



ADAPTATION FUND

AFB/PPRC.12/8
17 June 2013

Adaptation Fund Board
Project and Programme Review Committee
Twelfth Meeting
Bonn, Germany, 1-2 July 2013

Agenda Item 4 e)

PROPOSAL FOR BENIN

I. Background

1. The Operational Policies and Guidelines (OPG) for Parties to Access Resources from the Adaptation Fund (the Fund), adopted by the Adaptation Fund Board (the Board), state in paragraph 42 that regular adaptation project and programme proposals, i.e. those that request funding exceeding US\$ 1 million, would undergo either a one-step, or a two-step approval process. In case of the one-step process, the proponent would directly submit a fully-developed project proposal. In the two-step process, the proponent would first submit a brief project concept, which would be reviewed by the Project and Programme Review Committee (PPRC) and would have to receive the endorsement of the Board. In the second step, the fully-developed project/programme document would be reviewed by the PPRC, and would ultimately require the Board's approval.

2. The Templates approved by the Board (OPG, Annex 3) do not include a separate template for project and programme concepts but provide that these are to be submitted using the project and programme proposal template. The section on Adaptation Fund Project Review Criteria states:

For regular projects using the two-step approval process, only the first four criteria will be applied when reviewing the 1st step for regular project concept. In addition, the information provided in the 1st step approval process with respect to the review criteria for the regular project concept could be less detailed than the information in the request for approval template submitted at the 2nd step approval process. Furthermore, a final project document is required for regular projects for the 2nd step approval, in addition to the approval template.

3. The first four criteria mentioned above are:

1. Country Eligibility,
2. Project Eligibility,
3. Resource Availability, and
4. Eligibility of NIE/MIE.

4. The fifth criterion, applied when reviewing a fully-developed project document, is:

5. Implementation Arrangements.

5. In its seventeenth meeting, the Board decided (Decision B.17/7) to approve "Instructions for preparing a request for project or programme funding from the Adaptation Fund", contained in the Annex to document AFB/PPRC.8/4, which further outlines applicable review criteria for both concepts and fully-developed proposals.

6. Based on the Board Decision B.9/2, the first call for project and programme proposals was issued and an invitation letter to eligible Parties to submit project and programme proposals to the Fund was sent out on April 8, 2010.

7. According to the Board Decision B.12/10, a project or programme proposal needs to be received by the secretariat no less than nine weeks before a Board meeting, in order to be considered by the Board in that meeting.

8. The following fully developed project titled "Adaptation of the Cotonou Lagoon ecosystems and human communities to sea level rise and extreme weather events impacts" was submitted by the National Environment Fund (FNE), which is the National Implementing Entity of the Adaptation Fund for Benin. This is the second submission of the project. It was first submitted as a project concept, using the two-step approval process, for the seventeenth Board meeting and the Board decided to:

- (a) *Endorse the project concept, as supplemented by the clarification response provided by the Fonds National Pour L'Environnement (FNE) to the request made by the technical review;*
- (b) *Request that the secretariat transmit to FNE the following observations:*
- (i) *The targeted private sector stakeholders should be consulted and proof of their engagement in the process should be provided;*
 - (ii) *The linkage between the five expected results, or “outcomes”, of the project should be clarified further;*
 - (iii) *The project’s “objective”, as currently stated, is too broad and could rather be defined as the “goal” of the project. For the sake of clarity the fully-developed project document should present a main project objective that would reflect that linkage, in addition to providing five specific objectives;*
 - (iv) *The fully-developed project document should provide more accurate data on the expected economic benefits and the targeted gender groups that would benefit from the project;*
 - (v) *The final concrete adaptation options chosen for this project should be provided (if a combination of “hard” and “soft” infrastructures is chosen) and the costs adjusted accordingly;*
 - (vi) *The fully-developed project document should provide a table which listed the relevant past and existing initiatives, and explained the expected synergies and complementarities with the proposed project or the best practices that will be replicated through it; and*
 - (vii) *The activities described in the “knowledge management” section should be reflected in the specific outputs or outcomes of the project and therefore be described in the “components and financing” and the “results framework” tables of the fully-developed project document.*
- (c) *Request FNE to transmit the observations referred to under item (c) above to the Government of Benin; and*
- (d) *Encourage the Government of Benin to submit through FNE a fully-developed project proposal that would address the observations made under paragraph (c) above.*

(Decision B.17/8)

9. The current submission of a fully-developed project document was received by the secretariat in time to be considered in the twenty-first Board meeting. The secretariat carried out a technical review of the project proposal, assigned it the diary number BEN/NIE/Coastal/2012/1, and completed a review sheet.

10. In accordance with a request to the secretariat made by the Board in its 10th meeting, the secretariat shared this review sheet with FNE, and offered it the opportunity of providing responses before the review sheet was sent to the PPRC.

11. The secretariat is submitting to the PPRC the summary and, pursuant to decision B.17/15, the final technical review of the project, both prepared by the secretariat, along with the final submission of the proposal in the following section.

Annex I. Project Summary

Benin – Adaptation of Cotonou Lagoon ecosystems and human communities to sea level rise and extreme weather events impacts

Implementing Entity: *FNE*

Project/Programme Execution Cost: USD 792,000

Total Project/Programme Cost: USD 8,347,000

Implementing Fee: USD 709,000

Financing Requested: USD 9,056,000

Project/Programme Background and Context: The Cotonou channel commonly referred to as *Cotonou lagoon*, with a length of 4.5 km, an average width, of 300 m, and a depth of 5 to 10 m, is at the heart of an area of major human activities, including an international market, the Government welfare and administrative offices, the private companies in the sectors of Hotel industry and catering, home-made dyeing and fisheries, inland water transports of persons and goods.

As the consequence of this intense human activity along the shores and within the lagoon, it has been subject to major environmental issues, including pollution and physical erosion of the shores. These environmental problems are likely to worsen with the rise in sea water level and the extreme weather events (mainly the floods, the long-term drought and hurricanes). The proposed project concept seeks to reduce the vulnerability of Cotonou's lagoon, along which key economic and socio-administrative infrastructures are established, to climate risks.

The project presents two components:

1. Protection of lagoon banks, struggle against seasonal floods and catering for socio-community infrastructures ;
2. Integration of climate variability in environment management by the waterside populations and capitalization of the project experiences.

Component 1: Protection of lagoon banks, struggle against seasonal floods and catering for socio-community infrastructures (USD 6,840,000)

Through this component, appropriate actions will be implemented to protect the banks and shores of the lagoon of Cotonou through a set of actions of anti-erosion fight, restoration and improvement of riparian social and community infrastructures threatened by sea level rise and extreme climate phenomena (floods, violent winds, increased surface temperatures, prolonged droughts), but also the anthropogenic pressure on banks and shores not maintained due to a lack of economic interest for local authorities. These actions include protection of the lagoon banks with rocky coating, the rehabilitation of Cotonou's dam and the development of pedestrian paved roads along the banks to stabilize the lagoon shores.

Component 2: Integration of climate variability in environment management by the waterside populations and capitalization of the project experiences (USD 715,000)

This second component will implement appropriate actions to significantly reduce the pollution of the lagoon environment by solid and liquid wastes. The degradation and lack of maintenance of the lagoon banks and shores have facilitated the invasion of such spaces by household and industrial wastes and their colonization by illicit activities of all kinds, sources of nuisance to the public health, which must be overcome. This component will also support

raising the awareness of the private sector for promoting floating bars and restaurants with a pedestrian access bridge, nautical sports, promenades in canoe and rowing boat, aquatic gardens. Local stakeholders are also expected to generate financial resources from the utilization of the new infrastructures for their own activities, which would partially support the maintenance of those infrastructures. Appropriate laws and provisions in force regulating fishing activities will be revised to take into account constraints linked to climate change. The improvement of the livelihoods of local fishermen communities will be supported through the promotion of new economic activities generated by the development of the banks of the lagoon of Cotonou. Finally, this component will help raise awareness of local communities on climate risks, adaptation techniques and good practices necessary for safeguarding the ecosystem, the human system and their own interests, and to limit the adverse impacts at a level compatible with their legitimate ambitions of economic and social development.



ADAPTATION FUND

ADAPTATION FUND BOARD SECRETARIAT TECHNICAL REVIEW OF PROJECT/PROGRAMME PROPOSAL

PROJECT/PROGRAMME CATEGORY: Regular-sized Project

Country/Region: **Benin**

Project Title: **Adaptation of the Cotonou Lagoon ecosystems and human communities to sea level rise and extreme weather events impacts**

AF Project ID: **BEN/NIE/Coastal/2012/1**

NEI/MEI Project ID:

Regular Project Concept Approval Date: **15 March 2012**

Reviewer and contact person: **Daouda Ndiaye**

NIE/MIE Contact Person:

Requested Financing from Adaptation Fund (US Dollars): **\$9,056,000**

Anticipated Submission of final RP document (if applicable):

Co-reviewer(s): **Charlotte Gobin**

Review Criteria	Questions	Comments on 16 May 2013	Comments on 7 June 2013
Country Eligibility	1. Is the country party to the Kyoto Protocol?	Yes.	
	2. Is the country a developing country particularly vulnerable to the adverse effects of climate change?	Yes. Benin is particularly vulnerable to sea level rise, flooding, drought, blustery winds, and increase in the sea surface temperature (TSM)	
Project Eligibility	1. Has the designated government authority for the Adaptation Fund endorsed the project/programme?	Yes.	

	<p>2. Does the project / programme support concrete adaptation actions to assist the country in addressing adaptive capacity to the adverse effects of climate change and build in climate resilience?</p>	<p>Yes. However it is not clear if the choice of infrastructures under component 1 results solely from the consultation with relevant stakeholders or if it is also based on sound technical studies or assessment of the suitability of similar structures already existing in Benin, for preventing the lagoon against risks of land erosion, flood and sea level rise.</p> <p>CR1: More information on the past trends and projected climate scenarios which are related to the threats to the lagoon ecosystem should be provided under section 1.1. "Climate context on the coastal zone of Cotonou". Such information can be found in the annex document "Rapport Berges Vulnérabilité".</p> <p>CR2: The adaptation measures under component 1 should be further detailed in Part II.A of the document and the technical rationale for the choice of infrastructures should be explained, based on specific studies or existing experiences of their use in Benin. It is not clear if the rocky coating, though cost effective, is the best solution to sustainably protect the lagoon banks from erosion. Also, the adaptation benefits of the paved roads need to be demonstrated based on scientific documentation.</p> <p>CR3: The activities to be implemented under component 2 are not clearly described in the document, and they are presented in a piecemeal manner. As an introduction to this component, the proponent should explain how those activities, as a whole, will reduce the pressure on the lagoon ecosystem and contribute to its climate resilience.</p>	<p>CR1: Addressed.</p> <p>CR2: Partially addressed. The scientific justification regarding the choice of rocky coating is not provided. The stakeholder consultation is important but should not constitute the only source of information for the decision on this technical issue. Furthermore, it is noted that the option chosen may have an impact on the hydraulic regime and may destabilize the upstream shore.</p> <p>CR3: Not addressed. No quantitative information is given on how the proposed activities would reduce the pressure on the lagoon ecosystem. The rationale to addressing fisheries management is still weak. The proposal does not provide information on the alternative livelihood that could be developed. Even at this early stage, a list of potential activities could be provided.</p>
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	3. Does the project / programme provide economic, social and environmental benefits, particularly to vulnerable communities, including gender considerations?	Yes.	
	4. Is the project / programme cost effective?	Yes.	

	5. Is the project / programme consistent with national or sub-national sustainable development strategies, national or sub-national development plans, poverty reduction strategies, national communications and adaptation programs of action and other relevant instruments?	Yes.	
	6. Does the project / programme meet the relevant national technical standards, where applicable?	Yes. The project will comply with national and sub-regional standards, including EIA and other standards validated by the Benin Centre for Standardization and Quality Management (CEBENOR).	

	<p>7. Is there duplication of project / programme with other funding sources?</p>	<p>Although there is no duplication of the “concrete” activities which will be implemented through this project, it is not clear if some duplication could not exist with the other initiatives such as the World Bank or DFID-funded projects PUGEMU and PUGC3C, respectively, in aspects related to awareness raising, training or local planning for instance. Finally, the expected synergies and complementarities with other initiatives are not clearly described. CR4: As requested in Board Decision B17.8 endorsing the concept document for this project, please provide a table which lists the relevant past and existing initiatives, and explains the expected synergies and complementarities with the proposed project or the best practices that will be replicated through it. CR5: Also, please confirm that there is no project related to the fishing sector that could be either duplicating or be complementary to this project. CR6: Finally, please outline any possible synergies with other adaptation projects, i.e. GEF-funded projects “Integrated Adaptation Programme to Combat the Effects of Climate Change on Agricultural Production and Food Security” and “Strengthening Climate Information and Early Warning Systems in Western and Central Africa for Climate Resilient Development and Adaptation to Climate Change – Benin” to be implemented by UNDP, or the project “Flood Control and Climate resilience of agriculture infrastructures in Oueme Valley- Benin” which is under preparation and which has been submitted to the GEF by the African Development Bank.</p>	<p>CR4: Addressed.</p> <p>CR5: Addressed.</p> <p>CR6: Addressed.</p>
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	8. Does the project / programme have a learning and knowledge management component to capture and feedback lessons?	Yes.	
	9. Has a consultative process taken place, and has it involved all key stakeholders, and vulnerable groups, including gender considerations?	Yes. However, the outcomes of the consultation with the private sector are not explained.	
	10. Is the requested financing justified on the basis of full cost of adaptation reasoning?	Yes.	
	11. Is the project / program aligned with AF's results framework?	Yes. The project objectives are aligned with the Fund's outcomes 4 and 7.	
	12. Has the sustainability of the project/programme outcomes been taken into account when designing the project?	Yes. However the engagement of the major private sector stakeholders, particularly in meeting part of the costs of maintenance of the infrastructures which will be crucial to ensure the sustainability of the project's outcomes, has not been demonstrated. CR7: Please demonstrate the engagement of the major private sector stakeholders in the process. For instance, letters of intent signed by SOGEMA, the Cotonou Port Authority or Dantokpa Market, are not provided. CR8: Given the importance of mobilizing the relevant stakeholders in ensuring the sustainability of the project outcomes, the establishment of the <i>Network of stakeholders for the monitoring of activities and field outcomes</i> , its institutionalization, including local and	CR7: Addressed. CR8: Not addressed.

		national government bodies, private entities as well as CSOs and community groups, and its efficiency should be monitored under the project results framework.	
Resource Availability	1. Is the requested project / programme funding within the cap of the country?	Yes. The total requested budget is \$9,056,000.	
	2. Is the Implementing Entity Management Fee at or below 8.5 per cent of the total project/programme budget before the fee?	Yes. The IE fees are set at 8.49% of the total project budget.	
	3. Are the Project/Programme Execution Costs at or below 9.5 per cent of the total project/programme budget (including the fee)?	Yes. The execution costs are set at 9.49% of the total project budget.	
Eligibility of NIE/MIE	4. Is the project/programme submitted through an eligible NIE/MIE that has been accredited by the Board?	Yes. FNE is an accredited NIE.	
Implementation Arrangement	1. Is there adequate arrangement for project / programme management?	Not clear. CR9: The role of FNE as the implementing entity with the main fiduciary and monitoring responsibilities for this project, should be clarified. It is not clear what the management agreement to be signed with the Directorate General of Environment entails. CR10: Please clarify, and provide a figure schematizing it, the linkages and roles of the different executing/implementing bodies.	CR9: Addressed. CR10: Addressed.

	2. Are there measures for financial and project/programme risk management?	Yes. However, see CR above on the responsibilities for monitoring and mitigating those risks, and on the difference between implementation and execution bodies.	
	3. Is a budget on the Implementing Entity Management Fee use included?	Yes.	
	4. Is an explanation and a breakdown of the execution costs included?	Yes. However, please explain the cost items “Support for the waterside Districts” and “Cost of outsourcing of the technical support”. Please refer to Board document AFB/EFC.4/07/Rev.1. Desk Study on Execution Costs, for more information on the costs covered by the execution costs budget. CR11	CR11: Addressed.
	5. Is a detailed budget including budget notes included?	Yes. However, the budget notes are incomplete. CAR3: Please complete the budget notes from C7.1 to C8.4. CR12: Please justify the organization of workshops, which costs include consultant fees, under Component 1 (sub-components 1 to 5). CR13: Please explain under sub-component 1 the cost related to “Development of the call for tender technical documents for stream bank stabilization” CR14: Please provide details on the initial grants under sub-component 7 (see CR3)	CAR3: Addressed. CR12: Not addressed. The number of workshops and related consultants are not justified and could be substantially reduced. CR13: Addressed. CR14: Addressed.
	6. Are arrangements for monitoring and evaluation clearly defined, including budgeted M&E plans and sex-disaggregated data, targets and indicators?	Yes. However, the costs of mid-term and final evaluations seem quite high, i.e. 35,000 and 45,000 USD respectively. Please justify such amounts, or revise to 20,000 USD each, which the usual average cost. CR15	CR15: Not addressed.

	7. Does the M&E Framework include a break-down of how implementing entity IE fees will be utilized in the supervision of the M&E function?	Yes.	
	8. Does the project/programme's results framework align with the AF's results framework? Does it include at least one core outcome indicator from the Fund's results framework?	Not clear. CR16: Please provide a completed results framework alignment table. CR17: The output targets of the project results framework should be aligned with the indicators, to allow for an effective monitoring of its achievement. As it is presented, these target objectives can be assimilated to activities. CR18: Please consider including health related indicator to monitor the effectiveness of pollution-reduction activities in the lagoon.	CR16: Not addressed. CR17: Not addressed. CR18: Not addressed.
	9. Is a disbursement schedule with time-bound milestones included?	Yes. However, there seems to be a mistake in the presentation of the columns. Is a disbursement expected upon signature of the agreement, and then a subsequent one at Year 2 (which is the equivalent of "one year after project start")? If yes, please correct the table accordingly. CAR4.	CAR4: Almost addressed. The amount requested upon agreement seems very high, knowing the usual delays in project implementation during year 1.

Technical Summary	<p>Benin's capital Cotonou, bordering the Atlantic Ocean, is particularly vulnerable to sea level rise, flooding, drought and hurricanes. The project seeks to reduce the vulnerability of Cotonou's lagoon, along which key economic and socio-administrative infrastructures are established, to climate risks. The lagoon is already subject to major environmental problems which are likely to worsen with climate change and variability.</p> <p>The project presents two components to achieve its objective(s):</p> <ol style="list-style-type: none"> 1. Protection of lagoon banks, struggle against seasonal floods and catering for socio-community infrastructures ; 2. Integration of climate variability in environment management by the waterside populations and capitalization of the project experiences. <p>The project will implement appropriate actions to protect the banks and shores of the Cotonou lagoon through a set of</p>
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actions aiming at fighting soil erosion, the restoration and improvement of riparian social and community infrastructures threatened by the rise of the sea level and extreme climate events. The project will also back up the revision of laws and provisions to enforce fishing activities regulation and mainstream adaptation to climate change into this sector. It is also expected that the new economic activities generated by the development of the banks of the Cotonou lagoon will create alternative livelihoods to local fishermen. Finally, the project will Implement appropriate actions to fight against the pollution of the lagoon and the living environment of populations by solid and liquid wastes, which was exacerbated by the degradation and lack of maintenance of the lagoon banks and shores.

This is the second submission of this proposal. It was first submitted as a concept and was endorsed. The initial technical review found that further clarification was needed on many issues, including the technical rationale for the choice of infrastructure, the institutional set up to ensure the sustainability of the proposed works, the engagement of the major private entities operating around the lagoon, the role of FNE as an NIE and the possible complementarities and synergies with other projects. Consequently eighteen clarification and four corrective action requests were made.

The proponent has revised the proposal following the observations made by the secretariat. However, a few issues remain, mainly related to the scientific justification regarding the choice of rocky coating, the rationale for addressing fisheries management, the project's results framework, the lack of AF alignment table, the evaluation costs and the disbursement schedule.

Therefore, the following observations are made:

- a) The scientific justification regarding the choice of rocky coating is not provided. The stakeholder consultation is important but should not constitute the only source of information for the decision on this technical issue. Furthermore, it is noted that the option chosen may have an impact on the hydraulic regime and may destabilize the upstream shore.
- b) No quantitative information is given on how the proposed activities would reduce the pressure on the lagoon ecosystem. The rationale to addressing fisheries management is still weak. The proposal does not provide information on the alternative livelihood that could be developed. Even at this early stage, a list of potential activities could be provided. Finally, the proposal to support 75 people in giving them 2,000\$ has to be clarified. Grant to people without clear objective and framework has poor chance to succeed.
- c) Overall, the project should focus on a set of activities which have a robust ability to adverse effects of climate change.

	<ul style="list-style-type: none">d) Given the importance of mobilizing the relevant stakeholders in ensuring the sustainability of the project outcomes, an indicator to measure the effectiveness of the establishment of the Network of stakeholders for the monitoring of activities and field outcomes, its institutionalization, including local and national government bodies, private entities as well as CSOs and community groups, should be included in the project results framework.e) The project total budget should be revised to take into account the following issues: (i) the number of workshops and related consultants under Component 1 (sub-components 1 to 5) are not justified and could be substantially reduced and (ii) the costs of mid-term and final evaluations seem quite high, i.e. 35,000 and 45,000 USD respectively, and should be revised to 20,000 USD each, which the usual average cost.f) A completed Adaptation Fund results framework alignment table should be provided (https://www.adaptation-fund.org/page/results-framework-alignment-table) and output targets of the project results framework should be aligned with the indicators, to allow for an effective monitoring of its achievement.g) The amount requested in the disbursement schedule, i.e. US\$ 4,552,600, to be disbursed upon signature of the agreement seems very high and needs to be justified, knowing the usual delays in project implementation during year 1.
Date:	7 June 2013.



PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT INFORMATION

PROJECT CATEGORY:	REGULAR PROJECT
COUNTRY/IES:	BENIN
TITLE OF PROJECT/PROGRAMME:	ADAPTATION OF COTONOU LAGOON ECOSYSTEMS AND HUMAN COMMUNITIES TO SEA LEVEL RISE AND EXTREME WEATHER EVENTS IMPACTS
TYPE OF IMPLEMENTING ENTITY:	NATIONAL IMPLEMENTING ENTITY
IMPLEMENTING ENTITY:	FONDS NATIONAL POUR L'ENVIRONNEMENT (FNE)
EXECUTING ENTITY/IES:	DGE (DIRECTORATE OF ENVIRONMENT OF BENIN), MUNICIPALITY OF COTONOU, NGO, COMMUNITY ASSOCIATIONS.
AMOUNT OF FINANCING REQUESTED:	US\$ 9,016,000 (in U.S Dollars Equivalent)

PROJECT BACKGROUND AND CONTEXT:

Benin ratified the United Nations Framework Convention on climate change on June 30th, 1994 and the Kyoto protocol on February 25th, 2002.

With a total population of 9,6 million Inhabitants in 2012, and 115,762 km², the monetary poverty affecting 40.3% of its population in 2006 / 2007 (INSAE, 2008), a human development index of 0.435 in 2010, and a Gross Domestic Product (GDP) below the minimum required rate of 7% for achieving the Millennium Development Goals (MDG), Benin still has numerous challenges to struggle with as part of the various poverty reduction strategies.

The most significant increase in poverty between 2007 and 2009 was recorded in agriculture-animal husbandry-fishery-forestry, trade, industry, transport and Public work sectors and civil engineering (BTP) which nevertheless occupy the majority of the active population.

The economic growth initially projected for about 3% was estimated at 2.1% in 2010 against 2.7 % in 2009. This regression is the result of the combined effects of poor performance of the cotton sector, foodstuffs production sluggishness, harvest losses due to floods and low implementation of public investment projects. This occurs in a context of an annual average of 2.1 % inflation (PNUD, 2011).

The Report on the Millennium Development Goals (MDG) "BENIN 2000+10" reveals that the major constraints hindering the achievement of the MDGs are as follows:

- The low growth and inadequacy of pro-poor growth strategies;
- The low capacities of primary education services in terms of projects cycle management and lack of a reliable information system (school card, number and state of the infrastructures...);
- The low capacity of the services in charge of gender mainstreaming promotion as matter of projects cycle management and lack of sex-disaggregated statistic data;
- Lack of local component of the National Health Development Plan;
- The environment protection services' capacity to implement the multilateral agreements activities in the environment field ;
- The lack of planning tools at the Water and Power supply sector level and the low capacity of Water supply services in projects cycle management;
- The lack of commercial policy;
- The low capacity in terms of mobilization, management and aid coordination
- The lack of operational Monitoring-Evaluation mechanism in the sectors of agriculture, education, and in the ministry in charge of Gender promotion.

The distribution of foods consumption expenses by the way of Integrated Module Survey on the households living conditions (EMICoV) in 2006 and 2007) revealed that 26.5% of the population suffered from hunger in 2007 against 23.1% in 2006. As such, the number of underfed persons increased by 3.4 points between 2006 and 2007. This upwards trend could be explained by the 2007 food crisis impacts. The results by residence area reveal that food shortage is more dominant in rural area (28.4%) than in urban area (23.2%).

In the field of gender promotion, the various laws and measures enforcement contributed to strengthening the legal and institutional framework in view of reducing gender imbalance and enhancing women participation in the development process, though participation of Benin woman still, is far away from the objective of gender equity. As far as women participation in decision-making is concerned, there is a slight progress at the level of Parliament and local representation, mainly: (i) an increase of 3 points in the women representativeness at the National Assembly: 10% for the current legislative term (2007-2011) against 7.22% for the previous one (2003-2007); and an increase of 0.43 point in women representation during the last local elections organized in 2008: 4.18% (60 women elected out of 1,435 municipal councilors), against 3.75% (that is 46 women elected over a total of 1,199 municipal councilors) for the 2003 elections.

Though, in progress as a whole, health indicators could not reach the set targets. Health services attendance rate increased from 45.6% in 2007 to 46.1% in 2009, while the pentavalent vaccination rate for the 0-11 month children increased from 96% in 2007 to 98% in 2009. The percentage of less than 5 year-children sleeping under treated mosquito nets is steady between 2008 and 2009 that is 56.3% against a set target of 60% in 2009.

The industrial fabric still is embryonic (7.8% of GDP in 2009). In order to boost a processing-oriented economy with competitive enterprises, the following actions are planned: (i) promote the creation and development of new competitive industrial enterprises; (ii) continue the strengthening of the institutional, legal, judiciary and regulatory environment; (iii) proceed with reviewing the investments law to make it more encouraging; (iv) promote the frameworks of exchanges and consultation between the stakeholders of the industrial sector; (v) build the capacities of the industrial enterprises as well as backup and coaching structures; (vi) implement appropriate institutional reforms in order to make Benin more attractive to direct foreign investments in the fields like mining, hydrocarbons and other potentially-attractive sectors; and (vii) create an Investment Promotion Agency.

Being in progress, the indicators relating to decentralization should be reinforced, mainly with the passing of the law on Inter-community cooperation and the adoption by Government in 2009, of the National Decentralization and Devolution Policy (PONADEC), As such, the indicator « number of development territories constituted and formalized » increased from four (04) in 2007 to ten (10) in 2009. The same applies for many other indicators, mainly:

- (i) the share of the Local Governments' expenses in the total General Budget of Government, which stabilized at 8.8% in 2009 against 4.1% in 2007;
- (ii) the increase of the transfers to the local governments between 2007 and 2009, thanks to the launching of FADeC (Local Government Development Support Funds), passing from 1.5% of the General Budget of the State in 2007 to 3.7% in 2009; and
- (iii) the share of investment expenses in the total expenses of the Local Governments which increased from 26% in 2007 to 45.6% in 2009.

1.1 Climate context on the coastal zone of Cotonou

Previous climatic trends

The previous climatic trends are explicit on two elements controlling the situation of resources and human activities in the lagoon system: the rainfalls and the temperature

a) Spatio-temporal variability and trends in precipitations

The average pluviometric trends characterizing the period 1951-2010 in Cotonou is of bimodal type with two maxima (fig.2) : June for the main rainy season (354.6 mm) and October for the small rainy season (147.6 mm).

The inter-annual variability analysis of the rains observed over the same period reveals short periods of deficit alternating with some years of excess. (fig.3).

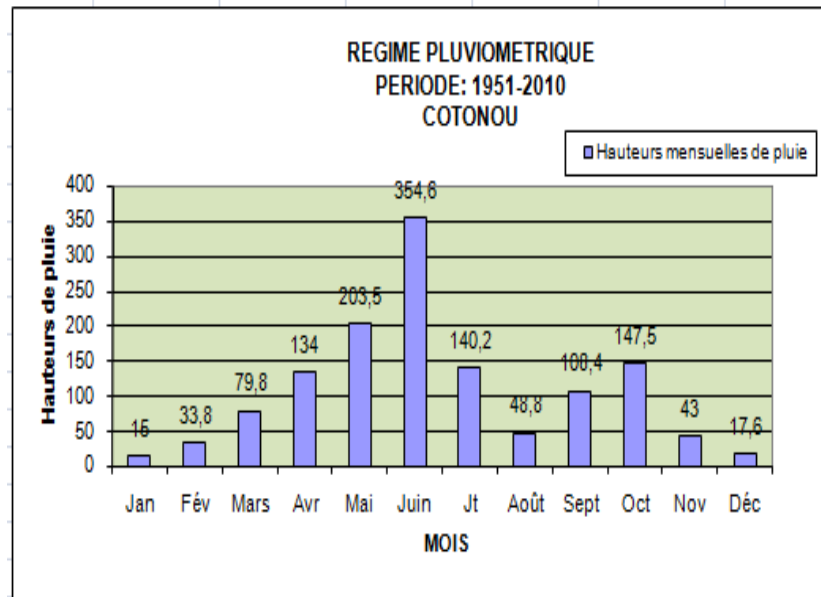


Diagram 1 : *Pluviometric trends in Cotonou from 1951 to 2010.*

Source of the data: SMN (2010)

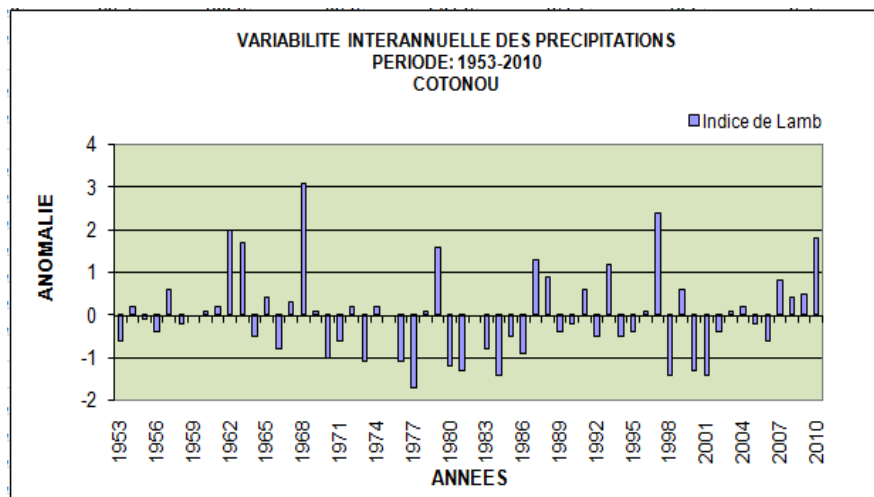


Diagram 2 : *Inter-annual variability of precipitations in Cotonou from 1951 to 2010.*

Source of data: SMN (2010)

The highest deficits were noted in 1977 and 1983 (Years of drought) while the highest pluviometric excess date far back to the years 1968 and 1997 (Years of floods).

At seasonal scale, this situation is characterized by some abnormalities materialized by:

- High concentration of rains over a short period, disturbing most of human activities;
- A sudden interruption of rains during the season;
- The paucity, during some years, of the clear demarcation between the two rainy seasons, which results in the flood phenomenon.

If at annual scale, the current climate analysis does not reflect significant trends in the precipitations variability, but the seasonal analysis reveals some major differences during the periods prior to 1971. It was observed that there were some delays of more than a month for the starting of useful rains; that disturbed agricultural activities planning in the region of the shoreline.

The analysis of the inter-annual variability of the number of rainy days during the period 1951 – 2009 reveals the general downward trends of the annual number of rainy days since the 50 with the passage from positive variances between 1970 and 1975 and a stabilization around the average of the period from 2005. (fig.4).

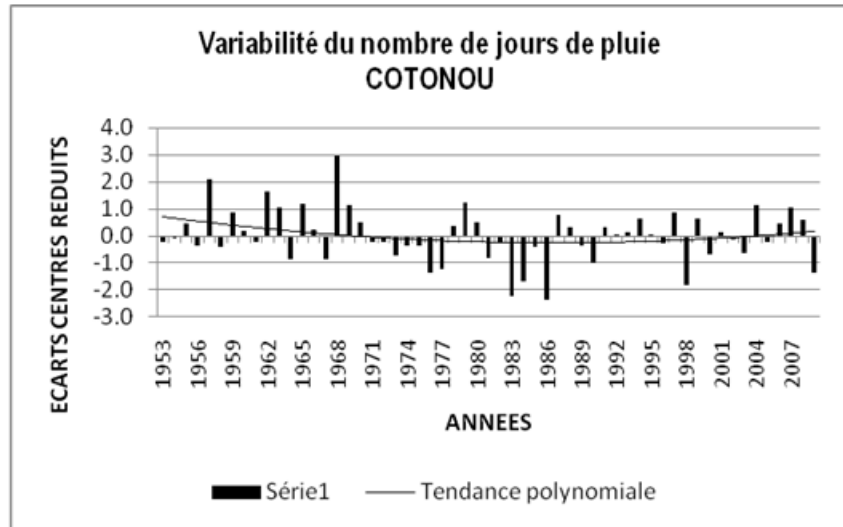


Diagram 3: Inter-annual variability of rainy days in Cotonou from 1951 to 2010.

Source of Data: SMN (2010)

By and large, the average annual number of referential rainy days

Between 1971-2000 is situated around the characteristic average of the period 1951 – 2010 in the shoreline area and all the regions in Benin.

b) Spatio-temporal Variability and Trends of the temperatures

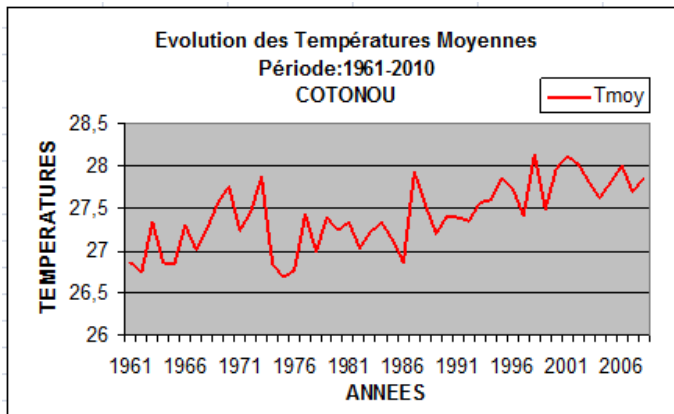


Diagram 4: Evolution of average temperature in Cotonou from 1961 to 2010.

Source of Data: SMN (2010)

The evolution of the average temperature in Cotonou from 1961 to 2010 reveals a general upward trend (diagram.5). The variances between the average normal temperatures recorded every year during the same season are sensitively in the range of -0.6 to +0.8°C and these do not allow to earmark an upward trend unless at the end of the decade 1970-1980 (Diagram.6).

The average minimum temperatures also sensitively increased (in the range of +0.5 to 1°C) during the last decade, particularly from 2003.

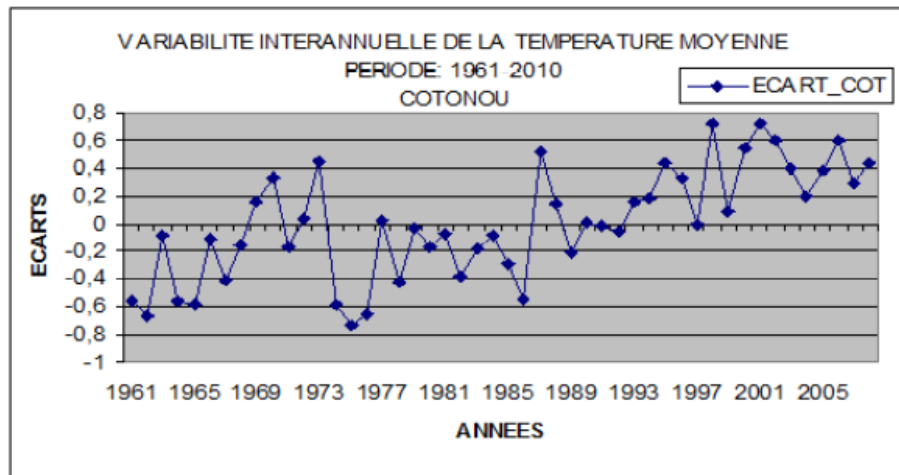


Diagram 5 : Inter-annual variability of the average temperature in Cotonou from 1961 to 2010.
Source of Data : SMN (2010)

c) Climatic scenarios

This has to do with describing in a coherent and plausible way the future situation of the climate in the lagoon environment.

Among the baseline scenarios proposed by the Intergovernmental Panel on Climate Change (GIEC/IPCC) for such studies, and mainstreamed in the version 5.3 of software MAGICC/SCENGEN (Wigley, 2008), the scenarios A1B and B1 are in use in Benin since a decade as part of the works of IMPETUS Project (or *Integrated approach for the Limited Water Resources Management in West Africa*) in North-Western Region of Benin. They have been adopted in this study in order to forecast at global level and at various future temporal horizons, the major climatic parameters encompassed by the study of the vulnerability / adaptation.

The scenarios A1B and B1 developed by the IPCC describe the future evolution of the climatic conditions by 2100, based on the economic, energy and environmental assumptions. Both scenarios admit the assumption of Globalization of economy that is already under verification through the Global economy process adopted by the International Community since the end of the last century. The first scenario has an economy-oriented purpose than the second which is more open on environmental concerns. The Scenario A1B assumes an international technological but environment-friendly development respecting the equilibrium between the sources of energy while scenario B1 targets energetic sustainability.

The average variances A1B-AIM and B1-AIM integrated in the software MAGICC 5.3 are the versions of the scenarios A1B and B1 of the IPCC/GIEC exploited in order to forecast the major climatic patterns at global level and at different future temporal horizons.

The temporal horizons 2015, 2025, 2050 and 2100 have been selected with a view to mainstreaming the socio-economic and ecological impacts of the climate change.

The local data are deduced from the global level by the "downscaling" technique, from the output of MAGICC and the climatic normal 1971-2000 of the temperature and rainfall. SCENGEN is used in order to obtain the spatio-temporal representations of the climate

change impacts at each grid point. (of resolution 2.5° of latitude on 2.5° of longitude) by using the results of the experiments of the coupled *Atmospheric-Ocean general circulation models* (MCGAO/AOGCM) available in the software. The average climatic sensitivity was set at 3°C, in compliance with the indications given by the IPCC/GIEC (Solomon *et al.*, 2007), and the average coefficient of turbulent exchange k_z equal to $2.3 \text{ cm}^2/\text{s}$.

The utilisation of the first results of simulation and acquired experiences in Benin and within the West African Sub-region on the general and regional models has enabled to select (4) models among the twenty (20) proposed by MAGICC/SCENGEN. Those are: CGCM3.1 (T47), MRI-CGCM2.3.2, UKMO-HadCM3, UKMO-HadGEM1 (cf. technical manual MAGICC/SCENGEN 5.3 version 2, 2008). The data produced by the software are of an average value of four models on the cells of the grid, in compliance with the recommendations of the software designers (Santer *et al.*, 1990; Giorgi et Mearns, 2002; Tebaldi *et al.*, 2004). The limitations of the grid cell covering the Cotonou Region are $5^\circ\text{N} - 7.5^\circ\text{N}$ and $0^\circ - 2.5^\circ\text{E}$.

c.1. Precipitations Scenario

In the study region, one could by 2100 witness a practically steady annual pluviometry, the variances observed every five years not exceeding 0.2%. A downward trend would therefore characterize the early period 2000 - 2100.

Table 1. *Abnormalities of the forecast annual precipitations from 2000 to 2100 along the Cotonou shoreline (Grid Cell: $5^\circ\text{N}-7.5^\circ\text{N}$ et $0^\circ - 2.5^\circ\text{E}$).*

Years	1971- 2000	2005	2010	2015	2020	2025	2030	2035	2040
Variations		-0.06	-0.36	-0.62	-0.88	0.82	0.49	3.62	3.97
Precipitations	980	979	976	974	971	972	985	1,015	1,019

At monthly scale, greater variations would be observed in the precipitations of the months of March and April which mark the first passage of the Inter Tropical Front and the beginning of the first rainy season in the region. They will culminate with a reduction of the precipitations up to 21% in April by 2100 (Diagram.7). The variances between the precipitations of March and April would intensify until the year 2025, obliging the rural populations to situate the beginning of agricultural activities in April or in May.

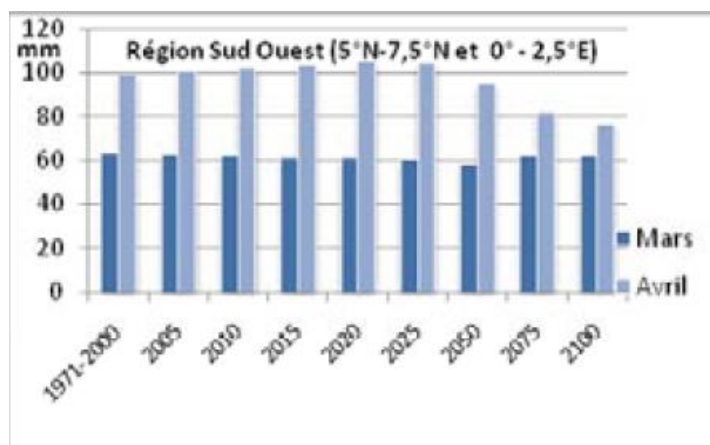


Diagram7: *Forecast of the Monthly precipitations of March and April for the South-Western Regions, from 2000 to 2100*

c.2. Scenario of temperature

According to the forecast, the temperatures would be upward in all the regions of Benin and in Cotonou (Table 2).

By 2100, the highest thermal temperature could increase up to 3.27°C in the North-Western region of the country, as regard the baseline period 1971 - 2100. The lowest increase value would be 2.6°C. It would characterize the South-Western region of the country where the Cotonou Lagoon System is located.

Table 2 – *Annual Average Temperatures Variations forecast from 2000 to 2100 along the Cotonou shoreline (Grid Cell: 5°N-7.5°N and 0° - 2.5°E).*

Years	2000	2005	2010	2015	2020	2025	2050	2075	2100
Variations (°C)		0.21	0.29	0.39	0.5	0.63	1.55	2.24	2.77
Temperature	27.4	27.61	27.69	27.79	27.9	28.03	28.95	29.64	30.17

One could expect an implicit increase in the water deficit and the potential evapotranspiration (ETP).

d) Scenario of rise in sea water level and subsequent losses of land

Vulnerability studies and assessment carried out as part of the National Adaptation Programme of Action (NAPA) and the Second Beninese National Communication on Climate Change (SNC) have revealed that coastal zone, water resources, agriculture and forestry are the most vulnerable sectors to climate change. Based on some climatic and non climatic scenario established for the future evolution of the coastal area, and according to the indications provided by DIVA Software, the sea level could continuously rise up to about 0.81 m, over the period 2000 – 2100, confirming in so

doing the Intergovernmental Panel on Climate Change (IPCC) projections (figures 1.1; table 1.1). Water resources will also be affected both quantitatively and qualitatively with a drastic impact on agriculture and populations' health. The vulnerability of water resources sector will also be translated into a falling tide in the rainfall varying annually between 3% and 8% (scenario A1B) or between 4% and 5% (scenario B1), a displacement of the quillwort 1000 by more than 350 km southwards between 2025 and 2050 along with all the consequences.

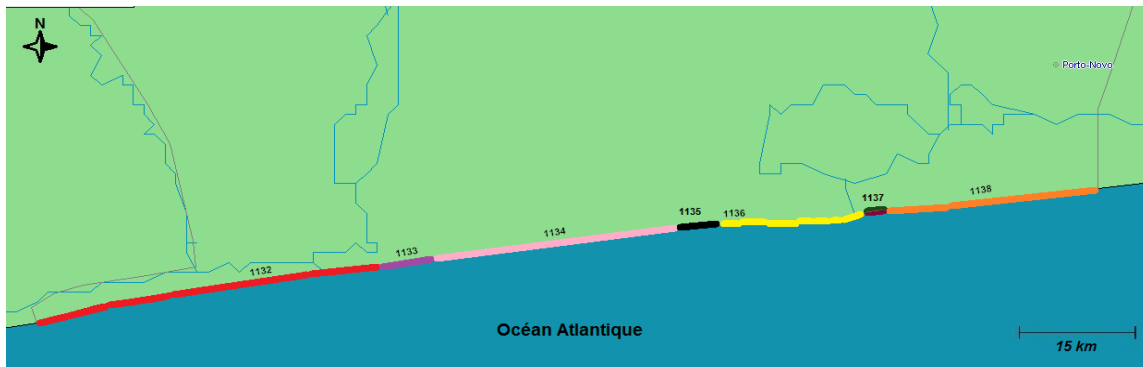


Figure 1.1: Coastal segments in the Beninese coast (after Consortium DINAS-COAST (2004)). Coastal segment concerned by Cotonou Lagoon is 1136 (the yellow one).

Specifically, the major climatic risks the area is exposed to are the rise in sea level, flooding, violent winds, and increase in the sea surface temperature (TSM). The vulnerable living conditions in this area are those of the fishermen, farm operators, craftsmen, traders, tourists and industrialists. The most vulnerable among the livelihoods are fishery and aquaculture, agriculture and truck-farming, handicraft and trade, tourism and industry. The potential impacts concern

Table 1.1 : Sea Level Rise in coast of Cotonou by 2100 (m)

Scenarios	Variants	Sea Level Rise by 2100 (m)
A1B	High	0.813
	Medium	0.422
	Low	0.206
B1	High	0.634
	Medium	0.323
	Low	0.151

sea level rise, land losses or gains (in surface and in volume), and floods (figures 1.2, 1.3 and 1.4).

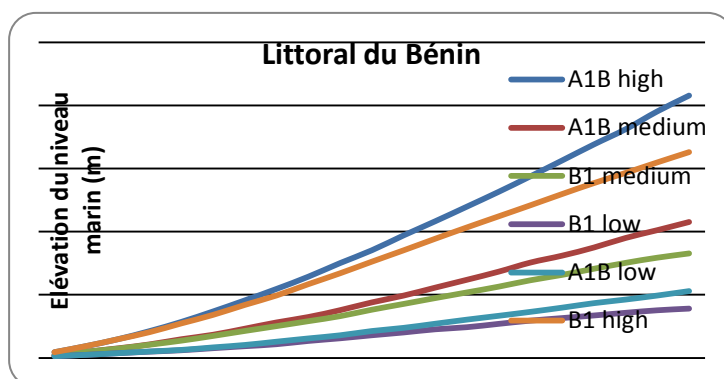


Fig. 1.2 : Evolution of sea level rise of Cotonou's coast

The Cotonou channel commonly referred to as *Cotonou lagoon*, with a length of 4.5 km, an average width, of 300 m, and a depth of 5 to 10 m, appeared further to the September 1885 catastrophic flooding as a result of Ouémé river floods and overflowing of Nokoué Lake.

until 2010

In order to channel the waters seawards and protect the nascent Cotonou town, the colonial administration, on September 21, 1885 dredged a 1.5 m width and 1 m depth cutting between the Nokoué Lake and the sea, passing through the areas settled by

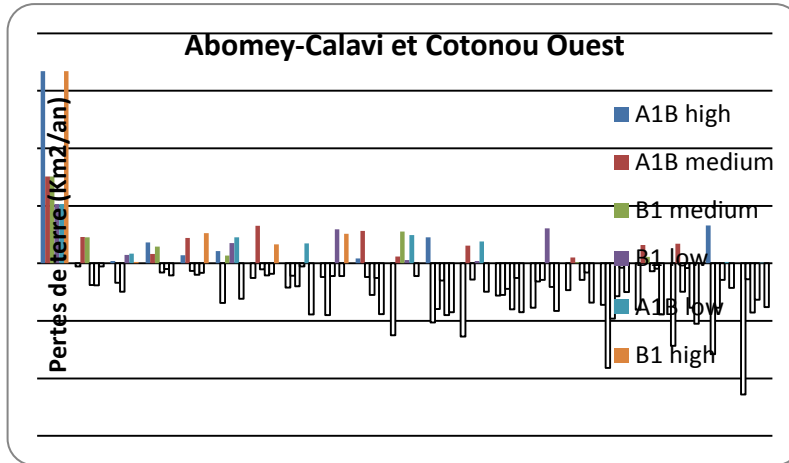


Figure 1.3 : Evolution of the losses of on-surface lands on West Cotonou coast until 2100.

the poorest populations (Bourgoinie, 1972; Pliya, 1980). According to Colleuil (1984), the resulting violent flow was sufficient to generate within a few days a 200 m wide channel which divided the town into two sectors up till now. (figures 1.5 and 1.6). From then, the social life has been reorganized around

the water body, with the populations settling, in the most precarious conditions, along the unstable shore (more than 30% of the Cotonou Populations), making Cotonou, the Benin town where poverty index is the highest: 38% against less than 30% in towns like Porto-Novo, Parakou, Abomey, Bohicon (PNUD, 1996, USAID-UNICEF-INSAE, 1996).

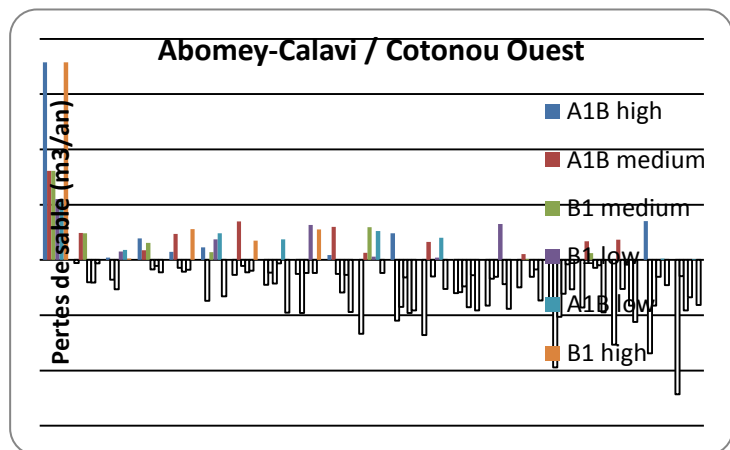


Figure 1.4 : Evolution of the volume losses of lands on West Cotonou coast until 2100.

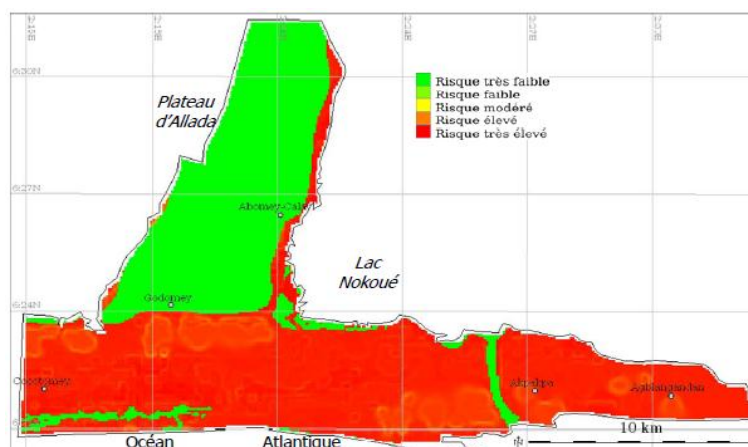
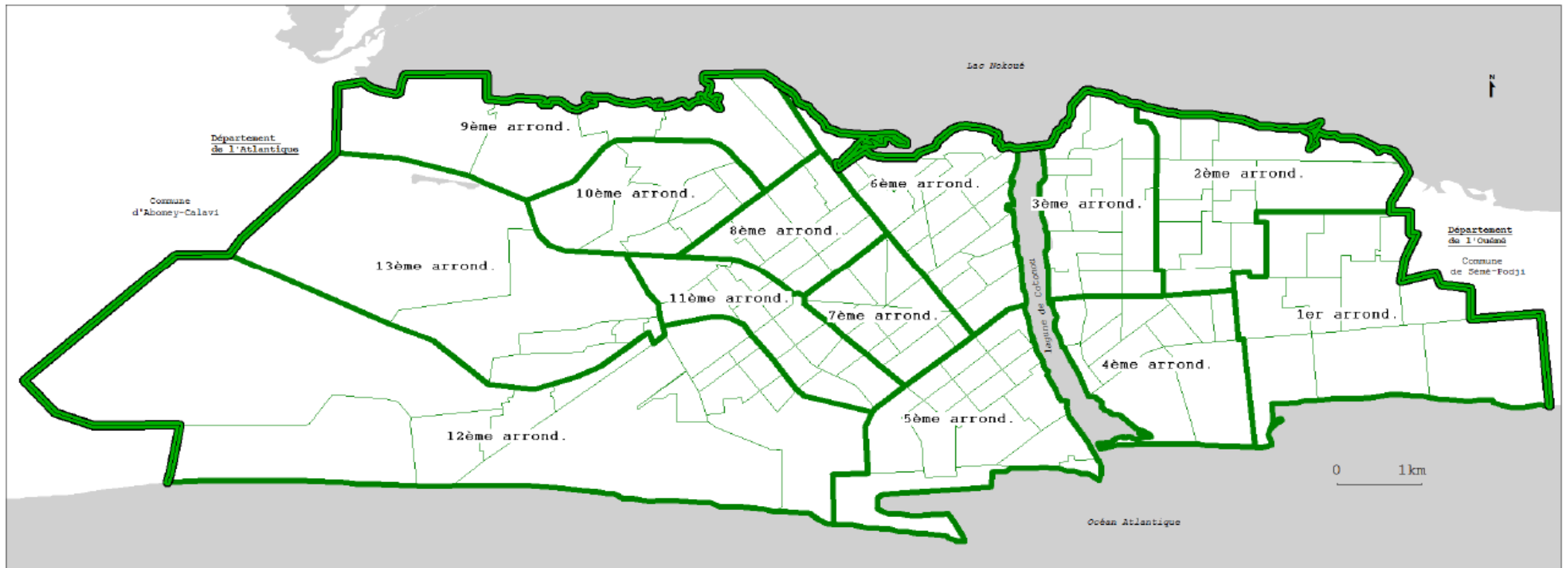





Figure 1.5 : Degrees of flood risk of the Cotonou lagoon environment
(CREDEL ONG, 2010).



-  limite de quartier
-  limite d'arrondissement
-  limite communale

Cellule du Registre Foncier Urbain (RFU) de Cotonou
Novembre 2007

Figure 1.6: Map of Cotonou town (Cotonou Municipality, 2008)

1.2. Socioeconomic context

Cotonou town contributes about 64.7% of urban poverty in Benin (PNUD, 1997).

The major human activities poles in the surroundings of Cotonou lagoon are the Cotonou International Market covering 18 hectares on the West shore, the Government welfare and administrative offices, the private companies in the sectors of Hotel industry and catering, home-made dyeing and fisheries, inland water transports of persons and goods.

The Cotonou International Market (Dantokpa Market including the Gbogbanou segment), where more than 500,000 users rush every day to encounter the 100,000 marketers, occupies the West shore of the lagoon covering a surface of 18 hectares (fig. 1.7). As a result of the transfer of the market on this site in 1962, there is an increase in the man-made pressure on the lagoon system, mainly bringing about various new sources of pollution (Ayadokoun, 1992 ; Montcho, 2005 ; Lawani, 2007 ; Vissin *et al.*, 2010).



Figure 1.7. Partial view of Dantokpa Market
(www.cotonou.org)

The physical and biological characteristics of the Cotonou channel evolve at the rate of the periodical alternation of obstruction and opening. When the channel is opened, some part of the overflowing from Ouémé river and Nokoué lake directly flow into the sea, resulting in acceleration of the water level drops in the whole lower delta. (Pélissier, 1963).

From December to April every year, there is always a reverse of the water-stream prompting the salty water to sweep into Nokoué lake meanwhile the following floods reduce the water salinity. At the same time the daily swell movements maintain a regular flow and ebb regime of sea water. As a result there are some impacts on the environment and human systems, on the sedimentation and filling up speed, water salinity as well as on the flora and wildlife sometimes prosperous, sometimes limited both within the channel and the whole South west Benin lagoon complex.

Districts directly concerned by the project are indicated in the figure 1.8. The table 1.2 shows the number of people which can benefit firstly from the project.

Based on the third general census of the population and the habitat in 2002, about 15% of the poorest and more vulnerable Cotonou population is concerned in the

The socioeconomic targeted groups by this project are the direct beneficiaries of this project or those who are positively or negatively affected by its implementation. This concerns people, community organizations, local authorities who will benefit from:

- Infrastructures set up by the project
- Economic and sanitary repercussions of the shores layout
- Capacity building of local actors on issues such as vulnerability and adaptation of their existence means and improvement of their standard of living

More specifically, different social categories are concerned:

- Fishermen
- Wholesale fishmongers (processed or not fish resources' sellers)
- Lagoon sand sellers
- restaurant managers
- Managers of touristic and amusement places (hotels, nightclubs, game rooms)
- Dyers
- NGOs
- Youth associations, women, handicapped people, diverse actors considered (e.g., fishermen, Wholesale fishmongers, Lagoon sand sellers, traders and sellers of diverse products)

The secondary actors involved are those who will influence the development project or are indirectly affected. These actors include: Government, guardianship Ministry, project personnel, implementation body, the SOGEMA, intervening NGOs in the sector, private sector enterprises, banks and other development bodies.

The derived benefits from this project are fundamentally improving the living conditions and protecting the shore (river bank or embankment). Infrastructures' planning will facilitate the organization of economic, touristic and pleasure activities. The cleaning of the lagoon will improve water physicochemical parameters and will favor the living resources: reproduction of shrimp and fish species, migration of aquatic species from sea water to fresh water. It will also favor waterside populations' health and that of all the consumers of fishing products, represent also the beneficiaries of the project as they will consume healthy without any microbiological intoxication risks and heavy metal present in the lake.

Furthermore, the fishing products' consumers represent also the project beneficiaries as they will consume healthy products without any risk of microbiological and chemical intoxication. Enterprises such as Crustamer, will collect and process

shrimps which have suspended their export activities, could restart them. Women and women groups who derive their benefits from shrimp network (filière) could easily increase their revenues.

The village communities living on the Nokoué Lake and the Totché canal (Ganvié, Aguégué and others) can also feel the effects of the control of the channel opening on the sea. Their ecosystems belong to the same fluvial-lacustrine complex called the Beninese South-East complex.

Table 1.2 : Waterside population directly concerned by the project

Arrondissement	District	Concerned population			Number of households	Average size of the households
		Total	Men	Women		
3 rd	Adogléta	5500	2689	2811	1302	4,2
	Gbenonkpo	3171	1529	1642	757	4,2
	Hlacomey	1552	806	746	339	4,6
	Kpankpan	5637	1787	2850	1208	4,7
	Midombo	5476	2638	2838	1229	4,5
	Agbato	6143	3024	3119	1339	4,6
4 th	Abokicodji Centre	3088	1447	1641	678	4,6
	Abokicodji lagune	1455	757	698	269	5,4
	Dedokpo	5042	2476	2566	1114	4,5
	Enagnon	11792	6344	5448	2805	4,2
5 th	Wlacodji Kpodji	603	293	310	159	3,8
	Wlacodji plage,	6103	3098	3005	1676	3,6
	Tokpa Hoho	1899	895	1004	446	4,3
	Missèbo,	1539	744	795	371	4,1
	Bocossi tokpa	1799	833	966	414	4,3
	Nouveau pont	1324	608	716	361	3,7
6 th	Dantokpa,	2396	1136	1260	587	4,1
	Aïdjèdo 3,	5037	2445	2592	1255	4,0
	Hindé 1	4795	2293	2502	1121	4,3
	Hindé 2	4157	2108	2049	965	4,3
	Djidjè 1,	4117	2039	2078	954	4,3
	Djidjè 2,	4637	2277	2360	1039	4,5
	Ladji	6075	3132	2943	1220	5,0

Source : RGPH, 2002

1.3. Environmental context

The Cotonou lagoon's major environmental problems likely to worsen with the rise in sea water level and the extreme weather events (mainly floods, long-term drought and hurricanes) result from (i) *lagoon shores erosion and degradation of socio-community and economic facilities*, (ii) *pollution by household waste, waste waters, home-made dyeing waste, oil products and other economic activities waste*, (iii) *occurrence of seasonal floods along the shores and riparian areas*, (iv) *disrespect of the regulation governing the lagoon fisheries by the fishing communities* and (v) *low*

level of awareness of the local populations about the climatic risks and adaptation techniques.

i) Lagoon shores erosion and risk of socio-community and economic infrastructure degradation

From the opening of the channel to the current situation, one observes the increase in the flows and ebbs rate between Atlantique Ocean and Nokoué Lake, throughout the Cotonou Lagoon (Dégbé, 2009). It ensues a process of physical erosion and degradation risk of the shores as well as the establishment of socioeconomic infrastructure along the Lagoon (figure 1.9) . Generally, the erosion phenomenon is intensified with the hurricanes and floods. The ecosystem dynamics enables to foresee the future aggravation of the situation with the rise in sea water level and the extreme weather.



Overview

Partial view

Figure 1.9 : Hôtel du Lac on the Cotonou Lagoon

Yet, one observes the collapse of the platforms of socio-administrative buildings, terraces of hotels and restaurants and other economic infrastructure established along the Lagoon. During the flooded periods, the average water level is higher than the level when these infrastructures were under construction 20 to 50 years ago. The hurricanes are the causes of the large waves that sweep into the lagoon, erode the unstable shores and hurl some solid waste and refuses of the wild dump at the shores. The waves' impacts added to those of household and industrial used waters poured out by the urban gutters and local small scale dyeing industries worsen more the unhealthy conditions of Cotonou Lagoon water and shores.

ii) Pollution by the household waste, used waters, refuses produced by the local small scale dyeing industries, the petroleum products and other waste generated by economic activities.

The water quality in the channel and exchanges between the sea and lagoon system will be negatively affected by the rise in sea water level and extreme weather. Presently, it is during the low water that the sea water sweeps more into the Cotonou Lagoon (November-March). This period might prolong with the rise in sea water level

which changes the water regime and quality as well as the ichthyofauna composition. More specifically, the waters drainage into the sea will be slowed down while the filling up of the lagoon will be accelerated, floods will be more catastrophic and the economic costs will be very expensive.

According to the findings published by Soclo (1999) and Roche International (2000), in the 1990s, Cotonou town used to produce annually 150,000 tons *solid waste* more specially from the households and Dantokpa market the major part of which is disposed on the lagoon shores. At the end of the years 2000, the production was estimated at 260,000 tons the collect of which is entrusted with 54 specialized NGOs. The refuse landfill strewing over the channel shores are composed of putrescent materials, biomedical waste, used apparatuses, batteries, heaps of iron and steel scrap, etc.

The **used waters** volume is evaluated to 4,750,000 m³ per annum, 72% of which is generated by the households and Dantokpa market and 28% by the industries and public services. 397,000 m³ if this is disposed of in the lagoon. The main used water sources are as follows:

- The waste generated by the local small-sized industries dyeing the so-called Senegalese or Malian clothes which are established along the channel since the 1990s;
- The urban waste generated by the storm-water drain of the Akpakpa-centre;
- The urban waste generated by the storm-water drain of the new bridge;
- The urban waste generated by the storm-water drain of Midombo;
- The urban waste generated by the storm-water drain of Hlacomey;
- The urban waste generated by the storm-water drain of Jéricho;
- The urban waste generated by the storm-water drain of the Dantokpa market;
- The urban waste generated by the storm-water drain of the Dantokpa Secondary School;
- The used water waste generated by “*Maternité Lagune de Cotonou*”.

The construction of about fifty profit-making floating latrines on the channel at Agbato size for instance, worsens more the water pollution.

The Cotonou channel is navigable for the transport of goods and persons along the channel and from one shore to the other. Inland water transport of goods and persons has no direct impact on the aquatic environment, but the risk of ecosystem degradation is huge when it comes to chemical pollution of water with the pouring of **chemical products** smuggled from Nigeria, transported by water route and off-loaded in bulk on the undeveloped land wharf over night per hundred jerry cans. Those petroleum products are frequently poured into the water during the handling operations.

The situation of the pathogenic germs is much more alarming. As far as the total coliforms are concerned, for instance, their number varies between 4,000 and

6,000/100ml in June (rainy season) and between 2,000 and 14,000 /100ml in September (end of the short dry season). As for the faecal coliforms, their number varies between 2,000 and 6,000/100ml in June with their quantities fluctuating between 1,000 and 11,200/100ml in September while the standard admitted for clean water is a maximum of 100 / 100ml.

The contamination by the coliforms is also observed in the wells in the riparian areas of the Cotonou Lagoon. (table 1.3)

Table 1.3: Bacteriological analysis of the Towéta 1 wells (according to Dovonou, 2008).

Parameter Sites	Total germs (1 ml)	Escherichia coli (100 ml) (1)	Faecal streptococci (100 ml) (2)	(1)/(2)	Clostridium perfringens (100 ml)	Staphylococci (100 ml)	Salmonella and Shigella (100 ml)
Well 1	700	1100	120	9	1500	8000	450
Well 2	200	1600	280	6	1400	7000	400
Well 3	350	1500	250	6	1800	7500	250
Well 4	300	1900	200	9	1600	6000	300
Well 5	600	2200	300	7	2000	8000	500

Those bacteriological contaminations are favored by the changes undergone by the physic-chemical parameters of the channel water.

