the exploitation of which will remain a challenge, especially when they are polluted or the particle size distribution does not allow for direct reuse. Dredged clay sediments will have two specific uses that will directly contribute to the objectives of projects in this area.

Fish ponds

For the construction of fish ponds, good quality clays will be necessary to guarantee the impermeability of the ponds and the construction of small dikes between the different ponds.

Artificial ecological islands

The creation of artificial islands can be a solution to reuse dredged sediments such as clay and mud. Various techniques can be applied to do this, but an example can be to create an outer shoreline with sediment-filled geotubes and use the area surrounded by these tubes as a sediment removal deposit. As sediments are reused in their original environment, the quality of the sediments is likely to be the same as that of sediments already present and, therefore, negative ecological impacts are less. Once an island is completed, it can be colonized by nature, for example as a bird island.

6.5.3 Restoration of mangroves and other ecosystems

Mangroves are an important breeding ground and an ecological "hot spot". Various small-scale initiatives exist to restore mangroves. Lessons learned from these initiatives should be used to explore the possibility of restoring mangroves on a larger scale, particularly around artificial islands.

Figure 6-4: Technical concept Action area 3

7 Evaluation Multi-criteria analysis

This chapter presents the Multi-Criteria Analysis (MCA) of the three action areas and their measures. The CMA is an integral part of the project's HSEA. The methodology is described below and then the results of the CMA are presented.

7.1 Methodology

The multidisciplinary evaluation of the action areas, the weighting chosen, as well as the scores assigned to each action area are based on the results of the project's public participation, the series of workshops held, the exchanges with experts and those with the ministries and national agencies concerned and on the experience of the group of Consultants. The methodology consists of 4 steps:

- Indicators
- Weighting
- Scoring
- Justification

7.1.1 Indicators

The AMC indicators were defined on the basis of the performance standards of the IFC (International Legal Framework (EESS), as well as on the state of play. As such, they reflect the characteristics of the ARNP project and simultaneously ensure the assessment and inclusion of key environmental, social, institutional and technical aspects in the development of the action areas and their measures. The indicators were first developed during the first phase of the project and presented at the CMA public participation workshop. The results of this workshop, as well as the environmental, social and strategic diagnosis, made it possible to refine the indicators so that they are as much as possible adapted to the ARNP project.

The indicators have been divided into four categories and are presented and explained in Table 7-1 below.

Table 7-1: Description of CMA Indicators

No.	Indicators	Explanation
Social and environmental		
1	Local labour needs	Local labour opportunities during construction and operation
2	Efficiency and potential for reuse of (natural) resources used	Availability and efficiency of (natural) resources required for the implementation of the policy area as well as the potential for reuse of these resources
3	Local and regional economic living environment and livelihoods	Improvement of the economic living environment and contribution of the field of action to the livelihoods of local communities and the Greater Nokoué region in general

No.	Indicators	Explanation
4	Flood safety	Contribution of the action area to flood safety
5	Food security	Contribution of the policy area to food security
6	Pollution and natural living environment	Improvement of the natural living environment and contribution of the action area to pollution reduction and a healthy environment
7	Physical and economic relocation	Resettlement of people or their economic activities due to the implementation of the policy area, including vulnerable groups
8	Ecology	Positive or negative impacts of the policy area on ecology and ecosystem services in the short, medium and long term
9	Cultural heritage	Positive or negative impacts of the policy area on cultural heritage
10	Adaptability and resilience	To what extent can the policy area cope with external pressures such as climate change, population growth, etc.? ?
Institutional		
11	Capacity requirements	Are capacity needs required to implement the action area, and if so, which ones? Do the existing institutional structures sufficiently meet the needs of the policy area?
12	Legislative Structure and Enforcement	Does the existing legislative structure, including law enforcement, meet the needs of the policy area?
13	Land/Land Ownership	Does the area of action require the acquisition of land and if so, who owns it?
14	Dependence & synergy	To what extent does the success of the action area depend on the successful implementation of other initiatives or projects? Does the area of action create synergy with ongoing initiatives/projects?
Participation		
15	Institutional Stakeholder Support	Level of support from institutional stakeholders to the policy area
16	Local Support	Level of support (expected) from communities close to the implementation area

No.	Indicators	Explanation
17	Alignment with PAG2 and other government plans	Level of compliance of the action area with the objectives and projects of PAG 2 and other government plans and policies related to sustainable development
Technical		
18	Constructability	To what extent is it technically realistic to build/build the infrastructure components of the action area?
19	Maintenance complexity	How complex is the maintenance of the solution once the action area is implemented?
20	Environmental capability	To what extent does the action area align with the existing physical system and is it able to manage (or benefit from) natural dynamics now and in the future

7.1.2 Weighting

The weighting assigned to each indicator varies between 4 and 8%. It is presented in Table 7-2 below.

Table 7-2: Weighting of AMC Indicators

No.	Indicators	Weighting
Social and environmental		
1	Local labour needs	4%
2	Efficiency and potential for reuse of (natural) resources used	8%
3	Local and regional economic living environment and livelihoods	8%
4	Flood safety	4%
5	Food security	4%
6	Pollution and natural living environment	8%
7	Physical and economic relocation	8%
8	Ecology	8%
9	Cultural heritage	4%
10	Adaptability and resilience	4%
Institutional		

No.	Indicators	Weighting
11	Capacity requirements	4%
12	Legislative Structure and Enforcement	4%
13	Land/Land Ownership	4%
14	Dependence & synergy	4%
Participation		
15	Institutional Stakeholder Support	4%
16	Local Support	4%
17	Alignment with PAG2 and other government plans	4%
Technical		
18	Constructability	4%
19	Maintenance complexity	4%
20	Environmental capability	4%
Total weighting 100%		

7.1.3 Scoring

The notation used varies between 1 and 5. In the event that an indicator is not applicable, i.e. without scope on the field of action, an NA rating is given. When an indicator cannot be scored because the required information does not exist or is not yet finalized, an IN rating is given.

Table 7-3: Rating of CMA Indicators

Rating	Note
Very positive	5
Positive	4
Neutral	3
Negative	2
Very negative	1
Not applicable	NA
Unknown	IN

7.1.4 Rationale

In addition to the rating of the indicators by area of action, a detailed justification is given for each indicator.