The temperatures recorded in the channel ranged between 28.5 and 30.8 °C (Bonou and Adisso 2002). These figures are higher to the temperature of the ambient air which is 27 °C. If temperature is a factor conditioning the abundance of living animals and plants, a variation of a few degrees in the temperature of water could, for instance, be a prejudice for the fish or other microorganisms that are important in the food chain.

The pH values recorded in the Cotonou channel vary between 7.3 and 8.55 (Bonou and Adisso, 2002). These values which are higher to those of the sea and raw waters which pH mostly range between 6.5 and 8.5 (Guilcher, 1959), are allegedly due to the used waters swept in the channel by the drain. If by definition, the pH of the water measures the acid-base equilibrium in most of the natural waters, it depends mostly of the carbon dioxide – carbon bicarbonate – carbonate equilibrium. pH reduces when the CO₂ content increases and inversely. The pH collected in the channel which is superior to the one of sea water and raw waters could therefore be harmful to the freshwater or anadromous species. As far as the water salinity is concerned, the values collected in the channel towards the river mouth (near to the sea) are higher (33.8 and 32.85‰) than those collected far away from the river mouth which were 30.05 and 31.33‰ (Soclo, 1999). Salinity which indicates the quantity of salt in a given mass of solution is an important factor for biodiversity. It varies according to

the depth, temperature, and sea water input and output (Marc, 1997). In the Cotonou Nokoué Lake-Lagoon system, the highest average salinity is observed at the inlet of the Cotonou channel with a strong difference between the surface water (9‰) and the bottom water (17‰). The highest annual salinity is observed in December with 36‰ in surface and 25‰ at the bottom (Mama, 2010). The salinity influences the electrical conductivity which translates the overall ions content in the water. The conductivity varies according to the electrolyte contents in the water and mostly with the temperature. (Le Barbe, 1993). The electrical conductivity in the channel varies between 41.5 and 51.6 mS/cm (Bonou and Adisso, 2002). The values of conductivity collected in the Cotonou channel that are superior to the threshold value ($>500\mu\text{S}/\text{cm}$) reported by Belaud (1987), reveal that the channel water are highly polluted as a whole.

The polluting ions peaks, namely ammonium (NH_4^+) and nitrates (NO_3^-) in the Cotonou Lagoon are observed from February to mid-May respectively, 0.9 mg/L and 5 mg/L (Mama, 2010)

Gases are of paramount importance for the welfare of the species in the water. Among those gases, are oxygen for the fish, CO_2 for the algae and the phytoplankton that are responsible for photosynthesis. The major part of the oxygen dissolved in the water is generated by the air where it represents 20.95% of dry air (Martin, 1985). The collected values oxygen dissolved in the Cotonou channel water range between 2 and 7.2 mg/l (Bonou and Adisso, 2002). Those values are low because the higher salinity of the waters, the more saline is a solution, and the less dissolved oxygen it contains.

In view of the above-mentioned impacts, one can agree with Bonou and Adisso (2002) whose studies have confirmed that the Cotonou channel waters are subject to an organic pollution under various forms, namely:

- Less oxygenated and less airy environment;
- Disturbed nitrogen cycle (low rate of nitrate and high rate of nitrites);
- Oligotrophic and less productive environment (low rate of phosphates);
- Strong charge in faecal bacteria corresponding to high values of biological demand in oxygen (BDO5) and chemical demand in oxygen (CDO).

It is worth recalling that the water content of oxydizable materials responsible for its impoverishment in dissolved dioxide can be evaluated by measuring the quantity of dioxide needed for their degradation. For that purpose, two different parameters are used, the chemical demand in oxygen or CDO which gives the measurement of the total quantity of materials reduced in the water may they be biodegradable or not and the biological demand or BDO5 which gives a measurement of the biodegradable pollutant materials. The BDO5 is the mass of molecular oxygen (expressed in mg) used by the microorganisms to deteriorate within five days at 20°C and in the darkness, the oxydable materials contained in one liter of water.

In the Cotonou Lagoon, the highest value in demand of biological oxygen (BDO5) is observed in February (35 mg/L). In the same way, the highest average content of chlorophyll *a* in the surface water (60 µg/L) translates an important activity of photosynthetic production. It is three times less deep (20 µg/L), and, the highest activity is performed in December (140 µg/L). However, the heavy metals (lead, cadmium, copper, zinc and iron) brought by the dyeing waste and other metallic residues have a negative impact on the oysters living in the channel (Dovonou, 2000).

By reference to the standard water quality (table 1.4) one realizes that the Cotonou channel pollution situation is alarming, and this can generate other negative impacts on the aquatic ecosystems. That pollution could lead to a drastic decrease in productivity of the channel as a whole, and halieutic resources, in particular. One should fear the risk of disappearance of this water body through filling up as its environment becomes more and more anoxic. Faecal pollution could constitute another danger to human populations' health and more specifically the fishing populations, although that water is not drunk, but it could be source of contamination through swimming, mostly to the fishermen and sometimes to some riparians. The numerous wastes strewn over the channel shores or which are directly disposed of in the channel affect the physico-chemical parameters of the water body, and subsequently the water quality as well as the biocoenosis. As such, the organic and chemical pollution resulting from those wastes and the induced hydro-sedimentological modifications constitute the major factors deteriorating the quality of fish habitat.

Table 1.4: Multicriteria matrix of water quality assessment (Beaux, 1998)

Decreasing quality	Excellent	Good	Passable	mediocre	pollution
Quality class	1A	1B	2	3	4
Temperature (°C)	<20	20-22	22-25	25-30	>30
Conductivity (µs/cm)	<400	400-750	750-1500	1500-3000	-
pH	6.5-8.5	6.5-8.5	6.5-8.5	5.5-9.5	<5.5 or >9.5
Dissolved Oxygen (mg/L)	>7	567	365	<3	-
Substance in suspension (mg/L)	0	<30	-	30-70	<70
BDO5 (mg/L)	<3	3-5	5-10	10-25	25
DCO (mg/L)	<20	20-25	25-40	40-80	>80
Nitrates (mg/L)	0	<44	-	44-100	>100
Ammonium (mg/L)	<0.1	0.1-0.5	0.5-2	2-8	>8

iii) Seasonal floods of the shores and riparian areas

Indeed, before the construction of Cotonou seaport as well as its East breakwater, the Cotonou channel and Nokoué Lake were like a lagoon close to the minimum flow and opened to the floods. During the minimum flow, the sea water level was averagely higher than the lake water level. The Lake water salinity was averaged due to the inflow of fresh water, though in low flow, from Ouémé River and Sô stream; this salinity is however slightly higher in the channel due to the closeness to the sea. One observed in the Lake a salinity gradient in a West-East orientation. During the floods, the water level in the Lake and the channel remained higher to that of the sea until the disappearance of the shoestring sand making up the junction mouth. The water level in the Lake and channel depended upon the importance of the floods and the width of the mouth. The waters were essentially fresh. When the Cotonou channel managed to sweep the floods into the sea, the longshore drift quickly closed the sand mouth, limiting the salty water flow into the channel and the Nokoué Lake (Roche International, 2000).

iv) Regulation governing the Lagoon fisheries

Fishing activities in the Cotonou channel are conducted by the riparian and professional fishermen originating the lakeside villages established along the Nokoué Lake. Some of the fishing gears and techniques used are sources of potential bloody conflicts among the fishing communities. That is the case of the narrow-mesh gears used by about 3,295 fishermen registered in twenty-one (21) villages on the Nokoué Lake, Porto-Novo lagoon and Cotonou channel (Alapini, 2001; Bonou and Adisso, 2002). Due to the devastating character of this gear, its utilization is prohibited on all the water bodies in the Republic of Benin, by Decree N°98-522 dated November 5, 1998.

Concerning precisely the South-East fluvial-lagoon network, the Ordinance N°068/MDR/DC/CC/CP/ dated March 12, 1997, stating Fishery Regulation on the Ouémé River-Porto Novo Lagoon Delta- Nokoué Lake Complex, in the provisions of its article 20, prohibits fishing on the Cotonou channel. The final aim is to enable this water body to play a role of physical and chemical exchange between the sea and the Nokoué Lake, to facilitate the migration of halieutic species in both directions, to ensure the sprawling grounds protection on purpose of the natural restocking of Nokoué Lake and to reestablish the ecological equilibrium along the channel. Through that Ordinance, Public Authorities have proved their willingness to protect the ecosystem. But the fishing communities still are pungently opposed to its enforcement.

As a matter of fact, eleven (11) fishing campings are identified in the riparian areas of the channel (Badahoui *and al.*, 2009). Those are Dancodji campings (Akpakpa Dodomé), Placondji Jetée, Ancien Pont (between the Old Bridge and the third bridge and the Directorate of Fisheries), Abokicodji Lagune, Dédokpo (between Yatch Club and Martin Luther King Bridge), Kpankpan, Midombo, Adogléta, Agbato, Minontchou and Ladji Campings. In these campings, the fishermen do not have access to potable

water, nor to a sustainable housing, nor to a sufficient habitable space. Sanitation and land security are compromised in the area. Those campings are established on the waste heaps and constitute unhealthy areas the occupation of which is formally prohibited by the public authorities. Along the channel, 270 canoes have been registered at the same time (some are drawn alongside the fishing campings while others are operating on the channel water body), as well as 22 local fish-trap (acadja) parkings, 352 pilling for set nets, 28 cast nets and 14 prawn nets traps (in a sedentary fishery specifically designed for the prawns. During the night, the fishermen hang vigil light to the net traps to attract the prawns which are trapped into the gear pockets). Fishery is the main activity of professional fishermen along the Cotonou channel.

However, the unauthorized fishing activities not only harm the movements of migrant species between the sea and the lagoon system, but also affect the populations health due to the strong contaminations observed in the fishing products. It is important and urgent to set up a platform of stakeholders, including the services in charge of regulation, to negotiate and reach a consensus.

v) Level of the local populations awareness on the climatic risks and adaptation techniques

The writing of national documents relating to climate change and commitments of Benin as part of the United Nations Framework Convention on the Climate Change has regularly been a matter of participative approach involving all the stakeholders. That is mainly the case of the National Action Program of Adaptation for climate change (NAPA) which ended in 2007. Cotonou Municipality belongs to the fishing agro-ecological area which is the most vulnerable to climate change in the country. The most vulnerable communities have taken part in the works through their representatives and NGOs. However, while addressing specific thematic like the Cotonou Lagoon Ecosystem and human systems vulnerability faced with the climate change, very few stakeholders really understood the issue. This entails the need for conducting a permanent information and sensitization campaigns to the large public, beyond the national traditional campaigns.

That is why at local level, it would be relevant to ensure the sensitization and training of municipal, district and town sections' authorities. It is their responsibility to respond to the needs of sensitization and training of the grassroots communities. Awareness campaigns will also be organized in permanent settings during the implementation of the project, and beyond, on the Cotonou Lagoon shores.

As such, the special conditions of its origin, the regulatory role it plays on the floods in Cotonou and on the wildlife and the flora within the South Benin Lagoon complex, the poverty of the riparian populations and the strong pressure on this ecosystem and the users of the Cotonou International market, constitute some circumstances worsening the vulnerability of Cotonou channel faced with the negative impacts of climatic variability, extreme weather and climate change. That is why Benin Government envisages to accompany the most vulnerable livelihoods along the

cotonou Lagoon with a view to implementing the most appropriate strategies of adaptation through the resolution of shores' erosion and infrastructure degradation, health, access to potable water supply and sanitation in a clean environment meeting the requirements of modern life for the current and future generations.

This project is a part of a larger coastal protection program to combat the rise of sea water level identified by the Benin Government in the NAPA (MEHU, 2007).

This is the general context substantiating this project aiming at enabling the Cotonou channel to fully play its regulatory role of hydrological regime of Beninese South-west fluvio-lagoon system and its role of facilitator of migrations of aquatic fauna in between the sea and the fluvio-lagoon system, irrespective of the negative impacts expected from the climate change. The main beneficiaries are the fluvio-lagoon ecosystem components, Cotonou populations, in particular the riparian communities of the channel.

In the sector of environment, one should observe the permanent effort of crosscutting mainstreaming of environment in the various strategic documents. On this purpose, the Government sees to ensure that the national development process is implemented in the strict respect of the global environmental standards contained in the conventions ratified by Benin. At this end, the national policy aims at: (i) strengthening through the implementation of the Strategic Environmental Evaluation (SEE); (ii) developing environment management tools such as the Millennium Ecosystems Evaluation approach (EEM), promoted by the United Nations System; and (iii) ensuring the enforcement of the regional and international conventions.

The sustainable management of environment, ecosystem and human systems of Cotonou lagoon, by and for the concerned populations, ie, the riparian populations, users of Dantokpa and Gbogbanou International Markets, the thousands of economic agents and craftsmen established along the shores and who undergo the ecosystem degradation impacts as well as the high pollution of those shores, are parts and parcel of this policy. Were this project not achieved, the Cotonou lagoon would fill up, bringing about the loss of its biodiversity and exposing half of Cotonou to quasi-permanent floods which would subsequently disorganize the economy of the town.

After all, due to the small dimensions of the stretch of water considering the extent to which the major climatic phenomena, climate risks of the coastal zone (rise of the sea level, floods, violent winds, increased surface temperatures, prolonged droughts) are not differentiated in the space of first approximation, alongside the lagoon. Where they are realized, the climate risks quickly propagate over the stretch of water. However, thorough studies show minor variations in climate risks, the importance of which will be appreciated in microclimatology.

On the contrary, the environmental issues are well differentiated alongside the lagoon depending on the nature and intensity of human activities (Figures .1.10 and 1.11).

The adaptation measures are not the response only to flooding risks though, these are the most obvious and further attract the attention of populations. The prolonged

droughts which determine a long period of minimum flow favors the sea water flow responsible for the erosion of foot of slopes just like the provoked waves by the violent winds and boats and power driven canoes during the same period. The rockfill of the foot of slopes proposed in the component1.



Figure 1.10 : Distribution of dumps and storm drains in the environment of the Cotonou Lagoon.

The Emergency Project for Environment Management in Urban Area (PUGEMU) funded by the World Bank, after the floods of 2010, for the benefit of all the major cities in Benin shows the importance of floods among the preoccupying climate risks.

Of course, adaptive actions taken into account as part of this project, such the treatment of urban waste from storm drains of the Cotonou city before their pouring into the lagoon are part of this project. This action will enable to avoid the propagation of contaminants in the whole Lagoon under the action of the Lagoon of flows and sea water back-flows.

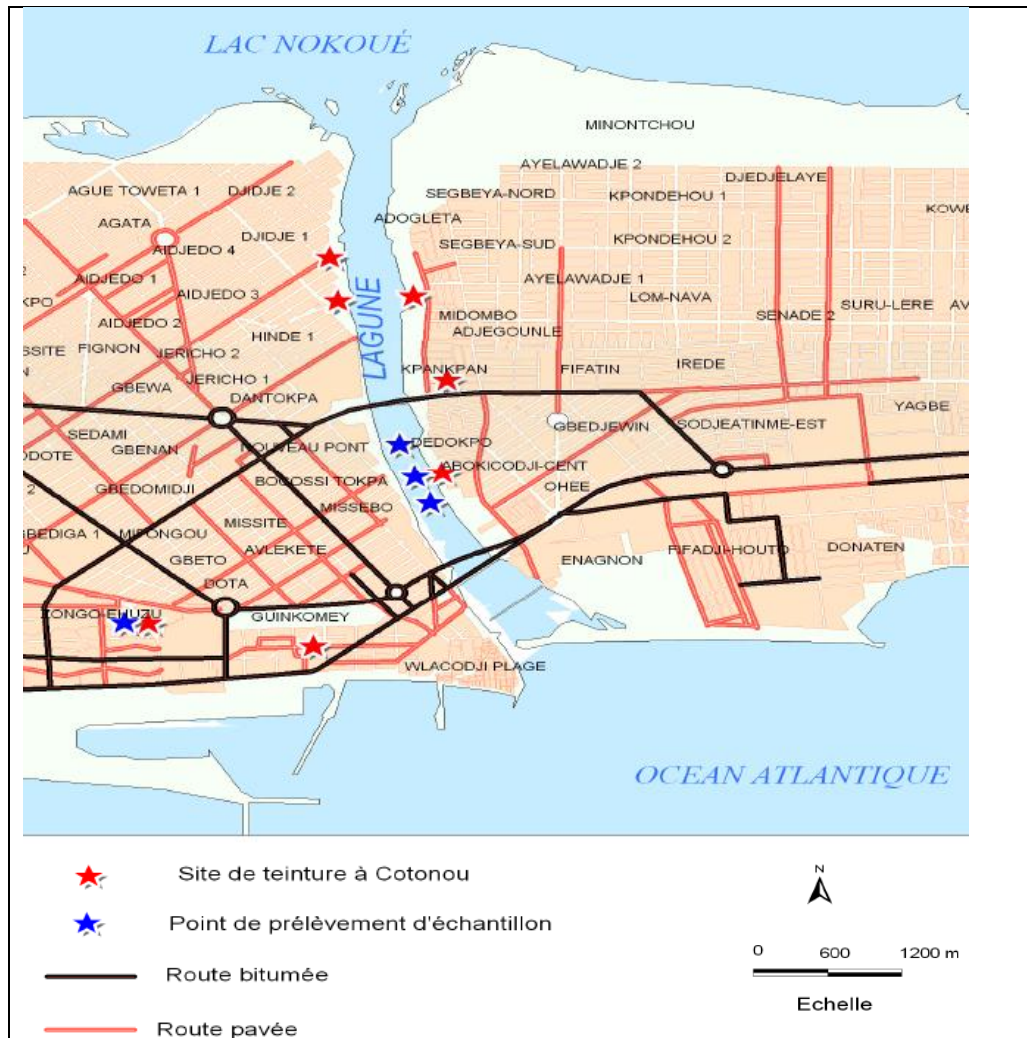


Figure 1.11 : Distribution of cottage-type dye works and control sites of waters polluted by heavy metals in Cotonou.

The protection groynes of the Cotonou harbour, especially the sand stoppage groyne extended to 300 metres in 2010 are the cause of lack of sand at the mouth of the Cotonou Lagoon (Figure 1.12). The Sifato groyne and 6 other groyne constructions underway at the East of the mouth of the Lagoon have no obvious direct influence on the lagoon system.



Figure 1.12 : Sand stoppage groyne at the Cotonou sea port extended to 300 in 2010.

■ PROJECT OBJECTIVES:

General Objective

The project aims to contribute to implement coastal component of Benin's National Adaptation Programme of Action for Climate Change (NAPA) drafted in 2007.

The overall objective is to accompany the Beninese Government to support the local authorities and the Cotonou Lagoon populations in their efforts to reduce the adverse effects of climate change on their livelihood and climate resilience.

Specific Objectives (SO)

- SO1. Implement appropriate actions to protect the banks and shores of the Cotonou lagoon through a set of actions of antierosive fight, restoration and improvement of riparian social and community infrastructures threatened by the rise of the sea level and extreme climate vagaries (floods, violent winds, increased surface temperatures, prolonged droughts), but also the anthropogenic pressure on banks and shores not maintained due to lack of economic interest for local authorities. The exploitation of community and adaptation infrastructures should enable local communities to generate financial resources usable for maintaining adaptation infrastructures.
- SO2. Implement appropriate actions to fight against the pollution of the lagoon and the living environment of populations by solid and liquid wastes. The degradation and lack of maintenance of banks and shores have facilitated the invasion of such spaces by the household and industrial garbage and wastes and their colonization by illicit activities of all kinds, sources of nuisance to the public health, which must be overcome.
- SO3. Implement actions appropriate for fighting against seasonal floods of banks and riparian areas of the Cotonou lagoon and sensitize businessmen for promoting floating bars and restaurants with a pedestrian access bridge, nautical sports,

promenades in canoe and rowing boat, aquatic gardens. The Cotonou dam built to regulate exchanges between the sea and the lagoon was not functional due to lack of maintenance. This specific objective aims to restoring the dam's initial function and creating economic conditions likely to guarantee local resources that can be mobilized for the maintenance of the dam and all adaptation infrastructures.

SO4. Back up the revision of laws and provisions to enforce fishing regulation activities and their adaptation to the constraints linked to climate change and to the improvement of subsistence means of local communities, as well as the retraining of some fishermen in the new economic activities generated by the development of the banks of the Cotonou lagoon. The official interdiction of fishing activities in the Lagoon and their continuance tolerated for social and political reasons give the lagoon fishing of shrimps and fish a stealthy nature which does not abide by any technical or ecological standard. It is necessary to integrate here regulatory laws and provisions taking into account climate risks, sensitize fishermen populations to that end and support some among them to shift to other economic fields.

SO5. Sensitize and train local communities on climate risks, adaptation techniques and good practices necessary for safeguarding the ecosystem, the human system and their own interests, and to limit the adverse impacts at a level compatible with their legitimate ambitions of economic and social development. The students and at the end of their training may exploit the assets of this project in drafting writing their studies completion dissertation and thesis defense. Such assets will be subject to a reporting at the end of the project at the local, national and international level.

Expected Results

Result 1: The Cotonou Lagoon shores are protected against the erosion resulting from the rise of sea water level and extreme weather events and the socio-community infrastructures are rehabilitated and improved to make the results sustainable.

Result 2 : The lagoon and living environments of the populations are protected against solid and liquid wastes-induced pollution to limit the spread of pollutants by the exchanges of water between the sea and the Lake Nokoué, the contamination of fishes and aquatic animals and the threats on the health of the waterside human communities.

Result 3 : The shores and riparian areas of the Cotonou Lagoon are protected against seasonal floods and the economic operators are sensitized to promote floating bars and restaurants fit with access foot bridge, the nautical sports, outing in canoes and aquatic gardens.

Result 4: The regulatory texts are reviewed and adapted to the constraints related to climate changes and adaptation strategies of the local communities and a support is brought for the redeployment of the affected fishermen.

Result 5: The local communities' awareness is raised on the climatic risks: they are sensitized and trained on adapted techniques to climate changes and the best practices needed for protecting the ecosystem, human system as well as their own interests, and to mitigate the negative impacts to a level that is compatible with their legitimate ambitions of economic and social development.

These objectives and expected outcomes are organized in two basic components dedicated respectively to (i) material adaptation activities consisting in physical measures of adaptation (installation or strengthening of infrastructures meant for fighting against the forms of degradation of banks and the lagoon environment, of a natural or anthropogenic origin and exacerbated by the variability and climate change) and (ii) social, educational and environmental adaptation activities (sensitization and training of populations, regulation of human activities likely to aggravate and degrade the life framework, capitalization of project's experiences).

The component of material adaptation activities will consist of works of civil engineering. These investments will allow to fight against adverse effects of climate risks on waterside communities and their resources. This component will be the most important in terms of cost (more than 85 % of the cost of operational activities).

The component of social, educational and environmental activities of adaptation aims to sustainably release the local populations suffering from social and environmental consequences of degradations that the first component will have helped to correct. Despite the low cost of this component, it is the one which will guarantee the sustainability of the adaptation infrastructures, owing to the behavioral change of the populations.

These components are:

3. Protection of lagoon banks, struggle against seasonal floods and catering for socio-community infrastructures ;
4. Integration of climate variability in environment management by the waterside populations and capitalization of the project experiences.

To these technical components, is added the component of management and administration without which the project cannot be successfully implemented.

The achieved results can be deduced from one another as follows:

Shores' stabilization and their protection against erosion due to flooding and effects of increased sea level, swell and violent winds (result 1) is the basis result, which will create the conditions for achieving the other results.

The stabilized shores will enable the free flux and reflux of sea water and that of the Nokoué Lake without shores' collapsing products, which muddies the lagoon water.

In clean water, the origin of solid and liquid refuse will be easily identified and controlled owing to actions that will be initiated by the project. Hence, the quality of water, fishes, and shrimps,....and people health will be protected (result 2)

Seasonal flooding is due to poor functioning of the Cotonou dam, which let with difficulty the run off of the Ouémé River and the Nokoué Lake flood towards the sea. The rehabilitation of the dam will enable to avoid the seasonal flooding and will guarantee the pursuing of economic operators activities who exploit the water plan at commercial, touristic or entertainment purposes (results 3).

On account of the cleaning of lagoon water, fishing activities, presently forbidden, could be permitted and the statutory texts will be revised accordingly: the fishermen too many will be oriented towards new employment opportunities created after the shores' management works or towards other opportunities (result 4)

The socio- community infrastructures, which will be rehabilitated or constructed on the shores, will enable the promotion of the adaptation culture to climate change. The promotional action could be prolonged by site visits, pupils and students' training actions, sociocultural animations organized by lakeside residents and the diffusion of acquired experiences in the framework of the project (results 5).

PROJECT COMPONENTS AND FINANCING:

Table 1.5: Project components and financing

Component 1 : Protection of lagoon banks, struggle against seasonal floods and catering for socio-community infrastructures					
ACTIVITIES	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	INDICATORS	AMOUNT (X 1000 US\$)	
Activity 1.1 : No of kilometers of sand segments of the banks protected with a rocky coating	Output 1.1 : 4.5 kilometers of banks sand segments are protected by a rocky coating	Outcome 1 : The banks of Cotonou's lagoon are stabilized by means of rocky blocks on slopes. The horizontal top of bank is stabilized by pedestrian ways paved, matched by landing stages facilitating the crossing of the lagoon by the waterside populations, and by sheds of demonstration with terrace concreted to promote healthy and sustainable activities round the lagoon. The dam of Cotonou is fitted out to limit the risks of obstruction of the mouth on the sea	Length of banks which rocky coating remains stable six (6) months after the works completion	2100	6840 Including transports and national and international missions charges
Activity 1.2 : Develop pedestrian paved roads along the banks	Output 1.2 : Three (3) kilometers of pedestrian roads of about 15 m of roads limit are paved along the banks		Length of banks including the paved road remains stable six (6) months after the works completion	4180	
Activity 1.3 : Develop on both banks, on appropriate sites, landing-stages for users access and economic activities (fishing, transports, nautical ports, pirogues and small boat ride, etc.)	Output 1.3 : Eleven (11) landing docks-landing stages – fixed wharfs established along the banks		Number of wrought works fully operational six (6) months after their establishment	220	
Activity 1.4 : Build control sheds with terraces in concrete, in places along the banks, in the same style as those already established opposite Dantokpa market	Output 1.4 : Eleven (11) control sheds are built along the banks to promote actions of awareness raising for populations on adaptation to climate change		Number of operational hangars six (6) months after their construction Number of new hangars built by private operators 12 months after	220	
Activity 1.5 : Rehabilitate the dam with gates of Cotonou	Output 1.5 : The crest of the dam is leveled at the +0.635 meter hydro coast to limit the risks of obstruction of the lagoon mouth		Hydrological behavior of the river mouth 12 months after the works	120	

Component 2 : Integration of climate variability in environment management by the waterside populations and capitalization of the project experiences				
Component 2.1: Fight against water pollutants and fishes and aquatic animals contamination				
ACTIVITIES	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	INDICATORS	AMOUNT (X 1000 US\$)
Activity 2.1.1 : Build capacities of heads of area and SOGEMA to reduce the practice of discharging household wastes on the ground	Output 2.1.1 : One thousand (1000) mobile refuse containers are placed in riparian areas and in Dantokpa and Gbogbanou markets	Outcome 2.1 : The pollution provoked in the lagoon environment by flows and ebb of water and by human activities is limited by the proposed systems or mechanisms for the management of solid and liquid waste and the prevention of pollution	Number of mobile refuse containers still operational 18 months after their installation	40
Activity 2.1.2 : Build capacities for collection and conversion of non biologically decomposable wastes by the Women Associations based on Recycled Materials of Dantokpa market (AFRMD)	Output 2.1.2 : Two hundred (200) aluminum basins and two hundred (200) baskets are made available for AFRMD for collection and recycling non biologically decomposable wastes		Rate of increase of AFRMD volume of activity 12 months after material support	4
Activity 2.1.3 : Build capacities for conversion of non biologically decomposable wastes by the Association of Houéyiho market gardeners	Output 2.1.3 : Two hundred (200) pieces of small tools for biodegradable waste composting are made available for the Houéyiho truck gardeners Association		Rate of increase of volume of compost manufactured by AMH 12 months after material support	2
Activity 2.1.4 : Destroy the floating latrines and replace them by public improved public latrines without any contact with channel	Output 2.1.4 : Sixteen (16) improved latrines without any communication with water from the channel are built on the banks		Number of operational latrines 12 months after their construction	32
Activity 2.1.5 : Treat urban discharges of the main sewers from rain waters of Cotonou city before their discharge in the channel	Output 2.1.5 : Urban discharges from the main sewers of Cotonou city rain water are treated before their discharge in the channel		This component is taken into account in the Emergency Project of Environmental Management in Urban Area (PUGEMU) financed by the World Bank	PM
Activity 2.1.6 : Raise populations awareness against petroleum products transportation by fluviolagoon route and support Naval Forces unit posted on the channel entrance to strengthen the fight	Output 2.1.6.1 : Populations are aware of real and potential impacts of petroleum products on living resources of the lagoon and on the women and men living from these resources		Rate of reduction of illicit discharges of oils in riparian areas, 6 months and 12 months after the beginning of the awareness raising campaign	30
	Output 2.1.6.2 : New means of night interventions made available for Naval Forces Units posted at Ladji area.		Rate of increase of night missions of the Naval Forces Unit 6 months after the support	40
Activity 2.1.7 : Raise awareness on and train dyer craftsmen on the good practices of managing residual waters containing heavy leads	Output 2.1.7 : dyer craftsmen are aware of and apply rational techniques of residual waters management	Percentage of dyer craftsmen having adopted the new techniques of residual waters management 6 months after	20	

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Including transports and national and international missions charges

			training		
Activity 2.1.8 : Raise awareness of business men for the promotion of floating restaurants bars with pedestrian bridge of access , nautical sports, pirogues and small boat ride, water gardens	Output 2.1.8 : Ten (10) businessmen at least are involved in tourism valuation of Cotonou lagoon		Number of entrepreneurship files on the lagoon initiated 6 months after the beginning of the awareness raising campaign	50	

Component 2.2: Integration of the constraints to climate variability in texts regulating fishing in the lagoon

ACTIVITIES	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	INDICATORS	AMOUNT (X 1000 US\$)	
Activity 2.2.1 : Support the integration of constraints related to climate change and strategies of adaptation in the laws regulating fishing activities	Output 2.2.1 : An interministerial order regulating fishing on Cotonou channel is validated , signed by the ministers in charge of fishing and environment , and the riparian community is made aware of the standards of ecosystem sustainable management	Outcome 2.2 : The regulations of the fishing on the lagoon allowed to limit the escalation, by waves provoked by power-driven boats, of the erosion of banks due to streams between sea and lagoon and to violent winds, and to extreme meteorological events. The fishermen in excess on the lagoon agreed to move into the other economic activities created in the lagoon	Rate of decrease of breaches noticed by the agents of Naval Forces Units, the Environmental Police and the national Police , 6 months after awareness raising for fishermen on the basis of the new laws	40	357 Including transports and national and international missions charges
Activity 2.2.2 : Support fishermen concerned by the regulation for their retraining in the new activities generated by the development of Cotonou channel	Output 2.2.2.1 : A workshop of awareness raising for fishermen is organized on the new economic activities in the channel		Number of fishermen having chosen the new economic activities , three (3) months after awareness raising	17	
	Output 2.2.2.2 : Thirty (30) fishermen receive material supports to get involved in the new economic activities???		Number of fishermen maintained in the new activities six (6) months after the supports	300	

Component 2.3: Awareness raising and training local communities on climate risks, adaptation techniques and good practices, and capitalization of the experiences

ACTIVITIES	EXPECTED CONCRETE OUTPUTS	EXPECTED OUTCOMES	INDICATORS	AMOUNT (X 1000 US\$)	
Activity 2.3.1 : Raise awareness and train the local authorities , town councilors and heads of riparian areas on good practices and techniques of adaptation to climate change	Output 2.3.1 : 02 sessions of training are organized for local authorities, town councilors and heads of riparian areas on good practices and techniques of adaptation to climate change	Outcome 2.3 : The rise of the consciousness and the training of local communities on climatic risks, techniques of adaptation and good practices and the capitalization of the experiences in the form of memoirs and theses in the universities allow to assure the durability of the experiences and the scattering of the results of the project	Percentage of local authorities having initiated a strategy of adaptation faced with major climate risks of the coastal area 01 year after the sessions	69	140 Including transports and national and international missions charges
Activity 2.3.2 : Make assure the raising awareness and the training of the waterside communities of Cotonou lagoon on good practices and techniques of adaptation to climate change by the local authorities	Output 2.3.2 : local authorities have delivered to their target communities the training on good practices and techniques of adaptation to climate change		Number of members from communities having developed at least one adaptation measure to major climate risks of the coastal area , 01 year after the sessions	12	
Activity 2.3.3 :Receive pupils and students for their works of end of	Output 2.3.3 : At least ten (10) memoirs and theses are supported in the		Number of memoirs and theses supported on the theme of the	59	

training, spread the acquired experiences by the project and organize a seminar of the end of project	professional schools and the universities on the themes of the project; the project reports are given to the concerned national and international institutions; about fifteen (15) workshops and meetings with the journalists are organized; also, one conference of project end is organized as it is mentioned in table 3.3 (Monitoring and Evaluation Plan)		project, number of institutions having benefited from the experiences of the project		
Total for component 2				715	
TOTAL COMPONENTS				7,555	
PROJECT EXECUTION COSTS (9.5%)				792	
TOTAL PROJECT COST				7,555	
PROJECT CYCLE MANAGEMENT FEE (8.5%)				709	
AMOUNT OF FINANCING REQUESTED				9,056	

■ PROJECTED CALENDAR:

Table 1.6 : Schedule

MILESTONES	EXPECTED DATES
Start of Project Implementation	December 1, 2013
Mid-term Review (if planned)	December 1, 2015
Project/Programme Closing	December 30, 2017
Terminal Evaluation	Jun 31, 2018

■ PART II: PROJECT JUSTIFICATION

A. Describe the project / programme components, particularly focusing on the concrete adaptation activities of the project, and how these activities contribute to climate resilience. For the case of a programme, show how the combination of individual projects will contribute to the overall increase in resilience.

Based on the Cotonou channel referred to locally as “lagune de Cotonou”: Cotonou Lagoon, this project comes in support to local authorities and riparian communities in order to implement options of adaptation identified by themselves. Most of adaptation options are based on strategies some of which have already started being implemented. The projet integrates two components which are as follows:

Component 1: Protection of lagoon banks, struggle against seasonal floods and catering for socio-community infrastructures

The Benin littoral is naturally subject to coastal erosion. It is characterized by a barrier beach made up of soft sediments (coarse texture sands with fine), a high littoral transit of sand from the West to the East created by the obliquity of crests, and large seasonal variations of surge characteristics, which make the coastline unstable. With the construction of the Cotonou seaport and its protection finger slips, the eastern area of the coast is deprived of the natural contribution in sand while it is still providing the areas further in the East with sand. The first consequences constitute the erosion of the coast sections directly located in the East of the port, the permanent opening of Cotonou channel’s mouth, the increase of the rate of rise and fall in the channel and banks erosion. The rise of the sea level and the extreme meteorological phenomena will contribute to the worsening of erosion phenomenon.

The degradation level of the Cotonou Lagoon banks where the erosion has stripped the outlet of rain waters or waste waters’ main sewers and drink water carriage conduits, and where the insalubrities created by waste waters and municipal waste urge poor populations to abandon their slums, calls for urgent protection actions (fig.2.1). We must protect the integrity of the banks and the health of populations without being in the way of the migrating species movements, of which, water between Atlantic Ocean and Lac Nokoué, and the



Breeding grounds for fishes and shrimps. Options considered on the basis of bank segments specificities are :

Figure 2.1 : Outlet of rain waters or waste waters’ main sewer, drink water conduits stripped by erosion in an unhealthy environment on the banks of the Cotonou lagoon

- protection of banks sandy segments with a rocky coating;
- development of paved pedestrian footpaths, along the banks;
- development on the two banks, in appropriate sites, of landing docks – landing stages and fixed embankments of access for users and economic and tourism activities (fishing, transports, nautical sports, pirogues and small boat ride, etc.).
- construction of control sheds with terraces in concrete, in places, along the banks, in the same style as those already built opposite Dantokpa market. The interest of the control sheds is to serve as a model for business men who would like to involve themselves in the tourism development of the lagoon environment and house awareness raising actions for the population on the issue of climatic risks, vulnerability and adaptation strategies;
- rehabilitate the dam with gates of Cotonou in leveling the crest at the +0.635 meter hydro coast initially provided for and in re-activating the setting system for sea-lagoon exchanges, to avoid the obstruction of the lagoon mouth and fight against seasonal flood of banks.

The proposed measures answer potential threats which come true periodically in the lagoon environment.

The specific threats associated to the adaptive measures proposed by component 1, are presented in the following table 2.1.

Table 2.1 : Specific threats associated to the adaptive measures proposed by component 1

Proposed adaptive measures	Associated specific threats
1 : Protect the sandy segments of the banks with the rocky coating	Erosion of the bank slope by currents of sea water flows and backflows and waves caused by the wind and canoes and power canoes. These threats are aggravated by the rise of the sea level, floods (top of slope), violent winds, long dry periods (foot of slope).
2 : Develop pedestrian paths alongside banks	Erosion and caving of shores (flat parties extending the slope) by storm waters. Threat aggravated by violent rains and floods)
3 : Develop on the two banks, on the appropriated sites, landing stages–passengers access and drop-off places for users and economic and tourist activities (fishing, transports, nautical sports, promenades in canoes and rowing boats, etc.)	Banks degradation by populations to access to income generating licit or illicit activities on the stretch of water. The gaps opened in the slope may be enlarged by violent rains and floods and lead to the collapse of any infrastructure.
4 : build pilot sheds with concrete verandas, on some places alongside the banks, in the same	Degradation of banks by inappropriate infrastructures, erected by the populations for

style with those already set in face of Dantokpa market.	proximity economic activities. violent rains and floods may aggravate the degradation.
5: rehabilitate the dam with gates of Cotonou	Obstruction of the lagoon mouth on sea and seasonal flood of banks

Rocky coatings are already used by some private business operators established along the channel in order to reinforce the shore with their own funds (Hôtel du Lac, Bar restaurant Le Berlin, etc.). The right shore of the channel mouth is also equipped with rocky coatings since 1976 with the view to de protecting this shore segment against the erosion provoked downstream the Cotonou Port West Breakwater. This proposal would extend the rocky coating protection to other segments of the unprotected shores. Of course, the rocky coatings which seem to yield good results on the Cotonou lagoon shores also have their general aftermaths in a context like that of the Cotonou channel: while mitigating the shore rugosity, they would speed-up the flow, changing thereby the hydraulic regime of the channel along the linear; one could also witness the destabilization of the shore upstream or opposite if the works do not cover both shores (SMMAR, 2013)¹ The slow flow due to the low slope between Nokoué Lake edge and the mouth on the ocean and the envisaged protection should limit the negative impacts on the environment where the salty water does not allow to practically resort to plan engineering technology. In a nutshell, technical studies are envisaged on purpose of sizing the works and complying with the technical and environmental standards.

The pavement technology proposed in order to stabilize the shores top and the one in use in Cotonou town apart from the stilted and un floodable main roads. In any other situations, the sustainability of the works is ensured by the cavernous coatings (pavements, pebble stones). Here also, the vegetation would pose maintenance problem since the lagoon water salinity cannot allow its use for watering operations. The major benefit for laying out the top of the slope into foot way and rehabilitate a socially-oriented function to that space in lieu and place of the illegal off-loading place used by the smugglers and traffickers of any kind of products which are nowadays source of insecurity in the Lagoon riparian areas.

The proposed landing wharfs / docking areas would come to rehabilitate and complement the existing works in order to facilitate the riparian populations movements in-between the two shores and vacate to their economic activities.

The shed fit with concrete terraces constitute nowadays the pride of the Benin Markets Management Company which installed some prototypes along the shoreline and hired them to the traders. Those infrastructures limit the floods impacts, the goods being outside the water. The stakeholders proposed that those infrastructures be close to the landing wharfs / docking areas in order to grant opportunities to the business operators desirous to tap into the sanitized environment. The proceeds from the rent of those infrastructures could be used by the authorities of the riparian areas for the maintenance of the works and facilities. Finally, those sheds could be partially used by the local authorities for promoting climate change adaptation measures in the lagoon environment.

The intervention proposed onto the Cotonou dam is a rehabilitation which should enable to re-establish the functionality of this work in terms of regulation of waters flows and floods on the

¹ SMMAR (2013). Le confortement des berges. <http://www.smmar.fr/travaux-types/le-confortement-des-berges/>

lagoon shores. Its blades are blocked by sand heap to such extent that one cannot change the orientation without using nowadays powerful cranes.

The choice of infrastructures was based on the outcome of the consultation with the stakeholders who made reference to the existing achievements. As a matter of fact, the right bank of the mouth of the Cotonou channel was, in 1977-1978 equipped with coating rocks prolonging the pier (West breakwater) and intended to curb the erosion provoked by the breakwater at its immediate lower reach on that bank. Against those rocky coatings learn the small dam downstream of the old bridge which slows down the speed of the water flowing from Nokoué in case of floods. (Diagram 1). Those rocky coatings are functional and ensure a proper protection of the right bank of the mouth downstream the West breakwater. The riparian populations have cleared a path on top of the rocky coating for their movements. It is the efficiency observed at those rocky coatings level and which motivated the stakeholders' interest for that technology for the protection of the banks all along the channel.

The bank or shore segments concerned by such measures are the ones on which a minimum agreement was reached in 2010 between municipal authorities and local leaders, i.e, the heads of Town Sections, the Heads of Areas, the development Associations (Fig. 2.2). Those are also the segments whose development has been negotiated in 2011 (Fig. 2.3). The specific places of the works on the bank segments are underway of definition in consultation with local stakeholders.



Figure 2.2 : Bank Segment which development has been negotiated in 2010



Figure 2.3 : Bank Segment which development has been negotiated in 2011

The robustness of the remedial works and the joys of spring to which they will contribute within riparian populations and those living in the whole Cotonou should make populations be aware of their capacities to stand up to natural environmental stress if they show spirit of anticipation through relevant strategies of adaptation.

Concerning seasonal flooding, we have to recognize that from the opening of the channel in 1885 until the 1950s, the Cotonou Lagoon has relatively efficiently carried out its mission of flood control in Cotonou City. Under the pressure of flood waters from “fleuve Ouémé” : Ouémé river and “lac Nokoué” : Nokoué lake, The shoestring sand of the river mouth was giving way, causing waters drainage towards the Ocean and the fall of level in the fluviolagoon system. On low-water level, the sea water used to enter the channel and the littoral current would cause a sand deposition which finally blocked the river mouth until the following floods. The development of port wrought works in 1960 has changed the lagoon hydrologic operation.

Indeed, built from December 1960 in deep water, Cotonou sea port is made up of a certain number of wrought works including a Western wharf in coarse rock, with 1 424 meter long, and an Eastern crossing in steel-sheet piles, with 770 meter long, which close the harbor area in the East while leaving a harbor channel with 180 meter wide (Leite, 2002). The role of the Western wharf in coarse rock is to protect the harbor area against the effects of Cotonou surge and current, especially sandbank and waves. Each year, it blocks about 1 500 000 m³ of sand (Leite, 2002). There is then an almost total stopping of the contribution of sand in the East and an accumulation of sand in the Western part of the wharf. The consequences of this sand contribution stop constitute the phenomenon of catastrophic erosion observed on the socio economic wrought works on Cotonou Eastern coast and the permanent opening of Cotonou channel which resulted in important hydro biological and socio economic changes (Baglo, 1980).

In order to limit the consequences related to the permanent opening of Cotonou channel, a rockfill dam was built in 1977 (fig.2.4) which the objectives , according to Baglo (1980), was to:

- Reduce the speed of the subsidence in order to extend the period of reproduction and increase of freshwater species;
- protect the bridges on the lagoon in reducing the currents speed ;
- enable a certain intrusion of saline water in order to reduce the effects of waters pollution;
- avoid the flood of Cotonou City;



Figure 2.4 : Dam with gates at Cotonou Lagoon outlet

The dam was built out of a barrier of about 420 m and 6 straits of 4.5 m wide (Leite, 2002). The wrought includes a setting mechanism for sea-lagoon exchanges. But the dam built is 0.32 metre higher than the wrought provided for, the project owner having considered doing well in increasing the height. The exchanges were completely interrupted by a spit which has reconstituted itself in front of the dam, because of the significant reduction of the lagoon current, even before the end of the construction. This undesirable closing made the setting mechanism handling inefficient, changed the currents path at the river mouth, and caused the extension towards the western part of the current sand spit until it completely closed the river mouth on May 6, 1978, with biological consequences more catastrophic and compelling fishermen to carry out its damping (Roche International, 2000).

Analysis of coastal structures impacts on the banks of the Cotonou Lagoon

Impact of the Cotonou Harbour

After the construction of the Cotonou Harbour, bank protections near the outlet lagoon were installed. The following have been built:

- A West groyne rooted the sea shore and the extension of the western shore of the lagoon;
- A groyne of small length in the lagoon to limit sea movements in the channel to the west;
- A longitudinal defense between these two (2) groynes.

All these defenses were built from rockfill careers in Dan located about 140 kilometers from Cotonou. But only the western bank of lagoon was protected. The bottom of the lagoon between the outlet and the Old bridge and the east bank continued to be eroded. The outlet of the lagoon into the sea became permanent. This contributed to a sharp increase of salinity in the lagoon and Nokoué Lake with disastrous consequences on fishing.

Addressing the problems caused by the permanent opening of the outlet lagoon, a dam was built. Its double role is to partially close the outlet during low water and allow the evacuation of flooding during the rainy season. But the dam was built too high at 0.4 m. Before the end of the dam building, the Lagoon outlet was closed in May 1978. Then floods in Cotonou started again. Between 1977 and 1984, the Lagoon outlet was artificially opened between September and October to evacuate floods from Ouémé and Sô, but was closed few days after. In 1984, after several attempts to open the outlet failed (the outlet was closing in a few hours), fishermen living on the banks, have clipped the dam in October 1984. Then the opening was maintained. Until today the outlet is not ever completely closed. It widens during the flood period but shrinks itself during low water but is never completely closed.

Regulatory issue of the outlet is not yet fully resolved, although the salinity cycle is controlled. Fishermen admit that fish production is the largest since the opening in October 1984. They felt that the situation occurred in the presence of the dam. To better address the regulation of exchanges between the sea and the lagoon, a study was carried out by SNC-Lavalin in the context of the study of sanitation in the cities of Porto-Novo and Cotonou.

For the regulation of water exchanges between the sea and the lagoon, measures taken during the Cotonou harbor building and the dam in 1976-1977, lagoon helped to control erosion. Unfortunately, problems continue to arise regarding the regulation of the sea and the lagoon. To address these problems, SNC LAVALIN recommended to rehabilitate lagoon dam which must be leveled to + 0.635 meter hydro meters (+0.1 m ASL) and better resizing of the sluices.

It should be expected to have:

- a good evacuation of the Ouémé and Sô floods: the water level in the Nokoué lake and the Lagoon does not exceed a ten-year ten level with + 1.775 hydro (+1.24 ASL)
- a controlled rate of the salinity of the lake during Nokoué low water: a salinity of less than 7 g / L at any time and 4 g / L during 7 months out of 12 for the entire lake; salinity less than 10 g / L for Lake area close to the channel at any time

But another structure plays an important role in the stability of the lagoon banks in the area outlet: the West groyne built in 1962 along the Cotonou harbor. Since its construction, this has never been serviced. It is desirable that a detailed inspection of the work is done and that his rehabilitation is programmed as part of the Cotonou channel bank stabilization.

The Coastal Structures under construction

While the West harbor Groyne had blocked port the entire longshore littoral, as the littoral segment located between the harbor and Siafato groyne has been stabilized, the expected erosion is plotted on the part of the east coast. From this place, very strong erosion has occurred. To the East of the immediate area, a place called "Cotonou Creek", more than 600 meters wide strip of land were lost since 1963. This entails an average rate of erosion of more than 12 meters per year.

To ensure the protection of the coast on the east of Siafato Groyne, a project was initiated by the Ministry in charge of public environment. Works are currently ongoing. Coastal infrastructures in this project context are divided into two (2) areas and include:

- **Zone 1** : (see figure 2.5)
- ✓ New East groyne (Old one is shifted) with a length of 250 meters ;

- ✓ Covering high rockfill range of 290 meters longitudinally coastline;
- ✓ Groyne 1 with a length of 160 meters with a ground anchor of 15 meters. It has the shape of an “L” facing west to prevent leakage of sand from the cell formed by the zone 1; it will be strengthened to prevent erosion on its eastern side.
- ✓ Supply 340,000 m³ of sand (Phase I)
- ✓ A second phase of sand supply is expected later to fatten more area if necessary.

➤ **Zone 2 :** (see figure 2.6)

- Groynes 2-7 make an angle of 30 degrees with the east shore to prevent erosion on eastern side. They have a length of 160 meters with 30 meters of anchor ashore; the most easterly of the system will anchor 50 meters and thus a total length of 180 meters. The space between the groynes varies between 900 meters and 1,100 meters. Wherever possible, groynes will be built in areas that avoid the destruction of buildings already existing before the stabilization of the beach.

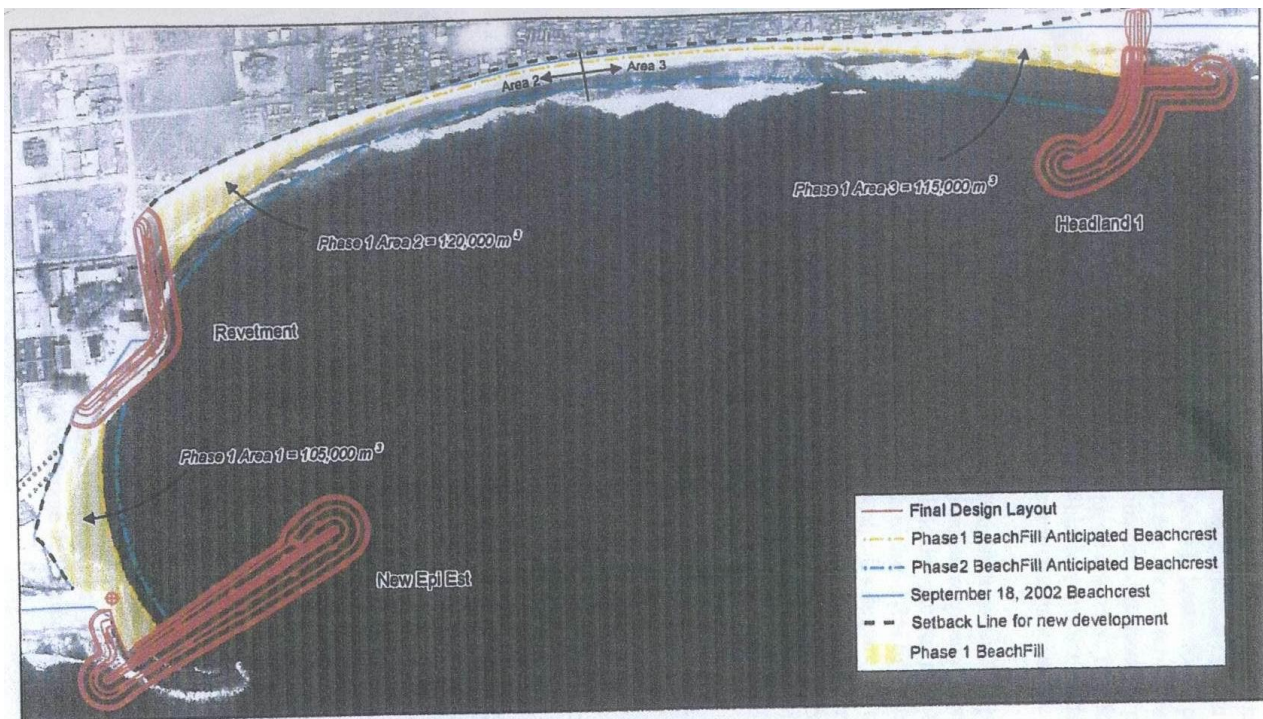


Figure 2.5 : Zone 1 of implementation structures

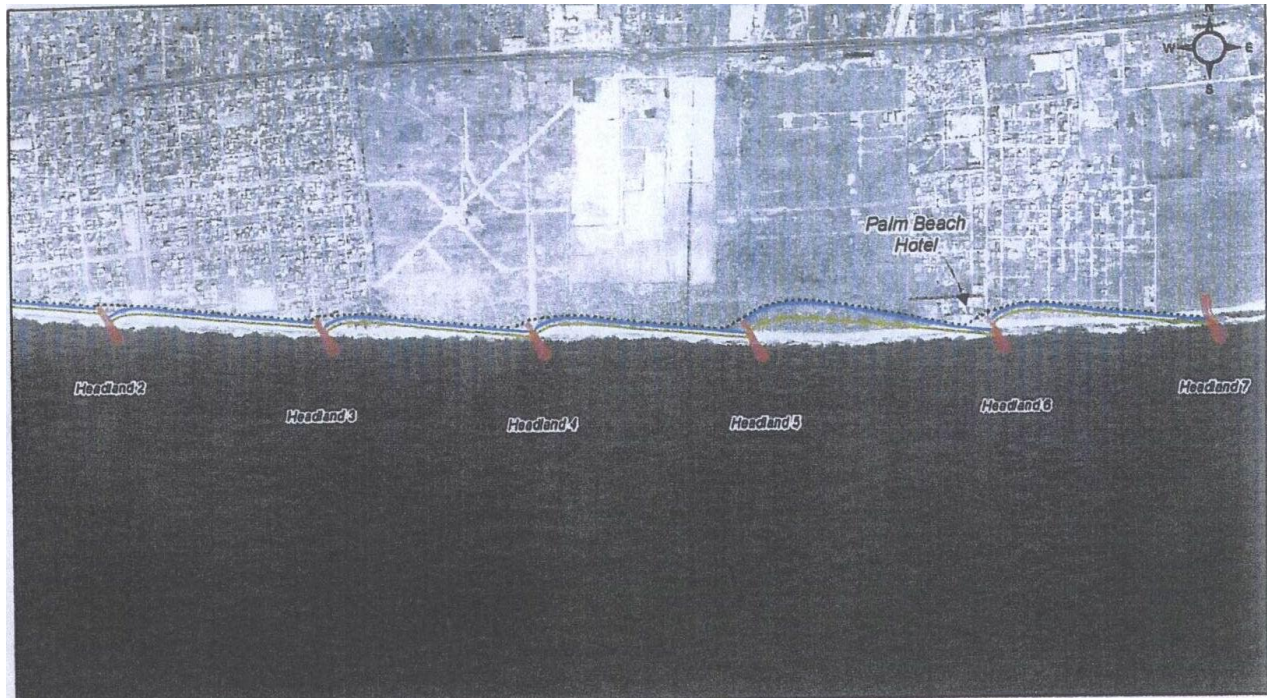


Figure 2.6 : Zone 2 of implementation structures

The rehabilitation of Sifato finger slip and the construction of 7 new finger slips in the Eastern part of Sifato, the works of which were launched on July 06, 2009, should result in stopping immediately sand losses in the Eastern part of Cotonou port when the works will be completed. However, the risks related to the rise in sea level and extreme meteorological phenomena and the efficiency of the 7 new finger slips in construction may be the cause of a phenomenon of fattening at the level of the channel mouth. We should then rehabilitate Cotonou dam in leveling the crest at the +0.635 meter hydro coast initially provided for and in re-activating the setting system for sea-lagoon exchanges, to avoid the obstruction of the lagoon mouth.

Component 2 : Integration of climate variability in environment management by the waterside populations and capitalization of the project experiences

The stabilized floods-free lagoon shores permit free ebbs and flows of the sea water and Nokoué lake, without rejecting on the shores some collapsed particles that would trouble the waters. The sources of solid and liquid waster could be easily identified and controlled thanks to the activities that the project would have induced. That is how the water, prawns, shrinks, fish... quality as well as the populations' health security would be protected (component 2.1). Due to the lagoon water sanitation, the currently prohibited fishing activities could be authorized by the regulatory texts that would be subsequently reviewed: the over-crowding

fishermen would be directed into newly created jobs opportunities further to the sanitation works done on the lagoon shores or other opportunities (component 2.2).

The socio-community infrastructures to be rehabilitated or built onto the shores will grant a space for the promotion of the culture of adaptation to climate change impacts. The promotional activity could be prolonged by site visits, trainings to students and pupils, socio-cultural facilitations organized by the riparian populations and the dissemination of acquired experiences within the framework of the project. (component 2.3).

Component 2.1: Fight against water pollutants and fishes and aquatic animals contamination

The sources of pollution observed in the Cotonou Lagoon, on its banks and in the wells exploited in riparian areas are as numerous as varied : biologically decomposable and non biologically decomposable solid wastes (fig.2.7), various wastes and liquid products (releases of municipal rain water, household and industrial waste waters, oils, etc.). They are at the root of chemical contaminants which are essentially heavy metals (lead, cadmium, mercury, zinc, etc.) and persistent salts (phosphates, nitrates, nitrites, ammonium, etc.) and microbiological contaminants (fecal coliforms, total coliform count, streptococcus, etc.). These contaminants get in the lagoon water, in the wells water and in the sediments feeding fishes and shrimps. This, results, in halieutic products, in levels of concentration higher than the standards admitted by the World Health Organization (WHO, 1995).



Figure 2.7 : *Rubbish dump on the banks of Cotonou channel*

The protection of waters quality requires strong measures to fight against all the sources and forms of pollution. Cotonou municipality, local authorities, all the populations involved and Non-Governmental Organizations (NGO) involved shall try to :

- Fight against the practice consisting in dumping household refuses/wastes on the ground in riparian areas and in Cotonou international market.

The mobile refuse containers that the Market Management Company : “Société de Gestion des Marchés” (SOGEMA) has put on the western bank of the channel, opposite Dantokpa market, is an initiative the extension of which could be supported on the two banks. The same applies to the initiatives of Women Associations based on Recycled Materials of Dantokpa Market and the Association of Houéyiho Market Gardeners which involved themselves actively in non biologically decomposable waste recycling and in organic waste conversion

through composting the products, which are used to fertilize the grounds of market gardener areas of Cotonou city.

- Destroy floating latrines and replace them by improved range closets without any contact with the channel. The initiative of range closets built on the western bank of the lagoon by an NGO for Gbogbanou market users seems to be an initiative, which will require to be reinforced ;
- Treat municipal waste from rain water main sewers of Cotonou city before their disposal in the channel. This constituent is greatly taken into account in the Emergency Project for Environmental Management in Urban Area (PUGEMU) which financing was approved by the Board of Directors of the World Bank on April 26, 2011.
- Fight against pollution of the channel by hydrocarbons by raising the awareness of populations especially people who carry these products through water route. The presence of Naval Forces Units posted at Ladji area is a dissuasive action to fight against the illicit fluvial lagoon transport of hydrocarbons. It would be advisable to build the capacities of the night patrols of these units and raise the awareness of dealers for their shift to other economic activities, including the new activities generated by the development of the lagoon.

In concrete terms, we shall have to:

- 1) build the capacities of responsables of area and SOGEMA to reduce the practice consisting in laying household wastes on the ground ;
- 2) build capacities for collecting and conversing non biologically decomposable wastes by the Women Associations based on Recycled Materials of Dantokpa market (AFRMD) ;
- 3) build the capacities for conversing non biologically decomposable wastes by the Association of Houéyiho Market Gardeners (AMH);
- 4) destroy the floating latrines and replace them by improved range closets without any contact with the channel;
- 5) treat municipal waste from rain water main sewers of the Cotonou city before their disposal in the channel;
- 6) raise populations awareness against the transport of oils by fluvial and lagoon route and support the Naval Forces unit posted at the entrance of the channel;
- 7) raise the awareness of and train dyer craftsmen on good practices of residual bulkwater management containing heavy metals;
- 8) raise business men awareness for the promotion of floating restaurant bars with pedestrian bridges of access, nautical sports, pirogues and small boat ride, water gardens. These tourism and economic activities will generate on the lagoon a

permanent life through the behavior of Cotonou dam and that of the channel mouth would be a subject of a real time collective surveillance that would reinforce the alert systems the naval authorities would establish.

Component 2.2: Integration of the constraints to climate variability in texts regulating fishing in the lagoon

The link between fishing regulations and climate change is not still evident in the Cotonou Lagoon.

Indeed, the national fish and shrimps production has almost not changed despite the stoppage of exports towards the countries of the European Union (table 2.2).

Table 2.2 : *Evolution of the production, import and export of halieutic products, in tons/year (Department of Fisheries, 2010)*

Years	2005	2006	2007	2008	2009
Productio	38696.88	39614	36396.42	37494.587	39691.587
Import	45227.99	46466	63479.723	77853.562	73471.195
Export	136.472	114.41	12.223	6.35	0.2617

Source : *Department of Fisheries (2010)*

Almost the whole production of shrimp is achieved in the Cotonou Lagoon for the average volume of 1000 tons per year. Since fishing is forbidden in the lagoon, it is difficult to have the figures on the real evolution of the fish stock.

The temperature and level of oxygenation of the water will be the main factors conditioning the aquatic life. The oxygenation is controlled by factors such as saltiness and the presence of organic material in decomposition.

The temperatures recorded in the channel will be between 28.5 and 30.8 °C (Bonou and Adisso 2002). The projections conducted on the basis of relevant climate scenarios show that the air temperatures would undergo a continuous increase in all the regions of Benin, by 2100; the highest thermal increase would be 3.27°C, in comparison to the reference period 1971 – 2000; the lowest value would be 2.6°C in the coastal region, with effects on the temperature of the lagoon water.

But a change of a few degrees of water temperature may be harmful to the aquatic fauna exploitable or to other micro-organisms important in the food chain. Therefore, the incidence of the climate change on the halieutic resources of the lagoon is understandable. Such incidence will be detailed per group of species in the project document.

The values recorded in dissolved oxygen in the channel of Cotonou are between 2 to 7.2 mg/l (Bonou and Adisso, 2002). Such values are low due to the high saltiness of the waters, because the more water is salty, the less they contained dissolved oxygen.

This means that the rise of the sea level and the flows of salty water in the lagoon are unfavorable to the aquatic animals.

In the Cotonou lagoon, the highest value of oxygen biological demand (DBO5) is observed in February (35 mg/L). At the same time, the average high concentration of chlorophyll in the water surface (60 µg/L) evidences an important activity of photosynthetic production. It the times less in depth (20 µg/L), and. The strongest activity is in December (140 µg/L). Furthermore, the heavy metals (lead, cadmium, copper and zinc, iron) brought by the waste from the dye works and other metal residues have a negative impact on oysters in the channel (Dovonou, 2000).

It is finally the flows of sea water and organic waste from human origin that regulate the animal life in the lagoon.

The general framework of management and control of fishing in the maritime environment is defined by the Code of shipping (Order N° 68-38/PR/MTPTPT dated June 18, 1968, modified by Order N° 69-49/PR/MAE dated December 9, 1969), which enables, per ministerial order, to define the conditions of exercising maritime fishery. It enables to define non fishing areas and periods, prohibited machines, size limits of catch, the nature of baits used, the measures of control and follow up of fishing and prohibited activities. It also enables to determine the measures of hygiene and healthiness of the products. It finally provides for provisions on all related activities (ship construction, fish trade, ice manufacture, etc.), as well as fines for breach of fishing conditions and related activities.

This statutory basis is completed by orders, decrees and ministerial orders which specify some conditions of fishing exercise, in particular on industrial fishing licenses. These are:

- ministerial order N°100/MTPTPT/MDRC dated July 31, 1968 defining the conditions of fishing exercise in territorial maritime waters;
- order N°73-40 dated May 5, 1973 related to the organization of industrial fishing;
- order N°76-92 dated April 2, 1976 related to the extension of territorial waters at 200 nautical miles (exclusive economic zone);
- decree N°78-18 dated February 9, 1978 related to the creation and power of the permanent technical Commission of the Nation a Committee on fisheries;

The main laws regulating precisely fishing activities in Cotonou channel and on fluviolagoon water facilities are Decree N°98-522 dated November 5, 1998 and Order

N°068/MDR/DC/CC/CP/ dated March 12, 1997 related to fishing regulation on Delta complex of 'Ouémé-lagune in Porto-Novo-lac Nokoué'. The Order has prohibited fishing on Cotonou lagoon in its article 20. The purpose is to enable this water facility to play a role of physical and biological exchange between the sea and the 'lac Nokoué' : Nokoué lake, favor migration of halieutic species in both directions, ensure the protection of spawning grounds with a view to future growth of the "lac Nokoué" and restore the environmental balance of the channel. Through this article, the government has expressed its good intentions towards ecosystem conservation. But, fishermen fiercely oppose to its implementation. In 2008, there has been in the channel, on banks and in riparian areas eleven (11) fishing stations, 270 fishing pirogues, 22 fish scrawls (acadja), 352 pilings for set nets, 28 cast nets, and 14 shrimp creels (Badahoui *et al.*, 2009).

Fishing remains an activity which is carried out permanently in Cotonou channel by professional fishermen. But the state of extensive unhealthiness observed in the lagoon environment also affects halieutic products most of which are unfit for food.

Works by Youssao *et al.* (2011) show with some species of fishes very consumed such as *Sarotherodon melanotheron*, *Tilapia guineensis* and *Hemichromis fasciatus*, fished in Cotonou lagoon in the period of low-water level, concentrations in lead of 1.25 to 1.50 mg/kg and exceeding 2 mg/kg at the level of the fishes liver. These values are very higher than the standards of 0.2 to 0.4 mg/kg defined by the World Health Organization (WHO, 1995).

Within the most prized shrimps species on the market (*Penaeus notialis* and *Macrobrachium sp.*), the content in lead is still higher during the period of low-water level. It was 3.5 mg/kg between August and September 2008 (Changotadé, 2010). This is one of the reasons which had made the European Union Food and Veterinary Office suspend shrimps import from Benin in 2004 and during more than one and half year.

Fishes and shrimps consume the lead from the sediment which content in lead has reached 535 mg/kg in period of low flow. In August-September (period of high water), the concentration of sediments in lead falls to 0.2-1.6 mg/kg.

The ecological effect of waters pollution is noticed at the level of organisms, population, biocoenosis and ecosystem. At the level of organisms, waters pollution, in particular food poisoning it causes is defined first and foremost on the basis of morphological and physiological criteria (Gaujous, 1995). So, in the case of a chronic poisoning, there is often the birth of abnormal forms, reduction of speed in growth with individuals and fertility decline. Under the effect of pollution, organisms change their behaviors and move to sites where physicochemical conditions are better. In an acute poisoning, aquatic organisms change their way of swimming and adopt another position in water. The number of young fishes decreases because they are more sensitive to poisoning

than adults. The change of sex- ratio is typical: there are more males which remain dwarf.

The non application of regulatory rules on lagoon fishery means that the ecological role of the channel and the health of halieutic products consumers cannot be really ensured without an effort to raise fishermen awareness and without the institution of concerted measures in the interest of fishermen of course, riparian populations and government. This is the reason why it is important to make the arrangements to:

- support the integration of constraints related to climate changes and strategies of adaptation in the laws regulating fishing activities;
- support fishermen concerned by the regulation for their retraining in the new activities to be generated through the development of Cotonou channel.

Component 2.3: Awareness raising and training local communities on climate risks, adaptation techniques and good practices, and capitalization of the experiences

The component 3 is the purpose of the project. It results in the sharing of acquired experiences with all the national and international community through awareness-raising activities of the general public on the climatic risks and the necessity of adapting to it and developing some impact strength at the community level, actions in favour of the young students in training(formation) and the distribution and broadcasting of the results in the widest possible frame.

In summary:

The current location of the lagoon, at the very heart of the town, was initially occupied by indigenous populations of Cotonou who were and remain fishermen. They have reorganised themselves to adapt their activities to the new situation and exploit the new opportunities offered (exploitation of migratory halieutic resources, utilisation of watersheds and banks as traffic lanes, etc.). Other populations of the inner country and foreign countries came to settle in riparian areas to develop parallel or additional activities or (processing and export fishing products, trading, social services, etc.). The populations of riparian areas are the basis of the human system organised around the Cotonou Lagoon (figures 2.8).

The sandy nature of the mother rock favours the erosion and falling rocks of the shores and banks of the lagoon, under the effect of the energy of the flow and back-flow of the sea and lake waters and waves caused by the wind and rowing boats and power canoes. This phenomenon, the impact of which increases during the period of high waters (caving of the top of the slope and the shore) or the period of minimum flow

(under washing or collapsing of the bottom of slope), or following extreme weather events (major floods, violent winds and prolonged droughts), is a source of insecurity for circulation on the banks. This motivated the decrease of populations and entailed the processing of important segments of the lagoon shores in dumping grounds for household and industrial garbage and wastes and platforms of activities for illegal oil traffickers. It was noticed since about fifteen years that after the major floods, oil products smugglers try to save space on the sailing water pouring trucks of household refuse on the eroded edges of the shores that they occupy. This behavior contributes to weaken more the lagoon banks, the decomposition of organic waste entailing new collapses, new erosions and the filling of the lagoon. On the basis of the climate and non climate scenarios set for the future evolution of the littoral zone and according to the les indications provided by the software DIVA, the level of the water on the coastal segment including the Cotonou city may rise continuously, till they reach about 0.81 m, during the period 2000 – 2100. The expected consequences will be the aggravation of degradations observed currently on the banks of the Cotonou Lagoon .

The adaptive actions envisaged as part of the project will be of two types: material actions (installation or strengthening of infrastructures meant for fighting against the forms of degradation of banks and the lagoon environment, of a natural or anthropogenic origin and exacerbated by the variability and climatic changes) and social and educational and environmental actions (sensitization and training of populations and regulation of human activities likely to aggravate and degradation of the life framework).

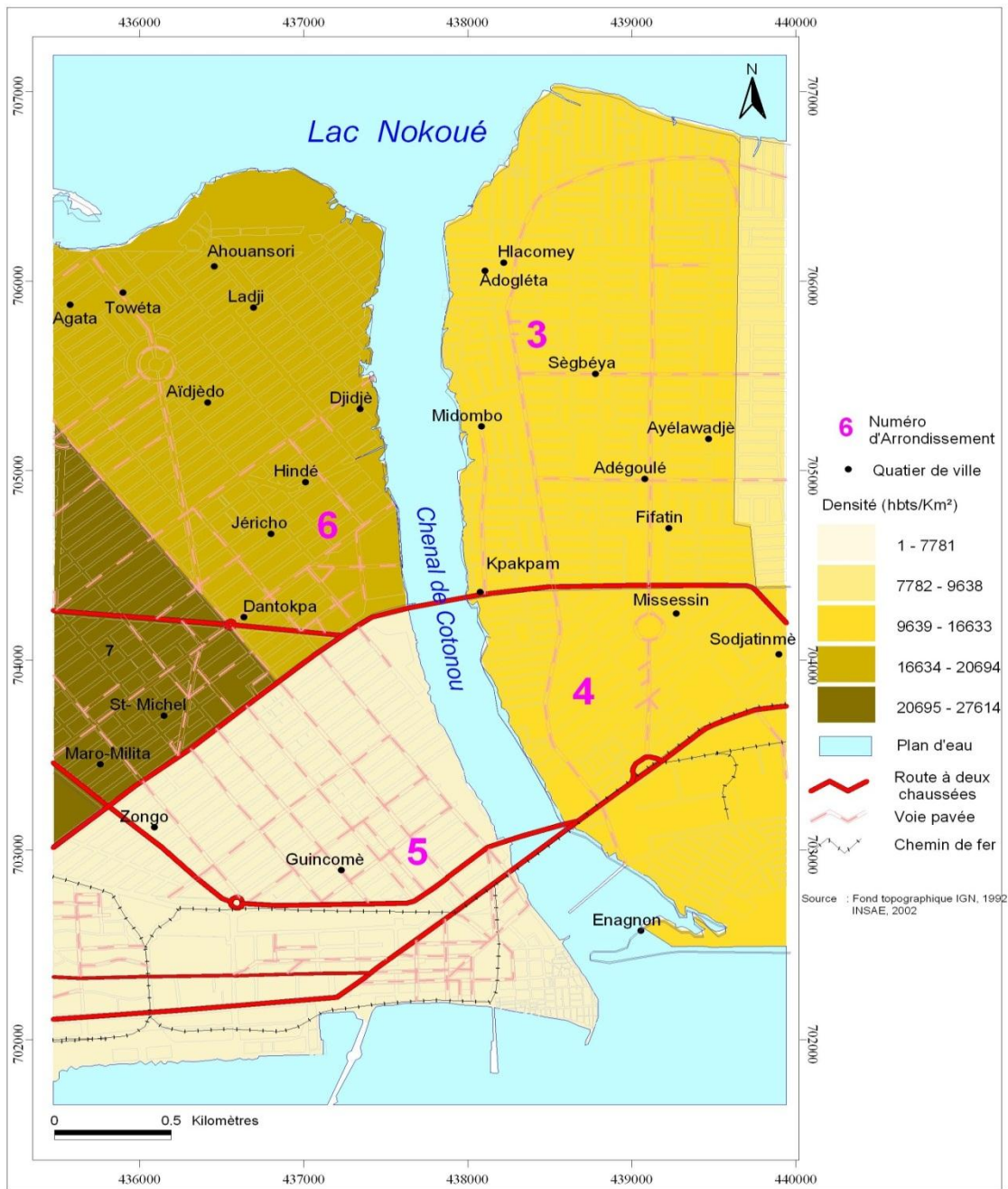


Figure 2.8 : Density of the population in the environment of the Cotonou lagoon

That's why especially:

- 1) In the component 1, two joint adaptive measures are envisaged to stabilize the lagoon banks : the stabilization of the slope or bank strictly speaking by a rocky coating (technical function) and the stabilization of the top slope or shore by a paved coating (technical and socio-economic function). The technical protection of slopes and sites with a strong slope by rockfill proved efficient in the coastal area of Benin where segments of coast especially submitted to erosion, groynes and other harbor infrastructures are sustained by rocky blocks. On the lagoon banks, the rocky coating will be laid on the foot of slope up to the top of slope from where it shall be extended on the shore by a flat paved coating surrounded by gutters likely to exploit the plant engineering on the bank's side and the regular techniques on the side of external wall leading to urban civil engineering works. The paved surface will enable to avoid the rain erosion of the shores while favoring the access of users to social and economic infrastructures which will justify the maintenance work by businessmen, local development committees, and even the municipal road system services. Without this minima economic function, and the resulting social animation, the developed banks would be subject to degradation by lack of maintenance.

- 2) In the component 2 two measures are planned to implement the regulation of fishing activities compliant with the requirements of the climatic change and to support the retraining of the outnumbered fishermen in new economic activities of which this project will enable the development. Actually, the regulation currently in force forbids the activities of fishing in the Cotonou Lagoon. This interdiction is never respected because the concerned populations are indigenous fishermen of Cotonou, the first to adapt to the situation resulting from the existence of the lagoon on their lands. But during the periods of swelling of waters, minimum flow, floods, violent winds or prolonged droughts, conditions of use of some fishing engines aggravate the impact of natural events on the lagoon system. More than the repression measures socially and politically difficult to implement, it would be worth to build up accountability among the populations regarding the extent of their activities. A sensitization and education work should enable them to understand the need for making the fishing activities compliant with the technical standards conducive for the sustainability of the lagoon system to integrate into the new regulatory provisions. The overall volume of fishing activities will thus be reduced. Therefore, there is a need for guidance of some actors towards other economic activities.

B. Describe how the project / programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities, and groups within communities, including gender considerations.

The populations benefiting from the project are estimated at 370,000 inhabitants in 2012 (Commune of Cotonou, 2008). They are women and men who live in the riparian town sections of the Cotonou Lagoon. Equally, the population residing in other areas, and whose economic activities are conducted in the lagoon environment during the day are also concerned. This population mainly increases on Dantokpa market official days, with users coming from all the regions of Benin and neighboring countries (Nigeria, Togo, Burkina Faso, Niger).

The economic, social and environmental benefits of the project will be facing in the sectors of fishing, human health and preservation of the biodiversity.

Actually, the problems of pollution in the lagoon environment led to the suspension of shrimps exports towards the European Union countries, with as consequence a very important loss of revenues for the stakeholders. Supplying export companies, namely CRUSTAMER and FSG, is a source of direct incomes for fishermen and fishmongers who resell the fish they catch. With regard to those companies, there was a drop in revenues of fishermen and fishmongers and revenues paid as wages from 80 to 90% from the years 2001/2002 to the years 2005/2006 (table 2.3).

The table 2.2 shows that between 2001 and 2006, the employees earned about CFA francs 5 billion.

The permanent or seasonal workers also earned revenues in the form of salaries and other social benefits. Salaries paid are estimated between 2001 and 2006 at about 390 million CFA francs.

The Beninese government drew from the taxation of such companies, some tax revenues, between 2001 and 2006, at about 77 million CFA francs.

Such financial advantages will be recovered and improved owing to the implementation of the project through the component of pollution control. It is particularly important for the company CRUSTAMER located a riparian area of the Cotonou Lagoon.

Other financial advantages are expected, especially new tourist activities whose promotion is planned. In the sub-sector of hotel industry, catering for and disk libraries, the annual turnover in Cotonou is evaluated at 38 billion CFA francs for a total of 58 billion of tourism turnover in Benin (Dumoulin, 2008)². The level of businessmen's interest in lagoon banks secured and cleaned may enable to mobilize a fraction of such resources for the benefit of recipient populations of this project.

² Dumoulin M. (2008). Projet d'Appui au Secteur Privé. Enquête sur l'offre touristique à Cotonou. Coopération Bénin – Union Européenne. TRANSTEC, Cotonou.
http://www.economiebenin.org/dmdocuments/enquete_portant_offre%20touristique_cotonou.pdf

Table 2.3 : Variation in the income of actors involved in halieutic products export industry from 2001 through 2006

<i>In FCFA million</i>	2001	2002	2003	2004	2005	2006
Income of fishermen and wholesale fishmongers	1516	1605	836	439	443	159
CRUSTAMER	1034	957	494	336	405	159
FSG	481	648	343	103	38	
Income paid in the form of wages	74	113	84	33	55	26
CRUSTAMER	43	46	41	19	42	26
FSG	32	66	43	14	14	
Tax revenues generated by the industry	14	14	25	7	8	6
result tax	7	7	4	1	0	0
CRUSTAMER	7	7	4	1	0	0
FSG						
Various taxes	7	7	23	5	8	6
CRUSTAMER	5	5	21	4	4	6
FSG	2	2	2	1	4	

Source : *Project to support the private sector (2007).*

The social benefits will be translated into the decrease mortality and morbidity rates of riparian populations whose children are subjects to intoxications of all kinds and accidents on the non secured banks.

A better regulation of exchanges of water between the sea, the Cotonou lagoon and the Lake Nokoué will promote the natural migration movements of the aquatic fauna and its reproduction in the river-lagoon system.

The upgrading of the tourist environment associated with the implementation of the project is also an obvious advantage for the whole community of riparians.

The economic profitability of infrastructures will be at long term. If it is obvious as regard to the processing and export of fishing products, activities which will begin again fully and sustainably when the lagoon environment will be cleaned up after the project, scenarios of economic activities induced by the project will enable to draft a profitability plan in other sectors.

The gender sensitivity of this project is mainly shown in the fishing sector where the roles are clearly distributed between women groups and men group in Benin. The fishing works are executed by men and the fishmonger activities are carried out by women. In charge of the wholesale trade of fishing products, fishermen's wives assisted by a few men are organized within the national Association of fishmongers and assimilated of Benin, the umbrella organization being the National Union of Fishermen, fishmongers and assimilated of Benin. Since, the securing and cleaning up of the lagoon environment must promote the revamping and improvement of halieutic products trading activities, substantial benefits for women can be expected. The project will also benefit to vulnerable women and populations working in other sectors, depending on the modalities that will be developed in the project document.

The working sessions with the stakeholders included men, women and disabled persons. The role and the interests of every particular group were well understood by all the stakeholders.

We can indicate that the initiative consisting in digging a trench (currently known as Cotonou channel) between "Lac Nokoué" and Atlantic Ocean has been taken by the colonial administration, on September 21, 1885, to drain to the sea waters from the exceptional rise in the water level of "fleuve Ouémé" and "Lac Nokoué", observed since the beginning of the month, and thereby spare the city the consequences of a catastrophic flooding. Almost 130 years later, this first function of Cotonou channel is typical at the moment. Currently, it is coupled with the function of facilitation for species migration between "Lac Nokoué" and Atlantic Ocean, their reproduction and ecologically rational management by riparian communities in a healthy environment. For the future, the erosion and degradation of the channel banks, worsened by the risks of sea-level rise and extreme meteorological phenomena, might be the cause of the city invasion by sea through the same channel.

Through the project suggested here, the Government of the Republic of Benin would like to support Cotonou Commune authorities, local authorities and areas communities involved in their effort to interven for the sustainable expression of both basic ecological functions of Cotonou channel. The Government would in the same time like to support the anticipating adaptation measures against the risks of flooding from the sea, which consequences will be more severe than those from "fleuve Ouémé": Ouéme River.

Cotonou channel, "Lac Nokoué" and riparian areas have important sources of economic value, especially:

- Direct value use of goods and services consumed (food resources, lagoon transports, etc.) ;
- Indirect value use of functional standard benefit (ecological function, regulating function, etc.) ;

- Option value on future uses (preservation of ecological functions, production of biodiversity, etc.) ;
- Legacy Value and living value conditions that the present generations have to pass on to future generations, either for their consumption, or to ensure the maintenance thereof (species in process of extinction, ecosystems threatened, life sustaining, etc.).

These are tangible and intangible properties, tradable and non tradable goods and services, exploited by the riparian populations of Cotonou lagoon and “Lac Nokoué”, and which have been threatened by climate changes. This project aims at limiting the impacts and turning the trend round, that is to say generating the goods in process of degradation and improving progressively populations living conditions.

The economic analysis should enable to compare the economic and social cost of the enjoyment and non enjoyment of these goods for the current and future generations in conditions of non intervention, and the economic and social cost of adaptation measures suggested by the project, together with the population concerned. The ratio of additional costs due to the implementation of adaptation measures and additional benefits at the level of ecosystems and human systems in terms of banks protection, channel and Lake replantation by species in process of extinction and in terms of poverty reduction, satisfaction of food and health requirements for example, should enable to appreciate the efficiency of adaptation measures. The tool for cost efficiency analysis imposes itself from then on as the best tool. But in this case, difficulties in evaluating the values of non tradable goods and services and intangible properties in ecosystems and human systems do not enable to use this tool. It would be advisable that the cost efficiency analysis be the subject of a workshop during the proceedings of formulation or revision of this project document as part of the Program Cycle Management.

For the time being, it can be reminded that in the situation of poor communities living in precarious hygiene and health buildings along Cotonou channel banks, doing nothing faced with harmful effects of climate variability and extreme meteorological phenomena noticed today is always more costly for ecosystems and human systems than adaptation measures. The secretary of United Nations Framework Convention on Climate Change (CCNUCC) estimates between now and 2030, the costs of adaptation for developing countries at between USD 28 and 67 billion a year. Oxfam International (2009) thinks that in developing countries, the cost for adaptation shall amount to at least USD 50 billion a year, and even more if emission of greenhouse gas worldwide are not reduced quickly.

But the models of evaluation in force hardly enable to go from data drawn up worldwide to those of reduced spaces such as riparian areas of the Cotonou lagoon. What is certain is that more than 30% of Cotonou population live in most precarious conditions

on non stabilized banks, thereby making Cotonou city contribute for 64.7% to urban poverty in Benin (UNDP, 1997; Cotonou Commune, 2010).

The variation in the income of actors involved in halieutic products export industry (especially shrimps) before and after the suspension of exports to European Union countries illustrates quite good the financial importance of this project one of the impacts of which, concerning development, will be to support the sustainable export rehabilitation. Indeed, the halieutic industry involves a community of about 90. 000 fishermen including 45 000 directly involved in shrimps sector. According to the professional Association (ATEP), national economic statistics establish that more than 350. 000 persons live on fishing.

The suspension of exports to European Union countries, in 2004, did not seem to have affected halieutic production (table 2.3). There has been the same trend on the rise of the annual production. But, the volume of export has declined significantly in 2009.

Supplies of the firms CRUSTAMER and FSG constitute direct income for fishermen and wholesale fishmongers who retail their catching to them. At the level of these firms, the income of fishermen and wholesale fishmongers, and the income paid in the form of wages have undergone a fall of 80 to 90% between the years 2001/2002 and years 2005/2006 (table 2.3).

These financial benefits shall be found and improved thanks to the project implementation through the component of fight against pollution. Other financial benefits are expected, especially new tourism activities which promotion is provided for.

The analysis of poverty levels reveals extreme poverty situations of in the waterside neighborhoods (Table 2.4)

Tableau 2.4 : Extreme poverty according to arrondissements

Arrondissement	Remaining of the rich households	Number of poor households	Total of the households	Arrondissement weight in poor households	Order of priority
3	10247	3121	13368	10,1	4
4	5892	3046	8938	9,9	5
5	6741	1021	7762	3,3	9
6	13832	2805	16637	9,1	6
Total	123472	30874	154346	100	

Source : Computation run from the RGPH3 data

Based on habitation conditions, it has been taken in 2002 a census of 61,000 poor and very poor households (from the 154,346 households who live in Cotonou). The very

poor households were evaluated at 30,874 (RGPH3). Poverty spacialization at the arrondissement level enables to better stress the arrondissements where poor people are more concentrated. It focuses on the proportion of very poor households (household described following profile 1). The use of this threshold allows distinguishing poor households from the rich ones. The table 2.4 illustrates the ranking of arrondissements based on the proportion of very poor living households

From this table, arrondissements 3, 4 and 6 are the most poorest and are prioritized for the interventions in order to improve the households' standard of living. There households who live in houses or isolated huts or poorly arranged specially, without track rendering difficult the circulation of people and goods; family properties of which the ground and the wall are clayey and the roof is made of precarious materials. They supply drinking water principally at a lagoon or at the springs. In terms of accommodation convenience, houses of these households do not have toilets. Kerosene is the principal lighting fashion and wood, energetic cooking means.

In these households, the waste water and household wastes are dumped with any care for the environment. The household head is illiterate. In short, the equipment means do not almost exist in the poorest households. The neighboring watersides of the 5th arrondissement are not of exception. The rank of table 2.4 is hidden by the richness level of non neighborhoods of the 5th arrondissement

The fire risk is very high with the use of kerosene in thatched houses of neighboring waterside. The use of firewood is a higher poverty indicator and a high pressure on natural resources. Tape water is not available. Certain waterside neighboring wash and brush in the channel. Children are not sent to school because of lack of socio-educative infrastructures and by the parents' disinterest themselves are illiterates. Beyond the climatic risks, the fire risks complexify this gloomy picture because of human practices. The epidemic risks are very high with the inexistence of toilets and the drinking of poor quality water. The promiscuity reinforces the theses of fire and epidemic. The inexistence or insufficient of health care centers and socio-educative infrastructures darken the picture in terms of poverty.

Finally, the socio-demographic indicators show that children are not sent to school because the household heads are illiterate. In such a condition, women and daughters too many than men and sons in the neighboring watersides could not be sent to school. Consequently, they do not perceive the need to go for prenatal consultations in the neighborhoods and they mostly deliver at home, hence increasing the maternal and infantile mortality rate and the reduction of life expectancy.

Women are held responsible for the (dirty) water supply duty for drinking and for the household (risk of hydrous illnesses), purchase of firewood and the cooking of foods in the thatched houses (risk of fire). The use of kerosene as a single energetic source for light aggravates their level of extreme poorness and a total poverty-stricken, showing

this gloomy picture to their progeny. Their situation of extreme dramatic poverty increases their state of vulnerability to climatic risks. A special attention must be deserved to their human being as well as to daughters and sons.

C. Describe or provide an analysis of the cost-effectiveness of the proposed project / programme.

The component 1 is particularly expensive (more than 85 % of the total cost of the project).

The issue of profitability of adaptation projects is always very sensitive. In this case, especially for the component 1, the options of protection of the banks and shores are technical options that seem to be the most adapted to the situation. Regarding the protection and stabilization of banks the cheapest techniques derive from the plants engineering; the most expensive techniques are those of the sheet piles; the rock fill techniques have intermediary costs. Technically the plant engineering is not applicable here because the average height of the lagoon water exceeds 3 meters (the traction forces being exerted on the foot of slopes exceed 100 Newtons per square meter): the plant engineering structures will not be able to resist.

On the shores opened to traffic, for social and economic reasons, the technology the most appropriate and requiring less maintenance is that of the paved lanes. The plant engineering, cheaper, may also be envisaged if the lagoon water was not salty, and non unusable for watering the plants. The fresh water supply to the vegetal cover will be difficult in the lagoon environment and particularly expensive.

The costing standards used are the average costs of the linear kilometer of coating applied by civil engineering companies operating in Benin, for similar works (construction of groynes, urban lanes, roads). The dimensions of the infrastructures are those proposed in table 1.5 (4.5 kilometers of segments of bank slope; 3.0 kilometers of pedestrian lanes with about 15 m of right-of-way).

Three options were proposed by stakeholders during the consultation meetings:

- paved lanes : only the pieces of pavement are used to cover the floor of banks on 3 km
- plants engineering : Only the grass planting will take on the floor of banks on 3 km
- combination of paved lanes (30%) and plants engineering (70%) on 3 km

The evaluation of every option is realized by scores allocation for every criterion following the modalities described in the tables 2.4 and 2.5. This evaluation is based on

the stakeholders and experts opinion because of the knowledge of these on the study zone and on the works to be built.

Table 2.4 : Evaluation matrix of the options efficiency per criterion

Criteria of the options evaluation	Modalities (and attributed exclusive scores)		
	Weakly satisfactory	Averagely satisfactory	Suitably satisfactory
Contribution to the reduction of the vulnerability to climatic risks and to the described problems resolution (35)	10	20	35
Ease in the maintenance (30)	10	20	30
Socioeconomic and environmental durability of the option (35)	10	20	35

For every option, the sum of the exclusive scores for 3 criteria is brought back to 100. This relationship represents the hope of the efficiency of each of the options. Finally, the estimated costs are brought back to the hope of the efficiency per option. This represents the relationship cost-effectiveness of every option. The best option is the one which presents the smallest ration cost-efficiency.

Then, the obtained results are explained and subjected for validation to the stakeholders.

Table 2.5: Summary of options to develop the Cotonou Lagoon bank floors

Identified measure to serve as bank floors	Advantages	Limits / constraints
Paved floor : Only pavement will revert floor of banks on 3km	Used primarily for pedestrian; Facilitate infiltration and rainwater runoff; Low stress for the soil	No problem if pedestrian use only
Floor with plants engineering: Floor will be made of grass on 3 km	Much cheaper than the paved floor; Enhanced landscape value Contribution to air purification	Demand regular maintenance: cutting, water requirement and fertilization Recruitment of labor Problem of fresh water not salty
Floor resulting from the combination Pavers (30 area%) and Grass (70%) of 3 km	Idem	Idem

The application of cost-effectiveness analysis gives the advantage to full paved lanes (table 2.6).

Table 2.6 : Estimation of the cost-efficiency ratio per option level.

Option	Unit cost (reference 2012) en F/m2	Criteria			Efficiency hope	Cost- efficiency ratio
		Contribution to the reduction of the vulnerability to climatic risks and to the described problems resolution	Ease in the maintenance	Socioeconomic and environmental durability of the option		
paved lanes : only the pieces of pavement are used to cover the floor of banks on 3 km	12000*	35	30	20	0,85	14117,6
plants engineering : Only the grass planting will take on the floor of banks on 3 km	6500**	20	10	10	0,40	16250,0
Combination of paved lanes (30%) and plants engineering (70%) on 3 km	8150**	35	10	10	0,55	14818,2

* : Excluding the costs of realization of gutters estimated in approximately 100 000 F / linear meter for size of 0,60 X 0,60

** : Excluding maintenance costs (cost of the volumes of water for watering, cost of cutting, cost of fertilization)

D. Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

The ratification by Benin of the United Nations Framework Convention on Climate Change on June 30, 1994, marked the starting point for the reorientation of documents of policy, strategy, plan and development programme towards sustainable development. The framework Law on Environment dated February 12, 1999, the sector policy papers and national development planning tools are established in the vision of sustainable development with a particular opening on concerted protection of ecosystems and their resources.

So, Benin sustainable development strategies fall within a partnership between public and private actors, based on the logic of threatened ecosystems preservation, through the Declaration of Population Policy (DEPOLIPO) in 1996, Benin by 2025, the Document on Poverty Reduction Strategy (DSRP 2003-2005), the national Strategy of Growth for Poverty Reduction (SCRP 2007-2011 and SCRP 2011-2015).

In the field of environment and sustainable development, the main policies and strategies developed and implemented by Benin are:

- ✓ *the Environmental Action Plan (PAE)* adopted in June 1994 by the government and up dated in 2001, and which aims at the change of behavior, especially through a rise of living standard and an awareness-raising for all Benin citizens, the control of the evolution of natural resources and the better management of biodiversity, and the improvement of life environment for all the Benin citizens ;
- ✓ *the National Agenda 21* adopted on January 22, 1997 and the objective of which is to define the orientations and the conditions to achieve sustainable development;
- ✓ *the Benin Long term Prospective Studies by 2025*, initiated since 1998, which integrate sustainable development concerns and thereby define the vision of Benin: « Benin will be in 2025, a pioneering country, a well governed country, a united and peaceful one, with a booming and competitive economy, cultural influence and social well-being ». This call for an economically rational management of natural resources and human systems;
- ✓ *the plan of National Orientation* 1998 – 2002 which, after defining the first priority which is to fight against poverty to strengthen the economic growth, has identified in the field of environment, the deforestation, soil degradation, coastal erosion, and pollution in cities ;
- ✓ *the Declaration on National Land Planning Policy (DPONAT)* adopted in 2002 and within the framework of which are created the National Commission of Land Planning (CNAT), the Delegation for Land Planning (DAT) and the Fund for

Intervention to Land Planning (FIAT), responsible for seeing to the development of Land Planning Policy and the follow up of its implementation;

- ✓ *the National Action Program to Fight Against desertification (PAN/LCD)*, developed in 1998 to identify the factors which contribute to the desertification and the concrete measures to be taken to fight against desertification and reduce the effects of dryness;
- ✓ *the National Strategy and the Action Plan for the preservation of biological biodiversity adopted in 2002* and aiming all in all at contributing to Benin sustainable development and reducing poverty through the preservation, sustainable use of biological resources and fair and equitable sharing of profits from the exploitation of the said resources;
- ✓ *the National Sanitation Policy, developed in 1998* and the objective of which is to promote sanitation in order to improve the living environment of populations ;
- ✓ *the National Strategy of Fight against Air Pollution in Urban Area adopted in 2001* and which is based on the development of legal, political and economic instruments likely to favor the fight against pollution and reduction of pollution sources and on the implementation of a strategy for households, the transports sector, industrial sector, management of wastes and hazardous substances, atmospheric control and international cooperation ;
- ✓ *the National Strategy for Urban Mobility*, adopted by the government in 2005 and aiming amongst others at ensuring conditions of movement within cities and preventing and limiting nuisances attributable to cities development ;
- ✓ *the Declaration on Housing National Policy* adopted in August 2005 and which aims at facilitating the access of the greater number of populations to a decent and cost effective housing and, consequently, contributing to poverty reduction;
- ✓ *the Strategy for Attaining Objective N°7 on MDGs* adopted in 2006 and which denounces the main challenges related to environment degradation : (i) the stopping of deforestation and destruction of protected areas ; (ii) fight against coastal erosion and soil degradation; (iii) air pollution reduction ; (iv) promotion of means of urban transportation; (v) taxi-moto transport improvement; (vi) free flow of traffic ; and (vii) appropriate treatment of household and industrial wastes;
- ✓ *the strategic development Orientations for the period 2006-2011 which point out the backward movement of the national forest cover of 70.000 ha a year between 1990 and 2001* and recommend, to turn the trend round, amongst others, promotion of concerted and participating of natural resources, strengthening the legal and regulatory framework in this field and the implementation of conventions related to environment, ratified by Benin;
- ✓ *the National Policy of Decentralization and Deconcentration (PONADEC)* adopted in 2009 with three main objectives : (i) implement an harmonious and balanced land planning policy, integrating the whole national territory to attain a sustainable and equitable development, (ii) ensure the implementation of principles of good territorial governance by a modernized and efficient

administration, (iii) reduce the level of poverty through the improvement of access to basic services and the economic development of communes economic potentialities.

As part of Benin commitments in multilateral agreements on environment, especially the United Nations Framework Convention on Climate Change, we have to insist on

:

- ✓ *the National Strategy for the implementation of United Nations Framework Convention on Climate Change*, adopted in 2003, which has defined a framing and an explicit vision concerning, climate change, related United Nations Framework convention and their relation with national economy business plans, on the one hand, and national commitments and available opportunities as part of the Convention, on the other hand.
- ✓ *The Initial National Communication of Benin on climate change presented at the 8th Session of the Parties Conference (CoP8)*, on October 23, 2002, and setting out the plans, studies and national action programs for environment and sustainable development;
- ✓ *the National Action Program for the purposes of Adaptation to climate change adopted by the Government in 2007* in which the "protection of the coastal area faced with the rise of water level" is identified among the first five national priorities for which a sheet of draft adaptation has been suggested for the financing by the international community.
- ✓ *The Second National Communication of Benin on climate change adopted by the Government in November 2011*, in which relations between the rise of sea level and coast flooding likely to affect human settlements, public infrastructures, fishing activities and other economic activities, as well as biodiversity of littoral ecosystems, are reaffirmed.

This project fall within this national dynamics in aiming at in particular to: (i) taking up two of the seven major challenges identified as part of the Strategy to Attain the Objective N°7 of MDGs in Benin – fight against coastal erosion and soil degradation and the appropriate treatment of household and industrial wastes – (ii) making commune authorities, local authorities and civil societies organizations be aware of their responsibilities, for the implementation of measures to clean up and protect the lagoon banks against erosion, (iii) getting riparian communities involved in following up the implementation of measures towards the cleaning up and rational management of the ecosystem.

At the local level, the project has been identified under the name "Development project for the lagoon bank" and integrated to a Cotonou City Hall programme entitled "Banks Development Programme". It was provided for to stabilize and clean up both banks of the Cotonou Lagoon between "Ancien Pont": former bridge and Hindé area (in the Northern part of Dantokpa market). It results from sessions of concertation organized with the managers of Land Affairs Department of the Town Hall and with the first authorities of the town hall that the project could not be worked out and

executed owing to sufficient financial resources, but it has remained one of the major priorities of the Cotonou Commune.

E. Describe how the project / programme meets relevant national technical standards, where applicable.

This project suggestion is developed in compliance with the structure and instructions of the Fund for Adaptation and guidelines of the Group of Least Developed Countries for the development programmes adaptation. The guidelines of the Group of Least Developed Countries for the development of adaptation programmes had been exploited for the development of the Benin National Action Program for the Adaptation to climate change in 2007 and the Adaptation Project for Benin agriculture and food sector to the climate change, which implementation started in January 2011 and is financed by the Global Environment Facility (GEF). The project also complies with the Benin national guidelines for the development of Adaptation projects resulting from the workshop organized by the national Fund for Environment, in Cotonou, on 04 and 05 October 2011.

As far as the evaluation of the cost of the works for development and cleaning up lagoon banks is concerned, the standards used concern essentially the definition of tasks, the reference price index for the use of the Public Administration (fourth version) published by the Ministry of Economy and Finance in January 2011, and prices on the market.

During the implementation of the project, the physical interventions on the ground shall comply with the national and sub regional standards in the field. In particular, the construction of infrastructures shall be submitted to environmental impact assessments recommended by Law n° 98-030 dated February 12, 1999 related to the Framework Law on environment in the Republic of Benin. Suppliers and operators in charge of any work shall apply the norm-creating and technical specification provisions validated by the Benin Centre for standardization and Quality Management (CEBENOR) established by decree N°97-520 dated October 17, 1997.

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

No project is implemented on the theme of stabilization of banks of the lagoon of Cotonou. Some projects are underway on the sensitization of populations of riparian areas as regards the environment protection, with the support of the Cotonou Municipality. The Civil Society Organizations (CSOs) in charge of implementing those projects will be the same that will be called upon for the extension of the sensitization to issues of adaptation to climate change. They will successfully find the anchoring point between the assets of such projects and the adaptation of human systems and the lagoon ecosystem, without duplication.

Indeed, the City Council of Cotonou and the Ministry of Environment, Housing and Urban Planning have been seeking funding for present project for more than five years.

The Emergency Project for Environmental Management in Urban Areas (PUGEMU) which funding was approved by the Board of Directors of the World Bank on 26 April 2011 included the treatment of waste waters of Cotonou before they are discharged into the lagoon through urban drains. That is why costs relating to those actions are not concerned by this project. PUGEMU was initiated by the government of Benin subsequent to the catastrophic floods which affected more than 680,000 people and caused 46 casualties in the country in 2010. The more affected regions included the coastal districts where more than 50,000 houses were destroyed, and 150,000 people were made homeless and 278 schools were flooded.

Likewise, the problem of sand loss at the mouth of the lagoon of Cotonou should also be solved through the project to rehabilitate the rock groin of Siafato and to construct 7 new rock groins east of Siafato; the works were launched on July 6, 2009 and are expected to be completed in 2012. Those works are not included in the activities of this project. It is rather envisaged the rehabilitation of the sluice dam of Cotonou to better manage the consequences of the new configuration of the river mouth.

Lastly, the project for the "Protection of the Urban Community of Grand Cotonou from Climate Change" (PUCG3C) was set up through a partnership agreement between the City Council of Cotonou and the Non-Governmental Organization "Research and Expertise Centre for Local Development" (CREDEL). This project, funded by the Research Centre for International Development (CRDI) and the Department for International Development (DFID) of the United Kingdom through the ACCA (Adaptation to Climate Change in Africa) program, is implemented in the 1st, 3rd, 6th, 9th, 12th, and 13th arrondissements of Cotonou. Relevant activities of this project will be implemented until 2012 in the 3rd and the 13th arrondissements located on the bank of the lagoon of Cotonou and will include:

- to identify and evaluate endogenous strategies to adapt and fight against floods and climate change and to share them within the platform;
- to identify and evaluate institutional measures to fight against floods and to make proposals for their integration;
- to develop and/or consolidate local strategies through endogenous experiences and research achievements;
- to disseminate lessons and achievements related to the implementation of strategies through various channels to populations of various arrondissements and local and national decision-makers.

The PUCG3C project was launched by the Mayor of Cotonou on 1st March 2010. The consultations held with stakeholders as part of the preparation of this project document helped to harness the partial social results obtained by the PUCG3C project to identify the technical interventions proposed.

The adaptation measures proposed in this project will take into account the acquired knowledge of the relevant activities of other projects. In the case of "The Emergency Project for Environment Management in Urban Area (PUGEMU) " funded by the World Bank, the activity of *treatment of urban wastes of storm drains of Cotonou city before their pouring into the channel will probably be executed* during the same period or before the activity of the same nature planned by this project. That is why a cost is not mentioned for that activity. A consultation between the coordinators of both projects will enable to ensure the quality of the structures considering the needs of this project.

In summary, the Cotonou channel triggered many project initiatives but none of those projects has been implemented, such as in chart 3

Table 3 : Non-implemented Projects initiatives on the Lagoon shores (to be filled in)

Title	Objectives/expected results	Cost/financing	Inception Date	Completion Date	Observation
Cotonou Lagoon shores Project	Develop infrastructures, mainly two footbridges and floating restaurants onto the lagoon	4,1 Billions, of which 400 millions emanating from the PIP 2001 and 100 millions from the PIP 2002 / National Budget	2000	2010	Non executed
Cotonou West Beach Project	The Project includes green space infrastructures and landscape lay-out with urban materials	5,212 Billion, of which 1 billion emanating from the PIP 2001 and 100 millions from PIP 2002. / National Budget	2000	2010	Non executed

The only executed project which covers the riparian areas of the Cotonou lagoon on the thematic of Climate Change is the project on the «Protection of the Urban Community of the Big Cotonou to face the Climate Change Impacts » (PCUG3C) funded by the International Research Development Center and the Department for International Development. (DFID) of the United Kingdom. The relevant activities of the Project are as follows:

- Identify and evaluate the endogenous adaptation strategies to combat floods, climate change impacts and share the best practices within the platform;
- Identify and evaluate the institutional means to fight against the floods and make suggestions about their integration;
- develop and/or consolidate the local strategies thanks to the endogenous experiences as well as the assets of research findings;
- disseminate the lessons learnt and assets of the implementation strategies through various channels in order to reach the various populations as well as the local and national policy-makers.

The social outcome of the PCUG3C project was exploited in the current phase of the project.

The Emergency Environmental Management Project in Urban Area (PUGEMU), the financing of which was approved by the World Bank Board of Directors on April 26 2011 intervenes on sanitation issues. Its results will be, for sure used by this project.

G. If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.

The project includes a learning and knowledge management component.

After launching the project, training and sensitization activities for local communities, local authorities and the public will be organized in order to set stakeholders for the establishment of a promoting environment and the implementation of all the components.

Local authorities, city councilors and heads of riparian districts of the channel will be trained on the themes of climate change, the adaptation techniques to climate change and best practices. That training will be attended by local chiefs, community intellectuals of districts, NGOs and media houses (printed media and broadcasting industry). The training will be led by national or international experts and consultants. Local authorities and community intellectuals of districts will be tasked with reporting the lessons learnt to the grassroots communities they come from, with the assistance of national or international experts. The personalities attending the training will also oversee sensitization sessions for the general public through relevant channels (local radio stations, conferences, etc.), under the patronage of local authorities.

During project implementation, students and researchers from technical and vocational training schools, national universities, research centers and private universities will have the opportunity to prepare and carry out their research works in the areas of urban and lagoon environment, sustainable management of natural resources, adaptation of livelihoods to the current variability of climates and to extreme weather phenomena and climate change. Experiences acquired, lessons learnt and the best practices developed will be compiled on hard copies and on films (photos, movies, radio and TV broadcast, etc.) and made available to the public through site visits, exchange of visits, conferences for schools, universities and the general public, and through scientific presentations during colloquia and conferences at the national or global level. All the items relating to costs, expenses and income will be capitalized and aggregated based on adaptation components and options; extreme weather phenomena, their impacts and the costs of responses will be recognized.

At the end of the project, a conference will be held to share results with professionals and the international scientific community both on organizational and environmental results and on the issue of adaptation costs on which little information is available globally. The results will be made available to universities, research centers and institutions involved in the management of marine and lagoon ecosystems and in the issue of sustainable development for their re-use.

During the execution of this project, apart from the activities of sensitization and training of direct recipients, the acquired knowledge will be documented through report or thesis works of pupils or students. At the end of the project, the acquired knowledge will be subjected to a reporting at the local, national and international level under the appropriated forms (radio and television broadcasting programs, field visits, workshops and conferences).

The component 2.3 is devoted to capture and disseminate lessons learned.

H. Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation.

The General Directorate of Environment under the supervision of the Ministry of Environment, Housing and Urbanism, and the Department for Land Affairs of the City Hall of Cotonou are jointly responsible for the technical implementation of the project in partnership with non-governmental organizations, local bodies of districts located on the bank of the lagoon, and fisheries exploitation and exportation enterprises based in those districts. All the stakeholders are involved in the development of the project, from the grassroots to the summit.

Project Concept Stage

The main consulted stakeholders are :

- ✓ heads of districts located on the bank of the lagoon of Cotonou;
- ✓ managers of development associations in riparian districts;
- ✓ managers of fisheries exploitation and exportation enterprises based in the districts;
- ✓ NGOs dealing in environment protection and the sustainable management of natural resources (Research and Expertise Centre for Local Development (CREDEL), Association of Female Scrap Dealers of Dantokpa Market (AFRMD), Association of Truck Farmers of Houéyiho (AMH), Coordination of Waste Management and Sanitation NGOs (COGEDA) which gathers 54 NGOs, etc.);
- ✓ heads of riparian arrondissements: 3rd, 4th, 5th, and 6th;
- ✓ authorities of Cotonou City Hall;
- ✓ managers of national technical institutions involved in the issue of sustainable development (General Directorate of Environment, General Directorate of Forests and Natural Resources, Beninese Agency for Environment, University of Abomey-Calavi, University of Parakou, private university centers, Fish and Ocean Research Center of Benin, etc.);
- ✓ the Ministry of Environment, Housing and Urban Planning, the Ministry of Agriculture, Animal Husbandry and Fisheries, and the Ministry of Energy, Oil and Mining Research, Water and the Development of Renewable Energies, the Ministry of the Youth, Sports and Leisure, the Ministry in charge of Maritime Economy and Port Facilities, the Ministry of

- Communication and Information and Communication Technologies, the Ministry of Culture, Literacy, Handicraft and Tourism;
- ✓ the National Assembly;

Project Development Stage

During project development stage, the staff of previous institutions and establishments were involved in the consultation.

The consultation approach used is different depending on each stakeholder.

For economic stakeholders (hoteliers, restaurant owners, fisheries exploitation and exportation enterprises, etc.), and communities suffering directly the harmful effects of climate variability and extreme weather phenomena, the consultation approach is based on the concerted evaluation of vulnerability; such evaluation is held on the workplace or the meeting room of heads of riparian districts (see Annexes 2 and 3). Those sessions helped to reach consensus on the ultimate purpose and the operational approaches of the project (figures 2.9 and 2.10).



Fig.2.9 A working session with the fishermen (February 26th, 2013)



Fig.2.10 Working session with the wholesale fish merchants women (February 26th, 2013)

Stakeholders providing support or institutional stakeholders are required to play important roles in the implementation of the project in terms of control, monitoring, evaluation, enhancement and reuse of results (see Annexes 2 and 3). The consultation approach used with them is that of free discussions on the national interest and the objectives of the project, the intervention mode of stakeholders and the specific role of each group of stakeholders. Most of them have intended to contribute to monitoring and evaluation for the implementation of the project. Representatives of government and parliament authorities are sensitized on the conducive conditions to establish through laws and/or regulations in order to preserve the sustainability and ecological functions of lagoon ecosystems threatened both by man-made actions and the increase of sea level and extreme weather phenomena.

The outcomes of the consultations with the private sector are as follows:

Relationships, powers and stakeholders' influence

The possible compromises. According to the fishermen and fishmongers, it is necessary to restore their rights. As, they said, they were born in the lagoon and have tremendous knowledge of the lagoon-related problems. They request to be associated to any issues related to the lagoon management. They also wish they could be recognized as such and enjoy their location at the lagoon level. They think that the Toffins and Xwla communities should stay and live along the Lagoon in order to identify the period of passage of the fish school so as to better organize the fishery activities in appropriate time.

Dependence relationship between the ones and the others. The Fish and Prawns Women Sellers associations depend on the fishermen associations because those are the people who sell their fishery products which are in turn retailed at Gbogbanou market.

Influence on the organizations. The organizations under consideration are influenced by MEHU, la SOGEMA, Cotonou Town hall and the Ministry of Agriculture, Animal Husbandry and Fishing in terms of Lagoon shores development and management. The level of influence and power relations (importance) of each stakeholder is summarized under Tables 4, 5 and 6. (7, 7 bis and 13 appended in annex to this report of consultation with the stakeholders) The fisher-women fishmongers appear as low-power stakeholders with high potential. They must therefore be involved and their interests should be protected along with the project (Table 4). The project should cooperate with the Municipal authorities, professional women associations, fishermen associations, hotels operators and managers of restaurants as well as leisure places established along the lagoon. However, the group of Traders, and sellers of various items and goods who are the majority of women populations in the market are excluded. Mined sand dealers associations, dyers and others should be monitored.

Identification of the stakeholders with the capacity to bring sustainable contribution. The groups of fishermen and women associations could significantly contribute to ensuring the technical sustainability of the project as the project will have improved the living conditions of the riparian populations.

Table 4: Acronyms and relationships among the various stakeholders

Main stakeholders	Abbreviations	Impact on the project	Importance vis-à-vis of the project
Fishermen,	A	4	2
Fishmongers	B	4	1
Lagoon mined sand dealers	C	2	1
Dyers,	D	1	1
Municipality Authority	E	5	5
Hotels and Restaurants Managers	F	5	4
Association of Traders and dealers in various products	G	2	2
Traders and dealers in Dantokpa market,	H	2	1
Fishermen Associations	I	4	3

Fishmongers Association	J	4	2
Lagoon sand dealers Association,	K	2	2
SOGEMA	L	5	3

Source: analysis carried out based on data gathered on the field in January 2013.

Strategies to be implemented for the management of the relationship among the stakeholders are indicated in chart 7 bis

Chart 5: Strategies for the management of relationships among stakeholders

Stakeholders Power // Potential	High potential	Poor potential
High power	Collaborate with	Alleviate the impact, defend against
Poor power	Involve, capacity building and guarantee the interests	Monitor or ignore

Source : analysis carried out based on data gathered on the field in January 2013

Identification of conflicts and challenge

Conflicts in the lagoon environment and affecting stakeholders

Conflict between fishermen and central authorities. Fishermen revealed that some of them were imprisoned because they took the initiative of reducing the level of reinforced concrete blocks used as dam on the river even though the authorities showed appreciation for the impact of their intervention.

Conflicts between riparian communities and the ministry for environment relating to their driving away by over 25 meters long on the lagoon shorelines.

Conflicts between fishermen and the Ministry of Agriculture, Animal Husbandry and Fishery concerning the decree forbidding fishing in the channel and the order dated December 2008 which prevents them from catching prawn.

Conflict between fishmongers and the SOGEMA concerning the location of the fishmongers in Dantokpa market. SOGEMA, being the manager of the market hardly provided the fishmongers with a non constructed site which was built up thanks to the money each of them contribute before being driven away by the SOGEMA.

Conflicts between SOGEMA and the Ministry in charge Environment concerning the improvement of the Gbogbanou area.

Stakeholders	Major factor	Impact of the project on the benefits	Impact on the project	Importance vis à vis of the project
Primary				
Fishermen,	Fish all the year long Expansion of their activity Increase of income	+ + +	4	2
Fishmongers	Expansion of their activity Increase of income	+ +	4	1
Lagoon sand mining dealers	Halt of sand selling	-	2	1
Dyers,	Mouvement Institution Capacity building	- +	1	1
Authorities of the Municipality	Improvement of the riparian communities living conditions Sanitation of lagoon shores Restocking of the Channel	+ + +	5	5
Hotels et Restaurants Managers	Attracting lagoon shores Affluence of clients and tourists Increase of profit Infrastructures are less damaged	+ + + +	5	4
Association of traders and dealers in various products.	Institution Capacity building Awareness of rights and duties	+ +	2	2
Traders and dealers of Dantokpa market,	More adjoining location Clean and attracting lagoon shores Purchase/sales of several kinds of goods	- + +	2	1
Fishermen Associations	Participation in the projet management Institution Capacity building Awareness of rights and duties	+ + +	4	3
Fishmongers Association	Institution Capacity building Awareness of rights and duties	+ +	4	2
Association of Lagoon sand mining dealers,	Institution Capacity building Awareness of rights and duties	+ +	2	2
Secondary				
SOGEMA	Conflicts dispute with the project Conflicts with the Ministry for Environment, Housing and Town Planning Conflicts with fishmongers associations	- - -	5	3

Chart 6: Synthesis of the stakeholders' power and influential relationships

Legend and abbreviations under Table 4

Legend

Importance	Influence
I=unknown	I =unknown
1= Minor/not important	1= Minor/not influential
2=A little bit important	2=A little bit influential
3= Moderately important	3= Moderately influential
4=Very Important	4= Significantly influential

5=Leading player

5=Very influential

Abbreviation

Main stakeholders	Abbreviation	Impact on the project	Importance to the project
Fishermen,	A	4	2
Fishmongers	B	4	1
Lagoon sand mining dealers	C	2	1
Dyers,	D	1	1
Municipal Authority	E	5	5
Hotels and Restaurants Managers	F	5	4
Association of traders and dealers in various products	G	2	2
Traders and dealers in Dantokpa market,	H	2	1
Fishermen Associations	I	4	3
Fishmongers Association	J	4	2
Lagoon sand dealers mining Association,	K	2	2
SOGEMA	L	5	3

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

Benin is one of the 48 least developed countries (LDCs) in the world. Its development index of 0.427 ranks it 167 out of 187 countries evaluated (UNDP, 2011). Considering that rank, the country's own resources do not enable it to cope with the climatic events suffered by the populations and to provide them with the physical and biological resources they depend on. That is the case of 30% of the population of Cotonou stacked all along the 4.50 line kilometers of a 300-meter wide lagoon. That is also the case, in a lesser extent, of 100,000 traders and craftsmen who spend their days in the international market of Cotonou, on the unhealthy banks of the lagoon where they receive 500,000 clients coming from the other districts of Cotonou, all the regions of Benin and neighboring countries. The continued deterioration of lagoon environment compromises not only the business and health of part of the population with no alternative solutions, but also the sustainability of the lagoon ecosystem exposed to the unceasing rise and fall of the sea and the river, which is incompatible with the physical equilibrium of water body and harmful to the biology of migratory species and the profitability of human business; this situation is worsened by the rise of sea level and extreme weather phenomena.

The Fund for Adaptation is an opportunity to rescue those natural and human systems from the harmful effects of climate change against which the concerned populations cannot develop in an autonomous way adaptation strategies up to the needs.

J. Describe how the sustainability of the project/programme outcomes has been taken into account when designing the project.

The rationale behind activities 1.3 and 1.5 is to help local populations to generate the required resources for a sustainable adaptation; it is a self-maintained adaptation basing on the resources produced owing to the conducive environment created by the adaptive regular activities. Creating conditions for the ecologically rational exploitation of the Cotonou lagoon environment for economic purposes (activity 1.3) and sensitizing businessmen for the effective development of economic activities (activity 2.1.8) seem a possible way for ensuring the resources necessary for the maintenance of adaptation infrastructures.

Actually, activities targeted in points 1.3 and 2.1.8 are not new in the environment of the Cotonou lagoon. Some landing stages/passengers drop-off places are functional, but in inadequate number considering the future development needs of the human system. Activities 1.3 and 2.1.8 proposed in the project aim at the promotion of local initiatives likely to financially support the infrastructures that the project will have set up. Without such activities, government or municipal authorities will have to ensure the maintenance of adaptation infrastructures using public funds, which could reduce quickness and regularity.

In summary, the economic activities favored by the developments proposed in this project, will provide the riparian populations with the resources usable to ensure the sustainability of adaptation infrastructures. To that end, some mechanisms proved efficient in Benin in the sector of hotel industry where a tax of CFA francs 500 per night will enable to maintain the tourist infrastructures of general interest. A similar mechanism will be negotiated with businessmen who intervene in the lagoon environment (exporters of halieutic products, restaurant managers, etc.). The principle was admitted during the dialogue meetings organized with the stakeholders from January 24th till February 4th, 2013. The practical modalities of implementation will be defined during the project execution.

PART III: IMPLEMENTATION ARRANGEMENTS

A. Describe the arrangements for project / programme implementation.

Four districts (Arrondissements) of the city of Cotonou are located on the banks of the lagoon of Cotonou; they include the 3rd, 4th, 5th and 6th arrondissements. An Arrondissement is a subdivision of the Commune of Cotonou administered by a council of arrondissement chaired by a deputy mayor who bears the title of Head of Arrondissement. The Head of Arrondissement is appointed by the Municipal Council among municipal councilors elected on the list of the concerned arrondissement. The council of arrondissement is made up of all the heads of area, each head of area having been chosen by their area council and appointed by the Mayor of Cotonou.

Thus, the 3rd, 4th, 5th and 6th arrondissements are the democratic territorial and social entities which are the most directly affected by the problems of the lagoon of Cotonou. The councils of arrondissement in charge of administering the arrondissements under the responsibility of the mayor are the authentic representatives of grassroots communities faced with problems related to the deterioration of the lagoon and its environment.

This project will be implemented on the ground by four horizontal entities: they include the arrondissement councils of the 3rd, 4th, 5th and 6th arrondissements, which encompass for each arrondissement one representative of the Area Development Committee, one representative of the association of women of the arrondissement, one representative of the association of the youth of the arrondissement, one representative of NGOs dealing in environment on the territory of the arrondissement, one representative of fisheries exploitation and/or exportation enterprises running their business in the arrondissement, one representative of the Land and Environmental Affairs Unit of the City Hall of Cotonou, one representative of the Regional Directorate of Environment, Housing and Urban Planning of Atlantique/Littoral region, one representative of the General Directorate of Environment. The Councils of Arrondissement with such make-up will be tasked with the implementation and the monitoring of the development works on their respective sections of lagoon bank. A permanent consultation framework between the chairpersons of Councils of Arrondissement will help to harmonize views and find out relevant solutions to common problems.

The national implementation body (National Environment Fund) will enter into a management agreement with the General Directorate for Environment (DGE). DGE will have a coordination team composed of a Coordinator appointed by the Director General of Environment, a Deputy Coordinator appointed by the Mayor of Cotonou, a monitoring and evaluation officer and an administrative assistant. The Coordinator will be accountable to the Director General of Environment who is his direct line supervisor.

At the national level, it will be set up a Steering Committee whose chairperson will be the representative of the Minister of Environment and whose vice-chair will be the representative of the Mayor of Cotonou. The Steering Committee will include such members as the General Directorate of Environment, the National Environment Fund, the Directorates in charge of Lands and Environment and technical units of the City Hall of Cotonou, the Beninese Agency for Environment, the Directorate for Fisheries, the General Directorate of Water, the Directorates in charge of Housing and/or Urban Planning, the Directorate in charge of Public Works, a representative of the universities of Benin, a representative of the Beninese Center for Scientific and Technical Research and the Chairpersons of Councils of Arrondissements from the 3rd, 4th, 5th and 6th arrondissements, the Focal Point for Climate Change, the Coordinator and the Deputy Coordinator of the project.

A Technical Committee will be tasked with developing the terms of reference of the different activities of the project, and evaluating and ensuring the quality of technical proposals from service providing enterprises and NGOs, and preparing the meetings of the Steering Committee. The Technical Committee will be made up of the Chairpersons of Councils of Arrondissements from the 3rd, 4th, 5th and 5th arrondissements, the Directorates in charge of Lands and Environment and technical units of the City Hall of Cotonou, the General Directorate of Environment, the Directorates in charge of Housing and Urban Planning, the Directorate in charge of Public Works, a representative of the universities of Benin, the Directorate for Fisheries, the Fish and Ocean Research Center of Benin, the Directorate in charge of port facilities, a representative of the Benin Navy, a representative of the Directorate in charge of Public Security, a representative of the Chamber of Commerce and Industry of Benin (CCIB), the Directorate for Sanitation, the Directorate for Pollution Prevention and Environmental Risk Management (DPPGRE), the Directorate in charge of Legislation, the Focal Point for Climate Change, the Directorates in charge of Handicraft and Tourism, the Monitoring and Evaluation Officer, the Coordinator and the Deputy Coordinator of the project.

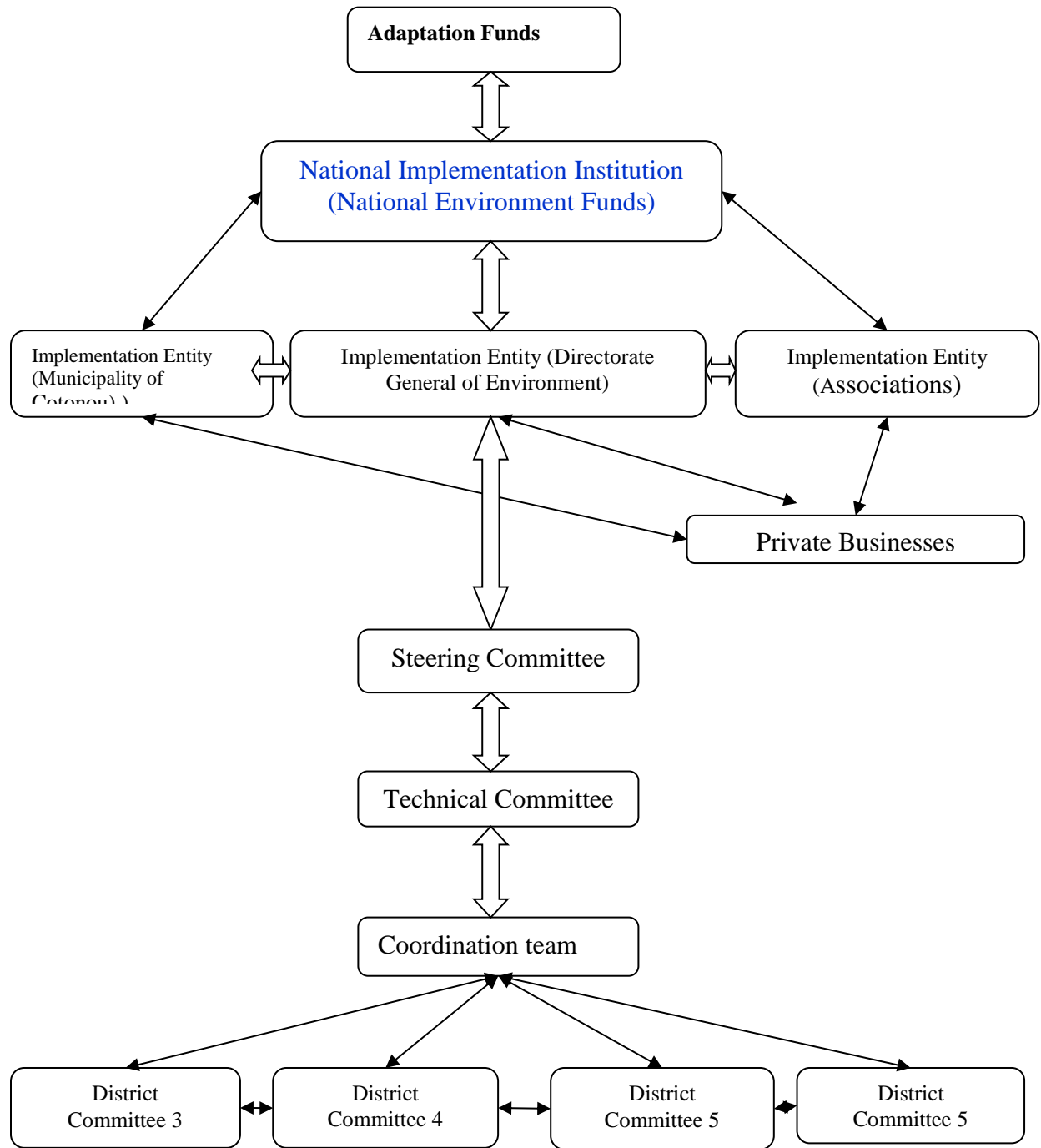
All the implementation contracts will be signed by the Director General of Environment.

The coordination team of the project will be hired through call for applications based on the competences required for each technical, administrative or accounting position (Coordinator, Deputy Coordinator, Monitoring and Evaluation Officer, Administrative Assistant and Accountant).

All the administrative or accounting operations will comply with the provisions of the manual of procedure which will be developed and validated by the Steering Committee upon a proposal by the national implementation body. The compliance with technical, administrative and accounting standards must be absolute during the implementation of the project.

The FNE is accountable for the project implementation before the Adaptation Funds. This is why; it shall strictly monitor all the procedures and activities needed for the project implementation. Upon the request of the Directorate General of Environment (DGE), the FNE shall disburse the funds necessary for the implementation of the project to the Coordinating Team acting on behalf of the DGE, the Municipality of Cotonou and associations which play a role on the field. The DGE shall be accountable for the FNE pursuant to the modalities specified in a procedures manual and in a management control agreement signed between the Implementation national Institution and the main management Entity. These documents should be prior validated by the Steering Committee which is the supreme management body of the Project before they could become effective. The FNE shall monitor all the bodies and structures involved in the project. It should ensure the monitoring of all activities and see to limit the risk sources which can affect the project.

In the procedures manual, a further detail on the roles of the bodies and institutions, the administrative management, the technical and financial standards coupled with implementation deadlines, the drawing up of a progress report with financial reports conditions shall be provided.



The activities of the main stakeholders are shown in Table 3.1.

Table 3.1 Activities of the main stakeholders of the project

Components	Activities	Responsible Organizations	Contractors
1. Banks protection, restoration and improvement of socio-community infrastructures and fight against seasonal flooding of banks and riparian areas of the Cotonou lagoon	Activity 1.1: To protect sandy areas on river banks with rock apron	DGE City Hall of Cotonou	Public Works Enterprises
	Activity 1.2: To build pedestrian walkways along river banks		Public Works Enterprises and NGOs
	Activity 1.3: To build on the two river banks, on appropriate sites, landing stages for users and economic and tourist activities (fishing, transport, nautical sports, promenades in canoe and small boat, etc.)	Municipality of Cotonou Councils of Arrondissements	Public Works Enterprises
	Activity 1.4: To build control sheds with terraces in concrete on various areas along the river bank, with the same style as those built opposite Dantokpa market		
	Activity 1.5: To rehabilitate the dam with gates of Cotonou	Directorate of Port Facilities	Public Works Enterprises
2.1: Fight against pollution of the lagoon to limit the distribution of pollutants by the exchanges of water between the sea and the lake Nokoué, the contamination of fishes and aquatic animals and the threats on the health of the waterside human communities	Activity 2.1.1: To build capacities for heads of areas and SOGEMA for them to be able to reduce the dumping of household refuse on the floor	DGE Municipality of Cotonou	NGOs
	Activity 2.1.2: To build capacities for non-biodegradable waste collection and reclamation by the Association of Female Scrap Dealers of Dantokpa Market (AFRMD)		NGOs
	Activity 2.1.3: To build capacities for biodegradable waste reclamation by the Association of Truck Farmers of Houéyiho		NGOs
	Activity 2.1.4: To destroy floating latrines and replace them with improved public latrines with no contact with the channel		NGOs Directorate of Sanitation
	Activity 2.1.5: To treat waste from the rainwater drains of the city of Cotonou before their discharge into the channel		PM
	Activity 2.1.6: To sensitize populations against the transport of fuel by rivers and lagoons, and to support the Navy Unit stationed at the entrance of the channel to scale-up the fight		NGOs Directorate of Sanitation
	Activity 2.1.7: To sensitize and train dyers on the best practices for the management of wastewaters containing heavy metals		NGOs
	Activity 2.1.8 : Raise awareness of business men for the promotion of floating restaurants bars with pedestrian bridge of access , nautical sports, pirogues and small boat ride, water gardens		Tourism Directorate CCIB
2.2: Integration of the constraints of climate change in texts regulating fishing in the lagoon, in order to prevent bad practices aggravating the negative impacts of climatic variability	Activity 2.2.1 : To support the integration of constraints related to climate change and strategies of adaptation in the laws regulating fishing activities	DGE Directorate of Fisheries Municipality of Cotonou	Directorate of Legislation NGOs
	Activity 2.2.2 : To support fishermen concerned by the regulation for their retraining in the new activities generated by the development of Cotonou channel		NGOs

2.3: Awareness raising and training for local communities on climate risks, adaptation techniques and good practices, and capitalization of the experiences	Activity 2.3.1 : Raise awareness and train the local authorities , town councilors and heads of riparian areas on good practices and techniques of adaptation to climate change	DGE	NGOs
	Activity 2.3.2 : Make assure the raising awareness and the training of the waterside communities of Cotonou lagoon on good practices and techniques of adaptation to climate change by the local authorities	DGE	NGOs
	Activity 2.3.3 :Receive pupils and students for their works of end of training, spread the acquired experiences by the project and organize a seminar of the end of project	DGE Municipality of Cotonou	NGOs, schools, Universities

B. Describe the measures for financial and project / programme risk management.

The National Environment Fund (FNE) could open a special bank account in which advance payments received from the Fund for Adaptation will be deposited. This measure will ensure the transparency of the accounting management system at the level of the national implementation body. Similarly, each implementation body will be required to open a bank account in order to safeguard payments and make the accounting system reliable. Periodic financial reports submitted to the Board of the Fund for Adaptation will testify to the strength of the management system.