7.2 AMC Results

Table 7-4 below presents the individual scores for each indicator by policy area as well as the final weighted score for each policy area.

As a result,

- All areas contribute significantly to the improvement of the economic environment and livelihoods, as well as to the generation of jobs;
- Areas 2a and 3 make a significant contribution to ecology and to the improvement of the natural living environment, and therefore to a reduction in pollution;
- All domains except domain 2a contribute strongly to food security;
- Each area contributes, in varying ways, to physical and/or economic resettlement;
- The cultural heritage, with the exception of domain 2a, is unknown and will have to be identified before any work is carried out;
- All areas require more or less institutional planning;
- The level of support from local stakeholders is insufficiently known for Area 2
- All areas are aligned with PAG2 or other government plans;
- Domains 1 and 2b have a less complex constructability than domains 2a and 3;
- Domain 1 and in particular domain 2 probably have a significant impact on the residents and owners of the acadjas.
- All areas have a more or less high environmental capability.

As a result, each area of action has its own impacts and will require different support and monitoring measures. It is important to take this into account in the next phase of project planning ARNP.

The rating assigned to each indicator by action area as well as the rationale is detailed in Table 7-5, Table 7-6, Table 7-7 and Table 7-8: AMC Results Action Area 3 below and in the following paragraphs.

Table 7-4: AMC Overall Results

#	Indicators	Weighting	Rating			
			Action area 1: Improvement of river-lake transport	Action area N°2a: Shoreline development	Area of action N°2b: Development of lowlands	Action area N°3: Promotion of fish production, ecology and tourism
	Social and environmental					
1	Local labour needs	4%	5	4	4	4
2	Efficiency and potential for reuse of (natural) resources used	8%	4	4	1	3
3	Local and regional economic living environment and livelihoods	8%	4	4	4	4
4	Flood safety	4%	NA	5	4	NA
5	Food security	4%	4	NA	4	4
6	Pollution and natural living environment	8%	3	4	3	4
7	Physical and economic relocation	8%	2	1	3	2
8	Ecology	8%	2	4	1	4
9	Cultural heritage	4%	IN	2	IN	IN
10	Adaptability and resilience	4%	3	5	4	4
	Institutional					
11	Capacity requirements	4%	2	2	2	2
12	Legislative Structure and Enforcement	4%	2	2	2	3
13	Land/Land Ownership	4%	2	2	1	3
14	Dependence & synergy	4%	3	4	2	3
	Participation					
15	Institutional Stakeholder Support	4%	4	4	IN	4
16	Local Support	4%	4	IN	IN	NA
17	Alignment with PAG2 and other government plans	4%	4	4	3	4
	Technical					
18	Constructability	4%	4	1	4	2
19	Maintenance complexity	4%	2	3	2	2
20	Environmental capability	4%	2	3	3	4
	Total weighting:	***100%***				
		Final Note:	**2,84**	**3,00**	**2,36**	**2,92**

7.2.1 Action area 1: River-lake transport

The area of action of river-lake transport includes the improvement of river-lake transport of passengers and goods by dredging navigation channels, the rehabilitation and creation of lake ports and their connections with the hinterland.

Table 7-5: AMC Results Action Area 1

#	Indicators	Rating	
		Action area 1: Improvement of river-lake transport	Justification
	Social and environmental		
1	Local labour needs	5	There are opportunities for the local workforce through this solution as the workforce will be needed during both the construction and operational phases.
2	Efficiency and potential for reuse of (natural) resources used	4	The need for natural resources will be limited because it is mainly sand dredging which will probably be dredged by dredging the channels between Porto-Novo and Cotonou, if not in the vicinity of these channels. Resources for port development can be obtained partially locally or regionally (sand, riprap) but iron for the quays will have to be imported. The potential for reuse will depend on the type of sediment made available by dredging. For example, the sand can be reused in projects around the lake or sold on the sand market. Other sediments can be reused in the creation of artificial islands or riverbanks or for fish ponds, for example, or processed and sold.
3	Local and regional economic living environment and livelihoods	4	If local interests are taken into account in the modernisation of lake ports, local communities will be able to benefit significantly. If improving lake transportation is a viable alternative to other transportation options, the regional economy can also improve, resulting in improved livelihoods and an improved economic living environment throughout the region. Additionally, the development of modern transportation options can improve the overall sense of a good economic living environment around the lake.
4	Flood safety	NA	
5	Food security	4	This area of action can facilitate the transport of food products and thus improve food security.
6	Pollution and natural living environment	3	For the construction of lake ports, the banks will be cleaned up. However, the natural living environment near ports could decrease if economic activity increases, resulting in more pollution.
7	Physical and economic relocation	2	Land acquisition and physical resettlement should be minor, although it cannot be ruled out that this may be necessary in the vicinity of ports to be developed or modernized. Some economic resettlement is also planned because of the kidnapping of the acadjas.
8	Ecology	2	Increased lake transport is likely to have immediate negative ecological impacts, but in the longer term cleaning of shipping lanes is likely to have some positive impacts. Protected areas should be avoided at all times by shipping lanes.
9	Cultural heritage	IN	At present, the data relating to cultural heritage are not sufficiently known and will have to be studied in depth before any work is carried out.