Project risks could stem from unexpected events, situations or abnormalities which may arise during the implementation period of the project. Directions will be given to all the stakeholders for the immediate conveyance of the information to the coordination team, the Director General of Environment (DGE) and the National Environment Fund (FNE). If satisfactory responses can be identified and applied to settle the risk, it is proper nevertheless to notify it to project managers. When the risks are important, they should be handled by FNE and the Steering Committee (CP).

The Board of the Fund for Adaptation will be referred to for all the risks and solutions applied.

Anyway, a list of risks experienced (financial risks and project risks) and solutions provided will be drawn up and maintained by the coordination team. This list will included in the results of the project and will be capitalized and used in the same way as the regularly expected results.

Table 3.2 Potential project risks and risk reduction strategies

Risks	Level of impact	Probability of occurrence	Reduction strategies
Change of the national strategy relating to climate change subsequent to Beninese cabinet reshuffle which removed responsible stakeholders	Low	Low	The components of sensitization of the project could be activated for new government officials on the basis of international commitments and the relevant documents already adopted by the Beninese government and parliament
Low effectiveness of the alleviation of the non-climatic factors of the deterioration of ecosystems: wastewater-caused pollution, solid waste, oil products, etc.	Average	Low	The increased accountability of nuisance offenders and local monitoring committees through sensitization, training pedagogy and the mobilization of umbrella organizations (associations, development committee, etc.) should contribute to limit that risk.
Lack of synergy between the implementation bodies on the ground	Average	Low	The strengthening of the consultation framework between heads of arrondissements and chairpersons of extended councils of arrondissements will help to boost the synergy.
High reliance of the project on subcontracting	Low	Low	The project will use quality control to check services provided and providers should accept this. Intermediate evaluations will be organized for that purpose.
Poorly designed budget estimates, under-evaluation or over-evaluation of allowances for some budget lines	Average	Average	Transfers of credits between budget lines and the exploitation of "miscellaneous" items up to 5% integrated in the budget of components will induce the flexibility needed for the smooth performance of the project.

C. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan. Include break-down of how Implementing Entity's fees will be utilized in the supervision of the monitoring and evaluation function..

Monitoring and evaluation for the implementation of the project will be carried out in two ways: through classical evaluations appropriate for all projects and whose results are destined in priority to technical and financial partners and decision-makers, and through participatory methods involving the beneficiary populations of the project.

The project coordination team will prepare annual technical and financial reports to be submitted to the Steering Committee and the Board of the Fund for Adaptation, based on the expected results and indicators. The sensitization of populations on adequate behaviors and best practices in the area of the non-consumptive utilization of

ecosystems and the human livelihoods of the lagoon environment should be based on the results of diagnosis and evaluation acquired on the ground, in order to establish the motivation of stakeholders over a time step inferior to the year. That is why the monitoring and evaluation plan can be defined as follows (table 3.3):

- The project team will ensure daily monitoring by referring to the provisions of the annual work plan and specific indicators;
- The extended councils of arrondissements will gather every month to evaluate the progress of works on the ground, to visit sites and to identify the community supports necessary to the progress of works;
- The permanent consultation framework of heads of arrondissements will ensure the daily watch and monitoring of works on the ground and will report discrepancies and problems identified to the General Directorate of Environment and the City Hall of Cotonou;
- The Technical Committee will meet every quarter to appreciate the progress of schedules works and to identify intermediate achievements that can be harnessed for sensitization of local populations, with site visits;
- The Steering Committee will gather once in a year to approve progress reports and financial reports and to endorse work plans and draft budgets;
- Two external independent evaluations will be organized:
 - Mid-course evaluation;
 - Final evaluation three months prior to the end of the project, targeting particularly sustainability and the impact of results.

Table 3.3 Monitoring and Evaluation (M&E) Plan

M&E Activities	Persons in charge	Costs (US\$)³	Periods
Startup workshop	Coordinator FNE	4,000	Within the first three months after the signing of the management agreement
Workshop to define methodology and to examine indicators with beneficiaries	Coordinator Monitoring officer	5,000	Within two months after the startup workshop
Session of the Steering Committee	Project team	10,000	Within three months after the startup workshop, then once in a year
Meeting of the Technical Committee	Coordinator	20,000	Quarterly
Meeting of extended councils of arrondissements	Coordinator	40,000	Monthly
Consultation of heads of arrondissements	Coordinator	5,000	Permanent
Development of annual work plans and budgets and technical and financial reports	Project team	0	Annual
Development of quarterly evaluation reports	Project team	0	Quarterly
Mid-term review	FNE Project team	35,000	Mid-course

³ Not included the project personnel time and coordination needs

	Consultants		
Audit	FNE Consultant	20,000	Annual
End-of-project seminar	FNE Project team	20,000	Before final evaluation
Final evaluation	FNE Project team Consultants	45,000	Three months before the end of the project
TOTAL		204,000	

D. Include a results framework for the project proposal, including milestones, targets and indicators.

The logical Framework of the Project is as follow (table 3.5).

Table 3.5 Logical Framework of the Project

Results	Indicators	Baseline situations	Targeted objectives	Sources of verification	Risks and assumptions
<p>Outcome 1 : The banks of Cotonou's lagoon are stabilized by means of rocky blocks on slopes. The horizontal top of bank is stabilized by pedestrian ways paved, matched by landing stages facilitating the crossing of the lagoon by the waterside populations, and by sheds of demonstration with terrace concreted to promote healthy and sustainable activities round the lagoon. The dam of Cotonou is fitted out to limit the risks of obstruction of the mouth on the sea</p>	<p>Indicator 1.1: The length of lagoon banks whose rock apron has remained stable six (6) months after the works</p>	<p>Sandy areas of lagoon banks are eroded by the rise and fall of sea and salty water</p>	<p>Protect sandy areas of lagoon banks with rock apron</p>	<p>Quarterly evaluation reports Implementation and delivery reports</p>	<p>The laying of the rock apron may disturb the interests of some riparian dwellers who use the lagoon sand.</p>
	<p>Indicator 1.2: The length of lagoon banks whose paved road has remained stable six (6) months after the end of works</p>	<p>Riparian dwellers dump garbage on the lagoon banks to get stable terrain over the water body.</p>	<p>Build pedestrian walkways along the lagoon banks</p>	<p>Quarterly evaluation reports Implementation and delivery reports</p>	<p>The physical configuration of the lagoon banks may constrain the regularity or the continuity of the paved road.</p>
	<p>Indicator 1.3: Number of fully operational landing stages six (6) months after their construction</p>	<p>A few landing stages are available but their number does not meet the needs</p>	<p>Build landing stages on the banks for users and economic and tourist activities (fishing, transport, nautical sports, etc.)</p>	<p>Quarterly evaluation reports Implementation and delivery reports</p>	<p>The consultation framework of heads of arrondissements should facilitate the harmony of works on the two lagoon banks.</p>
	<p>Indicator 1.4: Number of operational sheds six (6) months after their construction Number of new sheds built by private entrepreneurs 12 months later</p>	<p>The sheds with terraces in concrete built in front of Dantokpa market are models which suit the lagoon banks.</p>	<p>Build control sheds with terraces in concrete along the lagoon banks using the same style as those already built in front of Dantokpa market</p>	<p>Quarterly evaluation reports Implementation and delivery reports</p>	<p>Steps should be taken to avoid the occupancy of terraces by oil products traffickers.</p>
	<p>Indicator 1.5: Hydrologic behavior of the lagoon mouth 12</p>	<p>The height and the control system of the dam of Cotonou are not in</p>	<p>Rehabilitate the dam of Cotonou</p>	<p>Works reports Quarterly evaluation reports</p>	<p>The results of the rehabilitation project of the rock groin of Siafato</p>

	months after the works	compliance with the initial specifications.			and the construction of 7 new grains might not meet expectations.
Outcome 2.1 : The pollution provoked in the lagoon environment by flows and ebb of water and by human activities is limited by the proposed systems or mechanisms for the management of solid and liquid waste and the prevention of pollution	Indicator 2.1.1: Number of mobile garbage cans still operational 18 months after their installation	A few mobile garbage cans are already in use in Dantokpa market.	Build the capacities of heads of areas and SOGEMA to reduce the dumping of household refuse on the floor	Delivery reports Quarterly evaluation reports Field trips	The use of mobile garbage cans should not raise any particular problems.
	Indicator 2.1.2: Increase rate of the business of the Association of Female Scrap Dealers of Dantokpa market	The Association of Female Scrap Dealers of Dantokpa market (AFRMD) used to get material support from OXFAN QUEBEC as part of a project already completed.	Build capacities for the collection and reclamation of non-biodegradable waste by the Association of Female Scrap Dealers of Dantokpa market	Delivery reports Quarterly evaluation reports Field trips	The absorption capacity of the commercial partners of AFRMD may limit the rate of increase of the volume of women's business.
	Indicator 2.1.3: Increase rate of the volume of compost made the Association of Truck farmers of Houéyiho (AMH) 12 months after the material support	The truck farmers of Houéyiho are good at making compost for their own needs and those of the market but they are limited by material means.	Build capacities for the reclamation of biodegradable waste by the Association of Truck farmers of Houéyiho	Delivery reports Quarterly evaluation reports Field trips	The distribution mode of composting tasks involving actors in turn should not hinder market garden production.
	Indicator 2.1.4: Number of operational latrines 12 months after their construction	Populations badly need latrines in Dantokpa market and in districts located on the banks of the lagoon of Cotonou.	Destroy floating latrines and replace them with improved public latrines with no contact with the channel	Implementation and delivery reports Quarterly evaluation reports Field trips	Local authorities and Dantokpa market managers should use qualified personnel to manage the latrines.
	Indicator 2.1.5: This aspect is included in the Emergency Project for Environmental Management in Urban Areas funded by the World Bank	The wastes of the city of Cotonou are discharged into the lagoon of Cotonou without any anti-pollution treatment.	Treat urban wastes of rainwater drains of the city of Cotonou before they are discharged into the channel	Field trips	The City Hall of Cotonou should ensure the effective implementation of this item by the Emergency Project for Environmental Management in Urban Areas.
	Indicator 2.1.6.1: Rate of decrease of the illegal deposit of oil products in riparian districts, 6 months and 12 months after the beginning of the sensitization campaign	Oil products transported by night on the lagoon with thousands of 50-liter jerry cans are often discharged accidentally into the lagoon.	Sensitize populations against the transport of oil products by river and lagoon and provide support to the Navy units stationed at the entrance of the	Quarterly evaluation reports Field trips	The orientation of traffickers to the new business opportunities yielded by the development of the lagoon banks could help decrease the number of illegal deposits.
	Indicator 2.1.6.2: Increase rate of	Navy Units are stationed at the		Delivery reports Quarterly	Preliminary population

	nighttime missions of Navy units 6 months after the support is provided	entrance of the lagoon of Cotonou and monitor traffic between Nokoué lake and the lagoon.	channel to scale-up the fight	evaluation reports Field trips	sensitization activities will increase the effectiveness of the deterrence role of the Navy Units.
	Indicator 2.1.7: Percentage of dyers who have adopted the best practices for the management of wastewaters 6 months after the training	Wastewaters from dye-works contain ions of heavy metals.	Sensitize and train dyers on the best practices for the management of wastewaters	Training reports; Quarterly evaluation reports Field trips	The unhealthy environment in which dyers work can be a source of discouragement.
	Indicator 2.1.8: Number of entrepreneurship on the lagoon initiated 6 months after the beginning of the sensitization campaign	The current unhealthiness of the banks of the lagoon of Cotonou hinders tourist activities.	Sensitize entrepreneurs for the promotion of floating pubs and restaurants with pedestrian bridge for access, nautical sports, promenades in canoes, etc.	Workshop reports Quarterly evaluation reports Field trips	The interest of economic and tourist operators in the developed lagoon will depend on the quality of the stabilization and sanitation works on the lagoon banks.
Outcome 2.2 : The regulations of the fishing on the lagoon allowed to limit the escalation, by waves provoked by power-driven boats, of the erosion of banks due to streams between sea and lagoon and to violent winds, and to extreme meteorological events. The fishermen in excess on the lagoon agreed to move into the other economic activities created in the lagoon	Indicator 2.2.1: Reduction rate of offences recorded by Navy Units, the Environmental Police and the National Police 6 months after the sensitization of fishermen on the basis of new laws	The laws in force forbid fishing activities in the lagoon. Fishermen are opposed to such legal provisions which are not complied with.	Support the integration of constraints related to climate change and adaptation strategies in regulations governing fishing	Workshop reports Quarterly evaluation reports Field trips	Professional associations of fishermen should participate in analyses and discussions leading to the passing of regulations to support compliance by members of such associations.
	Indicator 2.2.2: Number of fishermen who turn to the new business opportunities three months after sensitization activities	Tourist and recreational activities are almost absent on the lagoon of Cotonou.	Support fishermen affected by the regulations for their reconversion in the new business opportunities generated by the development of the channel of Cotonou	Workshop reports Quarterly evaluation reports	The progress and quality of development works the lagoon banks will be critical in the choice by fishermen.
	Indicator 2.2.3: Number of fishermen who have kept carrying out the new businesses six (6) months after they got the support	Genuine alternatives are not proposed to fishermen.			
Outcome 2.3 : The rise of the consciousness and the training of local communities on	Indicator 2.3.1: Percentage of local authorities who have initiated an adaptation strategy	Local authorities have some idea of climate change and its harmful impacts	Sensitize/to train local authorities, councilors and riparian heads of areas on best	Workshop reports Quarterly evaluation reports Field trips	Local authorities show a great interest for climate change as an important theme

climatic risks, techniques of adaptation and good practices and the capitalization of the experiences in the form of memoirs and theses in the universities allow to assure the durability of the experiences and the scattering of the results of the project	to handle the major climate risks of the coastal area one year after the sessions		practices and climate change adaptation techniques		for the mobilization of populations.
	Indicator 2.3.2: Number of community members who have developed at least one measure of adaptation to major climate risks, one year after the sessions	Daily life problems do not allow members of the grassroots community to develop prospects on climate change.	Sensitize communities residing on the banks of the lagoon of Cotonou on best practices and climate change adaptation techniques	Workshop reports Quarterly evaluation reports Field trips	The impact of the sensitization of populations by local authorities will depend on the progress and quality of lagoon banks development works and the hope of a better life.
	Indicator 2.3.2: Number of memoirs and theses supported on the theme of the project, number of institutions having benefited from the experiences of the project	There are scientific publications on Cotonou's lagoon in the domains of the pollution and the threats on the alive resources. No previous work on the links with the climate change and the solutions	Distribution and broadcasting of the experiences and lessons acquired by the Project	Report of the end of project, report of final workshop, memoirs and theses of students	Pupils, students, local residents of other lagoons and concerned institutions should appreciate the knowledge produced by the Project

E. Include a detailed budget with budget notes, a budget on the Implementing Entity management fee use, and an explanation and a breakdown of the execution costs.

Table 3.6: Project Budget and Timeline

Investment category	Activities	Year 1	Year 2	Year 3	Year 4	Total (US\$)
Component 1 : Protection of lagoon banks, struggle against seasonal floods and catering for socio-community infrastructures	Activity 1.1 : Protect the sand segments of the banks with a rocky coating					
	1, Negotiation of the contracts with companies					
	2, Clearing of the garbage	500,000				500,000
	3, Search for stony blocks	500,000	300,000			800,000
	4, Installation and consolidation of stony blocks	500,000	300,000			800,000
	Activity 1.2 : Develop pedestrian paved roads along the banks					
	1, Clearing and elevation of banks	700,000				700,000
	2, Manufacturing of pavements in cement	2,000,000	1,000,000			3,000,000
	3, Installation of pavements		480,000			480,000
	Activity 1.3 : Develop landing stages on both banks for users access and economic activities (fishing, transports, nautical sports)					
	1, Negotiation of the contracts with companies					
	2, Construction of landing stages			220,000		220,000
	Activity 1.4 : Build control sheds with terraces in concrete, in places along the banks, in the same style as those already established opposite Dantokpa market					
	1, Negotiation of the contracts with companies					
	2, Building the sheds			220,000		220,000
	Activity 1.5 : Rehabilitate the dam with gates of Cotonou					
	1, Negotiation of the contracts with companies					
2, Rehabilitating the dam		120,000			120,000	
Total component 1		4,200,000	2,200,000	440,000	0	6,840,000

Investment category	Activities	Year 1	Year 2	Year 3	Year 4	Total (US\$)	
Component 2 : Integration of climate variability in environment management by the waterside populations and capitalization of the project experiences	2,1 Fight against water pollutants and fishes and aquatic animals contamination						
	2.1.1 : Build capacities of heads of area and SOGEMA to reduce the practice of discharging household wastes on the ground		40,000			40,000	
	2.1.2 : Build capacities for collection and conversion of non biologically decomposable wastes by the Women Associations based on Recycled Materials of Dantokpa market (AFRMD)		4,000			4,000	
	2.1.3 : Build capacities for conversion of non biologically decomposable wastes by the Association of Houéyiho market gardeners		2,000			2,000	
	2.1.4 : Destroy the floating latrines and replace them by improved public latrines without any contact with channel				32,000	32,000	
	2.1.5 : Treat urban discharges of the main sewers from rain waters of Cotonou city before their discharge in the channel					0	
	2.1.6 : Raise populations awareness against petroleum products transportation by fluviolagoon route and support Naval Forces unit poted on the channel entrance to strengthen the fight				70,000	70,000	
	2.1.7 : Raise awareness on and train dyer craftsmen on the good practices of managing residual waters containing heavy leads				20,000	20,000	
	2.1.8 : Raise awareness of business men for the promotion of floating restaurants bars with pedestrian bridge of access , nautical sports, pirogues and small boat ride, water gardens					50,000	50,000
	2,2 Integration of the constraints to climate variability in texts regulating fishing in the lagoon						

Investment category	Activities	Year 1	Year 2	Year 3	Year 4	Total (US\$)
	2.2.1 : Support the integration of constraints related to climate change and strategies of adaptation in the laws regulating fishing activities				40,000	40,000
	2.2.2 : Support fishermen concerned by the regulation for their retraining in the new activities generated by the development of Cotonou channel				317,000	317,000
	2.3: Awareness raising and training local communities on climate risks, adaptation techniques and good practices, and capitalization of the experiences					
	2.3.1 : Raise awareness and train the local authorities , town councilors and heads of riparian areas on good practices and techniques of adaptation to climate change		69,000			69,000
	2.3.2 : Make assure the raising awareness and the training of the waterside communities of Cotonou lagoon on good practices and techniques of adaptation to climate change by the local authorities			12,000		12,000
	2.3.3 :Receive pupils and students for their works of end of training, spread the acquired experiences by the project and organize a seminar of the end of project			25,000	34,000	59,000
Total component 2		0	115,000	159,000	441,000	715,000
Total component 1 & 2		4,200,000	2,315,000	599,000	441,000	7,555,000
Project Execution Cost		115,410	119,000	122,000	127,590	792,000
Project Cycle Management Fee charged by the Implementing Entity		215,000	176,000	164,000	154,000	709,000
TOTAL BUDGET		4,530,410	2,610,000	885,000	722,590	9,056,000

Component 1 – Protection of lagoon banks, struggle against seasonal floods and restoration of socio-community infrastructures.

	Expenditure related to the sub component	Unit	Unit cost (USD)	Number of units	Year 1	Year 2	Year 3	Year 4	Total cost	See Budget Note:
C1	Sub-Component 1 – Lagoon banks stabilization for the high priority sites with a rocky coating									
C1.1	National consultants									
C1.1.1	Production/compilation of data on soils, stream, land uses (02 consultants)	Per day	250	120					30,000	C1.1
C1.1.2	Identification of protection materials (stones) and its sources (02 consultants)	Per day	250	60					15,000	C1.1
C1.1.3	Development of the call for tender technical documents for stream bank stabilization (01 consultant)	Per day	250	20					5,000	C1.1
C1.1.4	Workshop (preparation & moderation)	Per day	250	42					10,500	C1.1
C1.1.5	Quality control	Per day	250	156					39,000	C1.1
	Subtotal 1.1				83,500	16,000			99,500	C1.1
C1.2	Local transportation									
	Subtotal 1.2				25,000	20,000			45,000	
C1.3	Workshops									
	Subtotal 1.3		1,500	07	7,500	3,000			10,500	C1.3
C1.4	Services Equipment & Supplies									
	Subtotal 1.4				1,384,000	561,000			1,945,000	C1.4
	Total 1				1,500,000	600,000			2,100,000	
C2	Sub-Component 2 – Execution of pedestrian paved roads along the banks									
C2.1	National consultants									
C2.1.1	Study of the lagoon banks land uses (02	Per day	250	120					30,000	C2.1

	consultants)									
C2.1.2	Elaboration of a participative development plan of Lagoon banks (04 consultants)	Per day	250	240					60,000	C2.1
C2.1.3	Workshop (preparation & moderation)	Per day	250	108					27,000	C2.1
C2.1.4	Quality control	Per day	250	156					39,000	C2.1
	Subtotal 2.1					124,500	31,500		156,000	C2.1
C2.2	Local transportation									C2.2
	Subtotal 2.2					25,000	20,000		45,000	C2.2
C2.3	Workshops			18						C2.3
	Subtotal 2.3					23,000	6,000		29,000	C2.3
C2.4	Services Equipment & Supplies									C2.4
	Subtotal 2.4					2,527,500	1,422,500		3,950,000	
	Total 2					2,700,000	1,480,000		4,180,000	
C3	Sub-Component 3 – Develop 11 landing-stages on both banks for users access and economic activities (fishing, transports, nautical sports)									
C3.1	National consultants									
C3.1.1	Workshop (preparation & moderation)	Per day	250	18					4,500	C3.1
C3.1.2	Quality control	Per day	250	52					13,000	C3.1
	Subtotal 3.1						17,500		17,500	C3.1
C3.2	Local transportation									C3.2
	Subtotal 3.2						6,000		6,000	C3.2
C3.3	Workshops		1,500	03						C3.3
	Subtotal 3.3						4,500		4,500	C3.3
C3.4	Services Equipment & Supplies									C3.4
	Subtotal 3.4						192,000		192,000	C3.4
	Total 3						220,000		220,000	
C4	Sub-Component 4 – Build 11 control sheds with terraces in concrete, in places along the banks, in the same style as those already established opposite Dantokpa market									

C4.1	National consultants												
C4.1.1	Workshop (preparation & moderation)	Per day	250	18					4,500	C4.1			
C4.1.2	Quality control	Per day	250	52					13,000	C4.1			
	Subtotal 4.1							17,500	17,500	C4.1			
C4.2	Local transportation												
	Subtotal 4.2							6,000	6,000				
C4.3	Workshops	Workshop	1,500	03						C4.3			
	Subtotal 4.3							4,500	4,500	C4.3			
C4.4	Services Equipment & Supplies												
	Subtotal 4.4							192,000	192,000	C4.4			
	Total 4							220,000	220,000				
C5	Sub-Component 5 – Rehabilitation the dam with gates of Cotonou												
C5.1	National consultants												
C5.1.1	Workshop (preparation & moderation)	Per day	250	18					4,500	C5.1			
C5.1.2	Quality control	Per day	250	52					13,000	C5.1			
	Subtotal 5.1							17,500	17,500	C5.1			
C5.2	Local transportation												
	Subtotal 5.2							6,000	6,000	C5.2			
C5.3	Workshops		1,500	03						C5.3			
	Subtotal 5.3							4,500	4,500	C5.3			
C5.4	Services Equipment & Supplies												
	Subtotal 5.4							92,000	92,000	C5.4			
	Total 5							120,000	120,000				
	TOTAL COMPONENT 1							4,200,000	2,200,000	440,000	0	6,840,000	
C6	Sub-Component 6 – Control of water pollution and aquatic animals contamination												
C6.1	National consultants												

C6.1.1	Workshop (preparation & moderation)	Per day	250	54					13,500	C6.1	
C6.1.2	Quality control	Per day	250	52					13,000	C6.1	
	Subtotal 6.1						4,500	19,000	3,000	26,500	C6.1
C6.2	Local transportation										C6.2
	Subtotal 6.2						6,000	8,000	4,000	18,000	C6.2
C6.3	Workshops			03							C6.3
	Subtotal 6.3						4,500	6,000	4,000	14,500	C6.3
C6.4	Services Equipment & Supplies										C6.4
	Subtotal 6.4						31,000	89,000	39,000	159,000	C6.4
	Total 6						46,000	122,000	50,000	218,000	
C7	Sub-Component 7 – Integration of the constraints to climate variability in texts regulating fishing in the lagoon and support for viable and sustainable alternative livelihoods for affected fishermen/women										
C7.1	National consultants										
C7.1.1	Study of integration of climate change and adaptation strategies constraints in the law on fishery (02 consultants)	Per day	250	80						20,000	C7.1
C7.1.2	Workshop (preparation & moderation)	Per day	250	116						29,000	C7.2
	Subtotal 7.1								49,000	49,000	C7.1
C7.2	Local transportation										C7.2
	Subtotal 7.2								20,000	20,000	C7.2
C7.3	Workshops			19							C7.3
	Subtotal 7.3								60,000	60,000	C7.3
C7.4	Services Equipment & Supplies										C7.4
	Subtotal 7.4								48,000	48,000	C7.4
C7.5	Training courses										C7.5
	Subtotal 7.5								30,000	30,000	C7.5
C7.6	Initial grants										C7.6
	Subtotal 7.6								150,000	150,000	C7.6
	Total 7								357,000	357,000	

C8	Sub-Component 8 – Awareness raising and training local communities on climate risks, adaptation techniques and good practices, and capitalization of the experiences									
C8.1	National consultants									
C8.1.1	Workshop (preparation & moderation), creation of a website	Per day	250	199					49,750	C8.1
	Subtotal 8.1					40,750	5,250	3,750	49,750	C8.1
C8.2	Local transportation									
	Subtotal 8.2					2,000	5,000	5,000	12,000	C8.2
C8.3	Workshops									
	Subtotal 8.3			10		5,000	6,000	6,000	17,000	C8.3
C8.4	Services Equipment & Supplies									
	Subtotal 8.4					21,250	20,750	19,250	61,250	C8.4
	Total 8					69,000	37,000	34,000	140,000	
	TOTAL COMPONENT 2					0	115,000	159,000	441,000	715,000

C1.1: Two national consultants will study of the soils structure, the land uses, the stream flow and the topography of the lagoon and the banks. Two other consultants will identify the kind of materials (rocks) and the quarries for the stream bank protection. One consultant will develop the call for tender technical documents for designing and implementing the protection works on the banks. The resulting document will be submitted to a validation workshop and another six workshop sessions are set aside for stakeholders for the monitoring of the stream banks protection activities. The quality control of the works will be assumed by the National Center for Research on Public Constructions at an average of twice a week.

C1.2 : Costs associated with transport for monitoring and field data collection, attending consultation workshops.

C1.3 : This allocation will cover costs associated with 7 workshops at US\$1,500 each, inclusive of venue, meals and refreshments for validation of the file of call for tenders and for monitoring and evaluation of the activities of protection of Lagoon banks by the stakeholders.

C1.4 : This allocation covers the cost associated to service contracts with local companies for clearing off the dumpsites on the banks (US\$461,000 in Year 1), and for providing blocks and stream bank stabilization (US\$738,000 and US\$746,000 in Year 1 and Year 2 respectively).

C2.1: The national consultants will study the lagoon banks occupation mode in all four waterside Districts and elaborate a participative development plan of Lagoon. They will moderate validation workshops and feedback workshops and workshops for the monitoring

and evaluation of the paving works for the stakeholders. The quality control of the work will be assumed by the National Center for Research on Public Constructions at an average of twice a week.

C2.2 : Costs associated with transport for monitoring and field data collection, attending consultation workshops.

C2.3 : This allocation will cover costs associated with workshops, inclusive of venue, meals and refreshments for validation of the file of call for tenders and for monitoring and evaluation of the activities of protection of Lagoon banks by the stakeholders.

C.2.4 : This allocation covers the associated costs of audio-visual equipment, supplies, and informational materials to facilitate community mobilization and planning activities and the cost of service contracts with local companies in the first year for clearing and elevation of banks and manufacturing of pavements in cement (\$2,547,500). This allocation also covers in the second year the costs associated with manufacturing of pavements in cement and installation of pavements

C3.1: The consultations purposes are : 1) moderating workshops for monitoring and evaluation of landing-stages construction by the stakeholders ,. 2) controlling the work.

C3.2: Costs associated with transport for monitoring and field data collection, attending consultation workshops.

C3.3: 3 This allocation will cover costs associated with workshop sessions, inclusive of venue, meals and refreshments for monitoring and evaluation of landing-stages construction by the stakeholders

C.3.4 : This allocation covers the cost of service contracts with local companies in the 3rd year for construction of landing stages (\$192,000).

C4.1: The consultant will moderate workshops for monitoring and evaluation of constructions by the stakeholders. The quality control of the work will be assumed by the National Center for Research on Public Constructions at an average of twice a week.

C4.2: Costs associated with transport for monitoring and field data collection, attending consultation workshops.

C4.3: 3 This allocation will cover expenditure related to the holding of workshop sessions, inclusive of venue, meals and refreshments.

C.4.4 : This allocation covers the cost of service contracts with local companies in the 3rd year for construction of control sheds (\$192,000).

C5.1: The national consultants will moderate workshops for monitoring and evaluation of works for rehabilitation of Cotonou dam by the stakeholders. The quality control of the works will be assumed by the National Center of Research for the Public Works at an average of twice a week.

C5.2: Costs associated with transport for monitoring and field data collection, attending consultation workshops.

C5.3: This allocation will cover costs associated with workshop sessions, inclusive of venue, meals and refreshments.

C.5.4 : This allocation covers the costs of service contracts with local companies in the 2nd year for rehabilitation of Cotonou Dam.

C6.1: National consultants will moderate workshops for raising awareness on pollution caused by heavy metals, ecological sanitation and promoting economic activities on Lagoon banks. The quality control of the construction of improved public latrines will be assumed by the National Center of Research for the Public Works.

C6.2: Costs associated with transport for monitoring and field data collection, attending consultation workshops.

C6.3: This allocation will cover costs associated with workshop sessions.

C6.4 : This allocation will cover costs associated with building technical capacities of heads of the area and SOGEMA to ecological sanitation.

C7.1: The national consultants will study the modalities of integration of climate change and strategies of adaptation constraints the laws regulating Fishery. They will moderate validation and feedback workshops for stakeholders.

C7.2: Costs associated with transport for monitoring and field data collection, attending consultation workshops.

C7.3: This allocation covers workshop sessions, inclusive of venue, meals and refreshments..

C7.4: This allocation covers the associated costs of informational materials and supplies to facilitate community mobilization

C7.5: Existing training facilities will be contracted to provide training in relevant individual marketable skills for small fishermen/women affected. Average cost per person is approximately US\$400 per module for 75 persons in total. Each module provided is self-contained and the cost includes support with job placement.

C7.6: This allocation will cover associated costs of basic supports for the fishermen/women who will opt for alternative livelihoods. Average cost per person is approximately US\$2,000 for 75 persons in total

C8.1: The national consultants will develop a strategic communication plan on climate risks, adaptation techniques and good practices. They will coordinate and facilitate the strategic planning process for the network of fishermen/women. They will moderate workshops for raising awareness and training on good practices and techniques of adaptation to climate change for local authorities, town councilors and heads of riparian areas and for communities. Later, the animation of the district workshops will be assured by the municipal authorities. Additionally, a web designer will develop a web-based platform and upgrade the website in Year 4 of the Project.

C8.2: Costs associated with transport to attend workshops and participate in the best practices forum.

C8.3: This allocation will cover a series of workshops for raising awareness and training stakeholders on good practices and techniques of adaptation to climate change.

C8.4: This allocation covers the associated costs of organization of students' visits and works, a best practices and a 2-day symposium including exhibits and poster presentations, seminars, and workshops, a seminar of the end of project, and the costs associated with the communications materials to increase capacity for climate change resilient communities, ecosystems and relevant economic sectors

???

Table 3.7 Planning of Activities

Activities	Schedule											
	Year 1			Year 2			Year 3			Year 4		
Activity 1.1: To protect sandy areas on river banks with rock apron												
Activity 1.2: To build pedestrian walkways along river banks												
Activity 1.3: To build on the two river banks, on appropriate sites, landing stages for users and economic and tourist activities (fishing, transport, nautical sports, promenades in canoe and small boat, etc.)												
Activity 1.4: To build control sheds with terraces in concrete on various areas along the river bank, with the same style as those built opposite Dantokpa market												
Activity 1.5: To rehabilitate the dam of Cotonou												
Activity 2.1.1: To build capacities for heads of areas and SOGEMA for them to be able to reduce the dumping of household refuse on the floor												
Activity 2.1.2: To build capacities for non-biodegradable waste collection and reclamation by the Association of Female Scrap Dealers of Dantokpa Market (AFRMD)												
Activity 2.1.3: To build capacities for biodegradable waste reclamation by the Association of Truck Farmers of Houéyiho												
Activity 2.1.4: To destroy floating latrines and replace them with improved public latrines with no contact with the channel												
Activity 2.1.5: To treat waste from the rainwater drains of the city of Cotonou before their discharge into the channel	Activities of the Emergency Project for Environmental Management in Urban Areas (PUGEMU) funded by the World Bank											
Activity 2.1.6: To sensitize populations against the transport of fuel by rivers and lagoons, and to support the Navy Unit stationed at the entrance of the channel to scale-up the fight												
Activity 2.1.7: To sensitize and train dyers on the best practices for the management of wastewaters containing heavy metals												
Activity 2.1.8: To sensitize businessmen on the promotion of floating pubs and restaurants with pedestrian bridges for access, nautical sports, promenades in canoes and small boats, and water gardens												
Activity 2.2.1: To support the integration of constraints related to climate change and adaptation strategies into legal provisions governing fishing												
Activity 2.2.2: To support fishermen targeted by the regulations for their reconversion in new business set up thanks to the development of the Cotonou channel												
Activity 2.3.1: To sensitize/to train local authorities, councilors and riparian heads of areas on best practices and climate change adaptation techniques												
Activity 2.3.2: To sensitize communities residing on the banks of the Cotonou Lagoon on best practices and climate change adaptation techniques												
Activity 2.3.3: Receive pupils and students for their works of end of training, spread the acquired experiences by the project and organize a seminar of the end of project												
Activity 3.1: To ensure the technical coordination of project activities												
Activity 3.2: To carry out internal management and monitoring and evaluation activities												
Activity 3.2: To carry out external evaluation activities												

F. Include a disbursement schedule with time-bound milestones.

Tables 3.8 and 3.9 show the executive cost and the Budget breakdown of the Implementing Entity Fee

Table 3.8 : Execution cost (x1000US\$)

Expenditure	Upon agreement signature	One Year after Project Start	Year 2	Year 3	Year 4	Total
Project Manager	20	31	33	34	35	153
Assistant manager		22	23	24	25	94
Senior Technical Officer	0	20	20	20	20	80
Administrative Assistant	3	10	4,3	0		17,3
Social Security	3,3	3,3	3,3	3,3	3,3	16,5
Equipment and furniture	0	75	25	15	0	115
Supplies, products, communication	0	7	7	7	7	28
Support for the waterside Districts ⁴	0	8	8	8	8	32
Cost of outsourcing of the technical support ⁵	0	150	50	37	19,2	256,2
Total	26,3	326,3	173,6	148,3	117,5	792

⁴ On grounds of efficiency, the Shareholders Network to be established for the monitoring of the activities as well as the project benefit on the field shall be decentralized in the 3rd, 4th, 5th and 6th watershed districts of the Lagoon. The Heads of those districts shall be saddled with the responsibility of ensuring the Network close support in terms of the material aspect of its mission: availability of meeting, processing and photocopy of document, etc. This support will continue beyond the end of the Project. The resources allocations provided for, are meant to acquire minor equipment and pay for the service needed by Heads of District in order for the Network not to suffer from any equipment issues.

⁵ In order to develop the terms of reference for the extensive works, an expertise budget is notably provided, for example. Other works for documents preparations or real-time appreciation work on the quality of the intermediary results of some activities of the project and for which the coordinating team lacks required competences should be submitted to the technical Committee or to the Steering Committee for validation. Relevant external technical supports to help management bodies to take timely sound decisions for the attainment of the results should be provided. This budget allocation is provided for these kinds of situations, instead of formal assessments making to realize the achievement of unacceptable outcomes

Table 3.9 : Budget breakdown of the Implementing Entity Fee (x1000US\$)

Expenditure	Total Staff person-days	Year 1 (x1000US\$)	Year 2 (x1000US\$)	Year 3 (x1000US\$)	Year 4 (x1000US\$)	Total fee (x1000US\$)
Technical assistance on environmental, legal and social safeguards	200	29	8	8	8	53
Legal support, Review of service contracts	100	8	4	4		16
Advise in the finances, in the budget	150	6	6	6	6	24
Resource management for Adaptation Fund through an appropriate Investment trust	100	4	4	4	0	12
Human resources management (capacity building and possible recruitment)	250	13	13	13	14	53
Assistance to the project, technical support and supervision missions	400	16	16	16	16	64
Support service of implementation	200	45	40	0	0	85
Technical support for screening and management of financial risks and selection of indicators and criteria of risks and performance	400	24	16	16	8	64
Management of the supply and diverse purchases of goods and services	200	12	10	10	10	42
Support for the information and telecommunication, Including the maintenance of management systems of the information and databases for the follow-up of the implementation of the projet	150	6	6	6	6	24
Technical support regarding methodologies, validation of terms of reference, experts' identification, validation of results and quality assurance	400	15	15	15	15	60
Assurance of the conformity of the practices of financial management with the	310	12	12	12	12	48


requirements of Adaptation Fund and support of the required shares of audit						
Assurance of the conformity of financial statements with the standards of National Fund for Environment and Adaptation Fund	500	20	10	10	10	50
Assurance of the identification and valuation of learnt lessons	150	0	10	10	14	34
Mid Term Review			20			20
Terminal evaluation and Implementation Completion and Results Report (ICR)					20	20
Total	3510	210	190	130	139	669

Disbursement Matrix

	Upon Agreement signature	One Year after Project Start	Year 2	Year 3	Total
Scheduled Date	02/12/2013	1/12/2014	1/12/2015	1/12/2016	
Project Funds	4,552,600	2,488,600	747,300	558,500	8,347,000
Implementing Entity Fee	210,000	195,000	130,000	134,000	669,000
	4,762,600	2,683,600	877,300	692,600	9,016,000

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

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT¹ *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

<p>Ibila DJIBRIL, Environmental Technical Adviser for The Minister of Environment, Housing and Urbanism, UNFCCC National Focal Point Cotonou, Bénin. Tél. +229 21 31 55 96 Mobile : +229 97 98 84 38 Fax : +229 21 31 50 81</p>	<p>Cotonou, February 14, 2013</p>  <p>Ibila DJIBRIL</p>
--	---

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

<p>I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans (Declaration of Population Policy, Horizon 2025, National Strategy of Growth for Poverty Reduction 2011-2015, National Adaptation Program of Action (NAPA), Second National Communication on Climate Change) and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.</p>	
<p><i>Théophile ADJE</i> <i>Managing Director / FNE</i> Implementing Entity Coordinator</p>	
<p>Date: <i>February 14, 2013</i></p>	<p>Tel. and email (229) 95189999 adjphile@yahoo.fr</p>
<p>Project Contact Person: Mathieu Biaou, Environmental Specialist/FNE Tel. And Email: (229) 97608219 – biaoumathieu@yahoo.fr</p>	

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

Annex 1. Endorsement Letter from Mr. Ibila DJIBRIL, Environmental Technical Adviser for The Minister of Environment, Housing and Urbanism, UNFCCC National Focal Point Cotonou, Bénin



REPUBLIQUE DU BENIN
FRATERNITE - JUSTICE - TRAVAIL



MINISTRE DE L'ENVIRONNEMENT, DE L'HABITAT ET DE L'URBANISME
CABINET DU MINISTRE

Cotonou, February, 14, 2013

The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 32 40/5

Dear Sir/Madam,

Subject: Endorsement for Benin Cotonou Lagoon Adaptation to climate change project.

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

Accordingly, I am pleased to endorse the above project proposal with support from the Adaptation Fund. If approved the project will be implemented by the Fonds National pour l'Environnement (FNE) and executed by the Direction Générale de l'Environnement (DGE).

Sincerely,

Ibila DJIBRIL
Environmental Technical Adviser for the
Minister of Environment, Housing and Urbanism.

Cc: M. Blaise Onésiphore AHANHANZO GLELE, Minister of Environment, Housing and Urbanism
M. Théophile ADJE, DG/FNE
M. Césaire GNANGLE, DGE.

Annex 2: Presence lists of some Stakeholders

Annex 3-1: Intention letters of some Stakeholders (1)

Annex 3-2: Intention letters of some stakeholders (2)

Annex 3-3: Intention letters of some stakeholders (3)

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Republic of Benin



National
Environment Fund



ADAPTATION FUND

Climate Change
Adaptation Fund



Ministry of
Environment,
Housing and Town
Planning

**Elaboration of the Project on the Cotonou Lagoon Ecosystems and human Communities
adaptation to the impacts of sea-level rise and extreme weather events**

**CURRENT AND FUTURE IMPACT OF CLIMATE CHANGE ON VULNERABLE
SOCIAL GROUPS AND COTONOU LAGOON LIVING RESOURCES**

@ @ @ @ @ @ @

STUDY REPORT

Cotonou, February 2013

Nestor AHO,

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General introduction

The West African coastal area is one of the world's most vulnerable to climate change. The often disastrous impact of climate variability and extreme weather events over the last thirty years is a good illustration and an alert-sounding sign of this vulnerability.

Therefore, at the completion of vulnerability studies conducted as part of the development of the Second National Paper on Climate Change of Benin (MEHU, 2011), it appeared that the coast, water resources, agriculture, human health, energy and forestry sectors are especially vulnerable to climate change. Based on climatic and non-climatic scenarios developed for the future development of the coastal area and according to the information emanating by DIVA software, the sea-level could rise continuously, reaching about 0.81 m over the period 2000 - 2100, confirming thereby the Intergovernmental Panel on Climate Change forecast (IPCC, 2007).

Climate variability in the coastal area has culminated with an increase in heavy rains and floods frequency reinforced by sea-level rise. Floods degrade the physical environment and populations' livelihoods quality in the periodically flooded and unhealthy areas. People are witnessing houses and socio-community infrastructure destruction, the diseases outbreak, loss of human lives. Some factors like the nature of the geological and pedological substratum as well as the topographical configuration have worsened the vulnerability, in particular, at Cotonou lagoon level, on the riparian areas residents and their economic activities. In areas of high population density, human-induced interventions and activities necessary to community life, but often poorly adapted, and the effects of which are exacerbated by climate change, are additional sources to the populations and resources vulnerability.

This is particularly the case of Cotonou Port built in 1962 and its two protecting breakwaters constructed in 1963. These breakwaters are the causes of a sedimentary deficit reinforced by sea-level rise and ocean currents change. The sediment deficit is responsible for a significant erosion of the coast, especially in the East of the East Breakwater or Sifato Breakwater (Fig. 1). The impacts on the lagoon ecosystem are persistent disturbances of the ecological equilibrium, modes of reproduction and quality of fishery resources, systems of social transformation and populations' health security.

If nothing is done, we may ultimately witness the degradation of the lagoon system and, especially, the loss its associated biodiversity and the destruction of the social fabric which is part and parcel of the lagoon system.

In view of the foregoing, the Government of Benin has adopted its National Climate-proofing Action Plan (PANA) as one of its priority measures for protecting the coast against the sea-level rise. In terms of environmental and lagoon ecosystem protection, the Government has submitted to the Adaptation Fund of the United Nations Framework Convention on Climate Change the identification sheet of for the lay-out of Cotonou Lagoon shores which host several economic agents, including shopkeepers and craftsmen of Dantokpa and Gbogbanou markets, settled along the shores and causing heavy pollution and degradation of Cotonou lagoon ecosystem.

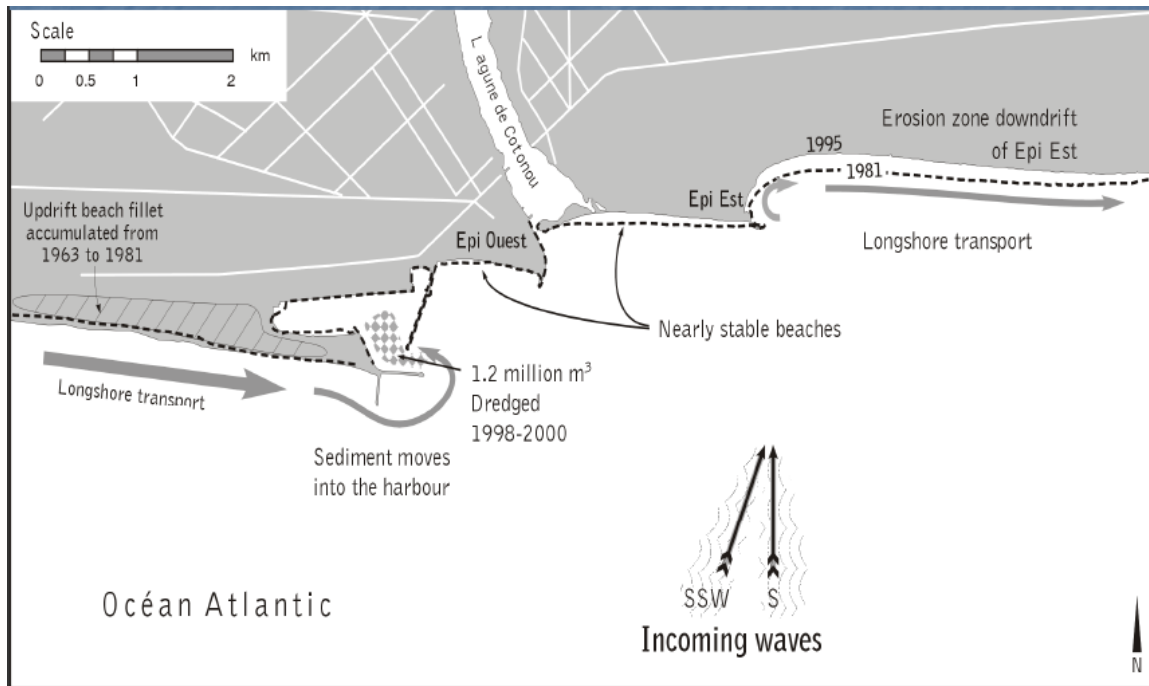


Figure 6 : Bed load movements and sea currents in the Cotonou and lagoon outlet vicinities.

The present study aims at furthering the knowledge of the current and future impact of climate change on vulnerable social groups (women, youth etc...) and the lagoon living resources in order to document the final project proposal for the Adaptation Fund. To this end, it will specifically:

- ✓ identify climatic risks observed in the lagoon environment;
- ✓ identify social groups (men, women, youth, etc..) and living resources are most exposed to climatic risks;
- ✓ assess the current and future vulnerability patterns and livelihoods to climatic risks;
- ✓ evaluate adaptation measures already taken and their effectiveness;
- ✓ propose potential adaptation options along with their conditions of success;
- ✓ specify the project purpose and clarify the relationship between the five deliverables of the project.

1. Methodological approach

The knowledge of the current and future impact of climate change on vulnerable social groups and living resources of Cotonou lagoon requires three phases of intervention: (1) literature review and preparation for the field mission (2) organization of meetings / exchange workshops and information collection and (3) the analysis of results and elaboration of the study report.

1.1.Literature review and preparation for the field mission

During this phase, the following activities are conducted:

- Analysis of available literature on the coastal area and lagoons subject matter, vulnerability/adaptation patterns and livelihoods to climate change, and the system of systematic observation and research on climate change;

- Develop an interview guide based on the literature review and the terms of reference of the study. The interview guide and the terms of reference are appended to this report.
- Preparation of the field mission stage which consists of establishing contact with the Cotonou Municipal authorities and the four Town sections bordering Cotonou lagoon, on purpose planning dates for organizing exchange meetings with local populations and resource persons. There are three categories of stakeholders affected by the lagoon system and the climate change drawbacks. There are:
 - a) Local populations representing economic and social interests:
 - the private sector (fishing, small and large-sized businesses, tourist and crafts promotion companies, as well as other private business operators);
 - civil society organizations, community organizations, traditional and religious leaders;
 - national public and municipal services established in the lagoon environment;
 - b) Local councillors (mayor, councillors, heads of Town section) representing the interests of the local politico-administrative communities;
 - c) The central services of the Ministry of Environment, Housing and Town Planning and other departments, representing the government's vision.

Material aspects of the field step mission (displacement of local populations, local councillors, central government representatives) were negotiated and covered by the Directorate General of National Environment Fund.

1.2. Organization of consultation meetings

Meetings are jointly chaired by the local councillors and representatives of the Ministry of Environment, Housing and Town Planning.

The approach used is free interactive exchanges, both on the perception of climate change and the resulting risks to the natural resources and socio-economic activities, on the adaptive strategies developed by the stakeholders, on potential adaptation options and conflicts arising from the protective administrative measures taken in some segments of the lagoon shores.

During the meetings, properly said discussions are preceded by an introductory statement presented by the lead consultant in the local language to ensure the understanding of the message by all participants. Through the presentation, he recalls the objectives of the project of Cotonou lagoon shores adaptation to climate change, the results expected by the Ministry of Environment, the Cotonou Municipality and all the stakeholders from this exercise, as well as the process which culminated with the development of the project identification sheet and its adoption by Board of Directors of the Adaptation Fund.

After the introduction, the representatives of stakeholders are invited to appreciate the organizational approach, and then share with the delegation of senior technical consultants and their views on various issues of the survey guide and other subject matters of their concerns.

This approach was used to assess the perception and the level of the local community understanding of climate change and its drawbacks, reach a large consensus on the major concerns of stakeholders, and to have the necessary information and data for conducting analysis works.

The participants' attendance list in the consultation meetings is on Schedule 1.

1.3. Analysis of results and preparation of the evaluation report

1.3.1. Conceptual basis for vulnerability analysis

For analysis purposes, two concepts of vulnerability are considered in this study: the socio-economic vulnerability and the climate change vulnerability.

In a poverty analysis approach, Turner and his collaborators (2003) defined vulnerability as the «aggregate measure of human welfare that integrates environmental, social, economic and political exposure to a range of negative phenomena». Technical literature on disasters uses the same term to translate the «degree of loss (from 0 to 100%) resulting from a potentially damaging phenomenon» (glossary of the United Nations Office for the Coordination of Humanitarian Affairs - UNOCHA).

These definitions underlying the concept of social risk, that is to say, groups whose opportunities of access to resources needed for a decent and sustainable existence is limited, either because resources are not available in their environment, or because they do not have the means to access them.

In terms of climate change, the Intergovernmental Panel on Climate Change (IPCC) recommends a definition of vulnerability almost exclusively related to climate change: «the level at which a system is likely to, or is unable to address the adverse effects of climate change, including climate variability and extreme weather events». Vulnerability is a function of the nature, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity» (Adger et al., 2004, Downing et al., 2002 and 2004). As a matter of fact, climate change contributes, at the populations and resources level, from which they draw their livelihood, to worsening the already fragile livelihoods through socio-economic constraints.

This vulnerability study essentially aims at assessing the sustainable livelihoods vulnerability and that of the way of living, in terms of socio-economic constraints and climate change adverse effects. Livelihood is sustainable when it enables social groups to cope with stress and shocks, maintain or enhance present and future capabilities and assets, without jeopardizing the natural resources availability for the generations yet unborn.

The collected information and data analysis, after discussions with the stakeholders, should primarily enable to answer three questions: Who is vulnerable? To what? To which extent?

Based on the level of relevance of the answers to these questions, the analysis would culminate with the appreciation of the merits of endogenous adaptation strategies and options considered in the short term.

1.3.2. Technical analysis approaches

It will actually establish:

- the list of modes of existence,
- the list of sustainable livelihoods,
- the levels of socio-economic vulnerability of livelihoods,
- the list of climatic risks
- indicators of the populations resources exposure to climatic risks
- indicators of the impact of climate risk on sustainable livelihoods;
- the range of endogenous adaptation measures
- adaptation needs expressed by the stakeholders,
- the level of the populations' commitment to the implementation of potential adaptation options.

Analysis tools developed by the Intergovernmental Panel on Climate Change (IPCC) and those adapted by the Least Developed Countries' Expert Group (LEG) are exploited for this purpose. Especially:

- **In terms of socio-economic vulnerability**, the sustainable livelihoods analysis is based on the method of spider web vulnerability curve proposed by the *Least Developed Countries Experts' Group* (LEG / UNFCCC 2004). This method uses the relationship between socio-economic vulnerability and the population difficulty to access to resources needed for meeting their basic needs: the level of socio-economic vulnerability is determined by the social groups' difficulty of access to the basic resources they need.

Reference resources are the five basic types of resources that characterize livelihoods, namely:

1. natural resources (land, water, biodiversity, fish, prawn, etc.).
2. human resources (skilled labour, seasonal labour, etc.).
3. physical infrastructure (roads, markets, health centres, schools, homes, etc.).
4. financial resources (lagoon fishing, sea fishing, micro-finance organizations, etc.).
5. social networks and relationships (participation in community organizations economic, social, etc.).

The weighting grid used to translate the social groups' easy access to basic resources is as follows:

- 100 for the social groups' unlimited access to abundantly available resources, compared with their needs;
- 75 for unlimited access to averagely available resources or an average access to resources available in abundance compared to the social groups' needs;
- 50 for a restricted access to resources available in abundance, or an average access to averagely available resources or unlimited access to inadequately available resources compared with the social groups' needs;
- 25 for an average access to averagely available resources, or a restricted access to averagely available resources, compared with the social groups' needs.

In terms of vulnerability to climate change, the technique of the sensitivity matrix was used to determine exposure indicators and impact indicators (LEG / UNFCCC, 2004).

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The assessment scale of the extent of climatic risks is as indicated in Table N° 1.

Table 1 : Climate risk assessment scale

Scale of importance	Range of risk
1	Low
2	Quite low

3	Fair
4	Quite Strong
5	Strong

1.3.3. Elaboration of the study report

An interim report of the study was submitted to the National Environment Fund. Based on the observations and amendments received, the interim report has been converted into a final report to be used for the elaboration of the entire project document of Cotonou lagoon shores adaptation to climate change.

2. Current climate and the impacts observed in the lagoon environment

2.1. Current climate of the lagoon environment

Pursuant to the IPCC recommendations, the current climate analysis should be only based on the baseline reference period (1971-2000) data. Those recommendations have been made in order to ensure the comparability of the national papers data being submitted to the United Nations Framework Convention on Climate Change (UNFCCC) relevant authorities. But in order to better understand some aspects of the climate this study rather covered a longer period: 1951 - 2010 for rainfall and 1961-2010 for other parameters. The period 1971-2000 remained the baseline reference period for the future projections.

The objective is to present the main features of the current climate in Cotonou, based on available data and information at the National Meteorological Service and some evaluation or study reports.

The situation is evaluated through the following rubrics:

- Rainfall patterns and their spatio-temporal variability;
- Temperatures patterns and spatio-temporal variations;
- Climatic risks and impacts observed.

2.1.1. Rainfall patterns and their spatio-temporal variability

The average rainfall pattern characterizing the period 1951-2010 in Cotonou is bimodal with two maxima (Fig. 2): June for the main rainy season (354.6 mm) and October for the short rainy season (147.6 mm).

The analysis of the rainfall inter-annual variability observed during the same period reveals alternating with short deficit periods with few years of surplus (Fig. 3).

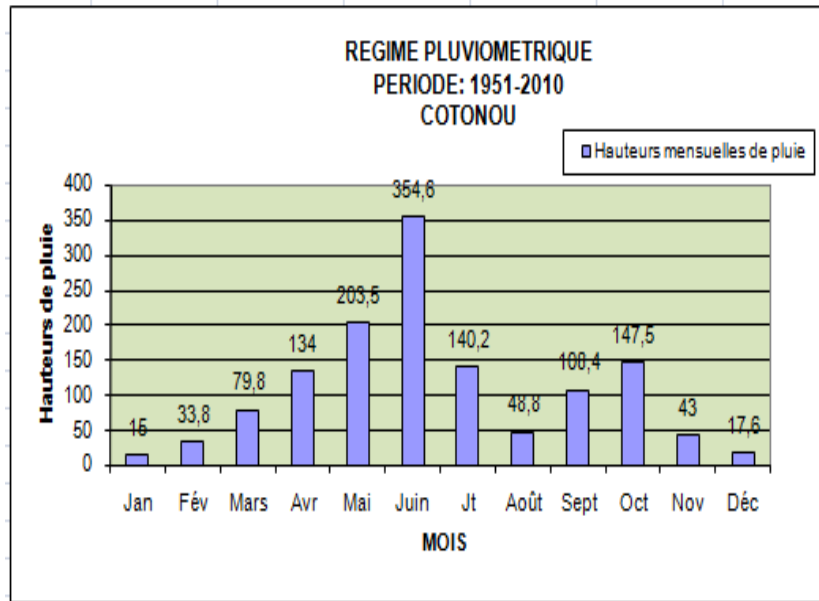


Figure 7 : Cotonou rainfall from 1951 to 2010.
Data source : SMN (2010)

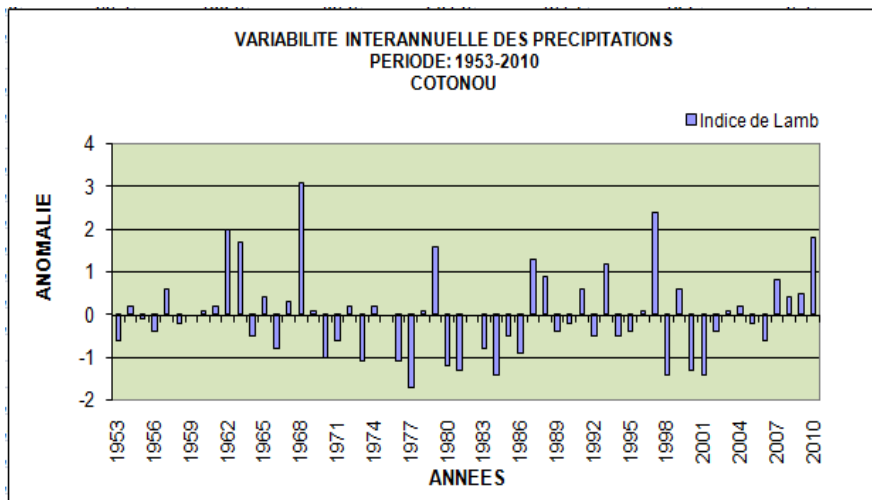


Figure 8 : Cotonou Inter-annual variability of precipitations from 1951 to 2010.

Data source : SMN (2010)

- high concentration of rainfall over a short period, causing disruption to most human activities;
- a sudden interruption in the middle of the rainy season;
- during some years, there is no clear demarcation between the two rainy seasons, that results in floods increases.

If on an annual basis, the current climate analysis does not reflect significant trends in precipitations changes, on the other hand the seasonal analysis shows large differences during the period prior to 1971. Over one-month delays were observed for the start of the useful rains, which disrupted the schedules of shoreline agricultural activities.

The largest deficits were observed almost between 1977 and 1983 (drought years), while the highest rainfall surpluses are between 1968 and 1997 (flood year). At the seasonal scale, the situation is characterized by some abnormalities, resulting in particular in:

The analysis of *the inter-annual variability in the number of rainy days* during the period 1951 - 2009 shows a general downward trend in the annual number of rainy days since the 50s, with shifting of the positive differences into negative differences between 1970 and 1975 and return to the period of average rainfall from 2005. (Fig.4).

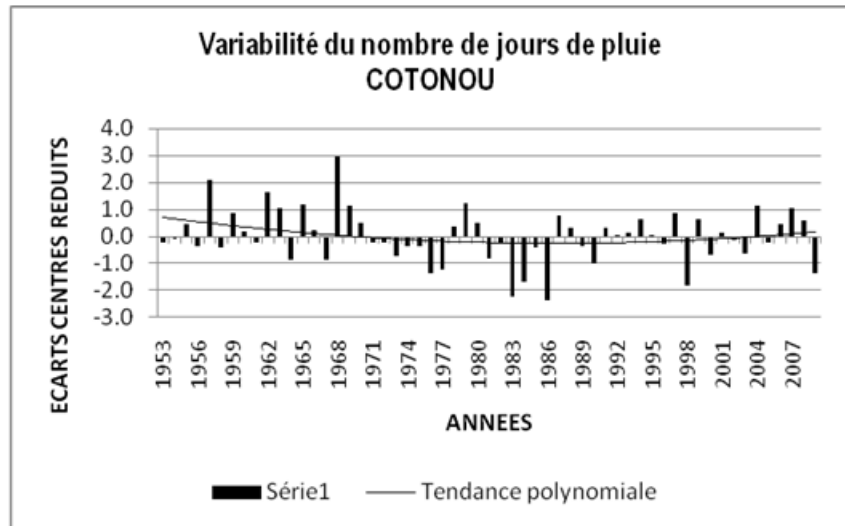


Figure 9: Inter-annual variability in the number of rainy days in Cotonou 1951-2010
Data Source: SMN (2010)

Ultimately, the average annual number of rainy days in the baseline reference period 1971-2000 is in the average characteristic of the period 1951 - 2010 in the coastal area and in all the regions of Benin

2.1.2. Temperatures patterns and spatio-temporal variations

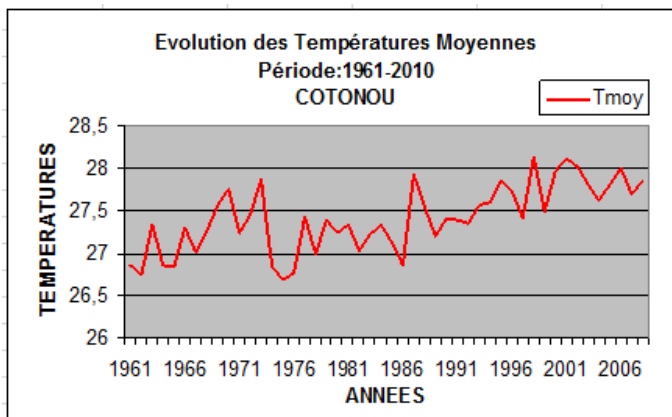


Figure 10: Evolution of the average temperature in Cotonou from 1961 to 2010.
Data source: SMN (2010)

The evolution of the average temperatures in Cotonou from 1961 to 2010 shows a general upward trend (Fig. 5). Deviations from the normal average temperatures recorded each year during the same period are substantially in the range of -0.6 to +0.8 °C and enables to earmark an upward trend until the end of the decade 1970-1980 (Fig. 6).

The average minimum temperatures also showed a significant increase (in the range of +0.5 to 1 °C) in the course of the last decade, especially from 2003.

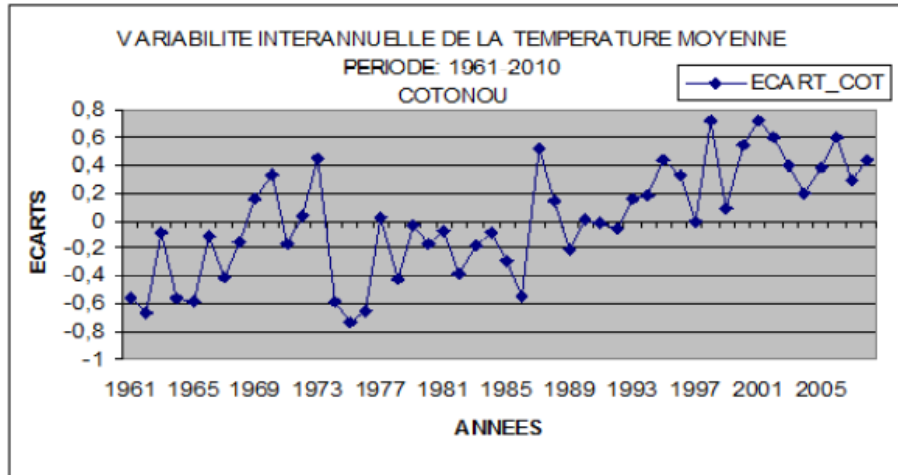


Figure 11 : *Inter-annual variability of the average temperatures in Cotonou from 1961 to 2010.*

Data source: SMN (2010)

2.2. Climatic and oceanographic risks, exposure units

2.2.1. Oceanographic and climatic risks

The climatic and oceanographic risks observed on Benin coast were identified during the works for the elaboration of the National Climate-proofing Action Plan and the Second National Paper on Climate Change (MEPN, 2005; MEHU, 2011).