#	Indicators	Rating	
		Action area 1: Improvement of river-lake transport	Justification
10	Adaptability and resilience	3	The increasing and projected increase in population will lead to new needs for decongestion. This area of action can serve as a basis for further investments. If electric passenger transport is included, it will make this set of solutions even more future-proof. However, this remains conditional on capacity, financial and institutional needs.
	Institutional		
11	Capacity requirements	2	To carry out activities in this area of action, an organisation is needed that closely follows the construction and introduces new regulations and measures. In principle, this could be coordinated by Adelac, with a reinforcement of its team. In addition, parts of this area of action may be the responsibility of the Department of Transport (MIT), which has already developed similar plans. However, there are also other Ministries and Directorates involved (DPH, Tourism, etc.) to be integrated. The management and ownership of lake ports (e.g. by a port authority) therefore requires special attention. The activity will require a highly regulated logistical organization, which can be quite complicated.
12	Legislative Structure and Enforcement	2	A basic legislative structure exists to regulate transport and port operations, but capacity needs to be improved to ensure their proper functioning, as well as a new legislative framework that regulates new activities in this area of action. The participation of the Ministry of the Interior/Justice will also be required. The implementation of the law on the acadjas is currently a challenge that is not easy to solve.
13	Land/Land Ownership	2	Land ownership and title could pose challenges.
14	Dependence & synergy	3	The success of this area of action depends on the development of the Greater Nokoué region as a trade hub and the role that water transport can play in it. It also depends on the need for residents to commute between different urban areas around bodies of water. In addition, it is dependent on the evolution (or lack of) developments in road transport. Nevertheless, given the current situation with traffic jams every morning and evening, given the population growth around Lake Nokoué expected in the coming decades, the number of trips will increase considerably and the need for transport routes (which is already high) will also increase. Finally, the interest of the private sector in investing in water transport is essential. On the other hand, this field can also attract investment, thus creating synergy with these developments. There is a certain synergy with existing projects, such as the rehabilitation of the port of Abomey-Calavi as part of the "Reinventing the lakeside town of Ganvié" project. The development of a good transport road on the water between Porto-Novo and Cotonou also depends on the construction of a new bridge over the Porto-Novo lagoon because the current bridge is too low.
	Participation		
15	Institutional Stakeholder Support	4	The Ministry of Transport (MIT), which is a member of the CP, is strongly in favour of this area of action. In addition, the stakeholder workshops showed that other government institutions and key stakeholders (the private sector) also view this area of action favourably.

#	Indicators	Rating	
		Action area 1: Improvement of river-lake transport	Justification
16	Local Support	4	On-the-ground consultations with stakeholders show that dredging shipping channels is a solution that local communities and communal administrations strongly support. However, concern persists about the kidnapping of the acadjas.
17	Alignment with PAG2 and other government plans	4	is not formally aligned with the PAG2, but lake transport is considered important by many at a high level of government and is on the agenda of some ministries, including the MIT.
	Technical		
18	Constructability	4	The construction of lake channels and harbours is not technically complicated. Port development and dredging are relatively expensive because of the lake's bottom, which is sometimes very clayey but technically feasible.
19	Maintenance complexity	2	The navigation routes will require recurrent maintenance because the dynamics of Lake Nokoué ensure regular silting. The frequency of maintenance will depend on morphology, sedimentation rates, and sediment runoff from upstream rivers and can be complex. As a result, it will probably be necessary to dredge the channels to a depth of 1 to 2 meters further so as not to obtain too high a maintenance frequency. More space may be required to dispose of unused dredged sediment. In addition, the blocking of navigation routes by water hyacinth is complex to prevent and can lead to a higher cost and a significant demand for organization.
20	Environmental capability	2	Although the lake and lagoon offer significant potential for lake transport, the existing dynamics of sedimentation and the growth of water hyacinth do not benefit this solution.

7.2.2 Action Area 2a: Shoreline Development

The area of action of riverbank development includes the development of banks by dredging and land rehabilitation in order to facilitate urban development and make way for new infrastructure (leisure, hotels, housing and shops).

Table 7-6: AMC Results Action Area 2a

#	Indicators	Rating	
		Action area N°2a: Shoreline development	Justification
	Social and environmental		
1	Local labour needs	4	There are great opportunities for the local workforce with this solution as the workforce will be needed during both the construction and operational phases.
2	Efficiency and potential for reuse of (natural) resources used	4	Sand dredging on Lake Nokoué offers the natural resources required for this field of action. Some of the dredged sediments will be reused directly in shoreline development and land reclamation. This offers an opportunity for the circular use of resources by partly ensuring a local supply of the necessary resources.
3	Local and regional economic living environment and livelihoods	4	This area of action partially improves local livelihoods as there will be a high demand for labour during construction. The opportunities for building new infrastructure (tourism, housing) and adequate urban development offered by shoreline development and land reclamation improve the regional economy and the economic living environment, in particular by creating new jobs.
4	Flood safety	5	This area of action makes a significant contribution to flood safety.
5	Food security	NA	
6	Pollution and natural living environment	4	The natural living environment will be improved thanks to this area of action. Reclamation begins with the removal of mud and solid waste. Indeed, it contributes to a healthier living environment (less waste and therefore pollution), and less flooding through the protection offered by land restoration and shoreline development. In addition, new infrastructure (house, hotels, building, etc.) will be obliged to follow recent environmental standards and will therefore no longer contribute to the pollution of the banks.
7	Physical and economic relocation	1	To achieve this area of action, resettlements (physical and economic) will have to take place. It is very important to ensure that resettlements offer positive prospects for those affected.
8	Ecology	4	Negative impacts on the ecology during the construction phase are expected due to the backfilling, but in the longer term the expected impacts will be positive (less stagnant water, less waste, better water quality).
9	Cultural heritage	2	At present, data relating to cultural heritage are not sufficiently known and will have to be studied in depth before any work is carried out. However, the houses on stilts on the banks are already recognized as part of the cultural heritage and measures will have to be taken accordingly to protect them.