In the Cotonou lagoon environment, the largest risk by its scope, its frequency and its impact on flood risk (Table 2). This is followed by heavy rains, fierce winds, sea-level rise and the sea surface temperature rise.

The most exposed services, resources and social groups to climate and oceanographic risks (exposure indicator greater than or equal to 70%) are (i) the ecological resources of the Atlantic Ocean and Nokoué Lake, (ii) the shore stabilization, (iii) the fishery resources harvesters (fish and prawn) and (iv) the fish resources operators (fishermen and fishmongers). The least exposed resources to climatic risks are the lagoon sand and tourism. The less exposed stakeholders are lagoon mined sand operators, traders, hotels and restaurants managers, craftsmen and tourists.

Floods resulting from rains, Ouémé River and Nokoué Lake floods and sea-level rise, proved to be the extreme weather events that significantly affect the livelihoods in the Cotonou lagoon environment. They are followed by fierce winds.

A flood is an invasion or submersion of a well-demarcated territory by the waters (Frécaut, 1983 Donou 2007). It occurs when waters excess cannot be drained off by natural or artificial channels meant for that purpose.

Table 2: *Matrix of the Cotonou lagoon environment sensitivity to climatic and oceanographic risks (coastal segment 1136).*

	Climatic and oceanographic risks					Exposure indicators
	Floods	Pelting rains	Fierce winds	Rise of the Sea Surface	Sea-level rise	

				Temperature		
Services rendered by the ecosystems						
Ecological equilibrium Ocean/Nokoué Lake	5	3	2	4	4	72
Shores stabilization	5	4	4	2	4	76
Water Supply	5	3	3	2	3	64
Transport	4	3	5	2	2	64
Shallow	5	3	2	2	4	64
Livelihoods						
Fish	5	2	3	3	3	64
Prawns	5	2	3	3	3	64
Lagoon sand	4	2	3	1	3	52
Hotel Industry, Craft Industry and Trade	4	3	4	1	3	60
Tourism	4	3	3	1	3	56
Livelihoods						
Fishermen	5	4	4	2	4	76
Fishermen and Fishmongers	5	4	4	2	3	72
Sea sand operators	4	4	3	2	2	60
Craftsmen	4	3	2	2	2	52
Traders	4	3	3	3	1	56
Hotels and Restaurants operators	4	3	2	2	3	56
Tourists	4	3	2	1	3	52
Impact Indicators (%)	86	69	57	40	51	

In fact, coastal area rains are characterized by very large volumes of water over a shorter period. Water heights observed after a rainy period sometimes correspond to monthly averages (Dasylya, 2009). The rain intensity is due to specific meteorological phenomena. The most pelting rains are squall lines, according to the World Meteorological Organization (WMO, 2006). Oriented north-south, squall lines occur under the form of very bright cloud masses, over a distance of 500-750 km, and can cover over 200,000 km². They are accompanied by fierce winds (from 15 to 30 m/s in a few minutes), an increasing pressure, a dropping temperature (from 1 to 10 °C) and eventually, a heavy and abundant rain (10 to 30 minutes) (Diarra, nd; WMO, 2006).

The rainfall intensity is a major factor in the magnitude of floods. But another natural parameter influences the magnitude of the rainfall consequences: soil typology and morphology. If there are several consecutive days of incessant rains or if the rainfall is very intense, the soil absorption capacity is exceeded: after saturation will water remains at the surface and runoff (Dasylya, 2009). The less the water infiltrates and the faster it drips, and solid materials transported over-dig the ground and will stagnate and accumulate sand in the shallows and marshy areas (LACEEDE, 2010).

The speed of runoff release increases the risk of flooding. This is all the more remarkable in urban areas, where buildings and roads cause soil sealing, and indeed, a greater risk of flood.

Cotonou lagoon is therefore part of the waterfront area affected by highest flood risk in Benin (fig.7).

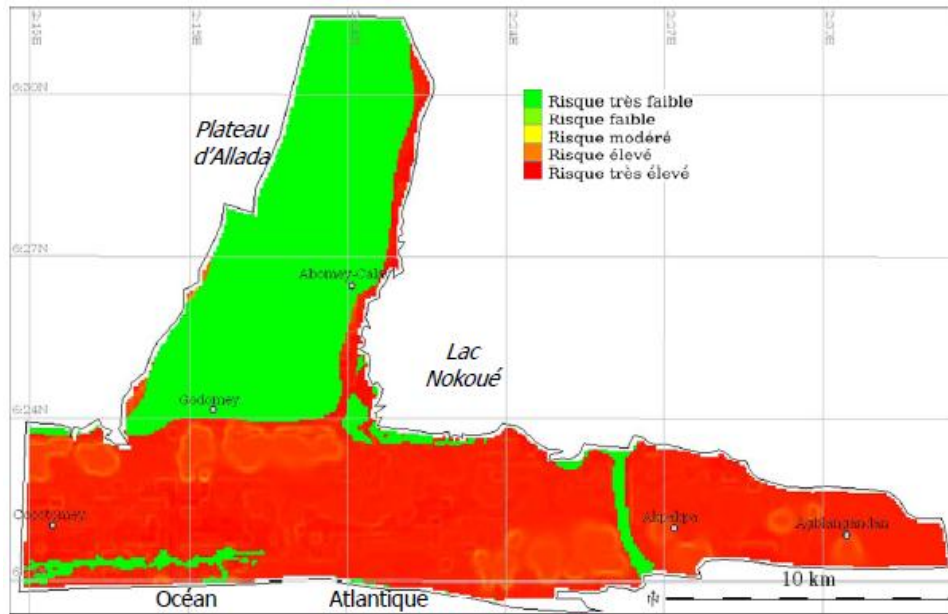


Figure 12 : Degree of flood risk in Cotonou lagoon environment.
Source : CREDEL NGO (2010).

In the lagoon environment, there are several types of wind: regional flows related to pressure fields and local winds. The prevailing winds on the Cotonou coast by their frequency have two directions:

- SW (64%): the monthly distribution shows very strong frequencies in February, March, April, May, June, October and November;
- WSW (16.07%): the highest frequencies are centred on July, August and September with an average speed of 6 m/s.

The winds are responsible, on Lake Nokoué and Cotonou lagoon, for the waves, causing usually an asymmetry between shores. Mud flats are always located in the south and south-west of Lake Nokoué, while on the north-eastern shores, hit by the waves, tends to be accumulated by sand.

In general, the wind is a very important factor of the environment by its strength and direction. It is responsible for the transport of droplets of salty water (spray). These sea sprays corrode heavily the iron roofs, doors and windows, houses walls, reducing thereby their use duration.

2.2.2. Climate impacts

The floods and winds impacts observed during the last twenty years in the area of Cotonou are the disruption of socio-economic activities, under the form of temporary closure of health centres, schools or businesses after floods occurrence. It is also the loss of biodiversity in the form of loss of animal and plant species that could not survive the extreme meteorological and hydrological phenomena or migrate to more favourable lands. Table 3 presents some impacts directly observed in the immediate environment of Cotonou lagoon.

Table 3 –Some climate impacts.

Events/	Date of	City/ Region	Impacts
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phenomenon	occurrence		
Major flood	14-jul-91	COTONOU	2 victims by electrocution
Heavy rain	14-june-03	COTONOU	Taxiways flooded preventing the free movement
Storms* with fierce winds and rain	8- may -01	SO-AVA	Two boats were Capsized on the Nokoué Lake with casualties
Heavy rain	2003	COTONOU	Taxiways flooded preventing the free movement
Rain and floods	16-sep-04	COTONOU and its surroundings	Secondary taxiways blocked by puddles
Storms* with fierce winds and rain	23-may-05	COTONOU	Uprooting trees, some houses roofs uncapping and flooding in several neighbourhoods
Storm squall lines **	11-june-05	COTONOU	Uprooting trees, some houses roofs uncapping
Rain-storm disturbance of squall lines type	21-may-07	COTONOU	Many damage: among others, trees uprooted, roofs blown away and loss of life
Floods	2010	55 Communes out of 77. All the coastal Communes	46 deaths directly caused by coastal flooding as at October 25, 2010. 680,000 people affected.

Source: National Meteorological Service, UAC and MEPN

* Sudden discharge of atmospheric electricity manifested in brief, intense light (lightning) and a sharp or dull rumble (thunder). These storms are often accompanied by precipitations in the form of rain (Source: International Meteorological Vocabulary. WM /WMO - N° 182).

** Atmospheric phenomenon characterized by a sharp and very important increase of the wind speed for a period of the order of a few minutes and diminishes rather quickly. It is often accompanied by showers or thunderstorms (Source: International Meteorological Vocabulary. WM /WMO - N° 182).

2.2.3. Environmental and economic impacts

Floods and heavy rains have negative as well as positive implications on the main economic activities like fishing, industry, trade and transport.

In the fisheries field, it is noted a decrease in fish production due to waters rising. The reasons given by the fishermen are salinity decline causing fish migration to brackish environments more conducive to their reproduction and development and deep water makes operations more difficult and less profitable. Fifty-six percent (56%) of the population surveyed reported that during flooding period fishing income hardly exceeds 1500 FCFA per person and per day while in the dry season, revenues reached 7000 FCFA per person and per day.

In the housing field, most homes are affected by excessive rains and the flood in times of flooding. According to direct observations made on the field, houses are constructed in the floodplain or wetland areas, in violation of housing standards. In the case of destruction of houses, people are forced to migrate to the dry land into youth centres, schools, shelters etc.. with a crucial lack of survival material and financial means. The houses vulnerability is enhanced by the traditional pattern of constructions made in makeshift materials which cannot resist flood waters. Even houses built with concrete materials undergo the scope of flooding

because the distance in height between the floor of the room and the roof does not reach two meters.

Also, another phenomenon generally observed with the water withdrawal is the damage of houses from the base which results in increased erosion and degradation of their foundations. In addition, another very important aspect in the rainy season is the spread of diseases affecting populations' health.

In the health field, most people consulted complained about pain related to flood waters. The best known in the lagoon environment are malaria, diarrhoea and other gastrointestinal diseases.

► **Malaria**

According to Gentilini (1993), malaria is a disease caused by a *Plasmodium* parasite that parasitizes the haematites transmitted by the female Anopheles mosquito. In Africa, the most common and rampant species is *Plasmodium falciparum* the larva of which grows in lentic water (WHO, 1997). Its incubation can last about 12 days and its lifespan is less than one year. Its development and survival in the environment are influenced by climatic factors such as temperature, humidity and precipitation (Tchoumavi, 2006). Generally, malaria occurs in three phases:

- the incubation phase that occurs in the subject by fatigue, cephalgia or headaches and nausea;
- the invasion phase, which begins with a high continuous fever, with vivid headache, muscle and joint pains, nausea followed by vomiting, epigastric cramps, or diarrhoea;
- Cerebral malaria that demonstrates the severity of malaria and which is caused by *Plasmodium falciparum*. This is a very advanced stage where hepatomegaly appears (liver volume increases) and neurological disorders varied up to coma and even acute renal failure leading to death (Akon, 1998).

Malaria is the major cause of mortality among the under four children (MS, 2009).

► **Diarrhoea**

Apart from malaria, diarrhoea is ranges among the commonest diseases during floods.

According to WHO/AFRO 2006, diarrhoea was defined as the evacuation of at least three loose or watery stools in 24 hours. It is caused by a germ (protozoa, viruses, bacteria) spread by faecal-oral route, including ingestion of fresh water or food contaminated with faeces or by direct contact with infected faeces (WHO, 1993) .

The survival and development of the pathogen in the environment depends on weather conditions (Tchoumavi, 2006). These diseases parasites occur especially in hot and humid regions because their larval development in the soil occurs between 20 and 30 ° C (AFEP, 1998). Generally, these diseases manifest themselves after the waters receded because the populations who lack drinking water use stagnant water, wells or even often polluted lake for domestic purposes. According to the (Ministry of Health, 2010), more than 5,000 people have contracted the disease in 2009 in the investigated Town sections.

► **Gastrointestinal Diseases**

Amoebiasis is a parasitic disease caused by a protozoan called *Entamoeba Histolyca*. The disease is manifested by abdominal pain and dysentery involving bloody stools. According to

the surveyed populations, this disease can cripple the sick and even cause psychological problems.

The analysis of Figure 8 shows that malaria, diarrhoea and gastrointestinal diseases are the most recurrent in the urban area. During exceptional flood situation, the diseases magnitude can double or triple because most people do not use mosquito nets.

In the field of drinking water, floods are sources of major problems. Indeed, the water used is contaminated. Wells are not protected and are heavily polluted. Some wells are installed closed to the toilet and in the swamps. Despite the access to the SONEB drinking water distribution network by the population, water is often contaminated during transport to the houses which also are in dirty waters (Fig. 9). All that fosters the growth of pathogens.

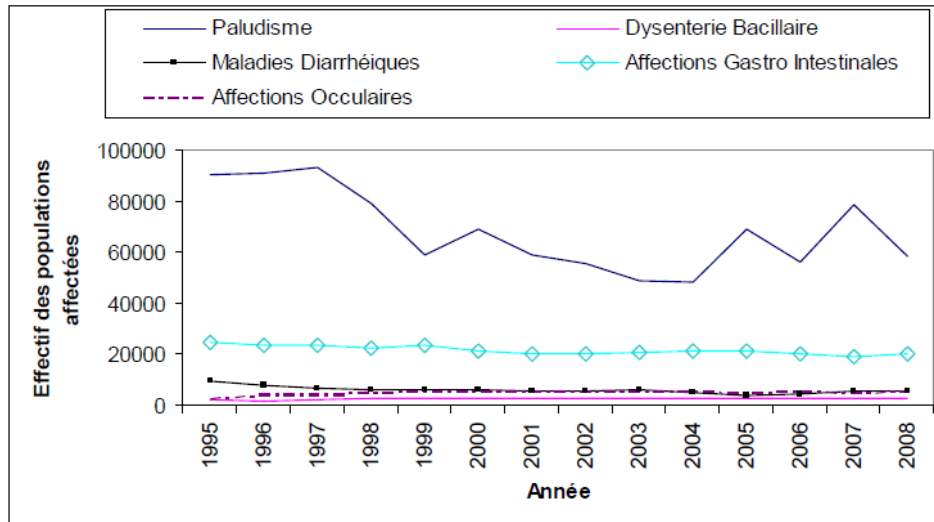


Figure 13 : *Main waterborne diseases of urban Municipalities of Cotonou coastal areas segments*
Source: MS (2009)

3. Current vulnerability of social groups and living resources

The main units of exposure to climatic risks are:

- **in terms of services provided by ecosystems**

- The ecological resources of the Atlantic Ocean and Nokoué Lake
- Shores stabilization
- Water supply
- Lagoon waterway transport
- Shallows

- **in terms of livelihoods**

- Fish
- Prawn
- Lagoon
- Hotel industry, craft industry and trade
- Tourism

- **in terms of lifestyles**

- Fishermen
- Fishmongers

- Lagoon mined sand operators
- Craftsmen
- Traders
- Hotels and restaurants operators
- Tourists

3.1.Social groups

The most exposed economic agents to climatic risks are fishermen and fishmongers. It should be noted that the lagoon mined sand operators, traders, hotels, bars and restaurants managers affected to a lesser extent, however, suffer great losses due to the alienation of their customers. They prefer to go to other service providers, even long after discovering the risk. Floods usually hinder freedom of movement and entail the temporary cessation of activities in schools, health centres and other public facilities. Exposed social groups are more numerous than those of the lagoon environment (fig.9).



Figure 14 : Recurrent floods scenes in Cotonou

Among social groups, there are groups to which particular attention should be paid because of their sensitivity to the impacts of climatic risks: women and children groups.

Indeed, as noted by the IPCC in 2001, «*the effects of climate change will be distributed among different regions, generations, age, social class, income, and gender activities.* » The IPCC also stated that the climate change impacts will disproportionately affect the least developed countries and the poor in all countries, exacerbating imbalances regarding health, access to food, drinking water and other resources.

Gender refers to the different roles and socially-constructed opportunities associated with being a man or a woman and interactions and social relations between men and women. The concept of gender determines what is expected, what is allowed and appreciated in a woman or a man in a given context.

The fairness of the status of both genders implies the possibility of differentiated treatments to correct initial imbalances, measures that are not always equal, but that lead to equality in terms of rights, benefits, obligations and opportunities. These inequalities are rooted in the development models that have guided the construction of our societies. The social assessment of people by their biological characteristics has led to inequitable distribution of resources and opportunities for accessing them, giving way to an injustice in terms of participation in development benefits sharing.

In the delineation of roles within the company, the women group is always put together with the children and adolescents because of their permanent assistance needs.

It is increasingly clear that climate change is increasing the burden of the disease. According to the World Health Organization in 2000, climate change was the cause of about 2.4 per cent of cases of diarrhoea worldwide and 6 percent of malaria cases in some countries with intermediary income – of the diseases that affect a disproportionate number of young children in developing countries.

If adults and young people are subject to the same risk of floods for instance, it is obvious that unclean waters affect more children and adolescents due to their greater sensitivity and greater relatively-exposed body surface (Fig. mmm).

According to the latest population and housing census (INSAE, 2003), the population of the Town sections bordering the Cotonou lagoon vicinity amounted to 87,262 Inhabitants including 46,939 women and 42,266 men, raising the women rate 54%. The population is divided into 21,608 households. It is women who dominate the active workforces involved in the project. They are in all the active economic sectors, thereby the most affected by this project.

Indeed, the most interested socioeconomic groups in this project are the direct beneficiaries of the project or those who are directly affected (positively or negatively) by the project. These individuals, community-based organizations, and local councillors who will benefit from the:

- structures installed by the project;
- economic and health benefits derived from the shores development;
- capacity building for the grassroots stakeholders on issues of vulnerability and adaptation patterns and livelihoods to climate change.

Specifically, different social groups can be mentioned:

- Fishermen,
- Fishmongers (sales of processed or not fishery resources),
- Lagoon mined sand operators
- Restaurants managers
- Tourism facilities owner: hotels, clubs, games room,
- Dyers,
- Non-governmental organizations
- Associations of youth, women, physically-challenged persons, various economic stakeholders.

Secondary stakeholders are those who influence the development or are indirectly affected. These include the government, the ministry, the municipality of Cotonou, project staff, implementing agencies, SOGEMA, NGOs involved in the sector, private sector companies, shores and other development agencies.

The benefits of this project are fundamentally to improve the populations' living conditions and shores protection. Infrastructure development will facilitate the organization of economic, tourist and leisure activities. The lagoon sanitation improves the status of the water physicochemical parameters and promotes the living resources: prawn and fish species reproduction, migration of aquatic species from the marine to fresh waters. It will also promote the health of local residents and all fishery products consumers are also beneficiaries of the project as they consume healthy products without the risk of poisoning the lake with microbiological products and heavy metals.

In addition, consumers of fishery products are also beneficiaries of this project insofar as, they consume healthy products without running the risk of microbiological and chemical poisoning.

Companies such as CRUSTAMER that harvest and process prawns and that have stopped the exports of these products could resume their business activities. Women and women's groups that take substantial resources as stakeholders in the prawn industry could easily increase their income.

Women are particularly active in the fish and prawns wholesale and other areas of trade. They are still those bearing the burden of housework and take care of the household members.

Women and children are also the poorest layers in the poor households of the Cotonou lagoon waterfront community

Actually, based on the housing conditions, in 2002, 61,000 households have been identified as poor and very poor (out of 154,346 households living in Cotonou). Very poor households are estimated at 30,874 (RGPH3). Spatial distribution of poverty at Town section level enables to better highlight the Town sections that host the majority of the poorest households. It is therefore based on this proportion of very poor households (households described according to the profile 1). Using this threshold distinguishes between the poor and rich households. Table 4 shows the classification of the Town sections according to the proportion of poorest households living in those Town sections.

Table 4 : Extreme poverty per Town section

Town section	Number of rich households	Number of poor households	Poor and rich households	Town sections weight in poor households
3	10,247	3,121	13,368	31.2
4	5,892	3,046	8,938	30.5
5	6,741	1,021	7,762	10.2
6	13,832	2,805	16,637	28.1
Total	36,712	9,993	46705	100

Source: Calculated from RGPH3data

According to this table, Town sections 3, 4 and 6 are the poorest and have priority for interventions to improve the of households' living conditions. These are households who live in houses or isolated huts or poorly organized in space, with no tracks, making movement of people and goods difficult, familial property whose floor and wall are made of clay and the roof with materials precarious. They cater for drinking water mainly in the lagoon or in the fountains. In terms of comfort housing, the houses of these households do not have toilets.

Kerosene is the main means of lighting, and firewood is the cooking energy. In these households, used water and waste disposed of in an environment unfriendly way. The household head is illiterate. Clearly, the capital goods do not almost exist in poorer households. The areas riparian of the 5th Town section are part and parcel to this description. The fire risk is very high with the use of kerosene in the thatched huts of the neighbours. The use of firewood indicates a high level of poverty and pressure on natural resources. The tap water is not available. Some residents do ease themselves in the channel. Children are not enrolled in schools due to lack of socio-educational infrastructure and lack of interest of parents who are themselves illiterate. In addition to climatic risks, fire hazards complicate the depiction due to human practices. The epidemics risk is very high with the lack of toilets and drinking dirty water. Promiscuity reinforces the risk of fire outbreak and epidemics. The lack or inadequacy of health facilities and socio-educational infrastructure darken the poverty table.

Ultimately, the socio-demographic indicators show that children are schooled because householders are also illiterate and non-educated. In such condition, women and girls outnumbering men and boys in the neighbourhoods cannot be educated. As a result, they do not perceive the usefulness of antenatal consultations in the adjacent neighbourhoods and most give birth at home, increasing the rate of maternal and infant mortality, with the risk of reducing their life expectancy.

Women in modest conditions are assigned the hard works of fetching drinking water, cleaning, buying firewood and preparing meals in the houses constructed with thatched roofs (fire hazard). The use of Kerosene as the sole source of energy for lighting exacerbates their poverty, leaving them in a state of extreme poverty, instilling this cliché to their future generations. Their extreme poverty dramatically increases their vulnerability to the climatic risks. Particular attention should therefore be given to them and their children both boys and girls.

3.2. Living resources

The abundance and diversity of West African lagoons fish fauna vary seasonally but also in connection with the entry of sea water in the lagoons.

According to the fish classification proposed by Albaret (1994), the fish species discovered in Nokoué Lake system - Cotonou lagoon are:

- Coastal marine euryhaline species that are seasonal or accidental in the lagoons (*Elops lacerta*, *Cynoglossus senegalensis*, *Citharichthys stampflii*, *Eucinostomus melanopterus*, *Lutjanus goreensis*),
- Estuarine species of marine origin (*Ethmalosa fimbriata*),
- Estuarine species of continental origin (*Chrysichthys nigrodigitatus*, *Chrysichthys auratus*, *Hemichromis fasciatus*)
- The freshwater species that appear only when the salinity tends to 0 (*Clarias gariepinus*, *Synodontis schall*, *Schilbe intermedius*).

Under zoobenthos, dominant groups are molluscs and crustaceans. The main shellfish are *Corbula trigona*, *Anadala senilis*, *Crassostrea gasar*, and *Pachymelania Tempanotonus* sp. sp. (Maslin, 1986; Maslin and Bouvet, 1986). Crustaceans are essentially *Goniopsys cruentata*, *Cardiosoma amatum* and *clibernhardius africanus* (Burgis and Symoens, 1987), some of which are harnessed by local residents. These are decapods (*Penaeus duorarum* and *Macrobrachium* sp.) and crabs of *Callinectes* kind (*C. amnicola* et *C. pallidus*).

The Cotonou lagoon and Nokoué Lake water quality is being degraded compared to the needs of the fish fauna. The water salinity regularly reaches 37 ‰, exceeding the salinity of

seawater (35 ‰), especially during the dry season, however conducive for fishing activities. The standard salinity (25-28 ‰) is observed from May to June (long rains). The dissolved oxygen is inappropriate for the development of some fish species: 0.5-0.8 mg/L against the needs 10 times higher (5-9 mg/L).

Temperature is a very important factor in water quality. It is involved in the metabolism of the fish and contributes to the different functions of digestion, growth and reproduction. A rise in temperature resulting in global warming affects the availability of dissolved oxygen.

Global warming and the increase in water temperature which is the living environment of fish species, contribute to the reduction of dissolved oxygen content. This action results in a redistribution of species, it being understood that the availability of oxygen will be seriously affected. In addition, it should be noted that, there could be a break and in the best cases a simple redistribution of the food chain; this situation increases the vulnerability of an already fragile ecosystem because of current biophysical and socio-economic forces.

These disturbances of fish resources habitat lead especially to:

- A changing ecological lagoon lakeside biodiversity;
- a loss or alteration of spawning areas of the lagoon and Nokoué Lake;
- changes in the food web and a decrease in fish growth;
- reducing the stock of fish available and the loss of biodiversity (extinction of species);
- decline of fishery outputs.

The loss of biodiversity is already a reality observed in the lagoon environment (Table 5)

Table 5: Evolvement of the specific lagoon ecosystem richness between 1950 and 2001

		1950-1961*	1990-1991**	1997***	2001****
Number of Families		43	36	33	33
Number of Species		87	78	67	50

* Gras (1961)

** Lalèyè (2000)

*** Lalèyè *et al.* (1997)

**** Niyonkuru (2001)

Such a development would be socioeconomically disastrous for the lakeside environment. The decline in the Nokoué Lake ecosystem productivity will greatly jeopardize and disturb the lives of thousands of people earning their livelihood from fishery resources.

In short, climate change is an additional threat to the survival of fish populations: warmer waters mean less food, less duplication and less oxygen for freshwater species. These climate changes will increase the pressure on fishery resources already weakened by overfishing, pollution and habitat destruction.

By and large, the physical and chemical conditions offered to most of the living resources harnessed by fishermen in the lagoon system (fish and prawns) are increasingly uncondusive, jeopardizing the development of these resources (fig.kkk). It is the water temperature increase that could be directly attributed to global warming. There is also an increase in water salinity and water pH due to the increasing intrusion of seawater into the lagoon and because of the waves' movements and sea-level rise. Eventually, there is the reduction of the water depth by the gradual filling of the lagoon as a result of the transfer of sand and sediments reinforced by

anthropogenic solid waste disposal. Transfer of marine sediments is provided by the ebbs and flows induced by sea-level rise.

Table 6 : Summary of biophysical and ecological characteristics of some species of the lagoon system

Species	Accepted Temperature (°C)	Water Temperature	Accepted Salinity (‰)	Water Salinity (‰)	Accepted pH	Water pH	Accepted depth (m)	Current lake average depth	Observations
<i>Chrysichthys nigrodigitatus</i> (Lacépède, 1803)	24 to 31.6	27.2 to 29.5	0 to 30	0 to 35	0 to 4.14	6.75 to 7.40	2.5 to 6	0.27 to 2.5 m	Quite unfavourable conditions
<i>Chromidotilapia guntheri</i> (Sauvage, 1882)	24 to 28	26 to 33.4	0 to 20	0 to 0.53	5.52 to 6	7.11 to 7.73	>3	0.27 to 2.5 m	Quite unfavourable conditions
<i>Eleotris senegalensis</i> (Steindachner, 1870)	23 to 31	26 to 33.4		0 to 0.53		7.11 to 7.73	0.9 to 2.50	0.27 to 2.5 m	Favourables Conditions
<i>Elops senegalensis</i> (Regan, 1909)	23 to 30.2	26 to 33.4	50 to 100	0 to 0.53	5.52	7.11 to 7.73	0.76 to 3	0.27 to 2.5 m	Unfavourable conditions
<i>Ethmalosa fimbriata</i> (Bowdich, 1825)	24 to 29.5	26 to 33.4	0 to 100	0 to 0.53		7.11 to 7.73	1.5 to 2.5	0.27 to 2.5 m	Still favourable Conditions
<i>Hemichromis fasciatus</i> (Peters, 1852)	34.5	26 to 33.4	0 to 30	0 to 0.53		7.11 to 7.73	0.9 to 2.50	0.27 to 2.5 m	Still favourable Conditions
<i>Liza falcipinnis</i> (Valenciennes, 1836)	20 to 26	26 to 33.4	0 to 20	0 to 0.53	0 to 4.14	7.11 to 7.73		0.27 to 2.5 m	Quite unfavourable conditions
<i>Tilapia guineensis</i> (Bleeker in Günther, 1862)	22 to 28	26 to 33.4	0.015 to 30	0 to 0.53	5 to 11	7.11 to 7.73	0.85 to 2.74	0.27 to 2.5 m	Unfavourable conditions

4. Potential patterns and livelihoods vulnerability to climatic risks

4.1. Climate scenarios

It is about describing in a coherent and plausible way the future state of the climate in the lagoon environment.

Among the reference scenarios proposed by the Intergovernmental Panel on Climate Change (GIEC / IPCC) for such studies, and integrated into the version 5.3 of the software MAGICC / SCENGEN (Wigley, 2008), A1B and B1 scenarios are used in Benin for the last ten years in the work by IMPETUS project (or *integrated approach to the efficient management of scarce water resources in West Africa*) in the Northwest of Benin. They are adopted in this study in order to plan at global level, and at different temporal moments, some key climatic parameters involved in the study of vulnerability/adaptation.

The IPCC A1B and B1 scenarios describe the future climatic conditions by 2100, based on assumptions of economic, energy and environmental issues. Both scenarios admit the assumption of the globalization of economy, an assumption already being verified by the process of globalization of economy, adopted by the international community since the last century. The first scenario has a more economical target than the second which is more focused on the environmental preoccupations. The A1B scenario assumes an equilibrium friendly international technological development between energy sources while the B1 scenario targets energy sustainability.

The medium variants A1B-AIM and B1-AIM integrated to the software MAGICC 5.3 are the versions of the scenarios A1B and B1 of IPCC used to plan the main global climatic elements and different future moments.

Time horizons 2015, 2025, 2050 and 2100 were selected to integrate the socio-economic and ecological climate change.

Local data are derived from the global "*downscaling*" technique from output results of MAGICC and 1971-2000 climate normal temperature and rainfall. SCENGEN is used for spatio-temporal representations of climate change by grid point (resolution 2.5 ° of latitude and 2.5 ° of longitude) using the results of the experiences of Atmospheric Ocean General Circulation Model (AOGCM) available in the software. The average climate sensitivity was set at 3°C, as indicated in the Working Group I of the IPCC (Solomon et al., 2007), and the average turbulent exchange coefficient k , taken equal to 2.3 cm²/s.

The first simulation operation results and experiment in Benin and the West African sub-region on the global and regional models enabled to choose four (4) Models out of twenty (20) proposed by MAGICC / SCENGEN. Those are: CGCM3.1(T47), MRI-CGCM2.3.2, UKMO-HadCM3, UKMO-HadGEM1 (see technical manual MAGICC / SCENGEN 5.3 version 2, 2008). The output of the software is an average value of four models of the grid cells, as recommended by the software designers (Santer and al., 1990; Giorgi and Mearns, 2002; Tebaldi et al., 2004). The limits of the grid cells covering the region of Cotonou 5°N - 7,5°N and 0° - 2,5°E.

4.1.1. Precipitation Scenario

In the study area, there could be by 2100 an almost invariable annual rainfall, variations observed every five years hardly exceeding 0.2%. A downward trend characterizes the beginning of the period 2000 to 2100.

Table 7. Annual precipitation deficiencies projected from 2000 to 2100 on the Cotonou coast (grid cells: 5 ° N-7, 5 ° N and 0 ° - 2.5 ° E).

Years	1971-2000	2005	2010	2015	2020	2025	2030	2035	2040
Variations		-0.06	-0.36	-0.62	-0.88	0.82	0.49	3.62	3.97
Precipitations	980	979	976	974	971	972	985	1,015	1,019

At the monthly scale, greater variations are observed in the precipitations for the months of March and April which marked the first passage of the Inter Tropical Front and the beginning of the first rainy season in the region. They would result in a decrease in rainfall of up to 21% in April 2100 in the south (Fig. 10). The differences between the rainfall in March and April will increase until 2025, goading the rural populations to locating the inception of agricultural activities more in April or May.

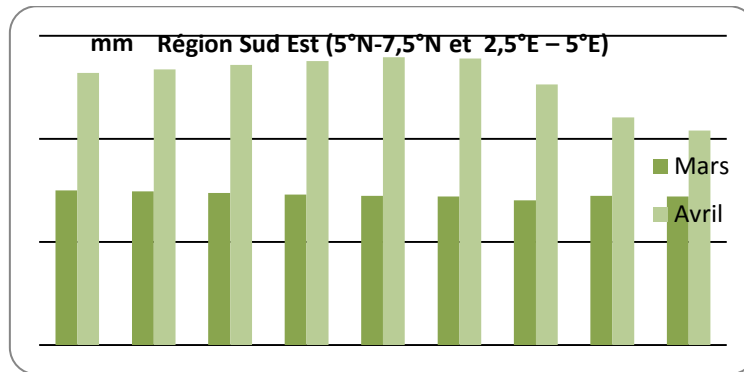


Figure 15 : *Projection of monthly precipitations in March and April for South and Central Regions, from 2000 to 2100*

4.1.2. Temperature scenario and consequences

According to the projections, temperatures are increasing in all regions of Benin (Table 8). By 2100, the highest heat increase could reach 3.27° C in the North-West of the country, compared to the baseline reference period 1971 to 2100. The lowest value increase would be 2.6° C. It characterizes the South - West in which Cotonou lagoon system is located.

Table 8 - Projected changes in annual average temperatures from 2000 to 2100 on the Cotonou coast (grid cell: 5° N - 7,5°N and 0 ° - 2.5° E)

Years	2000	2005	2010	2015	2020	2025	2030	2035	2040
Variations (°C)		0,21	0,29	0,39	0,5	0,63	1,55	2,24	2,77
Temperature	27,4	27,61	27,69	27,79	27,9	28,03	28,95	29,64	30,17

One could expect an implicit increase in the water deficit and evapotranspiration potential (PET).

4.1.3. Scenarios of sea-level rise

High, Medium and Low variants of the IPCC' A1B and B1 scenarios integrated to DIVA 1.5 software are used to evaluate future changes in sea-level on Benin coast. According to the projections, the sea-level would rise continuously during the period 2000 - 2100 (fig.11). In all variants of the B1 scenario, sea-level rises remained below the A1B scenario variants. This confirms the interest of ecological approaches to socio-economic development compared to those motivated almost exclusively by economic interests.

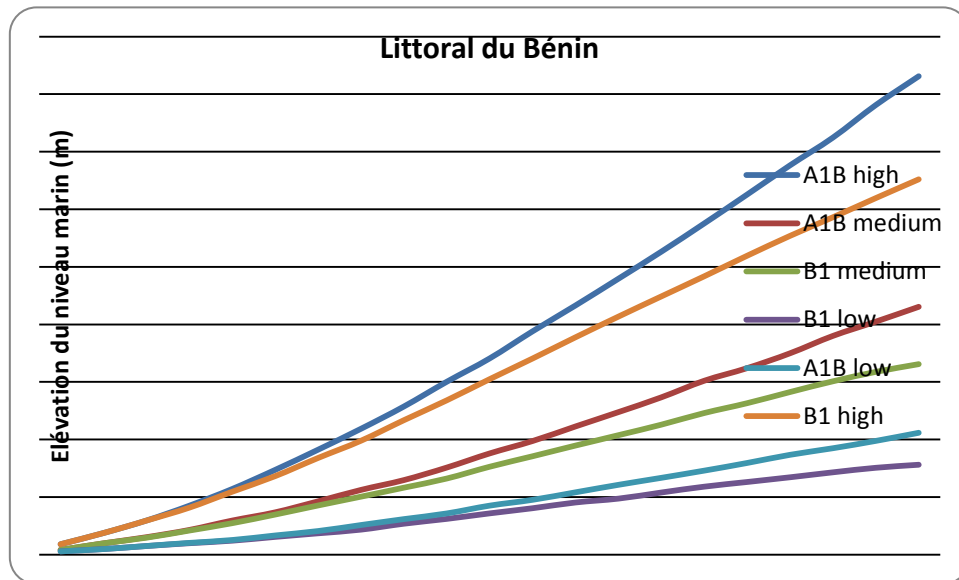


Figure 16: Evolution of the sea-level rises on the coast of Benin until 2100

4.2. Socio-economic and demographic scenarios

Following a lengthy participatory process, Benin in August 2000 defined the possible future in the «National Study of Long-Term Outlook - BENIN-2025 Alafia» (ENPLT) based on the national major trends and driving forces, environmental socio-economic and energy specificities. Excluding disaster scenarios incompatible with the inertia and natural quest of real systems balance, these guidelines for future development proved to be considered in both A1B and B1 scenarios published by the Intergovernmental Panel on Climate Change in its Third Assessment Report (IPCC, 2001) and presented in the above-mentioned Section 2.2. In terms of demographic scenarios, data published by the National Institute of Statistics and Economic Analysis (INSAE), and demographic indicators enable to admit that

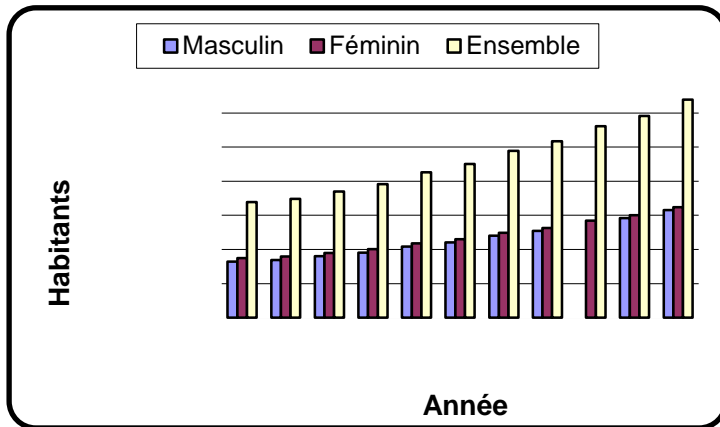


Figure 17 : *Benin Population trends as at 2025*

Source : DED/INSAE (2003)

Benin population identified in 2002 was to 6,769,914 Inhabitants, will increase to 9,790,516 inhabitants in 2015 (MDG target year) and 12,794,155 in 2025 (end of the ENPLT scenarios) (fig.12). Brought to the lagoon system level, the socio-economic and demographic data are translated as in the Figure 12:

4.3. The lagoon system vulnerability potential and adaptation measures

In Benin shoreline, the evaluation of the sensitivity to major climatic and oceanographic risks is achieved by means of the sensitivity matrix proposed by the Least Developed Countries Experts Group (LEG / UNFCCC, 2004). The major climatic and oceanographic risks identified along the coast are: floods, fierce winds, sea temperature rise and sea-level rise.

Among the coastal segments, those most exposed to climate and oceanographic risks (fig.13):

- The coastal area of the Municipality of Grand-Popo (segment 1132),
- The coastal area of the Municipality of Ouidah (segment 1133 and 1134),
- The coastal area straddling the Cotonou and Abomey-Calavi towns of (segment 1136),
- The Cotonou - Donatin-Tokplégbé Eastern area (segment 1137),
- The coastal area of the Seme-Kpodji Municipality (segment 1138).

The Cotonou lagoon system is between the coastal segments 1136 and 1137. Cotonou lagoon leads to segment 1136.

The existing literature, discussions with technical services in charge of the coastal area and DIVA 1.5 model of the DINAS-COAST Consortium (2004) are used for sector-based analysis, the assessment of its current and future vulnerability, and evaluation of adaptation strategies.

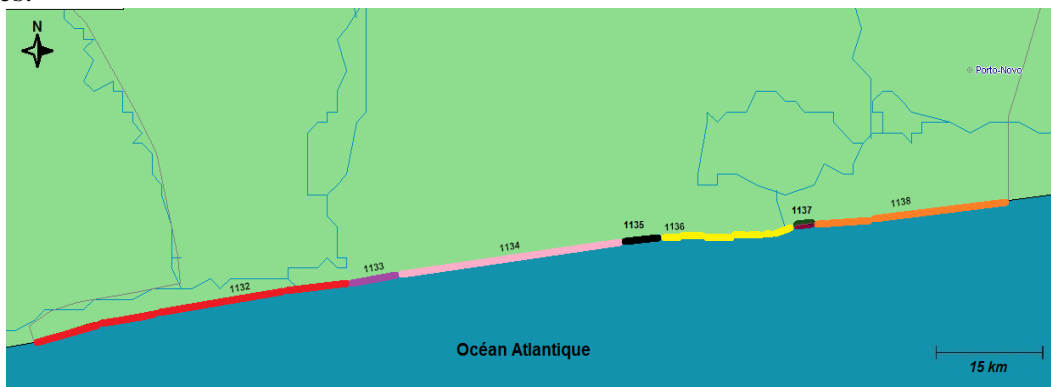


Figure 18 : *Coastal segments of Benin coast (Cotonou Lagoon leads to segment 1136)*

Source: Consortium DINAS-COAST (2004)

4.3.1. Potential Impacts

Alongside Benin coast, sea-level rise and the losses or gains of land (surface and volume) either by erosion or coast nourishment are of special concerns to populations and policy makers. Based on the future scenarios of the coastal area (climatic and non-climatic scenarios) and referring to the situation observed from 1971 to 2000 using DIVA model to evaluate by 2025, 2050 and 2100 the impacts of climate change. It should be noted that by 2100, a large gap between the sea-level rise forecast under A1B *High* scenario (0.81 m) and the forecast under B1*Low* scenario (0.15 m). The reality would probably be between these two results (Table 9).

Table 9 : *Sea-level rise in Cotonou as at 2100 (m)*

Scenarios	Variants	Sea-level rise (m)
A1B	High	0.813
	Medium	0.422
	Low	0.206
B1	High	0.634
	Medium	0.323
	Low	0.151

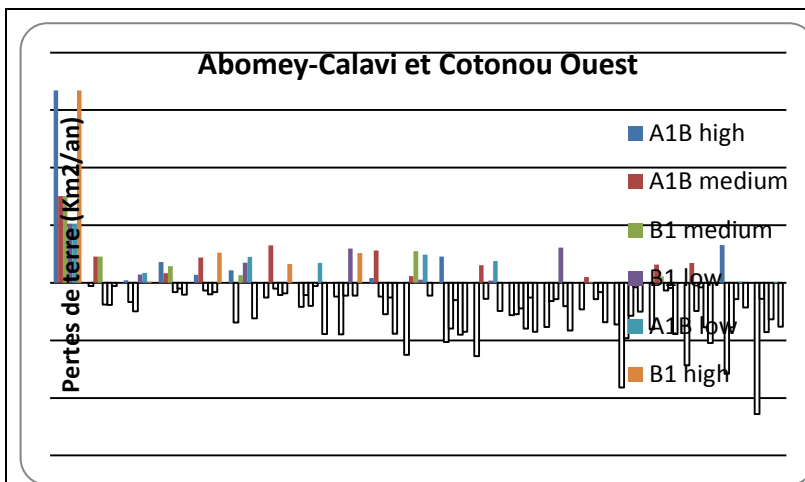


Figure 19 : *Evolution of lost land surface on the coastal segment Abomey - West Cotonou as at 2100.*

At the land loss level, the first decade of the 21st century is already marked on Benin coast by huge land losses due to coastal erosion: several acres on the shores of East Cotonou and Seme Municipality. Long-term forecast of land loss suggest a slowdown in the regime of land loss, with a clear tendency of nourishment from the 2050s (fig.14 and 15).

If in all likelihood the natural dynamics of the coastal system leads to the coastal erosion reduction, it is more likely that the population pressure and growing needs of sea sand for house construction and other socio-economic infrastructure purposes accelerate the opening scheme of sand quarries on the coast.

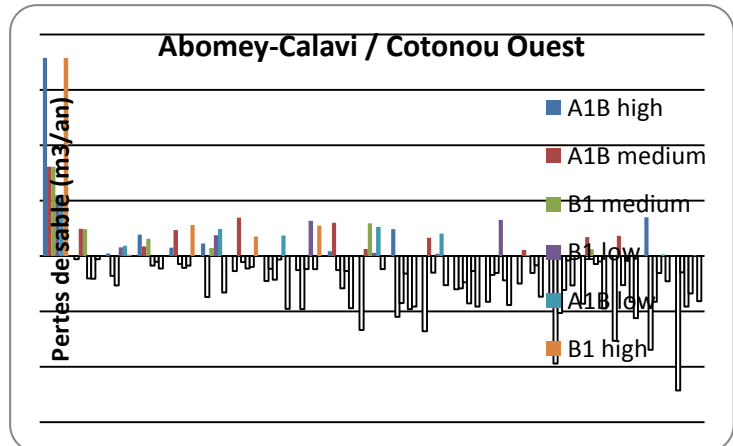


Figure 20 : *Evolvement of the land loss volume on Abomey - Cotonou West coastal segment as at 2100*

However, a strict enforcement of the regulations prohibiting the mining of marine sand quarries limit the extent of the phenomenon (Order N°. 2008-615 of 22 October 2008 on the

prohibition of sand collection along the beaches and in the channel area between its mouthpiece and the old bridge Cotonou).

Projected into the space occupied by socio-economic infrastructure over the coming decades, the loss of land surface constitutes a serious concern to populations, especially those living in the Cotonou coastal area. (fig.16).

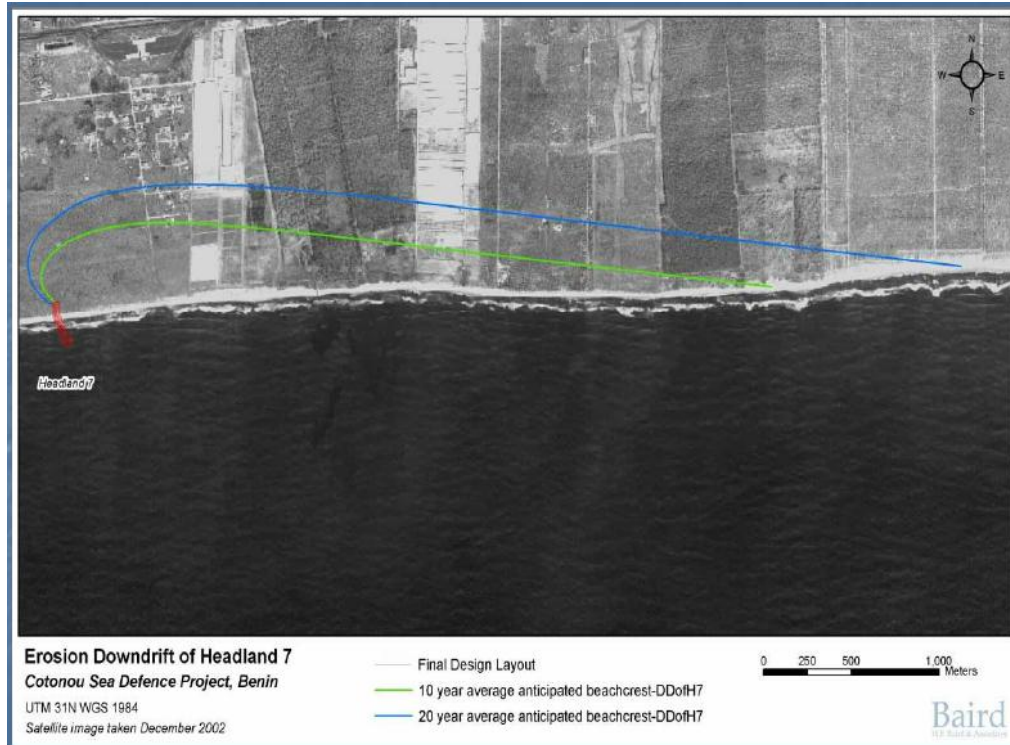


Figure 21 : *Loss of land surface projected in the Eastern Siafato Breakwater until 2022 if nothing is done.*

4.3.2. Adaptation measures already taken in the lagoon system and proposed adaptation strategies

Measures implemented by the stakeholders can be grouped into three adaptation options:

- Protection of structures and activities against sea-level rise;
- Flood Management;
- Aquaculture facilities.

a) *Protection Option*

Protection measures are taken in the context of development projects in the coastal area, the national Coast Management Policy and Anti-coastal and Lagoon shores erosion measures. Those are measures initiated since the Port of Cotonou construction, which consisted in erecting breakwaters and rock fill dams installed in the lagoon environment (Fig.17).

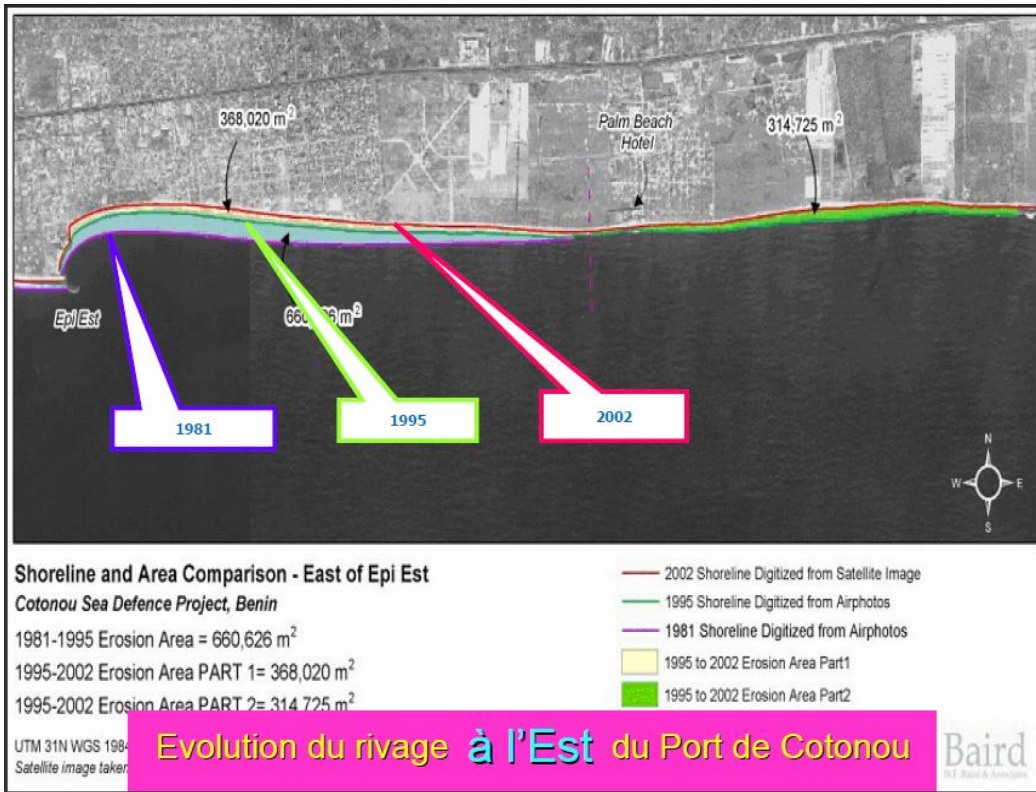


Figure 23 : Coastal erosion regime in the Eastern part of the Port from 1981 to 2002

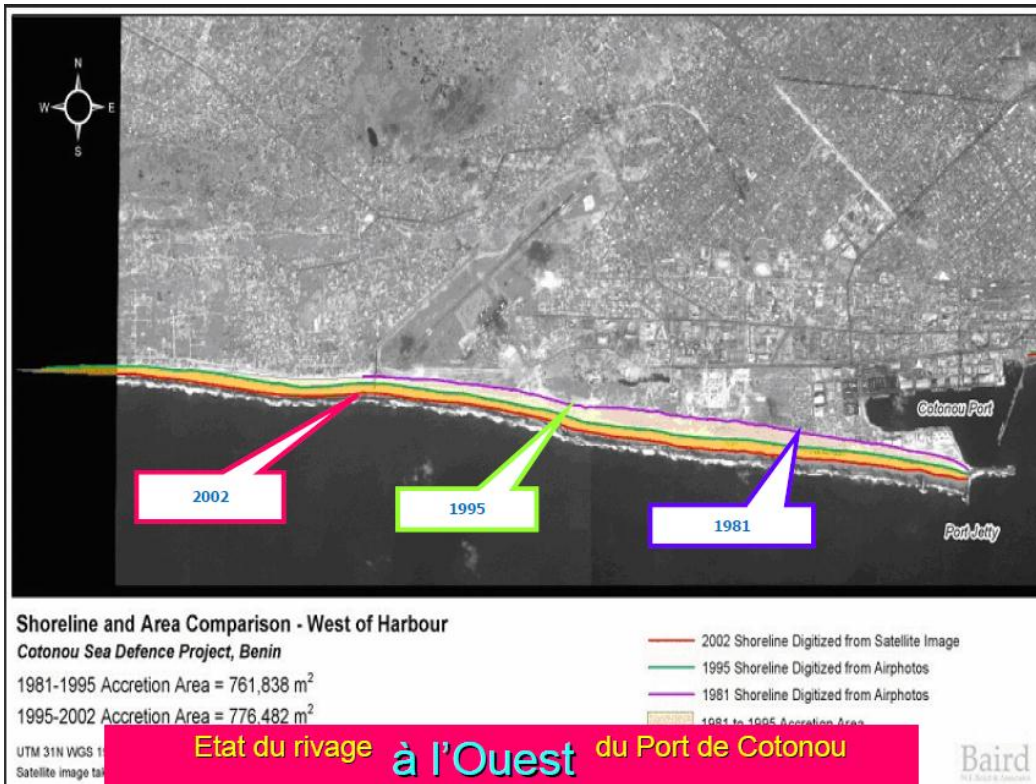


Figure 24 : Coastal nourishment regime in the Western part of the Port from 1981 to 2002

Why a dam on the Cotonou lagoon?

With the construction of the port of Cotonou in 1962, the sandy transit stopped, causing the deepening of the Cotonou channel which, since then, constantly was interconnected with the sea. The immediate consequence was the sudden and unusual rise of the lagoon salinity, reducing the duration of the freshwater stage, the impoverishment of the environment especially the phytoplankton (Leité and al., 2004). This has also led to the decline in the lagoon complex fish production from about 4,000 metric tons between 1960 and 1964, periods during which fish production reached 10,000 metric tons (Welcomme, 1971). Confronted with the environmental problems caused by the construction of the port, Benin authorities decided to build a dam on the Cotonou channel with a view to restoring the lake's ecological equilibrium. The dam is equipped with slide gates meant for regulating the ocean waters penetration into the lake but it has become an agent of an unexpected increase sandy pit which created a permanent shoestring sand offshore since 1978, blocking the functioning of the slide gates and completely closing the channel (Baglo, 1981). Since then, the artificial cut made by fishermen help ensure the water flow between the ocean and the lagoon.

Therefore, the Cotonou dam had never really played a role in regulating the water flow between the ocean and the lake. With a very high height, an undesirable sandy pit and difficult slides gates and to operate, the dam was almost constantly clogged by water-born sediments (fig.20). The persistence of coastal erosion in the Eastern part of the Port, especially beyond the Siafato East Breakwater (fig.21) and adverse effects on the socio-economic infrastructure, led national authorities to initiate a large -scale project of 7 additional Breakwater sites currently under construction.



Figure 25 : *Slides gates Dam at the mouth Cotonou channel*

These new breakwaters should now protect the socio-economic infrastructure up to 11 km on Cotonou East Coast (fig.22).

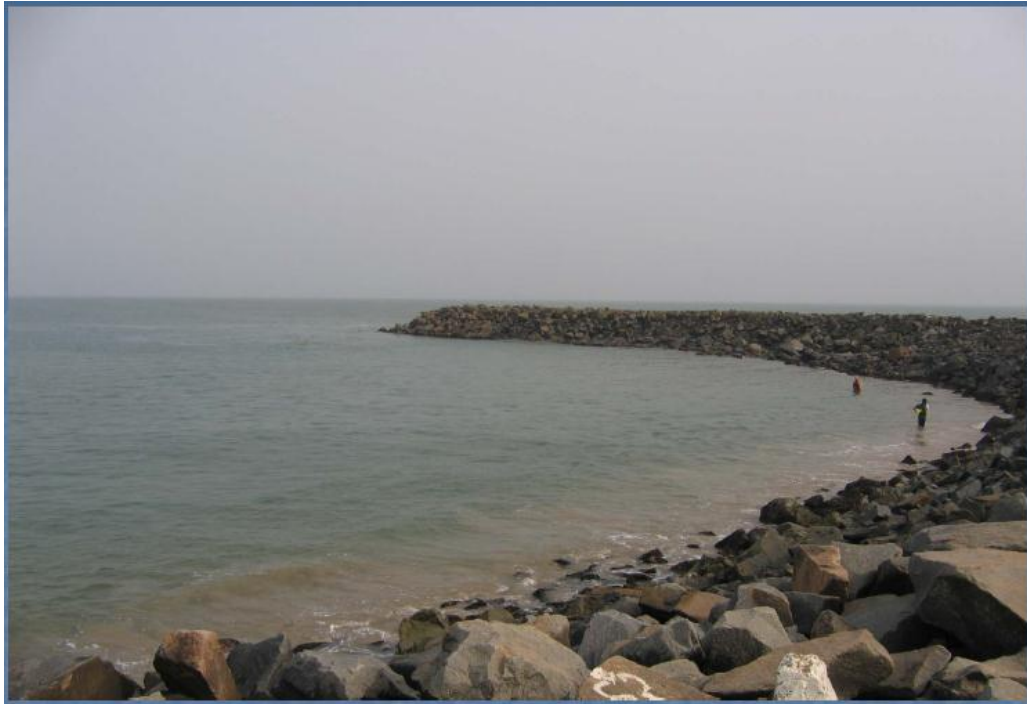


Figure 26: Siafato Breakwater or Eastern Breakwater (partial view)

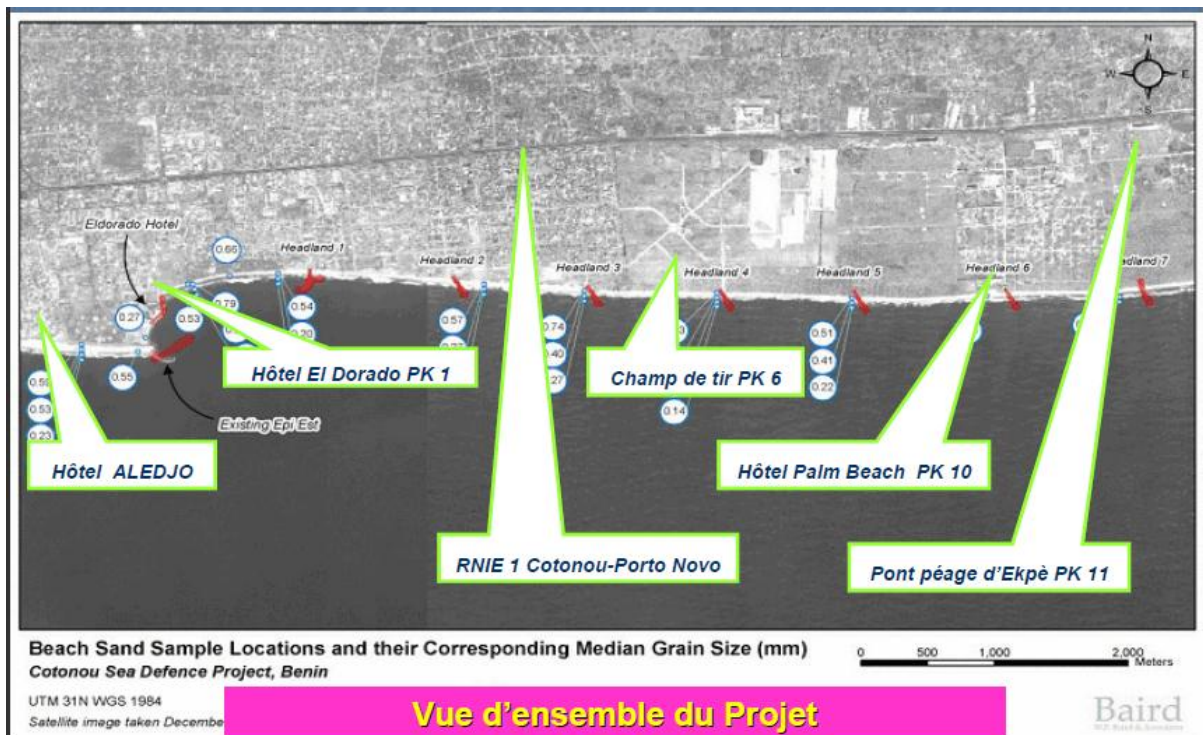


Figure 27 : Sites earmarked for the construction of seven new breakwaters at the Eastern part of the Siafato Breakwater

Questioned on the relevance and adequacy of coast protection measures offered by the project of 7 new Breakwater during the consultation meetings, the populations riparian of the lagoon mouthpiece think that these options only postpone the coastal erosion problem on the Eastern segments.

The lagoon shores protection and stabilization is an option that prior requires sanitation works. The he Biological Oxygen Demand (BOD) per year due to solid wastes volume directly disposed of into the lagoon and/or in the sea is estimated at over 1,200 metric tons, and 397 000 m³ the volume of used water disposed of into the lagoon per year, 217 tonnes of BOD₅ (MEHU, 2000; Directorate of Fisheries, 2004). The shores' occupation state does not generally enable physical interventions without hurting the interests of the poor (fig.23).

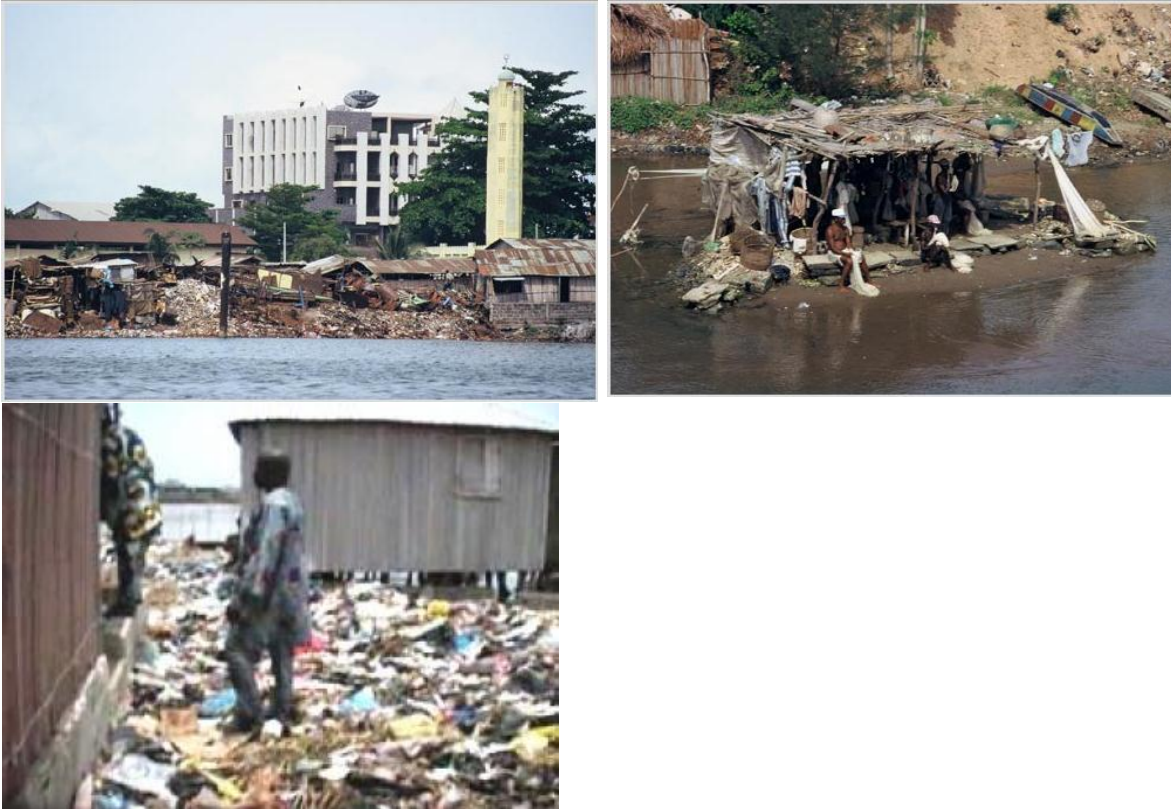


Figure 28 : *Waste dumps and squatters on the shores of Cotonou lagoon (SYFIA and Fraternity photos)*

Consultation meetings with stakeholders were conducted in order to find out the protection options (slopes nourishments, opening and paving pedestrian paths onshore, regeneration of the vegetation). It is also considered that adapted options to suit the situation of businessmen whose plots are already extended over the water be negotiated with them in the best interest of all the parties (fig.24).



Overview

Partial view

Figure 29 : «Hotel du Lac» on Cotonou lagoon

The installations that may be erected on the shores (embarkation/disembarkation space to promote adaptation strategies to climate change, etc...) were also discussed with stakeholders.

a) Flood Management Option

Flood management includes preventive and reactive measures.

Among the *preventive measures*, the first activity proposed by the riparian populations of the Cotonou lagoon is the rock-fill cofferdam of the lagoon. These populations had spontaneously taken the initiative to clip the dam in order to mitigate and cushion the water height in case of flood from Ouémé River and Nokoué Lake. This measure should be formalized by levelling the watershed originally planned for 0.635m deep in water and by putting back into service the sea-lagoon exchange control system in order to avoid clogging at the lagoon mouth.

It will also be about continuing the campaigns that the Municipality of Cotonou organizes periodically to adopt measures in order to minimize the floods impact (systematic gutters cleaning, drainage runoff, family health protection and property). Municipal authorities intervene directly in the following activities performed in the areas:

- ✓ tracks and paved roads development before the rainy season;
- ✓ roads resurfacing to improve traffic conditions;
- ✓ gutters cleaning;
- ✓ trenches digging;
- ✓ etc..

The reactive measures include urgent activities conducted after the rains and flooding in the event of:

- draining of flooded areas;
- trenches digging;
- pumping water from flooded health centres, schools and homes (fig. 25);
- systematic assistance to the victims.

Depending on the extent of the damage, the local Authorities initiatives can be supported by those of the Directorate of Prevention and Civil Protection (DPPC) of the Ministry of the Interior and Public Security. DPPC reactive actions are aimed to rescue the affected populations from any risk or danger. Fast Civil Relief Organization Plan (ORSEC) can be applied if circumstances require. In this context, the Department of Prevention and Civil Protection shall:



Figure 30 : Water pumping scene in a house

- assess the flood magnitude and the damage;
- identify foreseeable diseases outbreak that can occur as a result of flood;
- define predisposing flood factors;
- evacuate disaster victims to healthier facilities for their isolation and effective treatment;
- Informing people about the dangers of the disease and especially the complications and the need to effectively treat diseases.

In view of the magnitude and recurrence of floods in Cotonou town, the municipal authorities have implemented since 2003 a specific program called "Cotonou Town Conducting a Campaign to Combat Flood" (3CI). This is an emergency programme initiated by the Cotonou to relieve flood victims. The objectives of this programme among other things are to:

- Facilitate access of flooded populations to public places (schools, public services, social and community infrastructure etc.).
- Assist populations in the most catastrophic cases including Fire Fighters Department and all the stakeholders that can be involved;
- Have an appropriate response time as short as possible for interventions.

The programme has three (3) intervention phases, namely:

- the preventive phase in which operations are carried out (i) flushing of the channels, (ii) charging and resurfacing clay tracks, (iii) opening of the trenches and (iv) rehabilitate resurfaced tracks.
- the implementation phase during which operations are (i) maintenance of trenches (ii) pumping rainwater and (ii) drainage of flooded sites.
- Postoperative phase after the rainy season during which operations are carried out (i) track maintenance and (ii) resurfacing degraded tracks.

For the implementation of the programme, an intervention framework and organization is set up for flood management. In this regard, Cotonou town is divided into five (05) Zones; each with a Command Post (CP), which coordinates the interventions in each area. The Town sections are divided into zones as follows:

- ✓ Zone 1: 1st and 2nd Town sections;
- ✓ Zone 2: 3rd and 4th Town sections;

- ✓ Zone 3: 5th, 6th, 7th and 8th Town sections;
- ✓ Zone 4: 9th, 10th Town sections;
- ✓ Zone 5: 11th, 12th and 13th Town sections.

And the Town sections bordering the lagoon (Town sections 3, 4, 5 and 6) directly involved in the project to adapt the Cotonou lagoon to climate change are covered by the Command Post of Zones 2 and 3. The Heads of these Town sections therefore have a role to play in the management system.

In addition, interventions are provided in partnership with the social workers and the national patrol of fire fighters who are solicited according to the importance of flooded people. A diagram of the various stakeholders involved in the floods is even developed by the Cotonou town.

By and large, the consultation meetings came up with the resolutions to (fig.26):

- protect by 4.5 km linear riprap sectors sandy lagoon shores;
- develop 3 km of paved tracks for pedestrians alongside the shore with an average of 15 meters width, including structures for the collection and disposal of runoff, rest areas and waste collection systems for the users;
- build 11 embarkation/disembarkation points along the pedestrian path;
- build 11 shelters for promoting the culture of adaptation to climate change near the embarkation/disembarkation points



Figure 31 : Physical intervention framework of the project: existing infrastructure, industry to be developed, existing or planned breakwaters, lagoon dam, embarkation/disembarkation and associated infrastructure.



a) Aquaculture Development Option

The measures prohibiting fishing activities in the lagoon system did not support lawful measures for aquaculture development. Despite the prohibitions, in 2008 in Cotonou lagoon, shores and neighbourhoods, eleven (11) fishing camps, 270 fishing boats, 22 fish park traps (acadja), 352 nets piles, 28 hawk nets and 14 prawn traps (Badahoui et al., 2009) were outnumbered. These are encampments of Dancodji (Akpakpa Dodome) Placondji Pier, Old Bridge (between the 3rd and the Old Bridge and Fisheries Department) Abokicodji Lagoon, Dédokpo (between Yacht Club and the Martin Luther King Bridge) Kpankpan, Midombo, Adogléta, Agbato, and Minontchou Ladji. In these settlements, the fishermen have no access to drinking water or a sustainable housing or adequate living space. Sanitation and land security in that vicinity are compromised. These camps are installed on refuse and unhealthy areas the occupation of which is banned by the government. Among the 270 fishing boats identified, some were drawn alongside the fishing camps, while others are currently operating in the water channel. In a sedentary fishery designed specifically for prawns, fishermen hang lanterns to their nets in the night in order to attract prawns that are thereby trapped in the the fishing gear pockets.

Driving-off measures recently tried by the relevant authorities in order to drive away and deter fishermen, prompted them to reorganize in order to champion their so-called "their parents' legacy that no official from other regions of the country can confiscate." Fishing remains an activity performed permanently in Cotonou channel by professional fishermen; most of them are "Toffins" or water people born on the lagoon shores.

That is why these populations have proposed by way of adaptation measures, some lagoon sanitation system, the rehabilitation of fishing and aquaculture activities legality and the redeployment of surplus fishermen performing other professional activities.

The lagoon system sanitation passes through through:

- the control and management of solid waste generated from Dantokpa and Gbogbanou markets and the riparian areas of the lagoon,
- the control of sound dyeing technologies, compatible with the professional dyeing activities along the lagoon shores, the lagoon water chemical quality, the fisheries resources quality and the consumers' health,
- the control of used water generated in Cotonou town and continuously disposed of into the lagoon.

The restoration of the fishing and aquaculture legality is a measure that requires the revision of the regulations in order to capture climate change constraints.

The redeployment of fishermen in other professional activities entails the harnessing of new physical environment by private business operators by developing their businesses and creating new ones, especially in the sectors of tourism, catering, sports, etc... The proposed alternative activities outside the lagoon system are an asset that professional associations of fishermen would be willing to tap into, provided they emanate from traders or national employment institutions.

4.3.3. Implications of adaptation options and success conditions

In terms of environmental, institutional and socio-economic implications of the adaptation options, the main objective consists in ensuring the populations' socio-economic security and sustainable coastal and lagoon development.

The implications of the **Protection** options are environmental and socio-economic development. It should be noted that the protection of a segment of the beach in the area of Cotonou leads to greater erosion in the Eastern segment, without losing sight that the long-term impact of the protection works is essentially a geographical shift of erosion.

In addition, the coastline protection against sea-level rise and other climate change impacts will reduce coastal erosion, loss of land and socio-economic infrastructure, but rather requires huge investments for the construction works and maintenance costs.

The Lagoons shores protection and stabilization require preliminary sanitation works in terms of sanitation alternatives for the underprivileged populations on the shores. The support of relevant departments of the Cotonou town council and local authorities will be required to carry through this social intervention. The sustainability of the structures to be put in place will depend upon the commitment and support of the riparian development associations, the residents and traders in the lagoon environment.

The **Flood management** Option affects some previous works developed in response to environmental problems caused by the Cotonou Port construction. It is mainly the Cotonou dam. An inspection of the West Breakwater that protects the Lagoon mouthpiece from siltation could help make recommendations to officials of the Cotonou Port Authority about the maintenance of this work.

Flood management will mobilize the relevant departments of the Cotonou Town Council, the riparian areas Development Committees, and the professional associations established along the lagoon environment as part of the Cotonou in Campaign to Combat Floods. This programme will play a role of paramount importance in the assets sustainability mechanisms of the Project meant for the Cotonou lagoon shores Adaptation to climate change.

Aquaculture Development Option requires good collaboration of public regulatory authorities at regional and national level. It will be necessary to raise the awareness of these authorities in order to lead them to accept the need to adapt regulations to the dynamic needs of nature and society. A good cooperation of the fishing community is also required in order to ensure that the mechanisms that will have been put in place are strictly complied with for their own interest sake and that of fishery resources and other stakeholders.

5. Overall deliverables of the project

There are ultimately five deliverables for this Project:

Deliverable 1: the Cotonou lagoon shores are protected against erosion resulting from sea-level rise and extreme weather events while neighbouring social and community infrastructure are restored and improved.

Deliverable 2: the lagoon environment and the living populations' environment are protected against pollution from solid and liquid waste.

Deliverable 3: the shores and riparian areas bordering Cotonou lagoon are protected against seasonal floods and private business operators are aware of the need to promote floating bars and restaurants fit with a pedestrian bridge access, water sports, boat and canoe paddling, water gardens.

Deliverable 4: the legislations are revised and adapted to the climate change constraints and adaptation strategies for local communities and support is given to the redeployment of affected fishermen.

Deliverable 5: the local communities are aware of climatic risks: they are sensitized and trained on techniques of adaptation to climate change as well as the best practices needed for protecting the ecosystem of the human communities and their own interests, and limit the

negative impacts to a level consistent with their legitimate ambitions of economic and social development

These deliverables are derived from each other as follows:

Shoreline stabilization and protection against erosion due to flood and the sea-level rise effects, swell and winds is the basic outcome (Deliverable 1) creating the conditions for achieving other results.

Stabilized shores will facilitate the free ebbs and flows of fresh water and sea water from Nokoué Lake across the lagoon, without enabling the shore talus to pollute the lagoon water. In clear water, the origins of solid or liquid waste will be easily identified and addressed through the activities induced by the project. Therefore the water quality, fish, prawns, ... and human health will be protected (Deliverable 2).

Seasonal floods are due to Cotonou dam malfunction that prevents a free flow of Ouémé River and Nokoué Lake floodwaters into the sea. The lagoon dam rehabilitation will prevent such seasonal flooding and ensure the continuity of private business operators' activities as they will be harnessing the water body for commercial, tourist or leisure activities purposes (Deliverable 3).

Due to the lagoon wastewater sanitation, currently prohibited fishing activities, may be authorized and regulations will be revised accordingly: fishermen surplus will be directed towards new job opportunities created as a result of shoreline development works or to other opportunities (Deliverable 4).

Community social infrastructure that will be rehabilitated or constructed on the shores will provide a framework for the climate-proofing promotion culture. The promotional campaign will be extended by on-site visits, training activities for pupils and students, socio-cultural events organized by local residents and experiences sharing as part of the project (Deliverable 5).

If those deliverables are achieved, they will have led the project to contribute to the implementation of the coastal component of the National Climate-proofing Action Plan (PANA) elaborated by Benin in 2007.

The overall objective of the project is to assist Benin Government to support local communities and the riparian populations of the Cotonou Lagoon in their efforts to reduce the adverse effects of climate change on their livelihoods and to develop adaptation strategies to climatic variability and extreme weather events.

Conclusion

The physical, biological ecosystems as well as the human communities making up the complex "Nokoué Lake - Cotonou Lagoon – Lagoon mouthpiece into the Atlantic Ocean" appear to be especially vulnerable to climatic and oceanographic risks. Floods resulting from heavy rains, River Ouémé and Nokoué Lake, sea surface temperature rise and sea-level rise are the major risks observed. They are accompanied by fierce winds.

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SCHEDULE 1: TERMS OF REFERENCES
Further studies for the elaboration of the final document on the
Cotonou lagoon Adaptation to climate change

I. BACKGROUND

The National Environment Fund (FNE), in its capacity of authorized national institution implementing the Adaptation Fund programs and projects in Benin, received an allocation for the elaboration of the entire project document titled “*Cotonou Lagoon ecosystems and Human Communities Adaptation to the Sea-level rise and Extreme Weather Events*” submitted to the Adaptation Fund and approved by its Board of Directors in March 2012. One share of these resources is earmarked for financing the additional studies of which performance shall enable relevant information collection on purpose of elaborating the Project final document. The basic information used for developing the project identification sheet is relating to the five project deliverables, namely:

Deliverable 1: The Cotonou lagoon shores are protected against the erosion induced by the sea-level rise and extreme weather events and the socio-community infrastructures are rehabilitated and improved.

Deliverable 2: The Lagoon and populations’ living environments are protected against solid and liquid waste-induced pollution.

Deliverable 3: The lagoon shores and riparian areas are protected against seasonal floods and the private business operators are sensitized about the promotion of floating bars and restaurants fitted with an access foot-bridge, water sports, canoes and small boat paddling, water gardens.

Deliverable 4: Regulations are reviewed and adapted to the climate change and local communities’ adaptation strategies constraints and a support is brought for the redeployment of the affected fishermen.

Deliverable 5: Local communities’ awareness is created about the climatic risks: they are sensitized and trained on the climate-proofing strategies and the required best practices for protecting the ecosystem and human community’s interests and restricting the drawbacks to a level compatible with their legitimate economic and social development aspirations.

Those deliverables have induced the five following components among which the project activities have been identified:

- Shores protection, catering and rehabilitation of socio-community infrastructures;
- Fight against the lagoon and living environment pollution;
- Fight against seasonal flooding of the shores and riparian areas and raise the awareness of the private business operators;
- The integration of the climate change-induced constraints and adaptation strategies in the legislations regulating fishing and support to the redeployment of affected fishermen;
- The sensitization and training of the local communities on climate change, adaptation techniques and the best practices.

By adopting the project identification sheet, the Board of Directors of the Adaptation Fund raised some comments on information inadequacies and suggested that they should be taken on board in the complete project document. Those comments are as follows:

- (i) The target private sector stakeholders should be consulted and the evidence of their commitment in the process should be provided.

- (ii) The linkage between the five project deliverables should be better clarified.
 - (iii) The Project "objective", as put forth, is too wide and could rather be defined like the project "goal". In order to ensure clarity, the complete project document should present one major objective of the project which highlights that linkage, in addition to the presentation of five specific objectives.
 - (iv) The complete Project document should provide more concise data on the expected economic benefits and the target groups that would be the end-beneficiaries of the project.
 - (v) The final concrete adaptation options of the project should be presented (if the choice made is the combination of "hard" and "soft") and the costs should be subsequently adjusted.
 - (vi) The complete project document should display a matrix of past and current pertinent initiatives and explain the synergies and complementarities expected from the proposed project or the best practices which will be replicated on it.
 - (vii) The activities described in "the section on knowledge management" should be reflected in the specific output or project results and be described in the tables on "components and financing "and" Results framework" of the complete project document.
- 1) Ahead of the research on additional information, FNE had submitted a Project identification sheet to the Adaptation Fund along with a request of allocation for the execution of the five studies likely to generate those information data. As such, the project sheet had been adopted by the Board of Directors of the Adaptation Fund along with the request allocation for the following five studies: Furthering the consultations with the Municipal authorities, riparian areas development associations, private sector stakeholders as well as the youth and women organizations;
 - 2) In-depth study of the project activities profitability and cost-effectiveness ratio;
 - 3) Study of the arrangements and mechanisms of the project assets sustainability involving the private business operators;
 - 4) Furthering the knowledge of the current and future climate change impacts on the vulnerable social groups (women, youth etc.) and on the lagoon living resources;
 - 5) Furthering the knowledge of the impact of the breakwaters and waves quelling blocs under construction offshore and on the lagoon system.

It is on purpose of performing those studies and collecting additional information likely to help bridging the gaps underscored by the Board of Directors of the Fund that these terms of reference are elaborated.

II. GENERAL OBJECTIVE

Collecting additional information and data to those harnessed on the Project identification sheet on the Cotonou lagoon shores adaptation to climate change and likely to bridge the gaps highlighted in the comments of the Board of Directors of the Adaptation Fund with a view to elaborating the complete document of the project.

III. SPECIFIC OBJECTIVES AND DELIVERABLES

The expected objectives and deliverables of each of these studies are as follows:

3.1. Furthering the consultations with the municipal authorities, riparian areas development associations, private sector stakeholders as well as women and youth organizations;

3.2.

This study aims to:

- ✓ Organize consultations meeting with all the stakeholders (municipal authorities, riparian areas development associations, private sector stakeholders, youths and women organizations) in order to exchange about the economic activities performed by the populations living in the lagoon vicinity. The meeting will also deliberate on the risks run, their magnitude and lines of variation (floods, minimum flows, fierce winds, water exchange between the Ocean and Nokoué lake, variations in the water salinity, proliferation of floating plants, variation of fish and prawn stocks, etc.), the impact of the risks observed on the status of the lagoon and the riparian populations activities, the already taken adaptation measures, the already implemented or envisaged projects, the deliverables of this lagoon shores adaptation project, the assets or best practices of the previous projects into which this could tap, the interests of the project components for the stakeholders, the needs and modalities of participation of the stakeholders in the project;
- ✓ Identify the most exposed social groups (men, women, youths, etc.) to the risks and their resilience capacities (mostly the women);
- ✓ Identify the economic and social benefits that the stakeholders could draw from this project;
- ✓ Identify the social groups that could draw the maximum benefits from the project outputs and the women's position within those groups;
- ✓ Identify the stakeholders that could ensure the technical, financial, institutional, sociocultural and environmental sustainability of the project;
- ✓ Examine the modalities for involving the private business operators in the sustainability mechanisms;
- ✓ Identify the breakwaters, waves quelling blocs and other port facilities which have an impact on the Cotonou lagoon mouthpiece nourishment;
- ✓ Examine the adaptation options in matter of lagoon shores protection, socio-community infrastructures rehabilitation / development and solid and liquid waste control as identified in the project sheet and identify others;
- ✓ Lead the stakeholders to make formal commitment promises about their involvement in the project implementation, activities monitoring & evaluation and sustainability of the results;

At the completion of the study, the following documents will be produced:

- A study report having (i) a summary of consultations between consultants and stakeholders, (ii) the consensus reached on each of the discussion points discussed with all

stakeholder groups, and (iii) the relevant past and present initiatives table of assorted expected synergies and complementarities of the project and/or best practices that will be reproduced.

- Stakeholders' engagement documents in the implementation, monitoring and evaluation.

3.3. In-depth study of the project activities profitability and cost-effectiveness

The specific objectives of this study are as follows:

- ✓ Identify the economic and social benefits that the stakeholders could draw from the project;
- ✓ Identify the social groups that could draw the maximum benefits from the project outputs and the women's position within those groups;
- ✓ Identify the additional adaptation options in matter of lagoon shores protection, socio-community infrastructures rehabilitation / development and solid and liquid waste control;
- ✓ Evaluate the adaptation options identified in the project sheet as proposed by the stakeholders;
- ✓ Analyze the adaptation options and project activities cost-effectiveness.

The output expected from the study is a report presenting (i) the economic and social benefits that the stakeholders could draw from the project, (ii) the social groups that could draw the maximum benefits from the project output and the women's position within those groups, (iii) the adaptation options identified and their evaluation, and (iv) the analysis of the adaptation options and project activities cost-effectiveness.

3.4. Study of the arrangements and mechanisms for sustainability of project achievements involving private business operators

This study will help to:

- ✓ Identify the stakeholders that could ensure the technical, financial, institutional, socio-cultural and environmental sustainability of the project;
- ✓ Determine the measures and modalities for involving the private business operators in the sustainability mechanisms;
- ✓ Analyze the conditions for the post-project success;
- ✓ Propose relevant options for the sustainability mechanisms.

At the completion of this study, a report will be produced, presenting (i) the stakeholders that could ensure the technical, financial, institutional, socio-cultural and environmental sustainability of the project, (ii) the measures and modalities for involving the private business operators in the sustainability mechanisms, (iii) an analysis of the conditions of post-project success and (iv) a proposition of relevant options for the sustainability mechanisms.

3.5. Furthering the knowledge of the current and future impact of climate change on vulnerable social groups (women, youth etc...) and the living resources of the lagoon

This study aims to:

- ✓ Specify the climatic risks observed in the lagoon environment;
- ✓ Identify the most exposed social groups (men, women, youths, etc.) and the living resources to the climatic risks;
- ✓ Evaluate the current and future vulnerability of the modes and means of livelihood to the climatic risks;
- ✓ Evaluate the already taken adaptation measures and their efficiency;
- ✓ Propose potential adaptation options along with their conditions of success;
- ✓ Specify the project's general objective and clarify the linkage between the five project deliverables;

The expected output is a study report including the (i) climatic risks observed in the lagoon environment, (ii) the most exposed social groups (men, women, youths, etc.) and the living resources to the climatic risks, (iii) the current and future vulnerability of the modes and means of livelihood to the climatic risks, (iv) the already taken adaptation measures and their efficiency, (v) a proposition of potential adaptation options along with their conditions of success and (vi) some precisions on the project's general objective and clarifications on the linkage between the five project deliverables.

3.6. Furthering the knowledge of the impact of breakwaters and Waves quelling blocks under construction in the sea on the lagoon system

The objectives of the study are to:

- ✓ Make an inventory of the breakwaters, waves quelling blocs and other port works having an impact on the Cotonou Lagoon mouthpiece;
- ✓ Elaborate the diagram of erection of the new breakwaters under construction;
- ✓ Assess the current status of the ocean current in the Cotonou lagoon and Port Authority environment with its impact on sand movements;
- ✓ Propose the impact of the new breakwaters on the lagoon environment by 2025 along with its consequences on the lagoon bed and shores;
- ✓ Suggest measures for strengthening the Cotonou dam and the lagoon shores stabilizing works.

The report of this study is expected to give precisions on (i) the current and future status of the breakwaters, waves quelling blocs and port facilities with their impact on the bed loads movements, (ii) the impact of the new breakwaters on the lagoon environment by 2025 along with its consequences on the lagoon bed and shores and (iii) some measures suggested for strengthening the Cotonou dam and lagoon shores stabilizing works.

IV. METHODOLOGY

4.1. General Methodology

The general methodology should comply with the international standards of study and draw gist from the methodology applied to the studies conducted on vulnerability and adaptation to climate change.

The standardized stages in matter of study are the definition of the conceptual framework, the methodological scoping, review of literature and documentary analysis, and eventually, the organizational measures taken.

4.1.1. Definition of the conceptual framework of the studies

The conceptual framework of this mission is the one applied to the studies on vulnerability and adaptation to climate change as defined by the Intergovernmental Panel on Climate Change (IPCC) and operationalized by the Panel of Experts of the Least Developed Countries (LEG) (Carter *et al.*, 1994; Parry and Carter, 1998; LEG/UNFCCC, 2004). This is about applying the international guiding principles of the United Nations Framework Convention on Climate Change to the Cotonou Lagoon system, through additional studies required for the elaboration of the complete project document on the Cotonou lagoon shores adaptation to climate change.

4.1.2. Methodological scoping of the mission

The mission will be formally launched with a scoping meeting organized by the FNE. The main purpose of that meeting is to ensure that the mission objectives and those of the ToR are well understood by the consultants. The proposed methodology will be presented and useful comments will be collected in order to fine-tune it.

4.1.3. Literature review and analysis

Two document types shall be consulted as part of this review of literature and documentary analysis. Those are:

- The works outcome and the general documentations on the socioeconomic development and poverty alleviation policies and strategies, on the environmental policies, namely in connection with the Convention on Biodiversity and coastal areas ecology, and on the Cotonou town and Cotonou Lagoon riparian Town Sections Development Plan.
- Guidelines and documents pertaining to the studies of vulnerability and adaptation to climate change, namely the methods of intervention and specific tools to the coastal areas, ecosystems and human communities, the outcome of the works carried out on the lagoon system and the project identification sheet on the Cotonou lagoon shores adaptation to climate change as adopted by the Board of Directors of the Adaptation Fund.

Most of the consultants have already a good mastery of this documentation.

4.1.4. Organizational arrangements

This is about the mode of organization of activities fostering the achievement of the results set for these studies. It starts with the arrangements and appointments to be arranged with the stakeholders including the project owner's representatives, going through the measures to be taken in order to ensure the success of the activities and ends with the submission of reports and outputs upgrading.

4.4.5. Methodology of the study of vulnerability and adaptation to climate change

The methodology developed by the Intergovernmental Panel on Climate Change (IPCC) and operationalized by the Least Developed Countries Experts Group (LEG) has seven (7) steps that are as follows (Carter et al., 1994; Parry and Carter, 1998; LEG / UNFCCC, 2004):

1. Identification and definition of the problem through a participatory approach involving experts and stakeholders' representatives (*Coordinated assessment the lagoon ecosystem and human systems vulnerability*);
2. Selection of the most appropriate methods to solve the problem;
3. The test methods;
4. Selection of climate and socio-economic scenarios
5. Evaluation of biophysical and socio-economic impacts
6. Evaluation of endogenous adaptation measures;
7. Evaluation of adaptation strategies.

Each methodological step calls for specific implementation tools and variables according to the problem typology. All the studies do not need all the steps.

- 1) *The first step (joint vulnerability evaluation)* is common to all the focus studies of this mission. The 5 thematic will be considered with the stakeholders during the single joint vulnerability evaluation meeting, per category of stakeholders holding some given information. Each sub-team in charge of addressing a thematic will have to judiciously harness that single session with each stakeholders category in order to collect the information needed for the next stage of the study.
- 2) *The second step (Selection of the most appropriate methods for solving the problems)* is specific to the thematic. The teams in charge of addressing each thematic will have to choose based on the thematic, information available on the most appropriate methods out of the thirty methods, software and tools of the coastal area sector, and about twenty available participatory tools, to address the Cotonou lagoon shores vulnerability and adaptation problems. (http://c3d-unitar.org/c3d/userfiles/Module_2/M2_Inventaire_outils-doc.pdf)
- 3) Regarding *the third step (Test of the selected methods)*, the limited time allotted to the teams will not allow them to test the selected methods in actual size. They will rather have to prioritize proven methods on the field.
- 4) *The selection of climatic and socioeconomic scenarios (Forth step)* refers to the outputs acquired for the national territory and presented in the Second National Paper of Benin on Climate Change (DCN), including the coastal area.
- 5) *The biophysical and socioeconomic impacts evaluation (fifth step)* will draw on the joint vulnerability evaluation results (step 1), of the national vulnerability evaluation data documented in the National Climate-proofing Action Program and DCN; and the scientific bibliographical bases.
- 6) *The sixth step (Endogenous adaptation measures evaluation)* draws on the results of the first and fifth steps for the thematic concerned by that step.

- 7) The adaptation strategies evaluation will use the traditionally-enshrined methodologies and involve the Municipal authorities and business operators who will have a special role to play in order to ensure the post-project sustainability.

4.5. Mission Specific Methodology

All the studies will draw their gist from the general methodology. The teams in charge of the five thematic will address together the steps of the conceptual framework of the studies, the mission scoping, the literature review and documentary analysis, organizational arrangements and joint evaluation of vulnerability to climate change. Based on the relevant data collected during the consultation meetings with the stakeholders and the outputs harvested from the documentation, the teams will perform stand alone works on the steps 2 through 7 of the studies on vulnerability and adaptation depending on the specificity of their thematic.

Timing of the tasks

The mission duration is thirty (30) days covering the period running from February 15, 2013 to later, including the additional period for elaborating and translating of the entire project document. By way of indication, Tables 1 and 2 display the proposition of activities timing and the tasks diagram. The complete project document elaboration and drafting could be envisaged from Monday February 4, 2013, mobilizing the core implementing task force of these studies meanwhile the exchanges are held with the international expert.

Table 11: **Planning of the envisaged activities (for guidance).**

Activities	Duration in days	Period*
Organizational arrangements	9	January 14-22, 2013
Meeting for planning the studies conceptual framework	2	January 19-20, 2013
Meeting of methodological scoping of the mission	1	January 21, 2013
Joint lagoon ecosystem and human communities vulnerability evaluation meeting	5	January 22-26, 2013
- Consultation with the municipal authorities		January 22
- Consultation with the heads of the town sections and areas riparian of the lagoon		January 23
- Consultation with the fishermen and fishmongers associations		January 24
- Consultation with the women and youths associations		January 25
- Consultation with the business operators		January 26
Bibliographical review and documentary analysis	20	From January 19 2013
Execution of the technical studies steps	10	January 19 – 28, 2013
Elaboration of the draft study reports	4	January 25 – 28, 2013

Rendition of the results to the municipal authorities and business operators	1	January 29, 2013
Submission of the draft study reports	PM	January 31, 2013
Submission of the final studies reports	PM	February 4, 2013
Total	52	

Note²: The simultaneous performance of several activities enables to reduce the real duration of the mission

Table 2 : Tasks diagram²

		1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3				
		4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	1	2	3	
Making organizational arrangements	5	█																					
Studies conceptual framework definition meeting	2						█	█															
Meeting of methodological scoping of the mission	1								█														
Participatory assessment of vulnerability of the lagoon ecosystem and human systems	5									█	█	█	█	█									
Consultation with local authorities	25	█																					
Consultation with the heads of Town sections and neighbourhoods bordering the lagoon	7						█	█	█	█	█												
Dialogue with associations of fishermen and wholesale fishmongers	5												█	█	█	█							
Consultation with women's and youth associations	5																					█	
Consultation with traders	5																						█
Literature review	5																						
Conducting technical studies stages																							

Note²: the simultaneous execution of multiple activities can reduce the actual duration of the mission

To conduct the studies, it is proposed a multidisciplinary team of seven (7) consultants covering the required skills. It is, in alphabetical order:

1. AGOINON Norbert, Cartographer at the University of Abomey,
2. Ahlonsou Epiphane, Climatologist at ASECNA, National Focal Point of the Intergovernmental Panel on Climate Change (IPCC)
3. AHO Nestor, Bio-climatologist at the University of Abomey, Head of Mission,
4. Babadankpodji Pascaline, Sociologist at the University of Abomey,
5. DOSSOU Krystel, Agro economist at NGO OFEDI, the Observer Member of the Board of the Adaptation Fund / UNFCCC under the Civil Society Organizations,
6. GNONLONFIN Lazarus, Sedimentologist at the Directorate of Technical Studies of the Cotonou Port Authority
7. Toffi Mathias, Coastal Geographer at the University of Abomey,

The curriculum vitae of the consultants are attached to this technical proposal.

The staff assignment for the mission is as it is shown in Tables 3 and 4. In addition to the overall coordinating that is the responsibility of the Head of Mission, he also receives specific assignments.

Table 3: Overview of human resources allocation for the mission.

Staff	Assignments
M. AGOINON Norbert	<ul style="list-style-type: none"> • All mapping works that will be needed to illustrate and facilitate the understanding of the study reports
M. AHLONSOU Epiphane	<ul style="list-style-type: none"> • <i>Study provisions and mechanisms for the sustainability of project achievements involving private business operators;</i> • Furthering the understanding of the current and future impact of climate change on vulnerable social groups (women, youth etc...) and the lagoon living resources; • Furthering the understanding of the impact of breakwaters and Waves quelling blocks under construction in the sea and on the lagoon system
AHO Nestor	<ul style="list-style-type: none"> • <i>Furthering the understanding of the current and future impact of climate change on vulnerable social groups (women, youth etc...) and the lagoon living resources</i> • Study of provisions and mechanisms for the sustainability of the project' achievements involving private business operators; • thorough study of the profitability or cost-effectiveness of the project' activities;
BABADANKPODJI Pascaline	<ul style="list-style-type: none"> • <i>Further consultations with the municipal authorities, residents neighbourhood development associations, private sector, youth and women organizations;</i> • In-depth study of the profitability or cost-effectiveness

	<p>of the project' activities;</p> <ul style="list-style-type: none"> • Furthering the understanding of the current and future impact of climate change on vulnerable social groups (women, youth etc...) and the lagoon living resources;
DOSSOU Krystel	<ul style="list-style-type: none"> • <i>In-depth study of the profitability or cost-effectiveness of the project' activities;</i> • Study provisions and mechanisms for the sustainability of the project' achievements involving private private business operators;
GNONLONFIN Lazare	<ul style="list-style-type: none"> • <i>Furthering the understanding of the impact of breakwaters and Waves quelling blocks under construction in the sea on the lagoon system;</i> • Further consultations with the municipal authorities, residents neighbourhoods development associations, private sector, youth and women organizations;
TOFFI Mathias	<ul style="list-style-type: none"> • <i>Furthering the understanding of the impact of breakwaters and Waves quelling blocks under construction in the sea on the lagoon system;</i> • Further consultations with the municipal authorities, residents neighbourhoods development associations, private sector, youth and women organizations;

Table 4: Teams of consultants in charge of the studies

STUDY	CONSULTANTS TEAMS
<i>Further consultations with the municipal authorities, residents neighbourhoods development associations, private sector, youth and women organizations;</i>	BABADANKPODJI Pascaline TOFFI Mathias GNONLONFIN Lazare AGOINON Norbert
<i>Further the study of the profitability or cost-effectiveness of the project' activities;</i>	DOSSOU Krystel BABADANKPODJI Pascaline AHO Nestor
<i>Study provisions and mechanisms for the sustainability of the project' achievements involving private private business operators</i>	AHLONSOU Epiphane DOSSOU Krystel AHO Nestor TOFFI Mathias
<i>Furthering the understanding of the current and future impact of climate change on vulnerable social groups (women, youth etc...) and the lagoon living resources;</i>	AHO Nestor AHLONSOU Epiphane BABADANKPODJI Pascaline
<i>Furthering the understanding of the impact of breakwaters and Waves quelling blocks under construction in the sea on the lagoon system;</i>	GNONLONFIN Lazare TOFFI Mathias AHLONSOU Epiphane AGINON Norbert



Republic of Benin



Ministry of Environment,
Housing and Town Planning

**Elaboration of the project on the
Cotonou Lagoon ecosystems and
human communities adaptation to the
impacts of sea-level rise and extreme
weather events**



ADAPTATION FUND

Adaptation Funds to Climate
Changes



National Environment Funds

**Furthering knowledge on the impact of offshore
breakwaters and waves quelling blocks under
construction on the lagoon system**

@@@@@@

STUDY REPORT

February 2013

**Lazare GNONLONFIN,
Cotonou,**

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INTRODUCTION

Due to its low adaptation capacity to the current and future impacts, Benin, a least developed country, is highly vulnerable to climate change.

Besides, As part of the Second National Paper on climate change delivered by Benin, the vulnerability studies which were carried out revealed that the coast, the water resources, the agriculture and forestry are the most vulnerable sectors to climate change.

More specifically, the coastal zone which comprises the lagoon of Cotonou is prone to the following major climate risks, ie, flooding, fierce winds, sea surface temperature (TSM) rise, sea-level rise, coastal and lagoon shores erosion.

With a view to protecting both the environment and the lagoon ecosystem, the Benin Ministry of Environment elaborated an adaptation project tagged « *Project on the Cotonou lagoon shore ecosystems and human communities adaptation to the impacts of sea-level rise and extreme weather events* » meant to watch over the environmental integrity, the lagoon and its shores. The project submitted by the said Ministry to the Adaptation Funds through the National Environment Fund (FNE), falls within the scope of priority actions taken to protect the coastal zone, the Government of Benin listed in its National Climate-proofing Action Plan (PANA).

CHAPTER I: Context, Justification and Study Objectives

I.1 – Background

Approved as a national institution in charge of implementing the Adaptation Funds programs and projects in Benin, the National Environment Fund (FNE) was allotted a grant for the development of the entire project document which is titled « *Project on the Cotonou lagoon shore ecosystems and human communities' adaptation to the impacts of sea-level rise and extreme weather events* ». Then, the project identification sheet was submitted to the Adaptation of the Board of Directors of Adaptation Funds for adoption in March 2012. In this document, one share of the funds is earmarked for the financing of additional studies which could help to collect relevant information necessary for the elaboration of the final project document.

Based on the project deliverables, the following five components were identified:

- protection, rehabilitation and improvement of social and communities infrastructures established along the Lagoon shores;
- Fighting against the lagoon shores and the living environment pollution;
- Fighting against the seasonal flood of the lagoon shores and the riparian areas and raise the awareness of the business operators on the issue;
- Integrating adaptation climate-proofing constraints and strategies into the legislations governing fishing activities and fostering the affected fishermen deployment into other activities
- Raising the awareness and ensuring the capacity building for the riparian communities on climate change, adaptation techniques and the best practices.

By adopting the project sheet, the Board of Directors of the Adaptation Funds pointed out that there are information inadequacies and gaps which should be taken into account for the project document to be completed. This study titled « ADDITIONAL STUDIES FOR THE ELABORATION OF THE FINAL DOCUMENT OF THE PROJECT ON COTONOU LAGOON SHORES ADAPTATION TO CLIMATE CHANGE » and subdivided into five (05) sub-studies is supposed to collect and analyze the required information as follows:

- 6) Further dialogs with municipal authorities, riparian neighborhood development associations, private business operators as well as youth and women organizations ;
- 7) Carry out a thorough profitability or cost-effectiveness study on the various project activities;
- 8) Find out measures and mechanisms in order to ensure the project outputs sustainability by getting the private business operators involved;
- 9) Acquire thorough knowledge on the climate change current and future impacts the on vulnerable social groups (women and the youth etc.) and on the lagoon living resources;
- 10) Get more information about the ongoing offshore breakwaters and waves quelling blocks impacts on the lagoon ecosystem

This last study is the subject matter of this report.

1.2 – Objectives

The study objectives and deliverables were specified in the terms of reference and are as follows:

1.2.1 – General objective

This report aims at providing additional information and data to those harnessed in the project identification sheet of the Cotonou Lagoon shores adaptation to climate change. That will enable to bridge the gaps observed by the Board of Directors of the Adaptation Funds with a view to elaborating a complete project document.

1.2.2 – Specific objectives and expected outputs

The objectives of the study relating to the deepening of knowledge on the ongoing offshore breakwater and waves quelling blocks impacts on the lagoon system aims at:

- ✓ Making the inventory of breakwaters, waves quelling blocks and other port facilities' impact on the Cotonou lagoon's mouthpiece;
- ✓ Elaborating the installation diagram for the breakwaters under construction;

- ✓ Describing the ocean current situation in the Cotonou lagoon and Port environment along with its impacts on sand transportation
- ✓ Projecting the new breakwaters impacts on the lagoon environment by 2025 and their consequences on the lagoon bed and shores;
- ✓ Suggesting consolidation measures for the Cotonou dam and the lagoon shores stabilizing infrastructures.

The expected report of this study should specify:

- ✓ The current and future state of breakwaters, waves quelling blocks and other port facilities as well as their impact on the bed load movements,
- ✓ The impact of the new breakwaters on the lagoon environment by 2025 and their impact on the lagoon bed and shores
- ✓ Measures suggested for strengthening the Cotonou dam and the lagoon shores stabilizing infrastructures.

CHAPTER II: Methodology

II.1 – Methodological approach

The methodological approach used as part of this study prioritized documentary research and the survey in the field.

As a matter of fact, the document review was carried out during direct visits in public, private, national, regional and international institutions whenever possible and also through research online.

Data collection works on the field were carried out and have to do with:

- Visiting the port works and infrastructures constructed on the Cotonou coastline and lagoon shores.
- Conducting direct individual interviews with resource persons, community leaders, local elects, coastline river and fishery engineers, fishermen associations, private business operators established on the lagoon shores (Hotel, restaurant, night club, etc.);
- Small groups working sessions with the Cotonou Municipality elects, fishermen, fishmongers, traditional rulers, youth and women associations etc.;

II.2 – Study limitation

The mission was hampered by the short time allotted for study as it did not allow more in-depth fieldwork and a better use of the harvested documentation.

CHAPTER III – PHYSICAL CONDITIONS

III.1 – Benin coastline geomorphology

Benin coastline consists of a 125 km long low coastal and flat plain with an increasing West-eastward width (2.1 km in Grand-Popo) and in the East (10 km at the Benin-Nigeria border).

As most of the coasts along the Gulf of Guinea, the Benin coastline is dotted with the sandy coastal belts which are:

- Settled during a very recent geological past (during recent millennia),
- generally 2 to 10 km wide,
- Separated from the sea by lagoon swampy areas such as for instance the Nokoué Lake in the East.

The beaches continue offshore on beds which are generally concave on the Benin coast and with an average slope of 2% in the sequence of 0 and –10 m.

The coastline is connected to the sea by two adrets: Roy mouth which is an outlet of the Mono River and the West lagoon system and by the outlet of the Cotonou East river and lagoon system.

III.2 – Oceanographic Data

III.2.1- The Tide

On the Benin coast, the tide is of semi diurnal type: two high tides and two normal tides in about 24 hours.

The average level (N.M.) of the sea height is 0.93 m above IGN zero (the hydrographic zero is at 0.535 m under IGN zero).

Table No.01 below shows the main coastal features:

TABLE NO. I: Coastlines characteristic of the tide (Z.H)

	HIGH TIDE	LOW NORMALTIDE	AMPLITUDE
Deep water	+1.8 m	-0.20 m	2 m
Neap	+1.0 m	+0.40 m	0,6 m

III.2.2 - The swell

The average amplitude of the swell observed along the Benin coastline is between 1.0 and 2.0 meters (with the amplitude meaning here the height between the wave depth and the wave peak.). When the weather is good, it becomes low exceptionally around 0.5 meters without completely disappearing. The swell distinctive seasonal features are as follows:

- Low swell periods with average amplitude of 0.9 to 1.3 meters between December and March.
- High swell periods with average amplitude of 1.6 to 1.9 meters between June and August.

However, it should be noted that maximum amplitude swells of 4.5 meters were recorded in Cotonou between June and September.

The Benin coastline swells generally move in the South-Southwest direction (198°) but sometimes, they may vary in south-southeast direction.

III.2.3 – The Currents

General currents

The Benin coast is dotted by the same general currents of the Gulf of Guinea. That is the Gulf of Guinea current which moves from the west to the east and the sub-equatorial counter-current.

Periodic currents

The periodic currents are very low: less than 0.2 to 0.3 m/s and are not likely to cause any significant bed load movements. (They should be at least 0.5 m/s before a sensitive transport of "classic" sands starts).

The issues about swell current are addressed under section III.2.4 as part of the coastline transports and transit.

III.2.4 The sand transit

The waves reaching obliquely the shore cause a current referred to as « shoreline current or pit current» also known as «shoreline current» which flows parallel to the shoreline carrying out suspended or thrust sediments called sand transit. The shoreline sand transit along the Benin coast the sand transit is estimated between 1.500.000 m³ and 1.200.000 m³ per annum.

III.2.5 – The Factors acting upon the sedimentary dynamics

The swell and their induced longshore drift currents are the main sedimentary dynamics factors. The other types such as (general currents and waves current) are generally too low to provoke bed load transport resulting in sandy beaches. **However, the wave flow current as well as drift waves from the rivers flooding into the mouthpieces cause the sand spits erosion. This is what happens in the Cotonou channel mouthpiece where drifting waves from the Ouémé and Sô Rivers floods play a vital role in the sand spits evolution into the channel mouthpiece the opening and close up of which are alternately caused by it.**

III.3 – Introducing the Cotonou channel

With a length of about 4,500 meters and a width of 300 meters, the Cotonou channel interconnects the Nokoué Lake which is the most important lagoon water body in the South of Benin to the Ocean. The channel is part and parcel of Benin South-East lagoon system which also includes the Nokoué Lake and the Porto-Novo lagoon interconnected by a 15 kilometer-long narrow channel known as TOCTHE channel.

Interconnected with the Ocean in 1885 by the Colonial Administration in order to control floods in the Cotonou city, this channel plays a vital role in the Nokoué Lake ecosystem evolution. The annual or multiyear cycles of its outlet to the Ocean impact on the Nokoué Lake hydrodynamics. It is worth mentioning the water reversal flowing (especially during low water period) in the channel due to the waves impact which are semi diurnal in Cotonou (two high tides and two low tides in 24 hours). For sure, this variation influences the spread of the pollutants disposed of into the channel and which move from the channel into the Nokoué Lake or from the channel into the Ocean according to the flow direction.

III.4 – Hydrography of the Benin South-East lagoon system

The Benin South-East lagoon system receives waters from the two (2) main rivers of Benin hydrographic network: the Ouémé and Sô Rivers.

Approximately 523 kilometers long, Ouémé, which is the Benin longest River springs and originates the Atacora Mountains which lie North-West of Benin. The North-

southward River crosses the various climatic zones before flowing into the Nokoué Lake and into the Porto-Novo lagoon in the Southern region. Two (02) main parts are distinguished on the River course: the part located on the Dahoméyen basement called « Upper Ouémé » and the part located on the coastal sedimentary basin formation referred to as « Lower Ouémé ». The hydrology of this last segment begins after interconnecting with the Zou River which flows along the whole South Benin lagoon system of (Nokoué Lake - Cotonou channel - Porto-Novo lagoon).

The Ouémé River overflows during the flood period, not only floods the first alluvial plain of the Ouémé River Delta but also feeds the Sô River located on the right shore. The hydrology of both the delta of the Ouémé River and the lagoon system of Southern Benin largely depends upon the Ouémé and Sô water bodies which, in actual fact, are the (2) drainage lines of the same system. There are interconnected through several branches which at times may be distributary or tributary stream. These are the Zounga, the Agbagbè, the Ouovi and the Zouvi. (ref. 01)

III.5 – The channel flows and water depths

III.5.1 – Flows drained out through Ouémé and Sô Rivers

According to reference N°.01, the Ouémé River flood flow reaches its peak at BONOU (1,260 m³/s ten-year flood) and decreases significantly thereafter. It approximately reaches 540 m³/s (a ten-year flood) at Hêtin Sota at about (50) kilometers from Bonou and ten (10) kilometers from the Porto-Novo lagoon. This significant skimming of the flow is caused by the River overflows not only into the Sô River but also in floodable plains which are catchment where water is stored.

The Sô River flow regime as aforementioned depends on the flow regime of Ouémé River from where it originates.

According to J. Colombari and associates (ref N°.2), almost all the entire Sô River flow regime measured at Sô-Awa 4 kilometers from the Nokoué Lake comes from the Ouémé River overflow through Ouovi and Zounvi distributaries. At Sô-Awa, the ten-year flow volume is 293 m³ / s.

Therefore, the sum of the ten-year flood flow of both Ouémé River and the Sô Rivers respectively at Hêtin-Sota and Awa is inferior to 850 m³ / s and is far inferior to the flow at Bonou (which is 1,260 m³/s for a ten-year flow). As for hundred years flood, the sum of the flows is 993 m³/s (1.460 m³/s at Bonou) (See Table No.02).

Table No.II: Average flow and recurrent flows of the Ouémé and Sô Rivers at some stations

Rivers	Location	Average flow (m ³ /s)	Recurrent flood (m ³ /s)				
			2 years	5 years	10 years	50 years	100 years
1 – Ouémé	Bonou	173	805	1,120	1,260	1,420	1,460

2 - Ouémé	Hêtin-Sota	135	410	495	540	600	620
3 - Sô	Sô-Awa	66	210	270	298	348	373
4 - 2 + 3		201	620	765	838	948	993

Source: According to reference N°01

III.5.2 – The tide influences

The Cotonou channel flows into the Ocean through an outlet usually called « the Cotonou lagoon outlet » or « the Cotonou mouthpiece».

Both this outlet and the « Roy Mouth » outlet (both the mouth of the Mono River and the West Benin lagoon system) are the two existing openings into the sea along the coastline.

Therefore, tides affect the channel and the entire Benin South-East lagoon system. Besides, the channel outlet is influenced by waves and the sediments which they carry over.

It should be recalled that the tide is semi-diurnal ie, two high tides and two low tides within about 24 hours on the Benin coastline,.

III.5.3 – The Cotonou channel drained off flows and water depths

When the Ouémé and Sô Rivers overflow, volume of water to be drained off and the water depth is so significant. As stated above, waters from these two rivers flow into both the Nokoué Lake and the Porto-Novo lagoon. There are drained off into the sea through the Cotonou Channel (part of them) and through the channels of the West Nigeria lagoon system which is linked to the Porto-Novo lagoon.

According to several studies the most recent of which is SNC-LAVALIN (ref No.03), the Cotonou channel is assumed to drain off between 46 % to 51 % of the flood flow of both the Ouémé and Sô Rivers which overflow into the Benin South-East lagoon system. The remaining is drained off through the Porto-Novo lagoon.

As shown above, the sum of the peak flows of the Ouémé and Sô Rivers respectively at Hêtin-Sota and Sô-Awa is inferior to the peak flow at Bonou. However, the entire flow moving into the lagoon system of the South-East Benin (especially into the Nokoué Lake and into the Porto-Novo lagoon) should probably be superior to the sum of the flows of both (Ouémé) and (Sô) Rivers respectively at Hêtin-Sota and at Sô-Awa due to the following reasons:

- One part of the flow certainly escape from the gauging stations
- One part of the basin drained off by both the Ouémé and Sô Rivers is located downstream the Hêtin-Sota and Sô-Awa stations.

Considering the fact that the sum of the flows of both the Ouémé and Sô Rivers respectively at Hêtin-Sota and at Sô-Awa is inferior to the Ouémé River flow at Bonou,

SNC-LAVALIN uses the peak flow at Bonou for hydraulic simulations as part of the Cotonou and Porto-Novo cities Sanitation Project.

As such, the simulation of the hydraulic behavior of the Ocean-Lagoon regulation facilities of the Cotonou Lagoon mouthpiece culminated with the water flows and depth flows presented in the following table N°.03 taking into consideration a dam crest leveled-off to the shoreline at + 0,1 IGN that is + 0,635 hydro.

Table no. III: Flows and water depths in the Cotonou Channel

Event	Flow within the channel (m3/s)			depths (m IGN)		
	Average	Max.	Min.	Lac	Bridge	Down the dam
Dry-weather flow	33	290	-520	0.64	0.59	-0.16
				0.64	0.77	0.90
Average flow	100	325	-475	0.70	0.64	-0.15
				0.70	0.81	0.91
1 / 2 year Flood	403	580	-290	1.08	0.94	-0.04
				1.08	1.11	1.13
1 / 5 year Flood	560	650	170	1.18	1.00	-0.01
				1.17	1.16	1.16
1 / 10 years flood	630	700	350	1.25	1.06	0.03
				1.24	1.21	1.17
1 / 100 years flood	730	785	515	1.36	1.13	0.08
				1.36	1.27	1.20
Exceptional flood	730	825	355	1.42	1.17	0.11
				1.42	1.38	1.35

The average flow in the channel corresponds to the average flow in the daytime. In one day and due to the tide, this flow runs through a maximum and minimum as specified in the table. A negative rate means a Sea-to-Lake flow.

The phrase « downstream the dam » refers to the part of the dam located on the sea side and which does not always corresponds to the flow direction which varies during the day.

The flood drainage flows as well as the Nokoué Lake salinity should be considered taken on board while designing the infrastructures constructed with a view to regulating the sea-lagoon exchange at the Cotonou lagoon outlet level.

Chapter IV: Introducing the Cotonou Port Coastal Facilities

IV.1 – Port Facilities

IV.1.1 – The first port

Sand transit was the major concern for the authorities in charge of Cotonou port construction. After selecting the Cotonou Port project site, taking into account the Cotonou lagoon mouthpiece and the existing wharf, a systematic small-scale model study was carried out on the various Port types that could be constructed under similar conditions with a coastal sand transit: island port, artificial sand transit port, sandbank port.

In the end, it was this last model which was selected because it was the most affordable at that time. The port was supposed to include a sand blocking infrastructure which should stop the transit and stock the sand on the port west.

Therefore, the port basin was protected by two main infrastructures:

- a main dam, West jetty, 1,423 meters long in three parts: a straight line into EAST-South direction, a 120 meters long curved part and a rectilinear 421 meters part oriented towards the East;
- a counter-jetty, East jetty also known as crosspiece, 770 meters long part into two section : a 230 meters long loose boulders and a 540 meters long section with two double sheet piles.
- Both infrastructures delineate a sailing plan of approximately 40 hectares with 180 meters long entry channel (See Fig. 01).

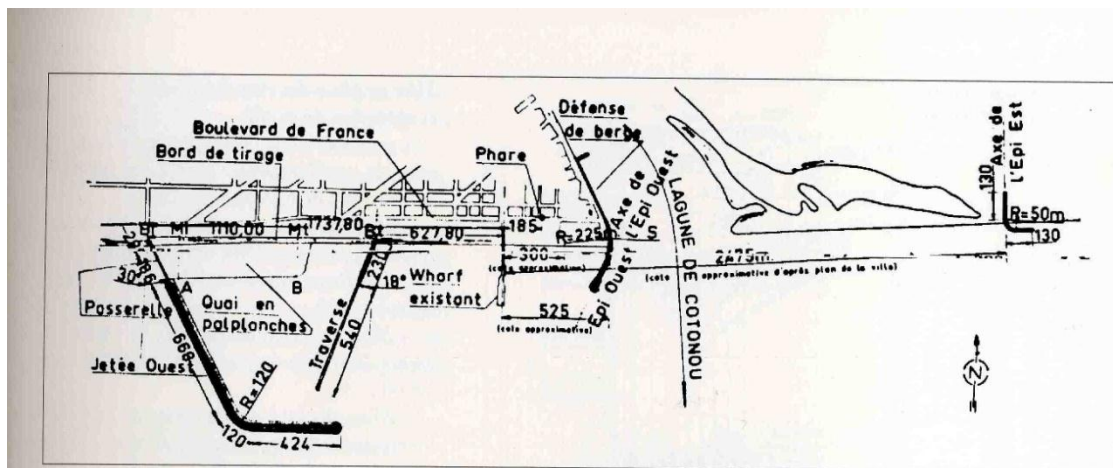


Diagram N°01: The first port and protection infrastructures built at the same time as the port facilities

IV.1.2 – Protection infrastructures constructed during the port installations extension work

The infrastructures affecting the bed load dynamics on the Cotonou right coast were built during the first extension Cotonou port facility (1979-1982) and during the recent works constructed with the financing granted by the Millennium Challenge Corporation (MCC) of the United States of America (2006-2011).

This is the construction and extension of a sand blocking breakwater built not far from the port west dam and continuing offshore to hit – 13 meters hydro depth. This infrastructure which is as at today approximately 600 meters long was necessary to continue blocking the sand transit in order to fight the sandbank obstructing the accessing channel and the port entrance channel and to get more space offshore.

IV.2 – Coastal infrastructures constructed at the same time as the Port facilities

A study was carried out on the coastline extension project as a result of the port facilities construction thanks to a physical template designed in the SOGREAH hydraulic laboratory in Grenoble France (Ref. 25).

The model analysis enabled to understand that the coast was stretching not only towards the western region of the Port but also the Eastern region was undergoing erosion resulting from the sand transit blocking.

A major part of the Cotonou city comprising businesses, buildings of the Chamber of Commerce and the industrial zone were constructed on the affected zone.

The Cotonou lagoon located at about 1,200 meters from the port was also in this zone.

Appropriate measures were taken in order to protect both the threatened part of the city as well as the lagoon shores. A study was conducted and as a result, a set of facilities were constructed as follows:

- A breakwater (called the West breakwater) rooted in the corner of the sea shore and in the extension of the lagoon western shore
- A (80 m) shortly long breakwater to limit the moving of the channel to the West
- A longitudinal protection between both infrastructures
- A breakwater (called « East breakwater » or « Sifato breakwater» was constructed at about 2 kilometers from the Western breakwater was established.

The shore located between the port and these facilities should become steady in the long run after slight drawback movements.



PHOTOGRAPH No.01: view of the west breakwater, the sand arrow and part of the dam



PHOTOGRAPH No.02: An 80 m shortly long breakwater on the lagoon



PHOTOGRAPH No.3: The western lagoon shore longitudinal protection at a point located between the western breakwater and the breakwater in the lagoon

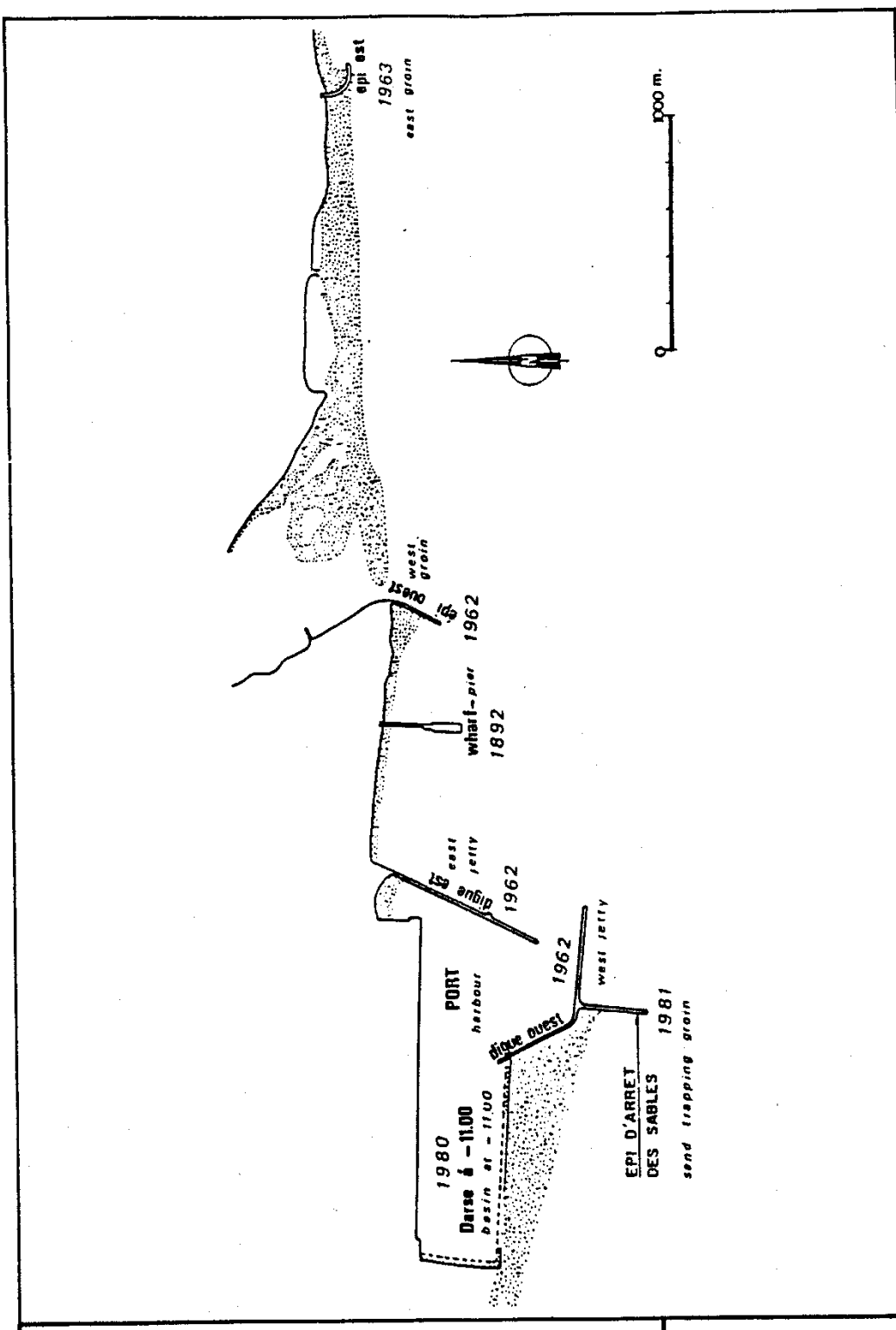


DIAGRAM .02: This diagram shows the Cotonou port and coastal facilities after the first extension of the port prior to the most recent works as well as the ongoing ones with their establishment years.

IV.3 – The coastal facilities under construction

As indicated above, the port west dam which blocked the entire sand transit and the coastal segment located between the port and the latest coastal protection infrastructure (the East breakwater or Sifato breakwater) having being stabilized, the expected erosion was transferred on the coastal part located on the east of the protected zone (on the East of the East Breakwater). A serious erosion developed as from this part. Immediately on the east of this zone, at the place called "la Crique de Cotonou", more than 600 meters wide of land strip has been lost since 1963 that is an average erosion rate of more than 12 meters per year.

As part of the coast protection East of the East Breakwater, a project the works of which are currently in progress was initiated by the Ministry of Environment. The coastal facilities envisaged in this project are shared between two (2) zones and include:

- **Zone 1** : (see diagram. 03)
 - ✓ New East Breakwater (East old reoriented breakwater): 250 meters long
 - ✓ 290 meters beach surface covering with loose boulders orientated towards the coastlines;
 - ✓ A 160 meters long breakwater with 15 meters long ground berthing; it looks like an **L** facing the west to prevent the sand erosion from the segment constituting the zone 1; it should also be reinforced on the establishment point in order to prevent erosion on the East.
 - ✓ Provision of 340,000 cubic meters sand (Phase I)
 - ✓ A second phase for the provision of sand is planned for later in order to reinforce the zone if necessary.

- **Zone 2** : (see diagram 04)
 - Breakwater 2 to 7: breakwaters 2 to 7 will be 30° degree-angle in relation to the coast in order to prevent erosion to bypass them on the east face. They are 160 meters long with a 30 meters long berthing on the ground, far on the east of the system, a 50 meters long berthing should be built on the ground on the east of the system. This infrastructure will cover a 180 meters long total surface. The spacing between the breakwaters varies between 900 meters and 1.100 meters. As far as possible, breakwaters should be established on places which will prevent the destruction of buildings existing before the beach stabilization. .

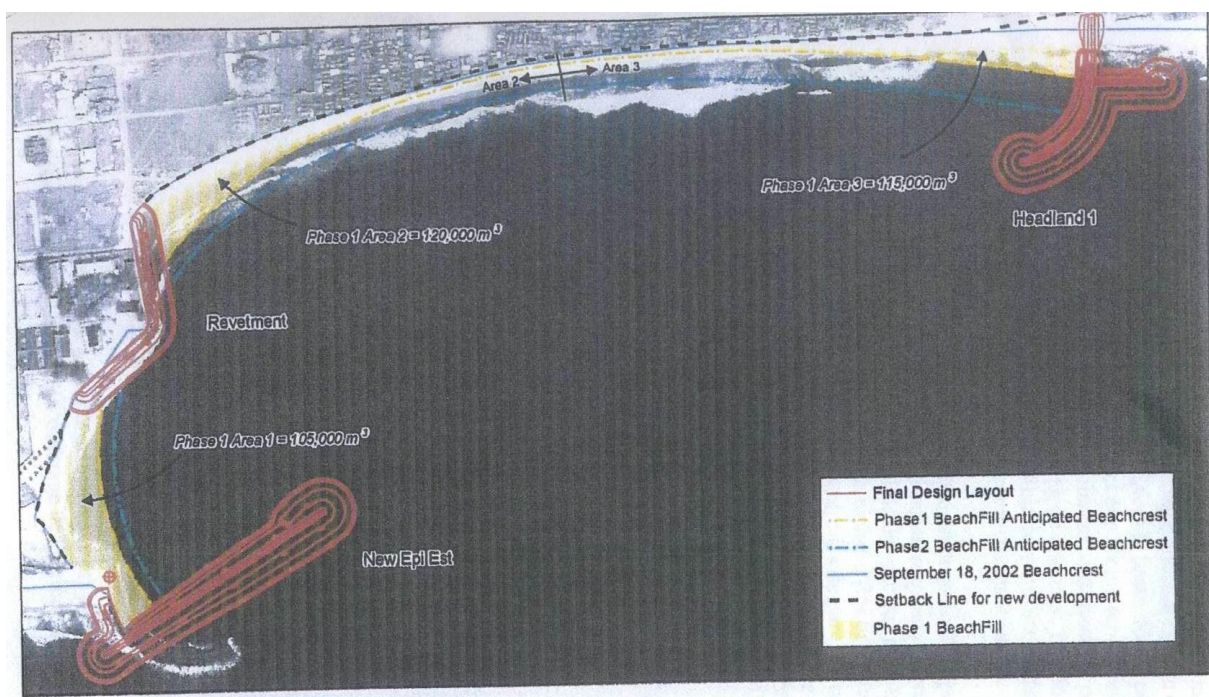


Diagram No.03: geographic location of the Infrastructures 1

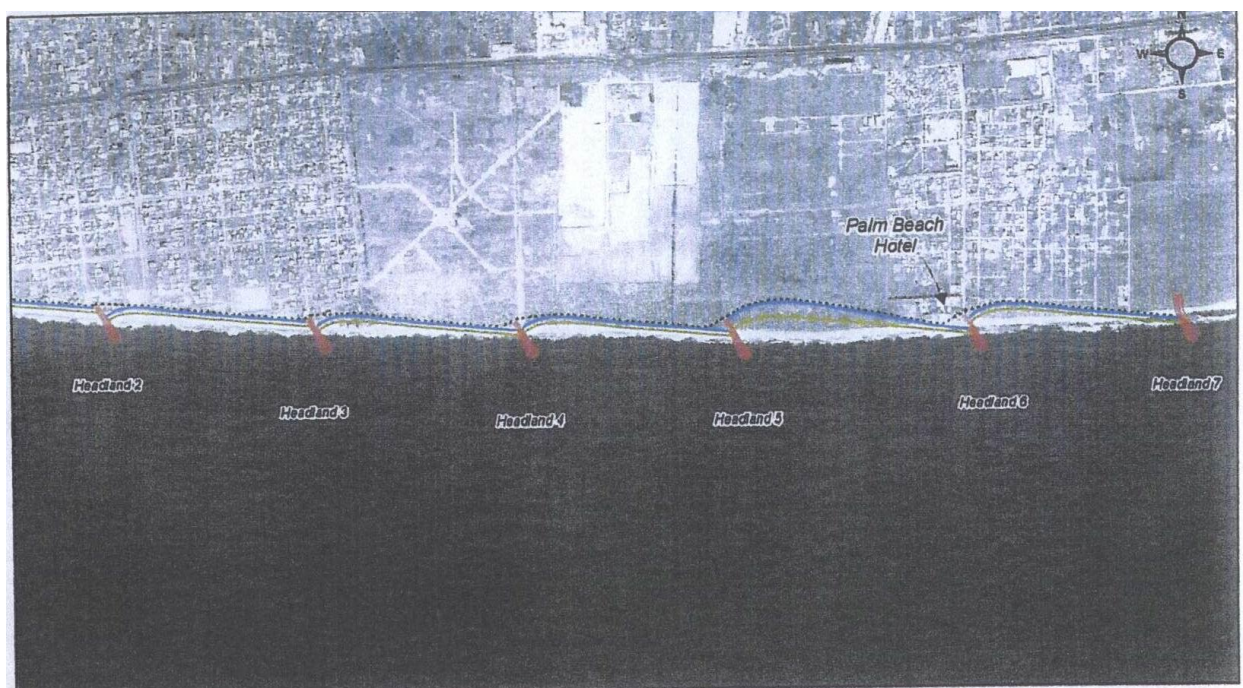


Diagram No.04 : Infrastructures geographic location 2

CHAPTER V: Analysis of coastal and Port infrastructures impacts on the Cotonou lagoon shores

V.1 – First port Facilities impacts

As indicated above and as a sequel to the Cotonou port construction, lagoon shores and lagoon outlet protection infrastructures were established. These are the following:

- a breakwater (called West Breakwater) built on the marine coast and on the lagoon west coast extension;
- a short length breakwater in the lagoon and which is meant to restrict the moving of the channel towards the West ;
- a longitudinal shore protection infrastructure built between two (2) infrastructures.