#	Indicators	Rating	
		Action area N°2a: Shoreline development	Justification
10	Adaptability and resilience	5	Well-planned shorelines contribute to long-term resilience against sea-level rise. By adding 1 meter of sand, the city of Cotonou is protected until 2100 against flooding from Lake Nokoué.
	Institutional		
11	Capacity requirements	2	Existing government structures will need to be strengthened in some aspects as well as cooperation between different ministries and institutions. Engineering capacity needs will be required, but also in planning.
12	Legislative Structure and Enforcement	2	A basic legislative structure exists, however the application of the law needs to be strengthened. The rules concerning dredging companies will have to be checked and adapted if necessary.
13	Land/Land Ownership	2	Although much of the proposed shoreline is in locations where there is state-owned lake water, there is also a long portion of the shoreline where ownership is unclear. Land ownership and title could pose challenges.
14	Dependence & synergy	4	This area of action is in synergy with the Northern Bypass and the ongoing rainwater sanitation programmes.
	Participation		
15	Institutional Stakeholder Support	4	The municipal administrations of Cotonou, Abomey-Calavi and Porto-Novo are (already) priority stakeholders in this area because these new protective banks must be integrated into the existing urban infrastructure. The ministries in charge and other agencies are involved in the decision-making process in this area of action as members of the PC.
16	Local Support	IN	
17	Alignment with PAG2 and other government plans	4	This area of action is very well aligned with the PAG2 and other government plans.
	Technical		
18	Constructability	1	The constructability of this area presents quite significant technical difficulties due to the clay layers present, which will be a challenge to obtain a situation where infrastructure can be built. Cleaning and treating waste already in the water is also a challenge.
19	Maintenance complexity	3	In principle, if the construction phase is done well, maintenance becomes relatively simple.
20	Environmental capability	3	Although part of the surface of Lake Nokoué will become land, this area of action meets the needs for the development of the banks for the future (flood control, return of biodiversity, population growth, etc.) However, this is also conditional on waste treatment, which must be integrated into the technical design of this area of action in order to improve the environment.

7.2.3 Action area 2b: Lowland management

The area of action for the development of lowlands includes the restoration of drainage functions, dredging, removal of plants, development of edges for intensive agriculture and fish ponds, construction of infrastructure (tourism, restaurants, etc.) and transport by boat to Lake Ahémé.

Table 7-7: AMC Results Action Area 2b

#	Indicators	Rating	
		Area of action N°2b: Development of lowlands	Justification
	Social and environmental		
1	Local labour needs	4	In the long term, this area creates labour opportunities as it creates opportunities for fish farming, agriculture and tourism.
2	Efficiency and potential for reuse of (natural) resources used	1	The work required to develop and remediate the lowlands, including dredging and remediation works, offers very little opportunity for the reuse of dredged sediments because the risk of sediment pollution is very high and in addition there will probably be large quantities of solid waste.
3	Local and regional economic living environment and livelihoods	4	Food security is increased through fish farming and agriculture; In addition, this area of action allows for urban development, improves transport and tourism opportunities, etc.
4	Flood safety	4	By cleaning the "5 fingers", upstream flooding will in principle reduce considerably in these areas. If the drainage of the watercourse downstream towards Lake Nokoué (parallel to the Cotonou – Ouidah national road) has been well calculated and carried out, the risk of flooding will be practically nihil.
5	Food security	4	In the long term, once the lowlands have been cleaned up, this area of action creates opportunities for more fish farming and agriculture.
6	Pollution and natural living environment	3	The remediation works improve the natural environment and reduce pollution in the short term because the lowlands are cleaned and remediated. However, after the cleaning, the waterways in the lowlands will be able to transport waste (especially plastic and other solid waste) which will flow into Lake Nokoué and then into the sea. .
7	Physical and economic relocation	3	In principle, this area of action does not give rise to resettlement.
8	Ecology	1	The ecology and biodiversity of the lowlands will be negatively affected by this area of action. There is probably an interesting ecological system because the lowlands have not been exploited for decades.
9	Cultural heritage	IN	At present, the data relating to cultural heritage are not sufficiently known and will have to be studied in depth before any work is carried out.
10	Adaptability and resilience	4	With the right maintenance measures, this area of action is adapted to future urban and climatic developments.
	Institutional		
11	Capacity requirements	2	Existing structures will need to be strengthened in certain aspects as well as cooperation between different ministries and institutions.

#	Indicators	Rating	
		Area of action N°2b: Development of lowlands	Justification
12	Legislative Structure and Enforcement	2	A basic legislative structure exists, however the application of the law needs to be strengthened.
13	Land/Land Ownership	1	Land ownership and title could pose challenges.
14	Dependence & synergy	2	The realisation of this area of action depends in part on the Godomey Bridge, as this bridge is too low to accommodate transport boats.
	Participation		
15	Institutional Stakeholder Support	IN	
16	Local Support	IN	
17	Alignment with PAG2 and other government plans	3	The development of the lowlands is aligned with the government's plans (PNVV, Greening Grand Nokoué). Its analysis and planning remain to be done.
	Technical		
18	Constructability	4	There are no technical hurdles planned.
19	Maintenance complexity	2	The current degraded state is proof of the difficulties of maintenance.
20	Environmental capability	3	As "green lungs" with little occupation in a (semi)urban area, there is potential to contribute to a healthy environment by making appropriate use of the current ecosystem.

7.2.4 Action area 3: Promotion of fisheries production, ecology and tourism

The field of actions of fisheries production and ecosystems includes the improvement of fish production and ecosystems through the development of fish farming, the protection of ecosystems by the enlargement of the depth of the lake and the lagoon, the construction of ecological islands and the reintroduction of mangroves. These activities are also expected to improve the tourism sector.

Table 7-8: AMC Results Action Area 3

#	Indicators	Rating	
		Action area N°3: Promotion of fish production, ecology and tourism	Justification
	Social and environmental		
1	Local labour needs	4	There are opportunities for the local workforce through this solution as the workforce will be needed both during the construction and operational phases.
2	Efficiency and potential for reuse of (natural) resources used	3	The dredging undertaken in action areas 1 and 2 provides the natural resources required for this action area. The dredged sediments will be reused directly in the creation of the islands. The increase in the water level in the lake (created by dredging) will benefit the aquaculture system and biodiversity. The large quantity of sediments dredged in action areas 1 and 2 can be difficult to use, especially when they are polluted[5] or when the characteristics of the dredged material do not allow for reuse or direct sale. One solution is the reuse of these sediments, especially clay, to create artificial islands.
3	Local and regional economic living environment and livelihoods	4	This area of action provides long-term employment and therefore improves the local economy and livelihoods. In the medium term, this area of action can lead to more tourism, which improves the regional economy and livelihoods.
4	Flood safety	NA	This is conditional on the replanting of mangroves which offers soil stabilization.
5	Food security	4	Food security is expected to increase in the medium term, but this remains conditional on the harvest generated by fish production.
6	Pollution and natural living environment	4	The natural living environment will be improved by strengthening ecosystems (islands/mangroves and deeper) and sustainable fish production, as well as the economic living environment in the medium/long term.
7	Physical and economic relocation	2	Some economic resettlement is planned due to the abduction of the acadjas.
8	Ecology	4	This area of action improves ecosystems and the biodiversity present, in particular mangroves offering a refuge and a place of production for fish, artificial islands offering a refuge for birds, etc. from

[5] *We are awaiting the results of soil and mud tests.*

#	Indicators	Rating	
		Action area N°3: Promotion of fish production, ecology and tourism	Justification
			furthermore, this area of action contributes to the RAMSAR values, aimed at restoring and protecting sites of important ecological values.
9	Cultural heritage	IN	At present, the data relating to cultural heritage are not sufficiently known and will have to be studied in depth before any work is carried out.
10	Adaptability and resilience	4	This area of action is resilient because it uses natural and circular solutions, and increases fish production, which is necessary for the expected increase in population. In the design of ecological islands, it is important to consider the rise of sea level.
	Institutional		
11	Capacity requirements	2	Strong long-term expertise needs will be required, particularly on the fisheries production chain and on the creation of artificial islands with geotubes and for the maintenance of these infrastructures.
12	Legislative Structure and Enforcement	3	A basic legislative structure exists but additions will potentially be required regulating aquaculture and the classification of islands as protected areas. The rules concerning dredging companies will have to be checked and adapted if necessary.
13	Land/Land Ownership	3	All the land required for the construction of ecological islands belongs to the state. But, nevertheless, there is the possibility that people will settle on the islands shortly after construction, which can lead to land problems.
14	Dependence & synergy	3	There is a strong synergy with the other two areas because these measures (especially the ecological islands) will be built with the part of the dredged sediments (clay) offering few other possibilities of use.
	Participation		
15	Institutional Stakeholder Support	4	The ministries in charge and other agencies are involved in the decision-making process in this area of action as members of the PC. In addition, the stakeholder workshops showed that other institutions and key stakeholders also view this area of action favourably.
16	Local Support	NA	
17	Alignment with PAG2 and other government plans	4	This area of action is very well aligned with the PAG2.
	Technical		
18	Constructability	2	The constructability of this area presents significant planning challenges that are extremely important for the realisation of the action area. Ecosystem-based planning in this area includes: o the stabilization and restoration of the banks through the planting of mangroves, o the construction of artificial islands (protected areas) with dredged sediments from the measurements of action areas 1 and 2, o the fisheries production chain, o the location and operation of a sustainable aquaculture system (locations, types, ownership, etc.).

#	Indicators	Rating	
		Action area N°3: Promotion of fish production, ecology and tourism	Justification
			This will be a complex and iterative planning process, which requires detailed information on the environmental and social factors influencing the success of such a design as well as extensive stakeholder participation.
19	Maintenance complexity	2	The maintenance for this area must be defined in the long term because before the islands become stable and attract birds by offering them refuges, and a sustainable aquaculture system develops, it will take a good number of years.
20	Environmental capability	4	This area of action lends itself to the existing environment by providing a refuge for birds in the form of protected artificial islands, healthy ecosystems (return of mangroves, shoreline stabilization) and improved but sustainable fish production.

8 Environmental and Social Impact Assessment

This chapter presents a high-level identification of the potential environmental and social impacts of the three areas of action and their measures. Only significant potential negative impacts are considered in this assessment. Potential impacts are ranked using the International Finance Corporation's (IFC) Environmental and Social Sustainability Performance Standards (PS).

This impact assessment provides a preliminary baseline framework for the potential environmental and social impacts of the three action areas to be considered in the preparation of the ESIA for each project in the next phase.

8.1 SFI Performance Standards

The International Finance Corporation's (IFC) Environmental and Social Sustainability Performance Standards are guidelines for identifying risks and impacts. They have been designed to help avoid, mitigate and manage risks and impacts in order to continue these activities in a sustainable manner. There are 8 SFI Performance Standards (SFI NPs), which are listed in Table 8-1 below. Excerpts from it are presented at the end of the table.

Table 8-1: SF Performance Standards

#	NP SFI
1	**Assessment and management of environmental and social risks and impacts**
2	**Workforce and working conditions**
3	**Resource efficiency and pollution prevention**
4	**Community Health, Safety and Security**
5	**Land acquisition and involuntary resettlement**
6	**Conservation of biodiversity and sustainable management of living natural resources**
7	**Indigenous Peoples**
8	**Cultural heritage**

- Performance Standard 1: **Assessment and Management of Environmental and Social Risks and Impacts**

Performance Standard 1 emphasizes the importance of managing the environmental and social performance of a project throughout its lifetime. To be effective, an Environmental and Social Management System (ESMS) must ensure the continuation of a dynamic and continuous process, set up and supported by the management team and which involves the commitment between the client, its workers, the local communities directly affected by the project (the Affected Communities) and, where applicable, other stakeholders.

This performance standard, at the current stage of the ARNP project (pre-feasibility), is not currently applicable and therefore is not considered in the assessment of potential environmental and social impacts.

- Performance Standard 2: **Labour and Working Conditions**

Performance Standard 2 recognizes that the pursuit of economic growth through job and income creation must be balanced with the protection of workers' fundamental rights. The workforce is a valuable asset for any company, and sound management of relations with workers is an essential factor in the sustainability of the company. Failure to establish and promote sound management of the relationship between management/organization in charge and workers can compromise worker engagement and retention as well as the success of a project. Conversely, through a constructive relationship between workers and management, the fair treatment of workers, and the guarantee of safe and healthy working conditions, customers can create tangible benefits, such as improving the efficiency and productivity of their operations.

The requirements set out in this Performance Standard have been guided in part by a number of international conventions and instruments, including those of the International Labour Organization (ILO) and the United Nations (UN).