The entire infrastructures have been built with loose boulders collected from the Dan quarry, in the central region of Benin, which lies 140 kilometers north of Cotonou. But they were protecting only the lagoon outlet west shore. The lagoon bed located between the outlet and the old bridge and the east coast continue to wear away. The lagoon is permanently opened offshore. This highly increases the lagoon and the Nokoué Lake salinity which resulted in serious consequence on fishery activities.

Due to challenges induced by the lagoon permanent opening, a lagoon dam was built. (Photograph No.01, 06 and 07). This is to partially close the outlet during low water and to favor flood flow during the rainy season. The dam was built on a coast and was 0.4 m higher than the one referred to in the project. Even before the construction completion, the outlet was closed in May 1978. This prompted Cotonou flood to resurge. Between 1977 and 1984, the outlet was artificially opened between September and October in order to drain off the Ouémé and Sô Rivers flooding. Unfortunately, it closed again within a few days. In 1984, after several failed attempts to artificially open it, (the outlet closed in a few hours.), the riparian fishermen lopped the dam in October 1984 and the opened outlet still remains. Till date, the outlet has never been entirely closed. It widens during flood and narrows down during low waters but it was never entirely closed.

But regulation issues at the outlet level were not entirely resolved even though the water salinity cycle gets improved.

If nowadays, fishermen confess that fish production has increased since the opening of the outlet in October 1984, they think that both its location and the presence of the dam hinder their fishing activities.

As part of the study relating to the sanitation of the Porto-Novo and Cotonou cities, a study on the outlet lagoon drainage project was conducted by SNC-LAVALIN in order to better understand the issues of sea-lagoon exchange regulation. This project is presented below with a few comments.



PHOTOGRAPH No. 4: The lagoon outlet opening on Thursday, January 31, at 3:00 pm



PHOTOGRAPH No.05: Another view of the opened outlet



PHOTOGRAPH No.06: Here are the lagoon dam channels (there have never been closed as originally planned)



PHOTOGRAPH No. 07: The dam is entirely flooded during half tide.



PHOTOGRAPH No. 08: The Cotonou lagoon first dam foundations which were threatened by the erosion of the bottom of the lagoon outlet

The lagoon shores instability issues have become more acute at the lagoon outlet level than on the other lagoon shores segments.

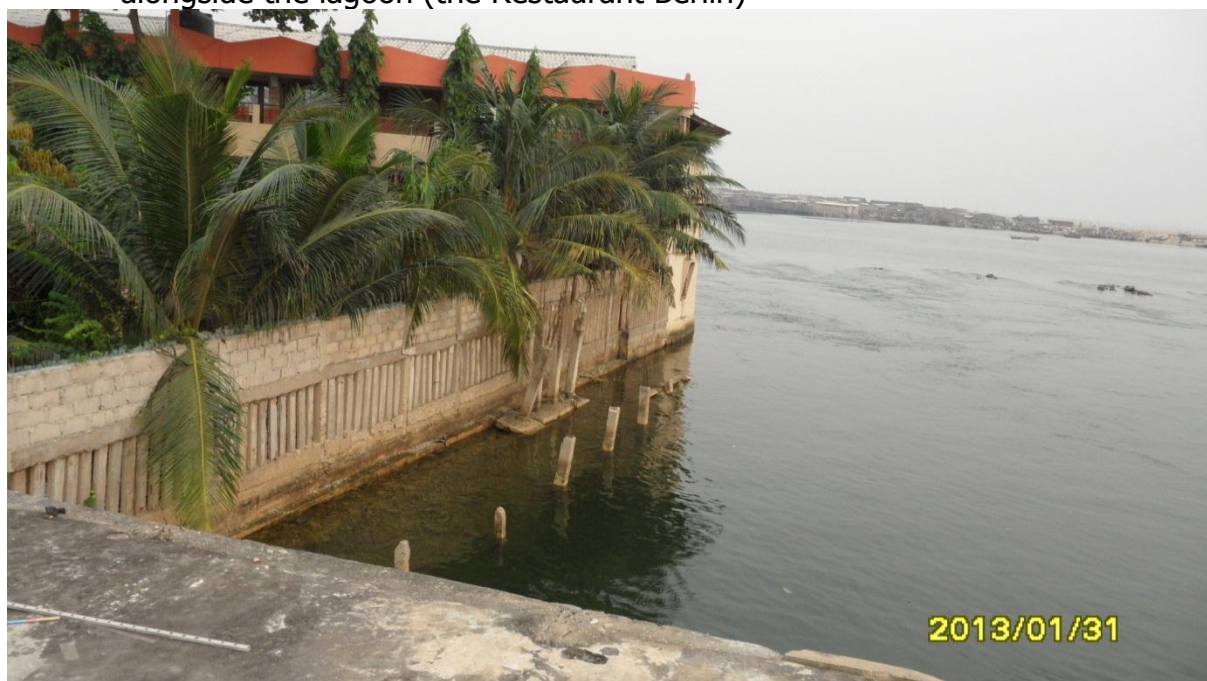
In fact, the issue of lagoon shores instability encountered is due to the overflow during flood and the longitudinal currents along the lagoon shores. The said currents speed increases during the floods drainage.



PHOTOGRAPH N°08: The Hôtel du lac alongside the lagoon between the old bridge and the dam



PHOTOGRAPH No.9: Protection of the front floor of a restaurant alongside the lagoon (the Restaurant Berlin)



PHOTOGRAPH No.10: Another portion of the Hôtel du lac



PHOTOGRAPH No.11: Other tourist facilities alongside the lagoon between the bridge and the dam.

V.2 – The most recent infrastructures impact

V.2.1 – Infrastructures meant for the east coast protection of the East breakwater

The basic function of the coast protection breakwaters is to protect part of the coast located upstream the sand transit direction (the West part in the case of Benin coasts). Since a range of breakwater should be constructed as in the case with this project, a dynamic equilibrium should be reached in each compartment (a coast segment circumscribes by two consecutive breakwaters) after some time. Before achieving this equilibrium, the shoreline rotates between the two strong points made by both breakwaters delineating the compartment which is the coastline which tends to become orthogonal to the wave crest direction. Under these conditions, there is an erosion at the downstream root of the of breakwater located at the sand transit upstream (this erosion at the East rooting of the breakwater demarcating the West compartment as far as Benin coast is concern) and a growth at the upstream rooting of the downstream breakwater.

Besides, the coast protection by means of breakwaters transfers the erosion on the downstream coast segment (in comparison to the sand transit direction) included in the protection infrastructures. The East coast of the last breakwater of the infrastructures of this project will intensively erode after the infrastructures construction.

The East protected coast segment shall be affected by the protection infrastructures. The Cotonou channel and its offshore outlet located in the west of the protected zone are not directly affected by the protection infrastructures impact.

One might believe that the changing of the direction of the West breakwater provided in the project could cause sedimentary moves at the level of the coast segment located between the West and East breakwaters between which is the lagoon outlet. But if one takes into consideration the direction of the coastline on this dynamic balanced segment, it should be little sedimentary move before the dynamic balance of this zone.

V.2.2 – The Cotonou port and sand stopping breakwater and its extension

The (305 meters) long sand stopping breakwater constructed between 1980 and 1981 during the Cotonou port first extension works and which was made 300 meters longer in 2010-2011 by means works funded by the Millenium Challenge Corporation of the United States and meant to block the sand transit which was bypassing the port West dam causing a sandbank in the access channel, the port channel and basin. One could believe that this infrastructure could worsen the sediments deficit in the port east and increase the lagoon outlet and coast level erosion.

This was the main concern for both the port authorities and the financial partners before the construction and extension of this infrastructure. The studies carried out (ref. 4 and ref.30) revealed that this infrastructure has no influence on the port east sedimentary situation. The coast erosion is neither increased nor alleviated. Sediments which used to bypass the West dam and the first sand blocking breakwater do not move upstream to feed the sand transit in the erosion zone on the East of the East. The construction and extension of the breakwater did not increase the sediment deficit in the port east zone prone to erosion.

So in a nutshell, the new coast protection infrastructures built in the East of the Siafato breakwater under construction and the recent port facilities seem not to significantly impact on the Cotonou lagoon shores.

However, just as the sand transit started bypassing the port west dam generating a sandbank in the access channel, the port channel and basin aged 40 years, the climate change impacts especially the sea-level rise and fierce winds, in a short or long term, could cause undesirable risks on the lagoon outlet (sandbank or sediment deficit). That is why the riparian communities should pay careful attention to the zone in order to timely bring the corrective measures together with the port authorities by prolonging by 300 meters longer the sand blocking breakwater in 2010-2011.

CHAPTER VI: Sea-lagoon exchanges regulation proposal

Actions taken during the Cotonou port construction and the erection of the lagoon dam from 1976 through 1977 helped to cushion the lagoon shores erosion. But some challenges still are to be taken up because on the one hand, flood and extreme weather events resulting in water-level rise on lagoon shores and, on the other hand, there is a poor regulation of the sea-lagoon exchange. In order to take up this challenge, some studies were recommended and carried out by LAVALIN and the Benin Bureau IGEA as a sub-contractor. The studies outcome required the following actions to be taken:

- Rehabilitate the lagoon dam, the crest of which should be leveled on the coast to hit + 0.635 meters hydro (+0.1 m IGN) and the narrow regulating outlets should be better re-sized;
- Construct at the right side of the outlet, a second breakwater to ensure a convenient, adequate and stable flowing section; this infrastructure should have a flowing section in the sequence of 500 m² and be a "rubble mound breakwater".

These infrastructures should be useful for:

- A better evacuation of the Ouémé and Sô floods: waters depth in the Lake and the Channel shall not, within a decade, exceed + 1,775 hydro (+ 1,24 IGN)
- A better mastery of the Nokoué Lake salinity during the low water period. A salinity lower than 7 g/l every time and 4 g/l during 7 months out of 12 for the entire lake, salinity inferior to 10 g/l for the lakeside zone located near the channel,

Le coût de la réhabilitation ou de la construction des ouvrages était estimé à 3,225 milliards de francs CFA. L'étude date de 1994. C'est une étude de faisabilité commanditée dans le cadre du Projet d'assainissement des villes de Cotonou et de

Porto-Novo (réf. 3). The infrastructures rehabilitation or construction works cost was estimated at F CFA 3.225 billion. The study which revealing that amount dated back to 1994; that was a feasibility study funded as part of the Cotonou and Porto-Novo cities sanitation (ref. 3).

The project was not implemented due to the lack of funding. But before SNC LAVALIN INTERNATIONAL carried out its study in 1994, the fishermen expressed their belief that the dam low level would cause the poor sea-lagoon exchange regulation and as a result their activities would be affected. This led them in 1984 to destroy part of the dam crest in order to allow flooding water to easily flow through. Likewise, the Lagoon mined sand sellers started mining the sand spit and the growth of that activity caused a blockade of the Lagoon outlet blocking.

The updating of this study is part and parcel of the Regional Anti-Coastal Erosion short term Plan (1 or 2 years) of Component 3. The program was approved by the West African Economic Union (WAEMU) Ministerial Meeting on April 6, 2007. ***Since the fishery communities have been experimenting the dam crest leveling efficiency for the past 30 years, this action could be conducted in partnership with the relevant authorities without waiting for the additional studies the outcome might still remain unavailable for many years.***

When the additional study will have been carried out, taking on board the evolution of physical and hydrologic conditions and the opinions of the true stakeholders such as fishermen, and given the relevant evidence substantiating the construction of a second breakwater on the right side of the lagoon outlet, additional funding could be sought for its construction in order to ensure an adequate and stable flow area.

Besides, another facility seems to be playing an important role in the ecosystems and human communities' protection within the lagoon environment and the coastal segment located on the west of the east breakwater. This is the breakwater on the west, built in 1962 at the same time with the port infrastructures. This structure has never been maintained since its construction. ***It is advisable to carry out a thorough inspection of the infrastructure for its rehabilitation to be brought to fruition in a medium term period by the Port authorities.***

CONCLUSION AND SUGGESTIONS

This study helps to list the hydrologic and hydrodynamic conditions at the Cotonou Channel level with the presentation of the main (fluvial and oceanographic) factors affecting them. The impacts of Cotonou port and coastal infrastructures on the channel have been analyzed. According to the study, the significant impacts are caused by the first port facilities and the coastal and lagoon shores protection infrastructures between the outlet and the Cotonou old bridge.

As the fishermen representatives pointed out during the meeting held with them, the main concern is related to the sea-lagoon exchange regulation. The Cotonou Channel outlet into the sea should help, on the one hand, to drain off the overflow of the

Ouémé and Sô Rivers and, on the other hand, to maintain the salinity within the channel and the Nokoué Lake at a level consistent with the fishing activities of communities living alongside these sailing areas.

Only good water resources development project elaborated by taking into account the hydrologic and hydrodynamic conditions affecting the channel water could help achieve these two objectives.

For this purpose, the following three actions should be prioritized:

- 1) The lagoon dam rehabilitation as its crest should be leveled on the coast to hit + 0.635 meters hydro (+0.1 m IGN) and the regulating outlets. (*this project provided for it.*);
- 2) The update of the studies pertaining to the lagoon outlet sanitation carried out in 1994 by SNC-LAVALIN, a Canadian Consultancy Firm relating both to the improvement of the dam in the lagoon and the opening of a stable outlet taking into consideration the hydrologic conditions of the lagoon-river complex in the South of Benin including the Ouémé and Sô Rivers, the Nokoué Lake, the Porto-Novo lagoon and the Cotonou Channel (*this activity is already listed in the WAEMU / Regional Plan for Coastal Erosion Fighting*);
- 3) The West breakwater inspection in order to find out, shall the need arise, any necessary rehabilitation work. (*This falls within the duties of the Cotonou Port Authorities*).

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ADAPTATION FUND

NATIONAL ENVIRONMENT
FUNDS (NFE)



MINISTRY FOR ENVIRONMENT
HOUSING AND TOWN
PLANNING (MEHTP)

ADAPTATION FUNDS TO
CLIMATE CHANGE (AFCC)

Project on the Cotonou lagoon ecosystems and human communities' adaptation to the impacts of sea-level rise and extreme weather events

Costs-effectiveness studies concerning the options of the project on « the Cotonou lagoon shores ecosystems and human communities adaptation to the impacts of sea-level rise and extreme weather events.

Draft 2

Prepared by Ir. Krystel DOSSOU

Under the guidance of Professor Nestor AHO

Cotonou, February 2012

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1. Introduction

As part of the project on the Cotonou lagoon shores ecosystems and human communities' adaptation to the impacts of sea-level rise and extreme weather events, Benin, in January 2012, submitted a Project document. In furtherance with the review of that project draft in March 2012, the Governing Board of the Climate change Adaptation Funds (Bonn) recommended additional studies. That is why this study stems from a series of studies enabling to capture the observations raised by the Governing Board of the fund, and eventually, draw up the final proposal of Benin project.

It is worth recalling that one of the key objectives of the project is to take and implement appropriate measures in order to protect the Cotonou Lagoon shores through a series of construction of civil engineering *facilities*, anti-erosion control restoration and rehabilitation of the riparian socio-community infrastructures threatened by the sea-level rise and the extreme weather events.

In this regards, the most relevant activities have been clearly identified and validated, including mainly, the construction of rocky protection infrastructures meant fit for the better functioning of the dam located at the mouthpiece of the Cotonou channel. Subsequently, the planning of the protection infrastructures construction is understood and justified due to their usefulness in the move to protect the Lagoon shores.

On the flip side, the shores floor surface types clearly raise the issue of the efficiency of the project resources allocation. As such, available options have been thoroughly considered in this study through a simplified analysis meant for a sound, judicious and sustainable decision-making for both the environment and the populations.

2. Objectives

This study basically aims at assessing the profitability of the project tagged: « the Cotonou lagoon shores adaptation to climate change. » submitted to the Governing Board of the Adaptation Funds for (PPCR). More specifically, this study aims to:

- Identify additional adaptation options when it comes to the protection of the lagoon shores, the rehabilitation and development of socio-economic infrastructures as well as the control of solid and liquid waste;
- Assess the options identified in the project identification sheet proposed by the stakeholders;
- Analyze the cost-effectiveness ratio of the adaptation options and project activities.

3. Methodological approach

The methodological approach used revolves around the following:

3.1. Documents Review and Analysis

The various documents have been gathered on specialized sites such (AFB, Climate convention), in libraries such as those of the departments of (FSA, FLASH, EPAC etc.) of the UAC (University of Abomey-Calavi) and in private documentation centers. The research papers include (IPCC, AFB) guidelines, reports as well national documents relating to coastal and lagoon shores zones.

3.2. Meetings with the communities affected by sea-level rise and its impacts

At this level, group discussions as well as semi-structured interviews with key stakeholders enjoying the lagoon shores were conducted. (See photographs and attendance sheets). Those groups essentially include socio-professional categories harnessing the Cotonou lagoon resources for earning their livelihood. Each of them has been briefed about the current idea of project in Benin. Information was collected on their experience, opinions, comments as well as proposals for the improvement of the project. As such, fishermen / women, shrimps processing women, lagoon shores users, private business operators (hotels managers, traders as well as entertainment and leisure facilities managers) established along the lagoon shores and those of Dantokpa market were met for the same purpose. The Cotonou Municipality Authorities especially the heads of town sections (4 and 5) and some heads of areas have been consulted. The most relevant propositions stemming from those exchanges are put forth in this report as options which served as background for the cost-effectiveness analysis.

3.3. Brief background and justification of the cost-effectiveness analysis.

The cost-effectiveness analysis is traditionally known as a decision-making technique based on a comparison of several interventions in terms of positive impacts and implementation costs. As part of this study and due to the challenge encountered towards getting the clear breakdown of the costs relating to the identified adaptation options enabling come up with a fine-tuned analysis of the project profitability, there is room for the cost-effectiveness to be justified. As a matter of fact, it enables to compare adaptation options in the perspective of the populations' adaptation to the detrimental impacts of climate change. In this regard, the benefits as well as social and environmental costs relating to the project adaptation measures shall be assessed for the overall populations living on the Project implementation areas.

Nevertheless, CEA has both advantage and limits. (Chart 1)

Table 1: Advantage and constraints in using the CEA

Advantages	Limitations
<ul style="list-style-type: none"> ✚ Clear elect-oriented communication tool bringing the outcome to a single quantitative indicator. ✚ Ex-ante evaluation tool for comparing the various measures with the identified objectives ✚ Visibility of the efficiency of an intervention 	<ul style="list-style-type: none"> ✚ Focused only on the main impact. Therefore, the technique is less suitable for a set of positive and/or negative impacts. ✚ The technique suggests that one should know how to carry out a quantitative estimate of the output (Impact analysis). ✚ A comparison reference should be available

3.4. Conducting the cost-effectiveness analysis

Generally, the practical application of the cost-effectiveness analysis of the options for the laying-out of the lagoon shores floor revolves around five main stages as follows:

- Definition of information repository;
- Assessment of the total project cost;
- Assessment of the project impact: choice of relevant indicators;
- Determining the cost-effectiveness ratio cost;
- Comparison and conclusion.

Practically, in the context of this study whereby the cost-effectiveness ratio will be estimated, an inventory of the potential options for the covering of the floors should (identified by the project and completed with external proposals) be conducted. Indeed, the currently available and presented financial costs in the project document are supplemented and in connection with the effectiveness expectation. The expectation for the effectiveness of the options is estimated based on a criteria-driven assessment method.

3.5. Rating methods for the options effectiveness

At this point, an option is declared useful when it meets the relevant selected criteria set as follows:

- Contribution to cushion the vulnerability to environmental risks and solve the described sanitation problems.
- Easy maintenance of the option (or its infrastructures)
- Environmental sustainability of the option.

Each option is assessed based on the allocation of scores for each criterion according to the modalities described in Table 2. That assessment is submitted to the judgment of experts based on the proven knowledge of the team members both about the study area

and the facilities to be constructed. Those elements are submitted to the populations' appreciation.

Chart 2: Assessment matrix for option effectiveness per criterion

Options assessment criteria	Modalities (and exclusive scores allocated)		
	Weakly satisfactory	Averagely satisfactory	Properly satisfactory
Contribution to cushion the vulnerability to environmental risks and solve the described sanitation problems (35)	10	20	35
Easy maintenance of the option (or its infrastructures) (30)	10	20	30
Environmental sustainability of the option (35)	10	20	35

For each option, the sum of the exclusive scores for the 3 criteria is 100. This report represents the effectiveness expectancy for each option. Eventually, the estimated costs are related to the effectiveness expectancy for each option. This stands for the cost effectiveness of each option. Therefore, the best option in term of «cost-effectiveness» is the option totaling the lowest cost-effectiveness ratio. Thereafter the results obtained are explained and submitted to the populations for validation.

4. Studies outcome

The various outcomes emanating from the discussions with the project stakeholders, consultations as well as calculation techniques are presented as follows:

4.1. Socio-economic benefits and socio-economic groups involved in the project

The socioeconomic groups interested in the project are the direct beneficiaries of the project or those who are directly affected (positively or negatively) by the project execution. These include individuals, community-based organizations, and local elects who will tap into the:

- infrastructures constructed through the project
- Capacities building for the grassroots stakeholders on the issues relating to the vulnerability and adaptation of their livelihood to, and the enhancement of their living conditions.

To be more specific, various social categories can be quoted. These include:

- fishermen
- fishmongers and seafood wholesalers (sellers of fishery resources which are processed or not).
- lagoon mined sand sellers
- restaurant operators
- managers of tourist and leisure establishments such as hotels, night clubs, gambling rooms
- dyers
- non-governmental organizations
- youth and women associations, physically-challenged people and various stakeholders such as (fishermen, fishmongers, lagoon mined sand sellers, traders and sellers of various products)

The secondary stakeholders are those who will influence the development project or those who will be indirectly affected. These include the government, the responsible Ministry, the project staff, the implementing Agencies, the SOGEMA (Market Administration Company), the NGO involved in the sector, private sector operators, banks and others development organizations.

Basically, the benefits to be drawn from the project are in terms of enhancement of the target populations living conditions and the lagoon shores protection. The construction of infrastructures will foster the organization of tourist and leisure activities. The sanitation of the lagoon will help to improve its physic-chemical parameters such as the restocking of the channel and the Nokoué Lake by the wildlife and fishery species, the shrimps or prawns and fish species reproduction in the sea before their migration into freshwater.

Besides, the fishery products consumers are also beneficiaries of the project since they will consume healthy products free from microbiological poisoning and heavy metal ions contained in the lake. As a result, the population living in Cotonou will be healthier, and cases of poisoning due to the consumption of contaminated fish will drastically decline. Moreover, companies such as Crustamer could resume their prawns processing and collection activities. Likewise, women and women groups working in the shrimps processing industry will easily make more profit.

Moreover, village communities such as (Ganvié, Aguégué and other) living on the Nokoué Lake and the Toché channel could also feel the impact of the mastery and the connection of the channel into the sea. Their ecosystems belong to the same lagoon and fluvial complex called the South West complex of Benin.

4.2. Options for the laying-out of the lagoon shores floor

The project's ultimate goal is to protect the lagoon shores, the community and social infrastructures. That is why the Project components 1 and 3 is a matter of acute attention with regard to cost-effectiveness analysis because it is the largest investments made by the project. In fact, it consumes about 85% of the total resources.

The options the project identified to lay-out the lagoon shores floor are supplemented with additional measures proposed or gathered and they are described and commented as follows (Table 2).

Table 3: Summary of the available options for the laying-out of the floor of the lagoon shores.

Actions identified for the laying-out of the floor of the lagoon shores and their description	Advantage	Limitation / Constraints
Cobblestone floor: Only cobblestones are used to lay out the 3 km linear floor of the lagoon shores	Mainly used for walkways; Facilitate the infiltration and trickling of rain water; Less constraint on the soil	Not so risky in case it is used for pedestrian purpose
Plant-covered floor: Only grassing will be used to lay out the 3 km linear of the lagoon shores	Less expensive than cobblestone floor Enhancement of the landscape value Contributes to air purification	Requires regular maintenance: cutting, needs water and fertilizer Man power recruitment Issue of provision of non-brackish fresh water
Floor laid out with the combination of cobblestone (30 % on the surface and grassing (70%) along 3 km	idem	idem

Table 4: Assessment of the cost effectiveness ratio per option level

Option	Unit cost (2012 Reference) in CFA francs / m ²	Criteria			Efficiency expectation	Cost effectiveness ratio
		Instrumental alleviating vulnerability populations environment and in the settlement of sanitation issues specified	in the of to hazards issues	Easy maintenance of the option (or its infrastructures)		
Cobblestone floor: only cobblestones will be used to lay out the floor of 3 km linear of lagoon shores	12000*	35		30	20	0.85 14117.6
Plant-covered floor: Only grassing will be used to lay out 3 km of lagoon shores	6500**	20		10	10	0.4 16250
Floor laid out with the combination of cobblestone (30 % on the surface) and (70%) grassing	8150**	35		10	10	0.55 14818.2

of 3 km long						
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*exclusive of cutters construction costs estimated at about CFAF 100,000 / linear meter for dimensions 0.60m x 0.60m

*exclusive of maintenance costs (irrigation, cutting and fertilizer costs)

5. Conclusion and suggestion

A cost-effectiveness analysis was conducted as part of the elaboration of the project on the Cotonou lagoon ecosystems and human communities' adaptation to the impacts of sea-level rise and extreme weather events. The outcome indicates that laying out the lagoon shores floor with cobblestone seems to be the best option in terms of cost-effectiveness. However, the selected option could be accompanied with the planting of trees or shrubs for air purification and for enhancing the landscape value addition.

The best option selected is substantiated by the costs resulting from both competing options that served as gist for the cost-effectiveness analysis; they are not only expensive but also less efficient. Both options fail to take into consideration irrigation, cutting or coppice as well as fertilizer or other costs. The irrigation issue is a serious concern since: (i) the ground water is salty and (ii) plants such as lawn do not withstand brackish or salt water. Laying out the floor with cobblestone will be the subject of an in-depth technical study coupled with the updating of the financial costs carried out by civil engineering firms in accordance with the governing practice. Surveying the shores soils, doing the altimetry or height measurement, purifying or not the material and filling up them with non compactable substratum are issues that could lead to the satisfactory construction of infrastructures meant to protect and sanitize the lagoon shores and make them sustainable for vulnerable communities.

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République du Bénin



Ministère de l'Environnement,
de l'Habitat et de l'Urbanisme

**Elaboration of the Project on the
Cotonou Lagoon ecosystems and
human communities adaptation to the
impacts of sea-level rise and extreme
weather events**



ADAPTATION FUND

Fonds pour l'Adaptation aux
changements Climatiques



Fonds National pour
l'Environnement

**Sustainable Strategies for the outputs of the Project on the Cotonou
Lagoon ecosystems and human communities Adaptation to the
impacts of sea level rise and extreme weather events**

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Study Report

Nestor AHO,
Cotonou, February
2013

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General Introduction

The West Africa coastal area is one of the world most vulnerable regions to climate change. Over the last thirty years, the often disastrous impact of climate variability and extreme weather events offers good evidence and is an early-warning sign of such vulnerability.

And as such, on completion of vulnerability studies organized as part of the Second National Paper on Climate Change (MEHU, 2011), it appears that the shoreline, water resources, agriculture, human health, energy and forestry are some particularly-vulnerable areas to climate change. On the basis of climatic and non-climatic scenarios set for the future evolution of the shore area and according to indications provided in the DIVA software, the sea level could continuously rise up to about 0,81m, over the period 2000-2100, confirming in so doing the projections of the Group of Intergovernmental Experts over Climate Evolution (IPCC, 2007).

In the coastal area, the climatic variability has increased heavy rains and flooding frequency enhanced by the sea-level rise. Flooding degrades the physical environment and the quality of life of the populations settled in areas periodically flooded and unhealthy. The populations are faced with the destruction of houses and socio community facilities, the upsurge of diseases, to human life losses. Stakeholders like the nature of the geological and soil substratum and the topographical configuration have aggravating effect on the vulnerability, especially at the level of the lagoon of Cotonou, of riparian populations and their economic activities. In areas of high density, human-induced unsuitable interventions and activities have worsened climate change impacts, standing very often as additional sources of the vulnerability to populations and resources.

Cotonou Port, built in 1962 as well as its two protective breakwaters constructed in 1963 are tangible illustrations. The latter brought about sediment deficit enhanced by the sea-level rise and Ocean currents changes. The sediment deficit has caused intensive coastal erosion, especially East of Eastern Breakwater or Siafato Breakwater (Fig.1). The consequences on the lagoon system result in persistent disturbances on ecology, on breeding patterns and fishery quality, on social transformation systems and populations health security.

If nothing is done, we might shortly witness the lagoon system degradation and, in particular, the loss of its related-biodiversity as well as the destruction of the social fabric which is part and parcel of the lagoon system.

Based on the foregoing, Benin Government has identified the *coastal area protection in response to sea-level rise* as one of its urgent adaptation measures in its National Climate-proofing Action Plan (PANA) drafted in 2007. In order to protect the Cotonou lagoon system and increase the riparian communities resilience, the Government submitted to the Board of Directors of Adaption Fund which approved it, a project identification sheet titled “ *The Cotonou Lagoon ecosystems and human communities Adaptation to the impacts of sea-level rise and extreme weather events*”. Besides the riparian populations, Cotonou Lagoon System daily hosts thousands of economic agents, namely traders and craftsmen of the Dantokpa and Gbogbanou international market, established along the shorelines and as such highly polluting these banks and deteriorating the Cotonou lagoon ecosystem.

The project implementation will induce the rehabilitation and construction of facilities which would guarantee the lagoon shores stabilization and protection, the environment-friendly operation of the lagoon system and the promotion of climate change adaptation culture among the populations. Beyond the project execution period, another key concern which would trigger the decision of the Adaptation Fund Governing Board is the sustainability of the infrastructures and best organizational practices for

the development of the resilience. When the project facilities come to an end, the post-project management is normally assigned to the beneficiary communities. Therefore, it is important to agree with the stakeholders on relevant and effective outputs sustainability mechanisms.

This study focuses on the participatory approach in the provisions which could help ensure the project outputs sustainability mechanisms. To this end, it will specifically be about:

- ✓ Identifying the stakeholders who could contribute to the technical, financial, institutional, sociocultural and environmental sustainability of the project;
- ✓ Determining the provisions and modalities of economic private operators' involvement in the sustainability mechanisms;
- ✓ Analyzing the post-project success conditions
- ✓ Propose relevant sustainability mechanisms options.

On study completion, a report will be drafted out, mentioning (i) the stakeholders able to contribute to the technical, financial, institutional, sociocultural and environmental sustainability of the project, (ii) the provisions and modalities of economic private operators' implication in the sustainability mechanisms, (iii) an analysis of the post-project success conditions and (iv) a proposal on relevant options of sustainability mechanisms.

1. Methodological approach.

Identifying the sustainability mechanisms for the Cotonou Lagoon Shores adaptation project required a series of activities groups including: (1) the literature review, (2) the organization of consultation meetings with the stakeholders and (3) analysis of the results.

1.1 Literature Review.

The literature review has enabled:

- The analysis of the existing documentation. An emphasis was laid on the climate change adaptation projects sustainability as well as the development projects sustainability and the development;
- The draft of an interview guide based on the literature review and the terms of reference of the study. The interview guide and terms of reference are appended to this report.
- The preparation and execution of the field stage jointly carried out with the other studies ordered as part of the elaboration of the project document intended for the Board of Directors of the Adaptation Fund.

1.2 Organization of Consultation meetings

The meetings were especially meant for the economic operators, Heads of Areas, Chairpersons of Areas Development Committees, professional associations (fishermen, fishmongers, traders, hotel managers and operators of bars, restaurants, and night clubs established alongside the lagoon banks.

The approach used is one of free interactive exchanges on the perception of development projects sustainability as well as the project sustainability requirements.

During the meetings, the main consultant gives an introductory presentation in the local language prior to the exchanges, in order to ensure that all participants have good understanding of the message. The presentation recalls the objectives of the Cotonou Lagoon shores adaptation to climate change, the outcome that the Ministry in charge of Environment,

Cotonou Municipality and all the stakeholders are rightfully expecting from the exercise, the process which culminated with elaboration of the project identification sheet and its adoption by the Board of Adaptation Funds and the issue of projects sustainability.

At the end of introductory presentation, the representatives of the stakeholders have been invited to propose sustainability strategies for the project outputs.

The exchanges have enabled to identify a great number of sustainability mechanisms the benefits and drawbacks of which were discussed.

1.3 Analysis of the outputs and elaboration of the evaluation report

A draft report study has been submitted to the National Environment Funds. After observations and amendments had been collected, the draft report has been fine-tuned into a final report which should be harnessed for the elaboration of the complete project document on the Cotonou Lagoon shores adaptation to climate change.

2. Sustainable development and sustainability of the outputs of the project on the Cotonou lagoon shores adaptation to climate change

2.1. Sustainable development

Without referring to the origins of the concept of human communities' development as defined after the 1945 second world war, and its sustainability, we can refer to an intermediate historical rendition presented by the Centre d'Expérimentation Pédagogique of Florac (CEP Florac, 1996) and complemented with the recent inputs.

The theoretical foundations of the sustainability have been established in 1980 by the International Union for Nature Conservation (IUCN) which proposed in its report on the World Strategy on Conservation, the wording "**Sustainable Development**", successively translated in French by "développement soutenable" then "**développement durable**" or "développement viable". In 1987, the publishing of the report "*Notre Avenir à tous*" ("*Our future*") from the World Commission on Environment and Development (the Brundtland Commission, taking this name from Mrs. Gro Harlem Brundtland who presided over it) enshrines and adopts the wording of "**Sustainable Development**" (CMED, 1987).

Having noticed the harmful effects of development which damages the resources over which it stands, undermining its own foundations, the Commission concluded that the economic development and environment issues should not be addressed separately. It defines the concept of sustainable development⁶ as the set of processes of change through which the resources management, the orientation of investments and institutions are harmonized and strengthen the current and future potential for meeting men's needs.

The results of the World Commission culminated with the creation of an international environment law: *Sofia and Helsinki Convention* on air pollution, *Basel Guidance and Convention* on waste, *Montreal Convention* for the chloro-fluorocarbons (CFC) control and the protection of the ozone layer, *Ramsar, Washington, Bonn et Berne Convention* for the

⁶ The wording « sustainable development » was created in 1987 during the working sessions of the world commission on environment and development following the publishing of an alarming report by the Club of Roma in 1972 entitled « Halte à la croissance ! (*Stopping Growth*) » . this report proposes a prospective study of the world population growth in 2100 from here, detailed with computer simulations based on the consumption rhythm of the natural resources at that time; an outstanding growth fallout of the population is expected due to the natural resources restriction and diverse pollutions caused by the existing economic model.

protection of nature, *Oslo and Paris Convention* for the protection of the Mediterranean area of North-East Atlantic, North Sea Convention on waste pouring and incineration at sea, etc.

The Rio de Janeiro (1992) World Conference on Environment and Development definitively enshrined the concept of sustainable development defined as a « mode of development which meets the present needs without jeopardizing the future generations' capacities to meet theirs». Sustainable development as such embodies the acknowledgment of the lawfulness of the economic and social development while attempting to reconcile development requirement with those of the environment-friendly and streamlined management of natural resources and areas. The concept of sustainable development also implies the temporary space reassessment with consideration to the short and long term impact of the decisions (Strange and Bayley, 2008). In this respect, it is being widely used nowadays (Baddache, 2010).

Rio declaration has sprouted the Convention on biodiversity and the agenda 21, catalogue of recommendations to be implemented for sustainable development.

Sustainability in its most comprehensive definition lies on the three following dimensions:

- *Social sustainability*: this is about building a human civilization based on a more equitable share and on met material needs, cornerstone of human development.
- *Economic Sustainability*: that is to think out of the box of an economic logic only based on the business criteria so as to assess economic effectiveness in general and institute a more effective global system (avoid or limit debts, deterioration of the terms of exchange, etc..)
- *Ecological sustainability* : it implies the consumption restriction of non-renewable resources, the decrease of the wealthier people's pressure on resources, enhancement of the efficient use of renewable and non-renewable resources

Yet, in the specialized literature, these sustainable development dimensions are still controversial, including the basic concept of economic growth and development sustainability.

2.1.1 Social Sustainability.

The most important component of social sustainability is institutional sustainability which can be well understood through the existence of sustainable institutions, meaning resilient social structures which maintain and reproduce over generations. The different approaches on institutional sustainability refer to the definition of this concept as part of programs (Brown, 1998), projects (NORAD, 2000), or management initiatives (Agrawal, 2002). The institutional sustainability refers to governance as bottom line insofar as it raises issues of institutions effectiveness, continuity and institutional mechanisms related to governance characteristics as defined by the international institutions (World Bank, UNDP, etc). The institutional approaches as results of apprenticeship activities (Hazel and Gordon, 1999), or output of procedural effectiveness process (Spangenberg and *al.*, 2002) support this vision.

Governance as a tool should help improve the effectiveness (Offler 1990 cited by Froger 2006)⁷ in the sense of effectiveness and of the lawfulness of the public policies, especially the sustainable development policies, by enabling a shared vision of sustainable development, improving the multidimensional and integrated nature of policies, strengthening policies implementation, transparency and apprenticeship of stakeholders as well as the monitoring of the implementation procedures Uphoff (1992) identified in local institutions five

⁷ For Offler (1990), governance «*capacity to make coherent decisions, develop effective policies having public and non governmental stakeholders coordinate in a fragmented universe*»

stakeholders of interest for partaking in sustainable development. This is about (i) a long term vision of productive activities, (ii) a more efficient and sustainable use of resources, (iii) a faster and less expensive change, (iv) improve conflicts resolution capacities, and (v) create common expectations and ground for cooperation going beyond individual interests. All around this restrictive report between the move towards a sustainable development and quality of democracy, Rumpala (2008) aroused the issue of governance requirements, not only as an objective, namely in terms of margin of maneuver as regards the processes of change within the institutions, but also in terms of governance efficiency and « stakeholders institutional maturity » (Rey-Valette and *al.*, 2009).

The analysis of those institutional requirements goes through the regulation systems leading, from a structural and functional point of view, to these modes of governance and their potentials of evolving towards renewed modes of governance. In this respect, Mathé (2009) in fishery and aquaculture systems, demonstrated the importance of the taking the stakeholders' values and representations into account along with injunctions, recommendations, law and rules on sustainable development. The latter directly operate by their normative nature and their strategies framing role, and indirectly by reinforcing the epistemic communities who have influence on representations. The epistemic communities are not necessarily considered in the unifying sense of Haas (1992) where the commonest is exacerbated. These are dynamic communities within which knowledge takes place and is shared and where the promotion of the culture of sharing is a social objective (Meyer and Molyneux-Hodgson, 2010).

These two factor types must evolve jointly in order to foster the effective implementation of sustainable development, especially throughout the stakeholders' participation in defining modes of management (Alban and Lewis, 2005).

2.1.2 Economic sustainability

In terms of economic sustainability of development, Billaudot (2009) identified seven distinct theoretical approaches, hard to reconcile, the assumptions of the beginning were so different. The economics came after the human communities had invented money and needs of exchanging goods. Besides, it willingly emancipated from the ethics which founds the social cohesion of these communities. Therefore, we can understand the embarrassment the economic modern called neoclassical with the conclusions of Brundtland Commission (Sen, 1987, 1993; Cordonnier, 2011; Amable and Palombarini, 2005; Lordon, 2006, 2010; Caillé, 2005a and 2005b). Developing these theses does not seem necessary here. That is why this development will be briefly restricted the economic foundation of sustainable development.

Indeed, the economics basically demarcated « the field of production and distribution of wealth », which basically encompasses human activities (Berthoud, 2002; Berthoud and *al.*, 2007). Since the social organization of this field changes through time, the economics also does. The one currently in force at the national level is *political economy*: science governing the production and distribution of wealth to the scale of the whole city-nation, without worrying about local economy or *oikonomia* of Aristote (Pébarthe, 2008; Billaudot, 2011). It draws its inspiration from the works on development economy, namely those conducted by Perroux (1981) and Sen (1993, 2003).

Of course, development is not restricted to its economic dimension. Economic growth, which has to do with the volume of available goods or wealth circulating at this level, is by definition a positive category, characterizing this science. Development is a goods indicating change that can be regarded as a social or human progress with regards to the different criteria which cannot restrict their economic aspect. If development implies economic growth, on the flip side, economic growth does not necessary lead to development.

In the **neoclassical growth model** with a natural capital whereby *growth and development* are quite confusing, they refer to sustainable growth (Beckerman, 1994). This concept is associated to a trajectory of growth (called optimal) with gradual exhaustion of these resources according to the optimal diagram of Hotelling (1931), to the same pace with the one of substitutes update induced by technical progress.

In this type of analysis, growth is regarded as the requisite for which the relationship between growth and environment pollution reverse. This issue carries along the optimistic message that sustainable development, which maintains the global capital, will impose by force of circumstances, justifying this way the liberal version of neoliberalism founded on the assumption of the perfect substitutability between natural capital and technical capital. The reality is of course plain.

The ecological economy built on a criticism of the assumption of the perfect substitutability between natural capital and technical capital helped understand that the economic system could not entirely separate from the social system. The research of the conditions of re-insertion of economy in the human systems gave rise to three schools of thought:

- *The London School* which requests public intervention still admits the possibility of substitutions between technical capital and natural capital, but the latter are regarded as restricted given the existence of a critical existing capital for which there is no substitute, like in the case of biodiversity (Pearce and Atkinson, 1993)
- *The school of industrial ecology* (Porter and Van der Linde, 1995) which thinks that a profound *institutional change* in the field of technical procedures may lead to a sustainable growth. The requirement is that there should be enough information (no transaction costs should be regarded as too high), to foster the spontaneous rise of private arrangements allowing the achievement of a system whereby elements are continually renewed, in other words, a nature-oriented industrial system. This is about a self-regulated institutional change geared by the enterprises showing voluntary commitment and within the framework of a win-win perspective (Jordan and Vivien, 2005)
- *The American school* (Coestanza and Daly, 1992; Daly, 1999), much more radical, believes that there is no substitution possible between the natural capital and the other components. The sustainability condition would then be that the natural capital remains constant through time, in a given physical composition offering ground for determining *environmental standards*. Only the lack of quantitative growth would enable to ensure sustainability; as a result there is an advocacy for a stationary achieved through the pressure of interventionist measures.

The confinement of the three schools of thought of ecological economy in the renouncement of the moral or ethical standards did not foster their opening on sustainable development.

Moreover, the *School of fair-minded negative growth* by Georgescu-Roegen (1971, 1993) applying the second principle of thermodynamics (*principle of entropy*) to the earth planet assimilated to a closed system as regards the non-renewable natural resources, concludes that there could not be any indefinitely linear economic growth. Development or growth sustainability would be an illusion (Latouche, 2006; Ariès, 2005). That would be the image of a belief in an unlimited world whereby «Human being is almighty» (Ariès, 2005).

2.1.3 Ecological or environmental sustainability

With the rise of ecological issue, an environmental (or ecological) dimension is added to the economic and social dimensions which are development-related: the three pillars of sustainable development are thus obtained (fig.1).). "Sustainable" means that development must be at the same time *equitable* (economically possible and socially acceptable), *viable* (economically possible and preserving nature, species and natural and energy resources) and *worth living* (crossing of the social dimension and of the environmental dimension). Sachs (1993) qualifies this development as *eco-development* and Harribey (1998) insists that it should be equitable. Getting access to it requires big institutional changes. But the nature of the changes yet to be achieved varies from one author to another. We then come up with the different points of views earlier mentioned.

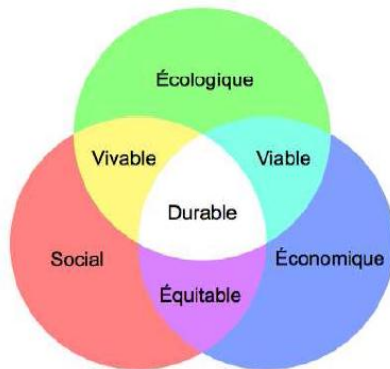


Fig.1: The three pillars of sustainable development. According to Passet (1979) and Veyret (2007)

From a formal point of view, the basic pillars of sustainable development remain the three social, economic and ecological pillars. Sustainability is at the intersection of the three dimensions.

The taking into account the three pillars implies that the economic, social and environmental objectives must be achieved in a parallel direction. The components are complementary and non competitive, even if the investors economic interests flows along with the interests of conservationists. The sustainable development looks for means of integration of the three elements so as to couple prosperity with environment (TRNEE, 2010).

The increasing weight of the endogenous knowledge and know-how in the management of ecosystems and human communities prompted the international community to give a more increasing importance to the fourth dimension of sustainable development, the one of traditions and knowledge peculiar to each area and each cultural context. This is about *cultural sustainability*.

The "*cultural dimension of sustainability*" and the different "*cultures of sustainability*" are a cross-cutting dimension which defines in their paradigm the systems of values, the standards and reality as human communities know it in their spatial environment. Assuming that the preservation of the living environment for the future generations is a requirement that each community should add up to the domestic dimensions of sustainability (ecological sustainability), the culture which goes beyond the physical frame was proposed on November 17, 2010, by the Third World Congress of United Local Cities and Governments in Mexico as being the one which should be the fourth pillar of sustainability. UNESCO took into account this proposal as one to be part of the pedagogical tools of Education for Sustainable Development (UNESCO, 2012). It is well in line with the first objective of the world Decade of cultural development, launched in January 1988 by UNESCO under the umbrella of the United Nations, in terms of the taking into account of the cultural dimension in development the same concern was taken back in the world declaration of UNESCO on cultural diversity (2001) and UNESCO Convention on the diversity of cultural expression (2005)

All in all, the humanist dimensions (social, cultural, ecological or environmental) of development which seem to be issues the modern economics has to deal with.

Development economists are the ones who borrowed the term *development* from biology to apply it to the human under the wording « *social progress* » any development is then beneficial to the given human group and this « goods » has been appreciated as such with

reference to the values that are dear to the present generations (example: being educated). The ecological dimension of the life of human beings in communities and the role of the social and environmental movements in the powerful rise of the ecology issue had not been integrated in the basic definition (Destais, 2011). Hence, why would individual groups ask themselves if the mankind could survive as species continuing to live by its current development?

It seems that the movements cannot be explained by an immediate economic interest meant to be defended faced with an environmental deterioration (Gendron, 2006).

By and large, the environmental dimension of development would leave the strict scope of modern economy the object matter of which is not widened to the interests of future generations. All the same, if economy is clearly defined as the field of production and distribution of wealth, on the flip side, what does the social pillar actually mean in economics?

2.2. Sustainability of the output of the Project on the Cotonou Lagoon shores adaptation to climate change

The sustainability of a project outputs translate their level of resilience after the financial support granted for the project had exhausted. Elaborating a sustainability strategy implies the mobilization of stakeholders in order to identify the criteria to be met so as to foster the maintenance, continuity or the development of those outputs by the beneficiary populations in an autonomous move.

The sustainability of actions will lean on the analysis while taking into account the various ecological, economic and social parameters at stake to integrate them into the stakeholders' capacities building, throughout monitoring-evaluation mechanisms – and their involvement in the dynamic and accountable management mindful of natural cycles. This approach is a balance between two requirements. The first is a development requirement to help improve the socio-economic conditions of the beneficiary stakeholders and increase their resilience faced with the consequences of climatic risks; the second is a sustainability requirement based on the necessity of socio-individuals behavioral change in order to protect the environment, better manage the natural resources and enable that best practices are replicated. At this junction, the pattern stakeholder means any natural or legal person affected by the project or likely to be influenced by it (Freeman, 1984).

Since the projects and the socio-economic development are geared to the same purpose, the sustainability of their impacts has the same social, economic and ecological components as the ones of development, discussed in Section 2.1 above. Despite the unresolved issues of the theoretical approaches that still divide the experts, projects are required to yield results as regards the sustainability of their outcomes. That is why the consensus view of experts in this exercise shall be used to shed light on stakeholders' inputs based on their field experiences and identify sustainability strategies as well.

2.2.1 Deliverables or achievements of the Project on the Cotonou lagoon shores adaptation to climate change

Deliverables which should be made sustainable at the project implementation completion are the major project outputs. They are divided according to the deliverables as follows:

For deliverable 1: Eight (8) kilometers shoreline are stabilized along the Cotonou lagoon over 4.5 kilometers with covering rocks, three (3) kilometers of paved walkways, accompanied by eleven (11) piers-jetties and eleven (11) special bungalows with concrete terraces to promote awareness creating activities at the level of the population regarding the adaptation to climate change.

For deliverable 2: Two hundred (200) mobile waste baskets are displayed in the vicinity of Dantokpa and Gbogbanou markets, two hundred (200) aluminum-based bowls and two hundred (200) waste baskets are availed to the Dantokpa Waste collecting Women Association, (200) pieces of small composting materials are availed to the Houéyiho Gardeners Association, sixteen (16) improved latrines with no interconnection with the channel water are built on the shores, the capacities of Navy Units are built for conducting night interventions at the Cotonou channel edge and awareness campaigns are organized for the dyers and oil products smugglers.

For deliverable 3: The Cotonou dam is resized in order to reduce the lagoon mouthpiece risks of obstruction and five (5) economic operators are involved in tourist activities development along the lagoon.

For deliverable 4: Climate change and adaptation strategies related-constraints are mainstreamed in the legislation regulating fishing activities along the Cotonou channel and thirty (30) former fishermen are redeployed in new economic sectors generated by the development of the channel.

For deliverable 5: Officials of the Municipality of Cotonou, Town sections and the riparian areas along the channel as well as the grassroots communities have raised their awareness about the adaptation capacities and development of initiatives regarding adaptation measures.

2.2.1. Stakeholders capable to ensure the project outputs sustainability

Numerous are the stakeholders that can play a role in maintaining the outputs flow for the Project on the Cotonou Lagoon shores adaptation to climate change. They can be divided into three teams:

a) Project strategic management team

This group is responsible for the development, implementation and monitoring and evaluation of the project. It is the political supervisory body that gives general guidelines on how the project is to be carried out, monitors its implementation, works for the mobilization of technical and financial resources for the implementation of the project Strategy and Action Plan and prepares the post-project. It will be composed of the Steering Committee expanded to the network of stakeholders responsible for monitoring the project activities and field outcomes, to the representatives of women and youth associations and representatives of NGOs and civil society.

If due to administrative affiliation of its members, the Steering Committee can effectively play its role as part of the project, after the completion and mission by the Committee, members do not have much margin of maneuver. From the project completion, the *Network of stakeholders for the monitoring of activities and outcomes on the field*, representatives of women, youth associations and NGOs as well as Civil Society will take over, based on the source of information and facilitation they can get from the civil workers of the former Steering Committee.

During the project implementation phase, strategic management Team sessions may be convened independently or in conjunction with the Steering Committee when items on sustainability issues on the Steering Committee meeting agenda. The joint sessions will be held when there is no risk of conflict interest dispute, since those stakeholders outside the administration may be involved in cases to be examined on the agenda of the Steering Committee meeting.

After the project completion, the Strategic management Team meetings will be convened by the stakeholders' network managers in charge of monitoring the project activities and outcomes on the field or by the Cotonou Municipality, the National Environment Fund or the Directorate of Environment.

b) Project technical management Team

This Team sets the priority areas of activities, supervises the project management in accordance with the established timing, studies and validates the terms of reference and surveys to be carried out as part of the project, advises on technical bids submitted by of companies and NGOs that are service providers, makes recommendations regarding the project management and technical sustainability of its outcomes, and eventually prepares the deliberations of the Strategic management Team. It will include the Technical Committee extended to representatives of the major professional organizations involved in the lagoon environment (fishermen associations, fishmongers, fishery products processors, lagoon mined sand sellers, traders, hotel-and-restaurant owners) and resource persons.

The Project technical management meetings will share to the same principles with the strategic management team sessions. As the project ends, the Technical Committee will cease work contrary to unofficial members of the *Technical management Team* who will continue to operate for the benefit of the *Network of stakeholders for the monitoring of activities and field outcomes* to which they belong. Henceforth, former members of the Technical Committee are an important source of information.

c) Stakeholders directly involved

These are the natural or legal persons receiving the positive impact of the project due to their physical or economic interests usually directly or indirectly compromised by the sea-level rise, floods, heavy rains, fierce winds and other extreme weather events. The indirect effects of climate change on populations' interests have destructive consequences including the lagoon shores erosion, Lagoon fish and prawns stock depletion, the lagoon filling with waste of all kinds running down the rivers. Those directly involved are fishermen, fishmongers, lagoon mined sand sellers, dyers, Dantokpa market traders and vendors, associations of fishermen, fishmongers and lagoon mined sand sellers, traders and sellers of various products, women and youth's associations of the neighborhood residents, as well as restaurants, hotels, bars, discos. It is also the Dantokpa Market Waste collecting Women Association and the Houéyiho Gardeners Association who are actively involved in solid waste recycling. Eventually, it is health centers, schools, technical departments of ministries such as the Fishing Department and the National Geographic Institute and other public institutions established in the lagoon vicinity.

Public establishments in the lagoon environment are specific stakeholders: if the technical departments of the central administration can be relocated to other places of the country and if the civil workers of the public institutions should serve wherever necessary, students, women and children and people living in the lagoon environment and enjoying the public services on the contrary will find it hard to shift residence. As long as the government is yet to make decision about relocating the headquarters of the central administration premises or to issue new assignments to civil servants, they are convinced that they must participate, as much as possible, in controlling the degradation of their working environment, just as the riparian populations get together to defend their living environment.

d) External stakeholders to the institutions in charge of the project management

This Team is composed of stakeholders directly affected by the project and the population in general. It is a lobby group which can make use of the medias and authorized channels to draw the national and international community attention on the technical or administrative management issues likely to delay the project or undermine the deliverables, especially when representatives of the civil society and the private sector in the management bodies are unable to alter the position of the administration over unfit solutions being taken or implemented. In

fact, the majority representation of the central administration in the project management units may not promote the balance of interests of the State and civil society.

The core stakeholders not involved in project management is a network of interest that could include Development Committees of riparian residents, women and youth organizations, professional organizations of the lagoon environment and key economic operators trading on the shores.

2.2.2. Project sustainability elements

Consultation meetings held with stakeholders enabled to identify the elements the operation of which would promote continuity and continuation of the project beyond the processes that will be incurred during the implementation phase, and the maintenance of erected infrastructures. These elements can be stated as follows:

a) Compliance with the national development policies and strategies elaborated by Benin Government.

This project is part of the national sustainable development dynamics initiated in Benin with the ratification of the United Nations Framework Convention on Climate Change and the Kyoto Protocol, on 30 June 1994 and 25 February 2002. This is one of the urgent measures identified in the National Climate-proofing Action Plan. The project aims notably at (i) meeting two of the seven major challenges identified under the Strategy for Achieving the Millennium Development Goal No. 7, coastal erosion and land degradation control and appropriate household and industrial waste management - (ii) empowering the municipal authorities, local-elect and civil society organizations for the implementation of sanitation measures and of the lagoon shoreline protection against erosion, (iii) putting the riparian communities at the center of the monitoring activities addressing the implementation of measures in order to increase resilience to climate change, sanitation and rational management of the ecosystem.

At the local level, the project had been identified under the denomination of "*Lagoon shores development Project*" and was part and parcel the Cotonou Town program titled "*Embankments Development Program*". It was intended for stabilizing and consolidating the two Cotonou Lagoon shores lying in-between the Ancien pont and Hindé Area (North of Dantokpa market). It appears from the consultation sessions held with officials of the Department of land affairs of the Cotonou Town top-level authorities that the project could not be finalized and run due to the lack of adequate financial resources, but remained one of the major priorities of Cotonou Municipality.

Therefore this project is likely to benefit from all the facilities from Benin Government and the municipality of Cotonou for taking political and administrative measures which ensure facilities maintenance and strategies for resilience and adaptation to climate change.

b) *Active Involvement of the beneficiary populations throughout the project development*

The project ownership by a large segment of the population is a basic requirement for the latter to take ownership project before, during and after implementation. This is also the condition of their commitment to the project outcomes, the outcomes they would gain and the measures they would take to extend these outcomes after the project completion. This ownership requires the effective involvement throughout the project cycle. It starts with consultation meetings and workshops currently organized with the stakeholders as part of the project elaboration process. This will continue with the planning of activities, implementation,

monitoring and evaluation during implementation, mid-term and final evaluation of the outcome.

In particular, the riparian areas development Committees and professional organizations of the lagoon vicinities will be empowered to monitor field activities (construction of facilities of shores protection and stabilization, rehabilitation of bodies in charge of regulating the exchanges between the Atlantic Ocean, the Lagoon and Nokoué Lake, setting up of small processing and management unit of solid and liquid waste, building the capacities of riparian communities and monitoring services of the lagoon transportations, etc.). riparian areas development Committees and trade associations shall also be associated to field visits organized as part of the activities of the project Management Team.

c) *Organizing and empowering a network of stakeholders for monitoring activities and field results*

Beyond the involvement of beneficiary populations in the implementation activities initiated by the project management team, it is more convenient to give them full scope to initiate follow-up activities of the project outputs. This does not imply the creation of a new committee the operating expenses of which would be source of financial problems during and after the project implementation phase. The riparian areas development Committees, women and youth organizations, professional organizations of the lagoon environment and the main economic operators trading on the banks will be organized into a network of interest. Tasks given to each member of the network for monitoring activities and results of the project will be achieved with as part of his common mission. Regular meetings will help share information, assess the actions and schedule new tasks.

During the development works of the draft project, most stakeholders have already made commitments in the form of letter of intent to participate in the monitoring activities of the project. The constitution of the network is therefore a matter of procedure. The purpose of the network is to promote ownership of the project by the beneficiary populations and bring them to ensure the continuity and continuation of outcomes and impacts after the project's end.

The network of stakeholders responsible for field monitoring will be involved in all the activities of monitoring and evaluation formally scheduled by the Management Group or Project Management Team.

In terms of methodological approach, the assessment method of reducing vulnerability called Vulnerability Reduction Assessment or (VRA / GEF) proposed by the United Nations Program for Development and the Global Environment Facility (UNDP, 2008) matches quite well. This method measures the perceptions of communities about the current risks, future risks, the adaptability, and the capacity of stakeholders to make the adaptation system viable (sustainability). The method is based on four indicators integrating locally-important issues throughout a series of 3 or 4 community meetings in the course of the project and after the project. It has two main functions: projects are independent to the communities they are meant to serve, and information is generated (collected throughout the project implementation) to steer the projects implementation and prepare for the post-project.

d) *Institutionalizing the project outputs*

At the end of the project, the outcomes will be integrated as appropriate to the heritage of the Municipality of Cotonou (Departments in charge of Lands, Environment and Technical Services at the Town Hall of Cotonou), the state property (bodies in charge of Environment, Housing and Urban Development at the Ministry of Environment, Housing and Urban Development, Structures of other departments (Autonomous Port of Cotonou, Fishery, Navy, home trade, SOGEMA, etc..) for their ownership by the communities of 3rd, 4th, 5th and 6th Land districts, the private sector and civil society (long-term effect on attitudes and

behaviors). Promoting Partnership for facilities management whereby co-financing would ensure the financial sustainability of the outcomes in an organized framework. Specifically, after the closing of the financing of the Adaptation Fund, the financial obligations associated with technical interventions for maintenance or facilities servicing will continue on equity of the town hall of Cotonou (Department of Economic and Financial Services), of the Government (National Fund for the Environment, National Fund for Tourism Development and Promotion) and on the outputs, contract-owned by the economic operators, on the 11 special hangars with concrete terraces to be built to promote public awareness on adaptation to climate change. In these hangars, economic operators can conduct compatible profit-generating activities jointly with resilience-promoted activities of the populations. Products from other partnerships aiming at promoting a clean lagoon environment (water sports, floating restaurants, etc.) will be useful inputs to these resources to ensure financial sustainability of the project outcomes. Tourist taxes amounting to CFA francs 500 per night, currently in force in all hotels in Benin and of which profits are meant to improve and service the tourism facilities are a model to use for the identification of additional resources.

e) Building the Project Stakeholders' Capacity.

The objective consists in creating an environment conducive for climate-proofing activities while contributing to create awareness about climate change, adaptation measures and intention management as well as the project outputs. The target stakeholders (planners, policymakers, interest groups, etc.) should be kept abreast of, and involved in the project implementation in order to ensure a smooth understanding of the information, behavioral changes and the willingness to take decisions. The project management mechanisms should also ensure that the lessons learnt are not lost, but rather disseminated and underscored as part of the apprenticeship mechanisms. A special attention shall be granted to national institutions that will provide the basis for the elaboration and implementation of the central activities as part of the project.

Capacities building modalities will depend on the beneficiaries' needs which should be assessed from the process inception in order to identify the loopholes and set a benchmark for future monitoring & evaluation. According to the stakeholders' groups, it will consist of:

- Sharing knowledge with the stakeholders on the major terms and concepts like climate change, vulnerable communities resilience and adaptation strategies within the coastal and lagoon environment;
- Promoting apprenticeship and institutions empowerment;
- Building capacity in terms of project understanding and management as well as the transfer of knowledge for the adaptations options to be implementable;
- Reinforcing the technical knowledge and understanding the causes and effects of the changes occurring along the shorelines level due to the climate change;
- Collecting, storing and disseminating the lessons learnt best practices and information documents pertaining to the project.
- Organizing exchanges likely to affect the achievement of the objectives, the disadaptation risks linked to politics, people's practices or the project as well as the existing opportunities in order to back-up the implementation of adaptation measures.

Regardless of the capacities building themes at stake, the implementation shall pass through communication activities, seminars, workshops, monitoring & evaluation and technical support.

Communication should be a permanent activity. It should not be restricted to the Project official launching ceremonies, launching of the major works sites or delivery of materials to the beneficiaries, ceremonies during which administrative, local and traditional authorities and the large public are informed about the existence of the project and its objectives. All the current channels should be made use of. In particular, the 11 bungalows envisaged to be constructed along the shores with a view to promoting the communities' resilience to climate change would strongly back-up communication activities. In addition to the photographs, posters, maildrops and other facilitation tools about climate change, those rooms could enable to exhibit the various reports written on the Project management Units. The proceeds generated by the partial rent of those spaces to business operators could cover the recurrent communication charges.

At community level, the participation in seminars and information sharing between the communities and the institutions as well as the awareness campaigns targeting the large public, the NGOs, the Private sector operators and National authorities will enable a knowledge sharing among the project partners.

The training of pupils and students on the project methods and assets will be part and parcel of the project deeds which contribute to capitalize and replicate the best practices and acquired experiences on other projects.

All the studies, maps, written documents of the projects will be published and distributed to the relevant interlocutors.

Monitoring-evaluation is a participatory process which enables capacities building and the application of the lessons learnt from the project experience. Undoubtedly, this is an important factor in the project ownership by the communities and subsequently ensures sustainability. But in order to draw all the benefits from their participation in the monitoring-evaluation activities, the communities should have been involved in the project activities planning and implementation processes.

It is worth observing that evaluation, according to its perception in this context, should not be restricted to the assessment of the level of achievements compared with those planned in the project document. Rather, it should analyze the project outcome and impacts in terms of local and global environment enhancement as well as the quality of life of the beneficiary communities. It should also explain if the project objectives regarding the Focal area of Adaptation Fund are achieved and, if not, analyze the reasons behind it. Those are the project objectives in line with the Adaptation Fund purposes as put forth in the Fund results framework.

Technical support could be required for some institutions involved in this project implementation and management. However, that will be exceptional insofar as most of the institutions involved in this project had been actively involved in the elaboration of the National Climate-proofing Action Program (PANA) and the National Second Paper on Climate Change (DCN). The Project Steering Committee will study on a case-by-case basis the needs in terms of technical support and modalities for meeting them.