- Performance Standard 3: **Resource Efficiency and Pollution Prevention**

Performance Standard 3 recognizes that increased economic activity and urbanization often generate increased levels of air, water and soil pollution and consume resources that are not inexhaustible. This situation could pose a threat to people and the environment at the local, regional and global levels. It is also recognized globally that current and projected concentrations of greenhouse gases (GHGs) in the atmosphere threaten public health and the well-being of present and future generations. At the same time, techniques and practices for more efficient and resource-efficient use, pollution prevention and GHG emission reductions are becoming more accessible and feasible virtually everywhere in the world. These techniques and practices are often implemented through continuous improvement methods similar to those used to improve quality or productivity and are generally well known by most companies in the industrial, agricultural and service sectors.

This Performance Standard defines an approach to resource efficiency, pollution prevention and control at the project level, consistent with internationally available technologies and practices. In addition, this standard promotes the ability of private sector companies to adopt such technologies and practices, to the extent that their use is practical in the context of a project that relies on commercially available skills and resources.

- Performance Standard 4: **Community Health, Safety and Security**

Performance Standard 4 recognizes that the activities, equipment and infrastructure associated with a project can increase the risks and impacts to communities. In addition, communities already experiencing the effects of climate change may experience an acceleration and/or intensification of these effects as a result of project activities. While recognizing the role of public authorities in promoting the health, safety and security of populations, this Performance Standard covers the client's responsibility to prevent or minimize risks or effects on the health, safety and security of communities that may result from activities related to its project, with a particular focus on vulnerable groups.

- Performance Standard 5: **Land Acquisition and Involuntary Resettlement**

Performance Standard 5 recognizes that land acquisition and project use restrictions can have negative impacts on the people and communities who use that land. These are mainly vulnerable groups such as women, fishmongers, fishermen, market gardeners and young people. Involuntary relocation refers to both physical displacement (relocation or loss of shelter) and economic displacement (loss of assets or access to assets resulting in a loss of source of income or livelihood) as a result of land acquisition and/or land use restrictions related to the project. Resettlement is considered involuntary when affected individuals or communities do not have the right to refuse that the acquisition of their land or restrictions on the use of their land result in physical or economic displacement. This situation arises in the following cases: (i) legal expropriation or permanent or temporary restrictions on land use; and (ii) negotiated transactions in which the buyer may resort to expropriation or impose legal restrictions on land use if negotiations with the seller fail.

If not properly managed, involuntary resettlement can lead to long-lasting consequences and impoverishment of affected people and communities, as well as environmental damage and social tension in the areas to which these populations have been displaced. For these reasons, involuntary relocations should be avoided. While involuntary resettlement is unavoidable, appropriate measures to minimize negative impacts on displaced persons and host communities must be carefully prepared and implemented. The government often plays a central role in the land acquisition and resettlement process, including the determination of compensation, and is therefore an important third party in many situations. Experience shows that direct client involvement in resettlement activities can lead to cost-effective, efficient and timely implementation of these activities, as well as innovative approaches to improving the livelihoods of those affected.

To help avoid expropriations and eliminate the need for government enforcement to enforce relocation, clients are encouraged to use negotiated settlements that meet the requirements of this Performance Standard, even if they have the legal means to acquire the land without the seller's consent.

- Performance Standard 6: **Conservation of Biodiversity and Sustainable Management of Living Natural Resources**

Performance Standard 6 recognizes that the protection and conservation of biodiversity, the maintenance of ecosystem services and the sustainable management of living natural resources are of paramount

importance for sustainable development. The requirements presented in this Performance Standard are based on the Convention on Biological Diversity, which defines biodiversity as "the variability of living organisms in all kinds of ecosystems, including terrestrial, marine and aquatic, and the ecological complexes of which they are part; This includes diversity within species, between species and ecosystems. ».

Ecosystem services are the benefits that people, as well as businesses, derive from ecosystems. Ecosystem services are grouped into four types: (i) provisioning services, which are the products provided to people by ecosystems; (ii) regulatory services, which are the benefits that people receive through regulation attributable to ecosystem processes; (iii) cultural services, which are the non-material benefits that people derive from ecosystems; and (iv) support services, which are the natural processes that maintain other services.

Ecosystem services valued by humans are often made possible by biodiversity and, as such, impacts on biodiversity can often adversely affect the provision of these services. This Performance Standard addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the lifecycle of a project.

- Performance Standard 7: **Indigenous Peoples**

Performance Standard 7 recognizes that Indigenous Peoples, as social groups with different identities from dominant groups within national societies, are often among the most marginalized and vulnerable segments of the population. Their economic, social and legal status often hampers their ability to defend their interests and rights to lands and natural and cultural resources, and can limit their ability to participate in and benefit from development. Indigenous Peoples are particularly affected if their lands and resources are transformed, encroached upon by outsiders or significantly degraded. Their languages, cultures, religions, spiritual beliefs and institutions may also be threatened. As a result, Indigenous Peoples may be more vulnerable to adverse impacts associated with a project than in the case of non-Indigenous communities. This vulnerability can include the loss of identity, culture and livelihoods based on natural resources and can also include impoverishment and the occurrence of diseases.

Private sector projects can create opportunities for Indigenous Peoples to participate in and benefit from project-related activities while meeting their aspirations in terms of economic and social development. In addition, indigenous peoples can play a role in sustainable development by promoting and managing activities and businesses as development partners. Similarly, governments often play a central role in managing Indigenous Peoples' issues, and clients must therefore collaborate with the appropriate authorities in managing the risks and impacts of their activities1

- Performance Standard 8: **Cultural Heritage**

Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. In accordance with the Convention Concerning the Protection of the World Cultural and Natural Heritage, the objective of this Performance Standard is to protect cultural heritage and to assist clients in doing the same in their business activities. In addition, the requirements of this Performance Standard for the use of cultural heritage by projects are based in part on the standards set out in the Convention on Biological Diversity.

8.2 Impact assessment for Action Area 1: River-lake transport

This area aims to improve the river-lake transport of passengers and goods through the dredging of navigation channels, the rehabilitation and creation of lake ports and their connections with the hinterland. Table 8-2 provides an overview of environmental and social (E&S) impacts at a strategic level.

Table 8-2: High-level assessment of the E&S impacts of Action Area and Measures 1

#	NP SFI	Potential impacts
2	**Workforce and working conditions**	Unsafe working conditions during the construction and operation of ports.
		Unsafe working conditions during dredging work.
		Involuntary, compulsory or child labour in port operations.
3	**Resource efficiency and pollution prevention**	Pollution from port activities entering water bodies.
		(temporary) increase in turbidity in the waters and suspension of organic matter during dredging work. Depending on the sediments (structure of the particles), the suspension can also have medium-term effects.
		Contaminated dredged material, including heavy metals, pollution of water bodies.
		Increased pollution due to increased traffic on new road networks.
4	**Community Health, Safety and Security**	Community disruption due to the influx of workers for the construction or operation phase of ports.
5	**Land acquisition and involuntary resettlement**	Physical and economic relocation to make room for port development.
		Economic resettlement of owners and users of acadjas and fish sellers (fishmongers), to make room for navigation channels.
		(temporary) disruption of the livelihoods of groups dependent on access to water and ports such as fishermen, youth, vendors, smugglers, tour guides, etc.
6	**Conservation of biodiversity and sustainable management of living natural resources**	Disruption of ecological values during dredging work, including an increase in the water column.
		Disturbance of macro-invertebrates due to dredging work.
		(Temporary) disturbance of fish species due to noise and vibration caused by dredging work.

#	NP SFI	Potential impacts
		Disturbance of lake flora due to increased turbidity caused by dredging work.
		Disturbance of terrestrial flora and fauna due to the expansion of the road network.
		Disruption of ecological values due to increased river traffic.
7	**Indigenous Peoples**	Unknown
8	**Cultural heritage**	Unknown

8.3 Impact assessment for Action Area 2a: Shoreline development

This estate aims to develop the banks by dredging and rehabilitating the land in order to facilitate urban development and make way for new infrastructure (leisure, hotels, housing and shops). Table 8-3 provides an overview of environmental and social (E&S) impacts at a strategic level.

Table 8-3: High-level assessment of the E&S impacts of Action Area and Actions 2a

#	NP SFI	Potential impacts
2	**Workforce and working conditions**	Unsafe working conditions.
3	**Resource efficiency and pollution prevention**	Shoreline pollution entering the lake or reclamation work during land reclamation.
		Contaminated sediment pollution during land reclamation activities.
		Contaminated dredged material, including heavy metals, pollution of water bodies.
		(temporary) increase in turbidity in the waters and suspension of organic matter during dredging work. Depending on the sediments (structure of the particles), the suspension can also have medium-term effects.
4	**Community Health, Safety and Security**	Community disruption due to the influx of workers during the creation of land reclamations.
		Unsafe living conditions along the riverbanks due to ongoing reclamation work.
		Reduced access to domestic water for lake-dependent communities affected by developments.
		Civil unrest and a sense of uncertainty with communities affected by projects.
5	**Land acquisition and involuntary resettlement**	Physical and economic relocation along the riverbank to make room for land reclamation work.
		Economic resettlement of acadja owners and users to make room for land reclamation.
6	**Conservation of biodiversity and sustainable management of living natural resources**	Disturbance of ecological values during dredging work, including an increase in the water column.
		Disturbance of macro-invertebrates due to dredging work.
		(Temporary) disturbance of fish species due to noise and vibration caused by dredging work.
		Disturbance of lake flora due to increased turbidity caused by dredging work.

#	NP SFI	Potential impacts
		Disruption (temporary) of ecological values along the shoreline due to land reclamation work.
		Unsustainable sand extraction due to large amounts of resources required for land reclamation work.
7	**Indigenous Peoples**	Unknown.
8	**Cultural heritage**	Loss of traditional stilt houses along the shores where land reclamation is being carried out.

8.4 Impact assessment for Action Area 2b: Lowland Development

This area aims to restore the drainage function, dredging, removal of plants, development of edges for intensive agriculture and fish ponds, construction of infrastructure (tourism, restaurants, etc.) and transport by boat to Lake Ahémé. Table 8-4 provides an overview of environmental and social (E&S) impacts at a strategic level.

Table 8-4: High-level assessment of the E&S impacts of Action Area and Measures 2b

#	NP SFI	Potential impacts
2	**Workforce and working conditions**	Unsafe working conditions.
3	**Resource efficiency and pollution prevention**	Increase and dispersion of pollution and solid waste from upstream to downstream in water bodies during works.
4	**Community Health, Safety and Security**	Community disruption due to the influx of workers during land reclamation.
		Civil unrest and a sense of uncertainty with communities affected by projects.
		Physical and economic relocation within the lowlands to make room for development work.
5	Land acquisition and involuntary resettlement	Physical and cost-effective relocation along the shoreline to make room for reclamation work
		Physical and economic relocation within the lowlands to make room for development work
		Economic resettlement of Acadjas owners and users to make room for land reclamation
		(Temporary) disruption of the livelihoods of groups dependent on access to the lowlands

#	NP SFI	Potential impacts
6	**Conservation of biodiversity and sustainable management of living natural resources**	Ongoing disruption of ecological values and biodiversity during dredging (including an increase in the water column) and during redevelopment work.
		Unsustainable sand extraction due to large amounts of resources required for land reclamation work
7	**Indigenous Peoples**	Unknown
8	**Cultural heritage**	Unknown

8.5 Impact assessment for Action Area 3: Promotion of Fish Production, Ecology and Tourism

This area aims to improve fisheries production and ecosystems through the development of fish farming, the protection of ecosystems through the deepening of the lake and lagoon, the construction of ecological islands and the reintroduction of mangroves. These activities are also expected to improve the tourism sector.
Table 8-5 provides an overview of environmental and social (E&S) impacts at the strategic level.

Table 8-5: High-level assessment of the E&S impacts of Action Area and Actions 3

#	IFC PS	Potential impacts
2	**Workforce and working conditions**	Unsafe working conditions during the creation of artificial islands, mangroves
3	**Resource efficiency and pollution prevention**	Pollution by contaminated sediments, including heavy metals, water bodies in the creation of artificial islands
		Water pollution from aquaculture practices in designated areas
4	**Community Health, Safety and Security**	Civil unrest and a sense of uncertainty with communities (mainly owners and users of acadjas) affected by the project
5	**Land acquisition and involuntary resettlement**	Economic resettlement of owners and users of acadjas and fish sellers (fishmongers), to make room for navigation channels.
6	**Conservation of biodiversity and sustainable management of living natural resources**	(Transient) disturbances of ecological values during the creation of artificial islands
		Eutrophication of the lake environment due to the activities of aquaculture farms

7	**Indigenous Peoples**	Unknown
8	**Cultural heritage**	Unknown

9 Environmental and Social Management Framework Plan

This chapter presents, as required by Decree 2022-390 Article 14, the necessary conditions and/or follow-up measures, to be carried out before implementing each measure.

This chapter complements the previous chapter by describing the conditions and/or follow-up measures necessary for future projects arising from the action areas, each of which will be subject to an ESIA. This chapter therefore offers a reference framework of conditions to be taken into account in the preparation of the ESIA of projects in the next phase. .

9.1 Conditions for Action Area 1: River-Lake Transport

Table 9-1: Conditions and framework for ESIA action area 1

#	Measurements	Conditions
1	Creation, rehabilitation and improvement of lake ports	• A comprehensive sociological study of residents and homeowners in the area's area of influence; the study focuses on vulnerable groups, including women, fishmongers, fishers, market gardeners and youth. • Depending on the results of the sociological study, an Action Plan for the Resettlement of the Populations and/or a Livelihood Recovery Plan. • A geotechnical study to assess constructability. • An environmental study to assess the nature and quantity of solid waste to be removed and treated. • A study of the terrestrial fauna and flora on the sites concerned • A hydrodynamic study of the impact on water currents in Lake Nokoué and the Porto-Novo lagoon. • A census of cultural heritage.
2	Connecting lake ports with the hinterland	• A study of the flow of traffic and transport in order to estimate the possible increase in congestion and pollution around the lake port sites. • A study assessing the effects of the expansion of the road network on the environment.
3	Dredging of navigation channels	• A detailed soil survey on the planned routes to define the type of materials (physico-chemical analyses); assess the quality of the dredged materials, contamination rates and their potential for reuse. • A study of macro-invertebrates. • A study of aquatic fauna and flora. • A study identifying potential sites for the storage of dredged material. • A sociological study identifying the location of the acadjas and who owns them and, depending on the results, a Livelihood Recovery Plan.
4	Maintenance Dredging	• An annual soil quality monitoring program.

9.2 Conditions for Action Area 2a: Shoreline Development

Table 9-2: ESIA conditions and framework Action area 2a

#	Measurements	Conditions
1	Land reclamation to create space for urban development	• A complete sociological and land study listing the residents and owners of homes in the area of influence of the estate. The study focuses on vulnerable groups, including women, fishmongers, fishers, market gardeners and youth. • Depending on the results of the sociological study, an Action Plan for the Resettlement of the Populations and/or a Livelihood Recovery Plan. • A geotechnical study to assess constructability. • An environmental study to assess the nature and quantity of solid waste to be removed and treated. • A hydrodynamic study to assess the impact of bank extensions on water currents on Lake Nokoué. • A study of terrestrial fauna and flora. • A study of macro-invertebrates. • A study of aquatic fauna and flora. • A census of cultural heritage.
2	Dredging	• A detailed study of the soil on the planned routes in order to define the type of materials (physico-chemical analyses); evaluate the quality of the dredged materials and their potential for reuse. • A study of macro-invertebrates, aquatic fauna and flora. • A study identifying potential sites for the storage of dredged material, depending on the type of material (in particular clay and silt). • A sociological and land study identifying the location of the acadjas and to whom they belong, and depending on the results, a Livelihood Recovery Plan.
3	Valorisation of dredged sediments and construction of infrastructure	• A complete sociological and land study listing the residents and owners of homes in the area of influence of the estate. • Depending on the results of the sociological study, an Action Plan for the Resettlement of the Populations and/or a Livelihood Recovery Plan. • A study of terrestrial fauna and flora. • A census of cultural heritage. • A geotechnical study to assess constructability.

9.3 Conditions for Action Area 2b: Lowland Development

This area of action requires above all a complete inventory of the situation, as has been done for the other areas.

Table 9-3: ESIA conditions and framework Action area n°2b

#	Measurements	Conditions
1	Development of the lowlands	Study on the state of play and trend developments and analysis: • A topographical study. • A soil study. • A hydrological study. • A study on solid waste. • A morphological study. • A study on terrestrial and aquatic fauna and flora • A socio-economic study. The study focuses on vulnerable groups, including women, fishmongers, fishers, market gardeners and youth.
2	Planning	Formulation of a clear vision and development strategy

9.4 Conditions for Action Area 3: Promotion of Fish Production, Ecology and Tourism

Table 9-4: ESIA conditions and framework for action area 3

#	Measurements	Conditions
1	Development of fish production	• A study assessing the environmental effects of fish farming on the environment, in particular water quality and aquatic fauna and flora. • A sociological and land study identifying the location of the acadjas and to whom they belong, and depending on the results, a Livelihood Recovery Plan. The study focuses on vulnerable groups, including women, fishmongers, fishers, market gardeners and youth.
2	Valorization of clay sediments: fish ponds and ecological islands	• A complete ecological study (terrestrial and aquatic fauna and flora) of artificial islands and their constructability. • A geotechnical study. • A hydrodynamic study. • A sociological and land study identifying the location of the acadjas and to whom they belong, and depending on the results, a Livelihood Recovery Plan.
3	Restoration of mangroves and other ecosystems	• A complete ecological study (terrestrial and aquatic fauna and flora) of the artificial islands and their constructability. • A hydrodynamic study. • A sociological and land study identifying the location of the acadjas and to whom they belong, and depending on the results, a Livelihood Recovery Plan.

REFERENCES

[01]. Report Public Participation Plan Preparatory Studies for the Development and Rehabilitation of Lake Nokoué and the Porto-Novo Lagoon, Benin, RHDHV, February 16, 2022.

[02]. Report Development and Rehabilitations of Lake Nokoué and the Porto-Novo Lagoon. Identification of problems and potential solutions with stakeholders "Tour du lac" RHDHV, 03 February 2022