3. Conditions for the post-project success

The conditions for the post-project success are identified during the project design and elaboration of the source document. In order to facilitate the project ownership along with its

results by the beneficiary communities and foster in so doing the communities commitment to sustain the earnings stream after the project completion, it is worth attaching a peculiar attention to the target communities' social norms of acceptance and their possible lines of regulation.

3.1. *Ensuring the acceptance of the project results*

3.1.1. Social acceptance dimensions

The social acceptance includes three dimensions (Wolsink, 2010):

- **Sociopolitical acceptance:** acceptance of the technologies, policies and frameworks laid down by the politicians and decision-makers, by the public and the major stakeholders;
- **Community acceptance:** acceptance of the facilities, promoters and managers, the authorities, the populations and other local stakeholders;
- **Market acceptance:** acceptance of incurred investments, financial risks, prices and taxes by the consumers, investors, target companies and the politicians.

Through its dimensions it is easily understood that the social acceptance admits two complementary definitions.

One of these currently-used definitions presents social acceptance as “the outcome of a process through which the concerned parties develop together the minimum conditions to be put in place to ensure that a project, program or policy becomes, at a given time, harmoniously integrated in the natural and human environment” (Caron-Malenfant and Conraud, 2009).

A second widely accepted definition rather refers to the notion of risk. The notion of social acceptance is directly linked to the perception of a threat that a project may cause to hang over the life or the quality of life in a given environment, thus on the use of goods and human activities in that environment. In this case, social acceptance is “the pre-empted acceptance of a short or long term risk going along with either a project or a situation”. A risk is regarded as acceptable by the community when it can bear its consequences and damages regarding the probability of its occurrence. (Beck, 2001).

Those two definitions are equal insofar as they provide the synthesis of the essential realities needed for understanding the social acceptance phenomenon. These concepts are not contrasting but rather complementary. For both of them, the social acceptance of a project does not consist in giving rise to the unanimous adhesion of the stakeholders, but to lead them to reach a consensus about the project.

3.1.2. Social acceptance variables

There are four variables likely to influence the social acceptance of a project: the promoter, project nature, the host environment as well as the planning and consultation processes used (Gariépy, 2009). The economic and environmental impact and risks studies (linked to extreme weather events) should provide back-up elements for the social acceptance.

The project initiator is usually able to adapt his project to each of those variables. He is therefore responsible for assessing, as soon as possible, the project risks and limitations according to those four variables while adopting the participatory approach for its elaboration in partnership with the target populations. In the case of the ongoing project, the elements considered are as follows:

a) The Promoter's reputation.

The communities' attitude towards the promoter is a variable likely to influence the social acceptance. The national mission assigned to the Ministry of Environment, Housing and Town Planning is to elaborate Government's policy in the domain of Land-use Planning, construction and control of works. As such, it is entrusted with all the prerogatives for the elaboration and implementation of this project in the interest of the Lagoon riparian populations. It enjoys the confidence of the direct target populations as well as the overall national community.

b) The Project nature.

Any project that would fail to meet the communities' needs can neither arouse their interests nor expect its outputs to be sustainable. This project oriented towards solving the recurrent problems of floods and other extreme weather events around the Cotonou Lagoon environment was initiated with the active participation of the target populations whose representatives' written commitment substantiates the nature of its ownership from the viewpoint of the human system aspirations to live in peace with the nature.

c) Relationship between the communities and their environment.

The host environment of this project is the most directly affected by the problems to be solved. The significance of this project is suggested by the vulnerability of its environmental characteristics and the precarious economic and social conditions of the populations. During the consultations meetings organized as part of the project document elaboration process, the community members raised the issue of the emotional relationship binding them to the family environments they have been living and working in for the past four to five generations, pointing out how they are bound to protect it without betraying the memory of their ancestors. Those historical ties spun between the nature and human beings in a system jeopardized by the climate change are the strong reasons behind the Lagoon shores communities' attachment to this project.

d) Planning and consultation process.

As part of this project, all the necessary measures for information, dialogue and adaptation put in place, their precedence as well as the coherence of their deployment are already planned in order to ensure an implementation in partnership with the stakeholders.

e) Anticipation on the economic and environmental impacts and risks

In order to increase the probability of the post-project success, a special attention should be focused on the economic and environmental impacts and risks while considering the basic values of the society. The issues taken on board in this project are:

- **The environmental issues:**
 - reduction of the Cotonou Lagoon water pollution by the solid and liquid waste;
 - reduction of the pressure on the Lagoon living resources;
 - fight against the climatic risks;
- **The social and economic issues:**
 - equal distribution of the project earning streams and an intergenerational equity;
 - creation of sustainable employments in a sanitized fluvio-lagoon environment;
 - Community's capacity to protect and control its resources;
 - respect and integration of the various social groups;
 - preserving and enhancing the population health and welfare;

- preserving and enhancing the population's quality of life;
- Respect the shores protection infrastructures capacity and fight against floods.

The constructive social acceptance approach started from the project inception; it should be pursued until the implementation completion. Thereafter, if it is carried out in this frame and proved to be conclusive, the social acceptance approach should be transformed into a neighborly approach within the communities, between public and private sector, between the communities and the administration. That will enable to take on board new stakes and problematic.

3.2. Anticipate on the possible lines of hindrance to the project earnings stream by developing the results upgrading plan

The social acceptance of the project and its results remains the prerequisite condition for the post-project success. Convinced about their interests, the beneficiaries of the sectors are getting well mobilized in order to counteract any hindrances likely to prevent the benefit from sprouting. Nevertheless, while formulating a project a sociopolitical and regulatory analysis of the environment enables to identify the hindrances that could occur at medium term and to capture them in the sustainability strategy. The potential hindrances that the consultations have helped identify are:

- The adverse community resolutions which could be taken as a result of the Regional Anti-coastal Erosion Program implementation, adopted on April 6, 2007 by the West African Economic and Monetary Union (WAEMU) Council of Ministers;
- The national legislation governing the marine and lagoon sand mining.
- The national regulation on the rivers and water bodies banks occupation.

Appropriate measures should be taken for the Project result upgrading plan.

Those hindrances lines and other potential handicaps should be developed in a document stating Project results' strategic upgrading plan. Right from the project inception, the elaboration of that plan will be entrusted to a taskforce including one representative of the direct beneficiaries, one representative of the local authorities and one representative of the Ministry in charge of Environment.

The Project results' strategic upgrading shall, among others, take account of the following steps:

- ✓ Adapt the upgrading stakes to participating stakeholders;
- ✓ Identify the results/experiences to be upgraded;
- ✓ Identify the target groups to whom those results should be directed;
- ✓ Determine the procedures;
- ✓ Determine the activities timing on three major phases of the project (planning, implementation, evaluation);
- ✓ Give a rendition of the upgrading activities.

4. Proposition of sustainability mechanism options for the Project on the Cotonou Lagoon shores adaptation to climate change

Based on the foregoing, it could be affirmed that, thanks to the interest manifested by the stakeholders there is room for the project results to be sustained. The judicious combination of the sustainability mechanism options reviewed during this study should lead to that end. That is:

- a) The effective participation of the mainly concerned stakeholders in the project identification works and the elaboration of the related-documents indicate the beginning of the sustainability mechanism which should be harnessed with the active involvement of the beneficiary populations all along the project cycle.
- b) The written commitment by the business operators, development associations and Head of the riparian Areas reached by this project, is an evidence of their availability to back-up the project as regards the implementation, monitoring-evaluation and results sustainability. This availability of the field stakeholders should go along with the availability of the Ministry in charge of environment, Cotonou Town Municipality and of the Project implementing Units management to effectively involve the direct beneficiaries at all the phases of the project cycle.
- c) Networking the professional Associations, Local development Associations, NGOs and the Civil Society Organizations and encouraging such a network to assume more responsibility would facilitate the integration of those stakeholders, their ownership of the project and the preparation of the post-project phase. The network will be established with the launching of the project as it is expected to appoint the beneficiaries' representatives within the management units and task force in charge of elaborating the project results' strategic upgrading plan.
- d) The project stakeholders' capacities building should be understood as a cross-cutting permanent mechanism consisting in delivering training on the relevant thematics, and providing technological support, should the case arise.
- e) Institutionalizing the project outputs by integrating its infrastructures in the heritage of Cotonou Municipality, Benin Government or local development associations will foster the maintenance of the works and the continuation of the earning streams. The tourist taxes principle amounting F CFA 500 per night which is currently governing in all the Hotels in Benin and its proceeds which are meant for the development and maintenance of tourist infrastructures will serve as source of inspiration for seeking financing sources without jeopardizing the private operators' interests. Institutionalizing the project output will also contribute to fostering the development of the lagoon environment which will be sanitized through the public-private partnership (water sports companies, floating restaurants, etc.). This mechanism is fostered by the similarity between the project objectives and the national development strategies and policies.

5. Conclusion

This study has enabled to identify about half-a-dozen sustainability strategies of which judicious combination could induce a sustainability system oriented towards the direct beneficiaries, Cotonou Municipality and Benin Government.

Since the stakeholders could contribute to the technical, financial, institutional, socio-cultural and environmental sustainability of the project, the exchanges with them have profusely focused on practical measures and modalities for an effective involvement of the private business operators in the sustainability mechanisms so as to ensure enabling conditions for the post-project success. Supported by the documentation, those exchanges culminated with the identification of the major sustainability stakeholders of this project and its outputs. The stakeholders who should play specific roles in the sustainability strategies were also identified. The mechanisms for an effective involvement of the private business operators, riparian areas development associations and other professional associations in course of the project elaboration are defined and implemented. Appropriate modalities for ensuring the sustainability of those mechanisms beyond the project document elaboration phase, the development of specific strategies for the implementation stages, evaluation and maintenance of the project earnings stream are worked out and proposed to be assigned to a taskforce of stakeholders yet to be put in place when the project will have effectively started. This taskforce will demarcate the mechanisms contours and the implementation will follow after validation by the steering committee.

The stakeholders will be assigned different roles, but all of them will be involved in the implementation of the propositions elaborated through their contribution.

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SCHEDULE 1: Terms of reference of the additional studies for drawing up the final Project document on the Cotonou Lagoon shores Adaptation to climate change.

I- BACKGROUND

The National Environment Fund (FNE), in its capacity of authorized national institution implementing the Adaptation Fund programs and projects in Benin, received an allocation for the elaboration of the entire project document titled “*Cotonou Lagoon ecosystems and Human Communities Adaptation to the Sea-level rise and Extreme Weather Events*” submitted to the Adaptation Fund and approved by its Board of Directors in March 2012. One share of these resources is earmarked for financing the additional studies of which performance shall enable relevant information collection on purpose of elaborating the Project final document. The basic information used for developing the project identification sheet is relating to the five project deliverables, namely:

Deliverable 1: The Cotonou lagoon shores are protected against the erosion induced by the sea-level rise and extreme weather events and the socio-community infrastructures are rehabilitated and improved.

Deliverable 2: The Lagoon and populations’ living environments are protected against solid and liquid waste-induced pollution.

Deliverable 3: The lagoon shores and riparian areas are protected against seasonal floods and the private business operators are sensitized about the promotion of floating bars and restaurants fitted with an access foot-bridge, water sports, canoes and small boat paddling, water gardens.

Deliverable 4: Regulations are reviewed and adapted to the climate change and local communities’ adaptation strategies constraints and a support is brought for the redeployment of the affected fishermen.

Deliverable 5: Local communities’ awareness is created about the climatic risks: they are sensitized and trained on the climate-proofing strategies and the required best practices for protecting the ecosystem and human community’s interests and restricting the drawbacks to a level compatible with their legitimate economic and social development aspirations.

Those deliverables have induced the five following components among which the project activities have been identified:

- Shores protection, catering and rehabilitation of socio-community infrastructures;
- Fight against the lagoon and living environment pollution;
- Fight against seasonal flooding of the shores and riparian areas and raise the awareness of the private business operators;
- The integration of the climate change-induced constraints and adaptation strategies in the legislations regulating fishing and support to the redeployment of affected fishermen;
- The sensitization and training of the local communities on climate change, adaptation techniques and the best practices.

By adopting the project identification sheet, the Board of Directors of the Adaptation Fund raised some comments on information inadequacies and suggested that they should be taken on board in the complete project document. Those comments are as follows:

- (viii) The target private sector stakeholders should be consulted and the evidence of their commitment in the process should be provided.
- (ix) The linkage between the five project deliverables should be better clarified.
- (x) The Project "objective", as put forth, is too wide and could rather be defined like the project "goal". In order to ensure clarity, the complete project document should present one major objective of the project which highlights that linkage, in addition to the presentation of five specific objectives.
- (xi) The complete Project document should provide more concise data on the expected economic benefits and the target groups that would be the end-beneficiaries of the project.
- (xii) The final concrete adaptation options of the project should be presented (if the choice made is the combination of "hard" and "soft") and the costs should be subsequently adjusted.
- (xiii) The complete project document should display a matrix of past and current pertinent initiatives and explain the synergies and complementarities expected from the proposed project or the best practices which will be replicated on it.
- (xiv) The activities described in "the section on knowledge management" should be reflected in the specific output or project results and be described in the tables on "components and financing" and "Results framework" of the complete project document.

Ahead of the research on additional information, FNE had submitted a Project identification sheet to the Adaptation Fund along with a request of allocation for the execution of the five studies likely to generate those information data. As such, the project sheet had been adopted by the Board of Directors of the Adaptation Fund along with the request allocation for the following five studies:

- 11) Furthering the consultations with the Municipal authorities, riparian areas development associations, private sector stakeholders as well as the youth and women organizations;
- 12) In-depth study of the project activities profitability and cost-effectiveness ratio;
- 13) Study of the arrangements and mechanisms of the project assets sustainability involving the private business operators;
- 14) Furthering the knowledge of the current and future climate change impacts on the vulnerable social groups (women, youth etc.) and on the lagoon living resources;
- 15) Furthering the knowledge of the impact of the breakwaters and waves quelling blocs under construction offshore and on the lagoon system.

It is on purpose of performing those studies and collecting additional information likely to help bridging the gaps underscored by the Board of Directors of the Fund that these terms of reference are elaborated.

V. GENERAL OBJECTIVE

Collecting additional information and data to those harnessed on the Project identification sheet on the Cotonou lagoon shores adaptation to climate change and likely to bridge the gaps highlighted in the comments of the Board of Directors of the Adaptation Fund with a view to elaborating the complete document of the project.

VI. SPECIFIC OBJECTIVES AND DELIVERABLES

The expected objectives and deliverables of those studies are as follows:

6.1. Furthering the consultations with the municipal authorities, riparian areas development associations, private sector stakeholders as well as women and youth organizations;

This study aims to:

- ✓ Organize consultations meeting with all the stakeholders (municipal authorities, riparian areas development associations, private sector stakeholders, youths and women organizations) in order to exchange about the economic activities performed by the populations living in the lagoon vicinity. The meeting will also deliberate on the risks run, their magnitude and lines of variation (floods, minimum flows, fierce winds, water exchange between the Ocean and Nokoué lake, variations in the water salinity, proliferation of floating plants, variation of fish and prawn stocks, etc.), the impact of the risks observed on the status of the lagoon and the riparian populations activities, the already taken adaptation measures, the already implemented or envisaged projects, the deliverables of this lagoon shores adaptation project, the assets or best practices of the previous projects into which this could tap, the interests of the project components for the stakeholders, the needs and modalities of participation of the stakeholders in the project;
- ✓ Identify the most exposed social groups (men, women, youths, etc.) to the risks and their resilience capacities (mostly the women);
- ✓ Identify the economic and social benefits that the stakeholders could draw from this project;
- ✓ Identify the social groups that could draw the maximum benefits from the project outputs and the women's position within those groups;
- ✓ Identify the stakeholders that could ensure the technical, financial, institutional, sociocultural and environmental sustainability of the project;
- ✓ Examine the modalities for involving the private business operators in the sustainability mechanisms;
- ✓ Identify the breakwaters, waves quelling blocs and other port facilities which have an impact on the Cotonou lagoon mouthpiece nourishment;
- ✓ Examine the adaptation options in matter of lagoon shores protection, socio-community infrastructures rehabilitation / development and solid and liquid waste control as identified in the project sheet and identify others;
- ✓ Lead the stakeholders to make formal commitment promises about their involvement in the project implementation, activities monitoring & evaluation and sustainability of the results;

At the completion of the study, the following documents will be produced:

- A study report presenting (i) the synthesis of the consultations between the consultants and the stakeholders, (ii) the consensus reached on each item discussed and examined with all the stakeholders' categories, and (iii) the table of the past and current relevant initiatives

along with the synergies and complementarities expected from the project and/or the best practices to be capitalized.

- The stakeholders' commitment documents on the project implementation, monitoring and evaluation.

6.2. In-depth study of the project activities profitability and cost-effectiveness

The specific objectives of this study are as follows:

- ✓ Identify the economic and social benefits that the stakeholders could draw from the project;
- ✓ Identify the social groups that could draw the maximum benefits from the project outputs and the women's position within those groups;
- ✓ Identify the additional adaptation options in matter of lagoon shores protection, socio-community infrastructures rehabilitation / development and solid and liquid waste control;
- ✓ Evaluate the adaptation options identified in the project sheet as proposed by the stakeholders;
- ✓ Analyze the adaptation options and project activities cost-effectiveness.

The output expected from the study is a report presenting (i) the economic and social benefits that the stakeholders could draw from the project, (ii) the social groups that could draw the maximum benefits from the project output and the women's position within those groups, (iii) the adaptation options identified and their evaluation, and (iv) the analysis of the adaptation options and project activities cost-effectiveness.

6.3. Study of the arrangements and mechanisms of the project outputs sustainability involving the private business operators

This study aims to:

- ✓ Identify the stakeholders that could ensure the technical, financial, institutional, socio-cultural and environmental sustainability of the project;
- ✓ Determine the measures and modalities for involving the private business operators in the sustainability mechanisms;
- ✓ Analyze the conditions for the post-project success;
- ✓ Propose relevant options for the sustainability mechanisms.

At the completion of this study, a report will be produced, presenting (i) the stakeholders that could ensure the technical, financial, institutional, socio-cultural and environmental sustainability of the project, (ii) the measures and modalities for involving the private business operators in the sustainability mechanisms, (iii) an analysis of the conditions of post-project success and (iv) a proposition of relevant options for the sustainability mechanisms.

6.4. Furthering the knowledge of the current and future climate change impacts on the vulnerable social groups (women, youth etc.) and the lagoon living resources

This study aims to:

- ✓ Specify the climatic risks observed in the lagoon environment;
- ✓ Identify the most exposed social groups (men, women, youths, etc.) and the living resources to the climatic risks;
- ✓ Evaluate the current and future vulnerability of the modes and means of livelihood to the climatic risks;
- ✓ Evaluate the already taken adaptation measures and their efficiency;
- ✓ Propose potential adaptation options along with their conditions of success;
- ✓ Specify the project's general objective and clarify the linkage between the five project deliverables;

The expected output is a study report including the (i) climatic risks observed in the lagoon environment, (ii) the most exposed social groups (men, women, youths, etc.) and the living resources to the climatic risks, (iii) the current and future vulnerability of the modes and means of livelihood to the climatic risks, (iv) the already taken adaptation measures and their efficiency, (v) a proposition of potential adaptation options along with their conditions of success and (vi) some precisions on the project's general objective and clarifications on the linkage between the five project deliverables.

6.5. Furthering the knowledge of the impact of the breakwaters and wave quelling blocs under construction offshore and on the lagoon system

The objectives of this study are to:

- ✓ Make an inventory of the breakwaters, waves quelling blocs and other port works having an impact on the Cotonou Lagoon mouthpiece;
- ✓ Elaborate the diagram of erection of the new breakwaters under construction;
- ✓ Assess the current status of the ocean current in the Cotonou lagoon and Port Authority environment with its impact on sand movements;
- ✓ Propose the impact of the new breakwaters on the lagoon environment by 2025 along with its consequences on the lagoon bed and shores;
- ✓ Suggest measures for strengthening the Cotonou dam and the lagoon shores stabilizing works.

The report of this study is expected to give precisions on (i) the current and future status of the breakwaters, waves quelling blocs and port facilities with their impact on the bed loads movements, (ii) the impact of the new breakwaters on the lagoon environment by 2025 along with its consequences on the lagoon bed and shores and (iii) some measures suggested for strengthening the Cotonou dam and lagoon shores stabilizing works.

VII. METHODOLOGY

7.1. General Methodology

The general methodology should comply with the international standards of study and draw gist from the methodology applied to the studies conducted on vulnerability and adaptation to climate change.

The standardized stages in matter of study are the definition of the conceptual framework, the methodological scoping, review of literature and documentary analysis, and eventually, the organizational measures taken.

7.1.1. Definition of the conceptual framework of the studies

The conceptual framework of this mission is the one applied to the studies on vulnerability and adaptation to climate change as defined by the Intergovernmental Panel on Climate Change (IPCC) and operationalized by the Panel of Experts of the Least Developed Countries (LEG) (Carter *et al.*, 1994; Parry and Carter, 1998; LEG/UNFCCC, 2004). This is about applying the international guiding principles of the United Nations Framework Convention on Climate Change to the Cotonou Lagoon system, through additional studies required for the elaboration of the complete project document on the Cotonou lagoon shores adaptation to climate change.

7.1.2. Methodological scoping of the mission

The mission will be formally launched with a scoping meeting organized by the FNE. The main purpose of that meeting is to ensure that the mission objectives and those of the ToR are well understood by the consultants. The proposed methodology will be presented and useful comments will be collected in order to fine-tune it.

7.1.3. Literature review and documentary analysis

Two document types shall be consulted as part of this review of literature and documentary analysis. Those are:

- The works outcome and the general documentations on the socioeconomic development and poverty alleviation policies and strategies, on the environmental policies, namely in connection with the Convention on Biodiversity and coastal areas ecology, and on the Cotonou town and Cotonou Lagoon riparian Town Sections Development Plan.
- Guidelines and documents pertaining to the studies of vulnerability and adaptation to climate change, namely the methods of intervention and specific tools to the coastal areas, ecosystems and human communities, the outcome of the works carried out on the lagoon system and the project identification sheet on the Cotonou lagoon shores adaptation to climate change as adopted by the Board of Directors of the Adaptation Fund.

Most of the consultants have already a good mastery of this documentation.

4.1.4. Organizational arrangements

This is about the mode of organization of activities fostering the achievement of the results set for these studies. It starts with the arrangements and appointments to be arranged with the stakeholders including the project owner's representatives, going through the measures to be taken in order to ensure the success of the activities and ends with the submission of reports and outputs upgrading.

4.5.5. Methodology of the studies of vulnerability and adaptation to climate change

This methodology is elaborated by the Intergovernmental Panel on Climate Change (IPCC) and operationalized by the Panel of Experts of the Least Developed Countries (LEG) comprising seven (7) steps as follows (Carter *et al.*, 1994; Parry and Carter, 1998; LEG/UNFCCC, 2004):

1. Identification and statement of the problem to be solved through a participative approach involving experts and stakeholders' representatives (*Joint vulnerability evaluation of the lagoon ecosystem and human communities*);
2. Selection of the most appropriate methods for solving the problem;
3. Test of the selected methods;
4. Selection of the climatic and socioeconomic scenarios;
5. Evaluation of the biophysical and socioeconomic impacts;
6. Evaluation of the endogenous adaptation measures;
7. Evaluation of the adaptation strategies.

Each methodological step calls for specific implementation tools and variables according to the problem typology. All the studies do not need all the steps.

- 8) *The first step (joint vulnerability evaluation)* is common to all the focus studies of this mission. The 5 thematic will be considered with the stakeholders during the single joint vulnerability evaluation meeting, per category of stakeholders holding some given information. Each sub-team in charge of addressing a thematic will have to judiciously harness that single session with each stakeholders category in order to collect the information needed for the next stage of the study.
- 9) *The second step (Selection of the most appropriate methods for solving the problems)* is specific to the thematic. The teams in charge of addressing each thematic will have to choose based on the thematic, information available on the most appropriate methods out of the thirty methods, software and tools of the coastal area sector, and about twenty available participatory tools, to address the Cotonou lagoon shores vulnerability and adaptation problems. (http://c3d-unitar.org/c3d/userfiles/Module_2/M2_Inventaire_outils-doc.pdf)
- 10) Regarding *the third step (Test of the selected methods)*, the limited time allotted to the teams will not allow them to test the selected methods in actual size. They will rather have to prioritize proven methods on the field.
- 11) *The selection of climatic and socioeconomic scenarios (Forth step)* refers to the outputs acquired for the national territory and presented in the Second National Paper of Benin on Climate Change (DCN), including the coastal area.
- 12) *The biophysical and socioeconomic impacts evaluation (fifth step)* will draw on the joint vulnerability evaluation results (step 1), of the national vulnerability evaluation data documented in the National Climate-proofing Action Program and DCN; and the scientific bibliographical bases.
- 13) *The sixth step (Endogenous adaptation measures evaluation)* draws on the results of the first and fifth steps for the thematic concerned by that step.
- 14) The adaptation strategies evaluation will use the traditionally-enshrined methodologies and involve the Municipal authorities and business operators who will have a special role to play in order to ensure the post-project sustainability.

4.6. Mission Specific Methodology

All the studies will draw their gist from the general methodology. The teams in charge of the five thematic will address together the steps of the conceptual framework of the studies, the mission scoping, the literature review and documentary analysis, organizational arrangements and joint evaluation of vulnerability to climate change. Based on the relevant data collected during the consultation meetings with the stakeholders and the outputs harvested from the documentation, the teams will perform stand alone works on the steps 2 through 7 of the studies on vulnerability and adaptation depending on the specificity of their thematic.

Timing of the tasks

The mission duration is thirty (30) days covering the period running from February 15, 2013 to later, including the additional period for elaborating and translating of the entire project document. By way of indication, Tables 1 and 2 display the proposition of activities timing and the tasks diagram. The complete project document elaboration and drafting could be envisaged from Monday February 4, 2013, mobilizing the core implementing task force of these studies meanwhile the exchanges are held with the international expert.

Table 12: **Planning of the envisaged activities (for guidance).**

Activities	Duration in days	Period*
Organizational arrangements	9	January 14-22, 2013
Meeting for planning the studies conceptual framework	2	January 19-20, 2013
Meeting of methodological scoping of the mission	1	January 21, 2013
Joint lagoon ecosystem and human communities vulnerability evaluation meeting	5	January 22-26, 2013
- Consultation with the municipal authorities		January 22
- Consultation with the heads of the town sections and areas riparian of the lagoon		January 23

- Consultation with the fishermen and fishmongers associations		January 24
- Consultation with the women and youths associations		January 25
- Consultation with the business operators		January 26
Bibliographical review and documentary analysis	20	From January 19 2013
Execution of the technical studies steps	10	January 19 – 28, 2013
Elaboration of the draft study reports	4	January 25 – 28, 2013
Rendition of the results to the municipal authorities and business operators	1	January 29, 2013
Submission of the draft study reports	PM	January 31, 2013
Submission of the final studies reports	PM	February 4, 2013
Total	52	

Note²: The simultaneous performance of several activities enables to reduce the real duration of the mission

Tableau 2 : Diagramme des tâches²

		14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14				
Organizational arrangements	5	█																																			
Elaboration of the studies conceptual framework	2							█																													
Meeting of methodological scoping of the mission	1											█																									
Joint lagoon ecosystem and human communities vulnerability evaluation meeting	5											█																									
Bibliographical review and documentary analysis	25	█																																			
Execution of the technical studies steps	7							█																													
Elaboration of draft study reports	5											█																									
Dissemination of the results to municipal authorities and business operators	5																		█																		
Submission of the draft study report	5																		█																		
Submission of the final studies reports	5																		█																		
Elaboration, completion and rendition of the entire project document to the municipal authorities and business operators																								█													

Note²: The simultaneous performance of several activities enables to reduce the real duration of the mission

V. MISSION TEAM

The performance of the studies required the mobilization of a multidisciplinary team of seven (7) experts covering the required fields. They are in alphabetical order:

1. AGOINON Norbert, Cartographer at the University of Abomey-Calavi,
2. AHLONSOU Epiphane, Climatologist at ASECNA, National Focus Point of the Intergovernmental Panel of Experts on Climate Change (IPCC),
3. AHO Nestor, Bioclimatologist at the University of Abomey-Calavi, Head of mission,
4. BABADANKPODJI Pascaline, Sociologist at the University of Abomey-Calavi,
5. DOSSOU Krystèl, Agro-economist at OFEDI NGO, Observer member of the Board of Directors of the Adaptation Fund /UNFCCC representing the Civil Society Organization,
6. GNONLONFIN Lazare, Sedimentologist at the Cotonou Port Authority Directorate of Technical Studies,
7. TOFFI Mathias, Coastline Geographer at the University of Abomey-Calavi,

The curriculum vitae of the consultants are appended to this technical proposal.

The mode of deployment of the personnel to the focus studies of this mission is as indicated in Tables 3 and 4. In addition to the role of general coordination covered by the Head of mission, he also receives some specific assignments.

Table 3: **List of tasks assigned to the human resources for the mission under consideration.**

PERSONNEL	Responsibility
M. AGOINON Norbert	<ul style="list-style-type: none"> • <i>Any mapping works needed for illustrating and fostering the understanding of the study reports</i>
M. AHLONSOU Epiphane	<ul style="list-style-type: none"> • <i>Study on the arrangements for ensuring the project assets sustainability mechanisms involving the private business operators;</i> • <i>Furthering the knowledge on the current and future climate change impacts on the vulnerable social groups (women, youths etc.) and on the lagoon living resources;</i> • <i>Furthering the knowledge on the impacts of the breakwaters and waves quelling blocs under construction offshore on the lagoon ecosystem;</i>
AHO Nestor	<ul style="list-style-type: none"> • <i>Furthering the knowledge on the current and future climate change impacts on the vulnerable social groups (women, youths etc.) and on the lagoon living resources;</i> • <i>Study of the arrangements and mechanisms of the project assets sustainability involving the private business operators;</i> • <i>In-depth study of the project activities profitability and cost-effectiveness ratio;</i>
BABADANKPODJI Pascaline	<ul style="list-style-type: none"> • <i>Furthering consultations with the municipal authorities, riparian areas development associations, private sector operators as well as women and youth organizations;</i> • <i>In-depth study of the project activities profitability and cost-effectiveness ratio;</i>

	<ul style="list-style-type: none"> • Furthering the knowledge on the current and future climate change impacts on the vulnerable social groups (women, youths etc.) and on the lagoon living resources;
DOSSOU Krystel	<ul style="list-style-type: none"> • <i>In-depth study of the project activities profitability and cost-effectiveness ratio;</i> • <i>Study of the arrangements and mechanisms of the project assets sustainability involving the private business operators;</i>
GNONLONFIN Lazare	<ul style="list-style-type: none"> • <i>Furthering the knowledge of the current and future climate change impacts on the vulnerable social groups (women, youth etc.) and on the lagoon living resources;;</i> • Furthering consultations with the municipal authorities, riparian areas development associations, private sector operators as well as women and youth organizations ;
TOFFI Mathias	<ul style="list-style-type: none"> • Furthering the knowledge of the impact of the breakwaters and wave quelling block under construction offshore and on the lagoon system; • Furthering consultations with the municipal authorities, riparian areas development associations, private sector operators as well as women and youth organizations.

Table 4 : Consultants Team in charge of the studies

STUDY	CONSULTANTS TEAM
<i>Furthering consultations with the municipal authorities, riparian areas development associations, private sector operators as well as women and youth organizations</i>	BABADANKPODJI Pascaline TOFFI Mathias GNONLONFIN Lazare AGOINON Norbert
In-depth study of the project activities profitability and cost-effectiveness;	DOSSOU Krystel BABADANKPODJI Pascaline AHO Nestor
<i>Study of the arrangements and mechanisms of the project assets sustainability involving the private business operators;</i>	AHLONSOU Epiphane DOSSOU Krystel AHO Nestor TOFFI Mathias
<i>Furthering the knowledge of the current and future climate change impacts on the vulnerable social groups (women, youth etc.) and on the lagoon living resources;</i>	AHO Nestor AHLONSOU Epiphane BABADANKPODJI Pascaline
Furthering the knowledge of the impact of the breakwaters and wave quelling blocs under construction offshore and on the lagoon system	GNONLONFIN Lazare TOFFI Mathias AHLONSOU Epiphane AGINON Norbert



Republic of du Benin



Ministry of Environment,
Housing and Town Planning

**Project on the Cotonou Lagoon
Ecosystems and Human Communities
Adaptation to the Impacts of Sea-level
rise and Extreme Weather Events**



ADAPTATION FUND

Fonds pour l'Adaptation aux
changements Climatiques



National Environment Fund

**In-depth Consultations with the Stakeholders of the Project on the
Cotonou Lagoon Ecosystems and Human Communities
Adaptation to the impacts of Sea-level rise and Extreme Weather
Events**

STUDY REPORT

Conducted by:

Dr.Ir. BABADANKPODJI Pascaline

Lecturer –Researcher at FSA/UAC

Assisted by DJEGBENOU Romuald and the other team members

for the Task force coordinated by Professor Nestor AHO.

February 2013

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Picture1 Working session with fishermen



Picture 2 Meeting with the Fishmongers



Picture 3 : Consultation among the Consultant Team members

1. Introduction

As part of the development of the final Project document for the Cotonou Lagoon Ecosystems and Human Communities Adaptation to the Climate Change Impacts, the National Environment Funds (FNE) appealed to a team of consultants to conduct additional studies in view of completing the Project document to be submitted to the financing of Adaptation Fund. In order to get a complete Project document on the Cotonou Lagoon Ecosystems and Human Communities Adaptation to Sea-level Rise and extreme weather events, a Task force of eight (8) Experts has been entrusted to conduct five (05) studies. The task force worked on end, harmoniously in a complementarity and interdisciplinary move on the terms of reference specified for the studies. Several meetings of harmonization and scoping were organized at the end of each working day in order to merge the outcome. Two workshops have been organized between the task force members (at mid-term and the end of Draft 1 writing) before giving a rendition of the outcome to the Owner and Stakeholders.

Regarding the study on the sociological aspects, the terms of reference (in the Schedule) guided the orientation and the approach to be adopted for this study. Titled «*In-depth consultations with the Municipal Authorities, Riparian Areas Development Associations, Private sector stakeholders and Youth and Women Organizations*», this study aims at organizing consultation meetings with all the stakeholders in order to exchange about the economic activities carried out by the populations living along the lagoon, the risks incurred along with their magnitude and lines of variation, the impact of those risks on the lagoon situation, the riparian populations' activities, the adaptation measures already taken, implemented or envisaged , the deliverables of this Adaptation Project on the Lagoon shores, the assets or best practices emanating from the previous projects and into which this one could tap, the interests of the projects components for the stakeholders, the necessity and modalities for the stakeholders' participation in the project. More specifically, this study aims to:

- ✓ Identify the most at-risk social groups (men, women, youths, etc.) and their resilience capacity (mostly women);
- ✓ Identify the economic and social knock-on-effects the stakeholders could draw from this project;
- ✓ Identify the social groups likely to draw the maximum advantage from the project outcome while specifying women position within those groups;

- ✓ Identify the stakeholders able to ensure the technical, financial, institutional, socio-cultural and environmental sustainability of the project;
- ✓ Examine the modalities for involving private sector operators (SOGEMA, CRUSTAMER, HOTEL DU LAC) in the sustainability mechanism;
- ✓ Identify the breakwaters structures and other port infrastructures affecting the Cotonou lagoon mouth;
- ✓ Examine climate-proofing modalities in terms of lagoon shores protection, rehabilitation /development of socio-community infrastructures as well as solid and liquid waste management as pinpointed in the project identification sheet, and identify others;
- ✓ Lead the stakeholders to formally commit themselves to getting involved in the project execution, monitoring and evaluation of activities and sustainability of the outcome;

Definition of key concepts

Les stakeholders are persons, groups, or institutions, likely to be affected (either negatively or positively), or those likely to influence the project outcome.

The stakeholders' power could be assimilated to a situation whereby the stakeholders are able to persuade or force third parties to take decisions and adopt some lines of conduct. It enables to assess the level of the capacity to help or have an impact on the project activities. The power may emanate from the stakeholders' organization nature or its position vis-à-vis other stakeholders.

The potential to influence or to be influenced by policy-makers and institutions lies in the special characteristics of a context and an establishment – such as knowledge and rights. The influence measures the level of support or opposition to the project purposes and objectives. At this level, a special emphasis shall be put on the high-level potential stakeholders but having low power.

Resistance has to do with a community's capacity to withstand the damages caused by an emergency situation.

The risk is the combination of the probability of occurrence of a hazard and the magnitude of its impacts. In other words, the risk announces the probability for the occurrence of a disaster to be realized with the likely consequences. Concretely speaking,

$$Risk = \frac{Vulnerability \times Chance\ factors}{Capacity}$$

Resilience

Ecological resilience is the level by which the disturbances could be absorbed by a system before it moves from one stage to another. **Stability** which is the other associate concept

means the trend for a situation to return to equilibrium position further to a disturbance. (Ludwig *et al.*, 2002).

Social resilience is the groups or communities' capacity to adapt to and learn to face some stress as well as some political, social, economic or environmental external disturbances (Adger, 2000). Therefore, it is the individual or community's capacity, ... to build up and live satisfactorily in spite of traumatism circumstances.

Vulnerability is the risk of being victim of damages or losses; it has to do with the capacity to forecast a natural vagary, face it, resist it and recover from its aftermaths. Besides the exposure probability, the term risk takes on board the socioeconomic and sociopolitical factors likely to affect the community's capacity to absorb and recover from major risks effects. Likewise its antonym resistance, vulnerability is determined by the physical, environmental, social, economic, political, cultural and institutional factors.

The stake means what one can gain or lose with the occurrence of a vagary. The stake encompasses the persons, goods, activities, means, heritage, systems ... likely to be affected by a natural or man-induced vagary or likely to suffer from prejudices or damages.

The more a stake is vulnerable to a vagary, the bigger the risk generated by exposure to the stake. **Human and socio-demographic characteristics of the assessment study area**

From the Native Toffin, Cotonou town has accomodated all the sociocultural groups from Benin and the sub-region. The Cotonou Lagoon shore is settled by the Toffins, the Xwla and related as well as the foreigners selling in Dantokpa international market. Cotonou town encompasses 13 Town sections subdivided into 144 areas. The ongoing study covers 23 areas distributed in 4 Town sections (3rd, 4th, 5th and 6th), that is 40% of the areas of those 4 Town sections as indicated in Table 1. Table 2 presents the demographic situation of the riparian areas.

Table 1: the number of riparian areas

Town sections	Total number of areas	Number of areas riparian of the shores	Percentage
3 rd	13	6	46%
4 th	11	4	36%
5 th	15	6	40%
6 th	19	7	32%
Total	58	23	40%

Source: Data culled from RGPH 2002.

In 2002, the Lagoon riparian areas population amounts 87,262 inhabitants including 46,939 women and 42,266 men that is, 54% of women. This population is distributed into 21,608

households. The evolution of the number and average size of the households between 1992 and 2002 is as follows (table 3).

Table 2: Target Riparian Population of the project

Town section	Areas	Target Population			Number of households	Average size of the households
		Total	Male	Female		
3 rd	Adogléta	5,500	2,689	2,811	1,302	4.2
	Gbenonkpo	3,171	1,529	1,642	757	4.2
	Hlacomey	1,552	806	746	339	4.6
	Kpankpan	5,637	1,787	2,850	1,208	4.7
	Midombo	5,476	2,638	2,838	1,229	4.5
	Agbato	6,143	3,024	3,119	1,339	4.6
4 th	Abokicodji Centre	3,088	1,447	1,641	678	4.6
	Abokicodji lagune	1,455	757	698	269	5.4
	Dedokpo	5,042	2,476	2,566	1,114	4.5
	Enagnon	11,792	6,344	5,448	2,805	4.2
5 th	Wlacodji Kpodji	603	293	310	159	3.8
	Wlacodji plage,	6,103	3,098	3,005	1,676	3.6
	Tokpa Hoho	1,899	895	1,004	446	4.3
	Missèbo,	1,539	744	795	371	4.1
	Bocossi tokpa	1,799	833	966	414	4.3
	Nouveau pont	1,324	608	716	361	3.7
6 th	Dantokpa,	2,396	1,136	1,260	587	4.1
	Aïdjèdo 3,	5,037	2,445	2,592	1,255	4.0
	Hindé 1	4,795	2,293	2,502	1,121	4.3
	Hindé 2	4,157	2,108	2,049	965	4.3
	Djidjè 1,	4,117	2,039	2,078	954	4.3
	Djidjè 2,	4,637	2,277	2,360	1,039	4.5
	Ladji	6,075	3,132	2,943	1,220	5.0
		87, 262	42, 266	46, 939	21, 608	

Source: Data compiled from the RGPH, 2002

The average size of households in all the areas established along the shores in 1992 was superior to the average in Cotonou town that is, 4.3 between 1992 and 2002. In 2002, the average size of households in the lagoon riparian areas is inferior to that of 1992 but the number of households doubled the one of 1992 in half of the riparian areas. This result suggests two movements: first and foremost, the displacement of some residents towards some developed areas in Cotonou town or their migration towards other fisheries like the Nigerian shores, but also the massive in-coming of foreign populations in the riparian areas of the banks due to its closeness to Dantopka International Market.

Table 3: Evolution of some socio-demographic indicators

Town section	Areas	Situation in 1992		Situation in 2002	
		Number of	Average size of	Number of	Average size

		households	the households	households	of the households
3 rd	Adogléta	637	17	1,302	4.2
	Gbenonkpo	669	5.0	757	4.2
	Hlacomey	550	5.6	339	4.6
	Kpankpan	527	5.3	1,208	4.7
	Midombo	805	5.7	1,229	4.5
	Agbato	645	5.4	1,339	4.6
4 th	Abokicodji Centre	511	5.8	678	4.6
	Abokicodji lagune	343	4.8	269	5.4
	Dedokpo	691	5.0	1,114	4.5
	Enagnon	1,878	4.8	2,805	4.2
5 th	Wlacondji,	677	4.9	159	3.8
	Wlacondji plage,	899	4.3	1676	3.6
	Tokpa Hoho	451	4.6	446	4.3
	Missèbo,	361	5.8	371	4.1
	Bocossi tokpa	418	4.4	414	4.3
	Nouveau pont	343	4.9	361	3.7
6 th	Dantokpa,	609	5.7	587	4.1
	Aïdjèdo 3,	1,361	4.8	1,255	4.0
	Hindé	1,208	5.4		
	Hindé 1			1,121	4.3
	Hindé 2			965	4.3
	Djidjè 1,	820	5.2	954	4.3
	Djidjè 2,	658	4.9	1,039	4.5
	Ladji	486	6.4	1,220	5.0
Total commune			4,3		4,3

Source: Data compiled from RGPH, 1992 and 2002

Education. The situation of the socio-educational infrastructures in those four (4) Town sections is presented in table 4 as follows:

Table 4: Distribution of Schools per riparian Town section

Town Section	Public Primary School	Private primary School	Public Secondary School	Private Secondary and Vocational School	Tertiary Institution	Size in Primary	Size in Secondary	Size in Tertiary
3	14	29	1	11	0	11,460	5,831	0
4	8	17	1	11	2	9,514	4,460	704
5	7	11	1	10	2	6,468	4,825	110
6	7	35	2	11	5	12,728	5,647	219
Sub-total	36	92	5	43	9	40,170	20,763	1,033
Total	112	282	20	158	36	113,28	79,014	8,856

Source: Socioeconomic data collected from /DPDM/MCOT2006

This table suggests that the Town sections 3, 4, 5, 6 respectively have 10%, 8%, 5.7% and 11.23% of the size at primary level, both in public and private schools. Since the domain located in the vicinity of the lagoon shore is neither divided into plots, nor marked out, nor

serviced, there is no public infrastructure built in those areas apart from some few private schools.

Medical coverage. Some of the 4 target Town sections of this study are made up of areas such as Tokpa Xoxo, Dantokpa, commercial area, with the *Maternité Lagune* (Mother and Child Hospital) which is one of the referral Health Centers in the town hosting mostly pregnant or laboring women coming from most of the moderate technical support centers established in the southern regions. The population of specialists working at *Maternité Lagune* overshadows the lack of health centers in the riparian areas of the shores.

Table 5: Socio-medical infrastructures distribution per Town section

Town section	Health Center (including dispensary, maternity)	pharmacy	Social welfare center	Medical Doctor	Nurse	Midwives	Care attendant	Laboratory Technicians
3	27	5	1	36	50	31	123	22
4	13	7	3	34	35	19	46	32
5	11	8	2	42	106	76	108	21
6	25	9	1	33	61	37	107	13
Su-total	76	29	7	145	252	163	661	88
Total	252	86	14	594	1,020	409	1,288	328

Source: Socioeconomic data from the DPDM/MCOT 2006

As such, the presence of Maternité Lagune and big pharmacies operating in the study area has contributed to inflating the inclusive medical staff population, while no public health center is built in the non-developed target areas of study. In that area, some pregnant women still avoid going to the health centers located in the neighboring Town sections. In terms of hygiene, the four Town sections are the most health-endangering in Cotonou town as the majority inhabitants of that area build their makeshift domiciles on wet, floodable and unhealthy places.

Poverty level. Based on the housing conditions, 61,000 households have been out-numbered in 2002, identified as poor and extremely poor (out of the 154, 346 households living in Cotonou). According to the RGPH3 statistic figures 30,874 households are classified very poor. Poverty spatial distribution at Town section enables to better highlight those extremely poor Town sections. It is based on the proportion of the very poor households (households described according to profile 1). This threshold enables to distinguish between poor and rich households. Table 6 below illustrates the Town sections classification according to the proportion of the extremely poor households living there.

Table 6: Extreme poverty according to Town sections

Town section	rests of wealthy households	Number of poor households	Inclusive set of households	Poor households rate in the Town sections
3	10,247	3,121	13,368	31.2
4	5,892	3,046	8,938	30.5
5	6,741	1,021	7,762	10.2
6	13,832	2,805	16,637	28.1
Total	36,712	9,993	46,705	100

Source: Figures Calculated from the RGPH3 data.

According to the statistic figures presented in this table, the Town sections 3, 4 and 6 encompass more extremely poor households and should be the priority focus of interventions in order to enhance the households living conditions. As a matter of fact, 26.1% of the poor in Cotonou town come from those three Town sections (that is an average of 8.7% of poor per Town section); while each of the remaining 10 other Town sections contributes an average of 7.39% to poverty level in Cotonou town (that is a total of 73.9% of poor) (cf Schedule 3'). Those poor households are those living in poorly spatially-organized and isolated houses or huts, with no access paths, complicating the movement of persons and goods, family estates, the soil and fence of which are made of baked clay and straw roofs. They mainly fetch their drinking water from the lagoon or street fountains. In terms of accommodation comfort, the houses of those households are not equipped with toilets. Kerosene is the main source of lighting while fire wood stands for cooking means. In those households, used waters and waste are disposed in open air and in the court yard. The head of the household is definitely illiterate. In a nutshell, there is almost a total lack of goods and facilities in those extremely-poor households. Those living in the areas riparian of the 5th Town section also share this described appalling situation. The rank displayed on table 6 is covered by the level of wealth of the households living in areas non riparian of Town section (5^{ème}).

There is a high-risk of fire with the rampant use of kerosene for lighting under the straw-roof huts of the neighboring areas. The use of fire wood is indicator of extreme poverty and high pressure on natural resources. Potable water is unavailable. The riparian populations ease themselves in the water channel. Children are not schooled due to the crucial lack of socio-educational infrastructures and the lack of interest of their illiterate parents. In addition to the climatic risks, the fire risks densify the situation due to human-induced practices. There are high-risk of pandemics spread due to the lack of toilets and consumption of dirty water. Promiscuity appears as a worsening factor of fire and pandemics spread. The lack and inadequacy of health and socio-educational facilities definitely cast a gloom over the poverty situation.

By and large, the socio-demographic indicators show that the children are not schooled because the heads of the households are also pure illiterate. In such a condition, the women and girls who are more numerous than the men and boys in the riparian areas can never be instructed. Subsequently, they do not perceive the usefulness of going for antenatal consultations in the neighboring areas; as a result, many give birth at home, increasing the maternal and child mortality rate along with the risk of life expectancy reduction.

Women are responsible for fetching the unsound drinking water (with high-risk of water-borne diseases), houseworks, procurement of fire wood and the cooking of foods under the thatched straw roofs (fire risk). The use of kerosene as source of lighting worsens the poverty level, sinking them in a hell of extreme poverty and impoverishment; moreover, it and sticks that cliché to the generations yet unborn. The appalling situation of extreme poverty worsens their vulnerability to climatic risks. Therefore, they and their children (boys and girls) deserve a special attention. The project shall mainstream gender discrepancies in order to effectively reach all the social categories.

2. Methodology

The general strategy designed for the whole studies consists in federating different methodologies used for analyzing climate change. The strategy used in the study focused on the stakeholders and is based on the combination of participatory approach and the synthesis of the outcome. The participatory approach enabled to identify the stakeholders and analyze the populations' means of livelihood, their resilience and perspectives.

Initial assessment of the system. After documentary research works, the task force created conducive conditions for a quality multipartite dialogue by considering from the inception the way people are organized and do function, by taking that on board all along the consultations, ensuring an adequate inclusive level. The key activities created on that purpose in order to ensure quality procedures are as follows:

- Introduction of the team members and guests;
- Creation of enabling conditions for making the stakeholders feel comfortable before the meeting organizers;
- Dialogue promotion;
- Conducive conditions created for the stakeholders to freely express their minds without fearing any reprisals;
- Request for the assistance of the stakeholders for identifying other stakeholders;

- Thorough introduction for a good preparedness and information of the stakeholders in order to take judicious decisions;
- Participation of the stakeholders in the definition of conditions of commitment and free adhesion;
- Planning of a public de-briefing and feedback information session.

Mainstreaming gender approach The Data were collected by mainstreaming all the social categories. The data analysis process equally mainstreamed gender approach in order to highlight social discrepancies and relationships between the various identified social categories and stakeholders.

Identification of stakeholders An illustrative list of stakeholders exists in the read documents. That list was first and foremost validated by the groups and associations invited and thereafter complemented. A combination of approaches (identification by the authorities of the groups, associations and private operators) was used in order to reduce the risks linked to a peculiar approach.

The major stakeholders are the direct beneficiaries of the project or those who will be directly reached (either positively or negatively) by the project. They include the riparian populations of Cotonou lagoon shore (individuals, households, community-based organizations), in particular the poor and marginalized groups who are traditionally excluded from participating in development efforts. The study targeted as major stakeholders: the Fishermen, Fishmongers, lagoon mined sand sellers, restaurants operators, hotels and night clubs operators, dyers, Dantokpa market traders and vendors, Fishermen, Fishmongers, lagoon mined sand sellers' Associations, various products sellers, the women and youths.

Secondary stakeholders are those that will influence the development projects or are indirectly reached by the project. Those include the government, the umbrella ministry, the project personnel, implementing agencies, SOGEMA, NGOs intervening in the sector, private companies, the Bank along with its shareholders and any other development organizations.

Households' profile. The analysis of poverty profiles in Cotonou town as presented in the 2008 Communal Development Plan (PDC) distinguished between five (5) households' categories or profiles based on the poverty threshold elaborated in the INSAE documents. This typology essentially draws on the housing conditions. It was elaborated in 2002 and distinguishes: profile 1 = extremely poor households; profile 2 = poor households; profile 3 = average income households; profile 4 = wealthy households; profile 5 = the richest

households. The classification criteria of those different profiles are summarized in the following table culled from the documentation.

Table classifying the households according to the poverty level.

Year 2002	Extremely	Poor	Average	wealthy	The richest riches
Housing Type	Isolated houses or huts	Isolated houses or Row-House	Row-House, isolated hut	Row-House, villa	Row-House, villa
Floor	Baked clay	Baked clay, cement	Baked clay, cement	Cement	Cement, tiles
Wall	Baked clay	Baked clay, bamboo	Baked clay, half-concrete	Brick	Brick
Roof	Straw	Sheet, straw	Sheet	sheet	sheet, slab
Drinking water	Stream, street fountains	Open well, village pump	Covered or Open well, village pump	Open well, village pump	Open well, village pump
Mode of easing	Nature	Nature, unventilated latrines	Nature, unventilated latrines	Latrines	Latrine, flush toilet
Waste disposal	Nature	Nature, burning	Nature and burning	Nature, burning	Public or private waste disposal companies
Used water disposal	Nature	Nature court yard	Nature court yard	Nature court yard	Nature court yard and septic tank
Cooking suggestions	Fire wood	Fire wood	Fire wood	Fire wood, charcoal	Charcoal
Lighting Mode	Kerosene	Kerosene	Kerosene	Kerosene, electrical power	Electrical power

Source : RGPH, 2002

Data collection and analysis tools

Data collection tools The study on the consultations with the stakeholders prioritized collective data collection tools through a participatory approach leading to a consensus and taking on board the differences in categorization. Those are groups interviews, individual interviews conducted based on the lists of preoccupations (semi-structured). Existing secondary data have also been useful and complemented the data list harvested with the stakeholders. The comments were useful as they contributed to the triangulation.

Analysis frameworks

The brainstorming This reflection melting pot has served to freely compile all the ideas on the different subjects raised. This tool has been used to lead the different stakeholders groups to express various risk types which their living conditions expose them to. The facilitator made sure that all the attending representatives of the stakeholders expressed their mind.

Oral history This tool was used to assess local vulnerability along with the adaptation alternatives. It enabled to illustrate the different risks identified and the adaptation types produced in the past. Those stories contributed to describing the individual perception of the past environmental and social situation. They proved to be particularly efficient in local

vulnerabilities data collection during the past decades for which the data were often limited. They culminated with the stakeholders' historical profile faced with the climatic and other risks in order to underscore their vulnerability.

The indicator-based approach of the stakeholders' way of living this tool was used to evaluate the climatic factors and extreme weather events impacts on the way of living of the identified stakeholders. It permitted to examine the resources, activities and socioeconomic factors making up the way of living of an individual, a household or groups. It also contributed to determining the level of sustainability of the way of living. Similarly, the framework has also enabled to take on board the wide range of adaptation possibilities which could be available for the households. The indicators-based approach of way of living relies on the framework of the way of living so as to evaluate the way of living typologies vulnerability at different stress. The method benefits from the knowledge and inputs of the various experts of the team and leans on local observations.

Stakeholders' consultation The consultations with individuals and/or groups that will be affected by the future processes entitled the latter to express their opinions on what could occur. That process will be more likely to succeed regardless of the fact that by expressing their concerns about the process, the stakeholders could finger out some issues that the external experts might have skipped. During the process, the stakeholders were clearly told the reason behind their involvement and the role they were expected to play. Once the process incepted, it will, for sure, contribute to the long term capacities building, and in so doing, build the capacities of a larger group of people on the adaptation process. In the process, all the groups were targeted in order to achieve a collective understanding of the issues at stake and the ways out with a view to ensuring sustainability and fostering adaptation capacity. The stakeholders' consultation also permitted to allow for the adaptation strategies types to be sought along with the viability of each of those choices. For that purpose, stakeholders' groups have been pooled up in order to identify the most appropriate adaptation ways as that would contribute to the adaptation policies implementation success.

Vulnerability profile The previously identified indicators were compiled in a set of aggregated index or profiles. Vulnerability profiles enabled to compare factors and trends at the households and groups level. As for the profiles, they contributed to encompassing several indicators of the way of living and to illustrating the climate change and environmental vulnerability impacts which pressurize or inflict chocks upon the households. They also helped identifying the exposure, sensitiveness and resilience modalities among the social

groups and throughout the time and based on the way of living strategies regarding the natural resources and the characteristics of individuals and households.

Analysis of the socioeconomic vulnerability of the way of living From the socioeconomic viewpoint, a social group living in a given environment is regarded as vulnerable when it lacks the capacities of access to the resources required for meeting its fundamental needs. While imposing additional constraints on the livelihood, the negative impacts of climate change worsen the target group vulnerability. The weighting grid used to translate the social groups' easy access to basic resources is as follows:

- 100 for the social groups' unlimited access to abundantly available resources, compared with their needs;
- 75 for unlimited access to averagely available resources or an average access to resources available in abundance compared to the social groups' needs;
- 50 for a restricted access to resources available in abundance, or an average access to averagely available resources or unlimited access to inadequately available resources compared with the social groups' needs;
- 25 for an average access to averagely available resources, or a restricted access to averagely available resources, compared with the social groups' needs.

The weighting grid of the social groups' easy access to the basic resources is subject to the participants' appreciation during the evaluation and / or validation workshops before its utilization for participatory evaluations pertaining to each resource or social group in order to elaborate some diagrams. The analysis mainstreams the different stakeholders and gender approach, in particular the women, the youths and the physically-challenged.

3. Synthesis of the consultations with the stakeholders

3.1 Stakeholders' preoccupations: Inventory of economic, social, cultural and environmental problems suffered

The stakeholders, experiences, benefits drawn Seven (7) stakeholders' groups participated in the consultation; among them range the Gbogbanou Gbenonkpo women Association, the Lagoon pink prawns Fishermen Association (APCRL), the Prawns Fishermen Association (APC), the Abokicodji lagoon Development Association (ADAL), the Lagoon mined sand sellers Association; the handy sport new leader Association, the 3rd Town section Alodo Agbodjèdo Association, Fishmongers' Association, Municipal authorities at various levels. Among the stakeholders of the private sector, the consultations were organized with four (4) groups of stakeholders, namely: some hotels managers, operators of restaurants and dancing

bars located along the lagoon shore (Hôtel du Lac, Fly, Restaurant Berlin), SOGEMA (Dantokpa Market Management Company). With those different stakeholders operating in various sectors such as fishing, fresh or processed fishery products sales, nobbing, fishery products processing, lagoon mined sand marketing, catering, Hotel industry, leisure (Night Clubs), value addition to and promotion of physically-challenged people, tourism, etc., the lagoon development will significantly contribute to the riparian populations' food security. The lagoon shore is a vital site for establishing trading and merchant activities (Dantokpa market), hotels operators, various catering and night clubs operators, etc. The Fishermen operate on the water while the fishmongers harness the water for drinking purposes, goods transportation way between the unloading docks, the market and their residence. They operate on the shores for the whole duration of their trading activities with their customers. The private operators tap both into the shore and the water depending on their set objectives (hotels, restaurants, passengers' transportation, etc.). Three out of the seven groups of stakeholders are women associations (Fishmongers, Gbenonkpo, Alodo). The private stakeholders encountered are only men. It has not been possible to meet the traders of other products marketed along and around the shores.

Incurred risks and costs There are the floods brought about by the encroachment of the sea, the rise in the Ouémé river and Nokoué lake water level, the increasing insalubrities, insecurity in the area and market (the shore congregated by several nationalities authors of theft and drugs trafficking), an unsound living environment, the spread of those risk-borne pandemics, the decrease in fishing, sale and processing activities, the conflicts. The Fishermen being always onto the water in the fisheries, the women and children layers are the most affected by the floods in the house, unsound shores and market. Therefore, the women and children are more exposed to the above listed risks than men.

Risks magnitude and trends:

Shelters, accommodations The riparian populations build their shelters with precarious materials while hotels operators make special arrangement for the construction, rehabilitation as well as the maintenance of the building.

Environment The tongue of sand has displaced. At a high tide, sea waves reach the hotels size. With abundant floods, the mouthpiece sand is completely swept. Big canoes arrive to mine and collect sand all night long till dawn without any control. As a result, the riparian populations observed a rise in the water level.

Insert 1. The port activities negatively impacted on the Fishermen's activities. If the Fishermen do not work very well, we fishmongers cannot earn anything. When the dam used to open and close, various fish species

could be harvested at different periods of the year. In the past, a ten day-fishing harvest yield exceeded the monthly salary of a Beninese high-ranking civil servant. Therefore, why should we send our children to school? Nowadays, there is nothing more to harvest from the channel. **Statement by a Fishmonger.**

Insert 2. With the decline in our fishing activities in the channel, we took the initiative to reduce the volume of height of stones used as dam over the channel but Authorities rewarded us by throwing us in prison although they also observed the change after the work done..**Statement by a Fisherman**

These statements clearly indicate that the riparian populations are seriously affected by the climate change in their ways of living. They confirm that the climatic risks are differently experienced depending on the gender (man or woman). On their side, they attempt to experiment some solutions. This observation substantiates gender mainstreaming in the project.

3.2 Identification of the desired changes

Changes desired by the stakeholders on the lagoon shores or its environment. (Fishermen and Fishmongers). Finding a solution for the smooth functioning of the dam constructed on the channel (closing and opening at different periods); getting them some shelters, restoring their confiscated rights (by dispossessing them of “their land”). The correction will consist in relocating the riparian populations living on the shores beyond the 25 meters, and the fishmongers in Gbogbanou market while bringing them financial oxygen to support their activities which declined since many years. Rehabilitate the urban inland waterway transport; sanitize the shore; abide by the sanitary and hygienic standards on the fishery products processing venues; review of the Decree stating prohibition of fishing activities on the channel along with the Ministerial order stating getting Pink Prawns Fishing License before operating activities on the sea; re-open the dialogue with governmental authorities. **Private business operators** Raise the crest; strengthen the dam in order to limit the waves hitting the hotels; build small marina’s landing docks. One hotel operator ordered a study which will examine the degradation level with a view to reinforcing the pilling supporting the building.

The groups likely to draw the largest profit from the project outcome The Fishermen, fishmongers, consumers because there will be more fishery products available on the market, a cleaner and more sound living environment along with a risk reduction. Hotels, restaurants and dancing bars managers, Municipality, SOGEMA, central Government will feel more comfortable.

The most-at-risk social groups (men, women, youths, etc.) their resilience capacity, those likely to be negatively affected their losses and needs. The minority setting acadja (fish trap) on Nokoué lake, the Fishermen established upstream could be penalized but the situation would be analyzed. The extremely poor, women and the youths of the community will not have enough resources to harness the project outcome if no financial support is brought to them during the project execution period. Their immediate needs have to do with technical, managerial and specific capacities building, financial supports, etc., in order to enhance their resilience capacity.

3.3 Identification of each stakeholders group's resources

The rights on existing resources, influences The first Fishermen who settled on the lagoon shores about a decade ago claim the landlords' rights on the riparian lands and the water which they harness in order to meet their fundamental needs. But the Associations of men and women operating on the lagoon shores have less opportunity to make their voice heard. The women associations having no concrete resources will be more vulnerable than the men and the Fishermen association. The Toffin and Xwla populations driven off from the lagoon shores will profoundly regret the change and could develop a resistance against the project. The same goes for the Dantokpa market traders and vendors who will henceforth lack place to display their goods in the market.

Competences, information and conditions for the project success The Toffin and Xwla populations have some key information that could be used in the lagoon shores rehabilitation projects. For being living along the shores since their birth, those stakeholders' groups have some decision-making information and have promised to participate in the monitoring & evaluation committees and ensured to develop the love of each other for the success of the project.

4. Analysis by the stakeholders

4.1 The power relationships and influence of the stakeholders;

The possible compromises According to the Fishermen and fishmongers, their rights must be restored. As they say that they are borne onto the lagoon and face some lagoon-borne problems. They claim to be associated to any issues pertaining to the lagoon. They wish they could be recognized as such and enjoy their location onto the lagoon. They affirm that the Toffin and the Xwla should live and stay on the lagoon shores in order for them to identify the period of passage of the fish school so as to better organize fishing activities at appropriate time.

Dependence bond between the ones and others. The women of the Prawns and Fish sellers Association depend on the Fishermen Associations because those fishermen sell them fishery products which they later on retail on the Gbogbanou market.

Influence on the organizations. These organizations are influenced by MEHU, SOGEMA, Cotonou Town Council, and the Ministry of Agriculture (MAEP) when it comes to the lagoon shore use. The levels of influence and power relations (importance) of each stakeholder are summarized in table 13 (in Schedule), table 7, table 7 bis and diagram 1.

One observes on the diagram that the fishmonger women and Fishermen are respectively some low and high potential stakeholders. They should thus be involved and their interests should be protected in the project (table 7 bis). The project shall collaborate with Municipal Authorities, professional women associations, fishermen associations, hotels operators, the managers of restaurants located on the shore and leisure places. However, the Traders and various products vendors groups which include a huge number of women are excluded. Mined sand sellers, dyers and other associations should be monitored.

Identification of the stakeholders who have the capacity to bring a sustainable input The Fishermen groups and women associations can significantly contribute to the technical sustainability of the project as it will have improved the riparian populations living conditions.

Table 7: Symbol and relationships between stakeholders

Major Stakeholders	Symbol	Influence on the project	Importance regarding the project
Fishermen,	A	4	2
Fishmongers	B	4	1
Lagoon mined sand sellers	C	2	1
Dyers,	D	1	1
Municipal Authority	E	5	5
Hotels and Restaurants Operators	F	5	4
Various products traders and sellers Association	G	2	2
Dantokpa Market Traders and vendors	H	2	1
Fishermen Associations	I	4	3
Fishmongers Association	J	4	2
Lagoon mined sand sellers Association,	K	2	2
SOGEMA	L	5	3

Source: analysis conducted based on the data collected on the field, January 2013

Table 7 bis: Inter-stakeholders relationship management strategies

Stakeholders' Power // Potential	High potential	Low potential
High power	Collaboate with	Mitigate the impact, champion against

L

Low power	Involve, build capacities and protect interests	Oversee or ignore	F
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Source: analysis conducted based on the data collected on the field, January 2013
 Strategies to be implemented for the inter-stakeholders relationships management are as indicated in table 7 bis

J

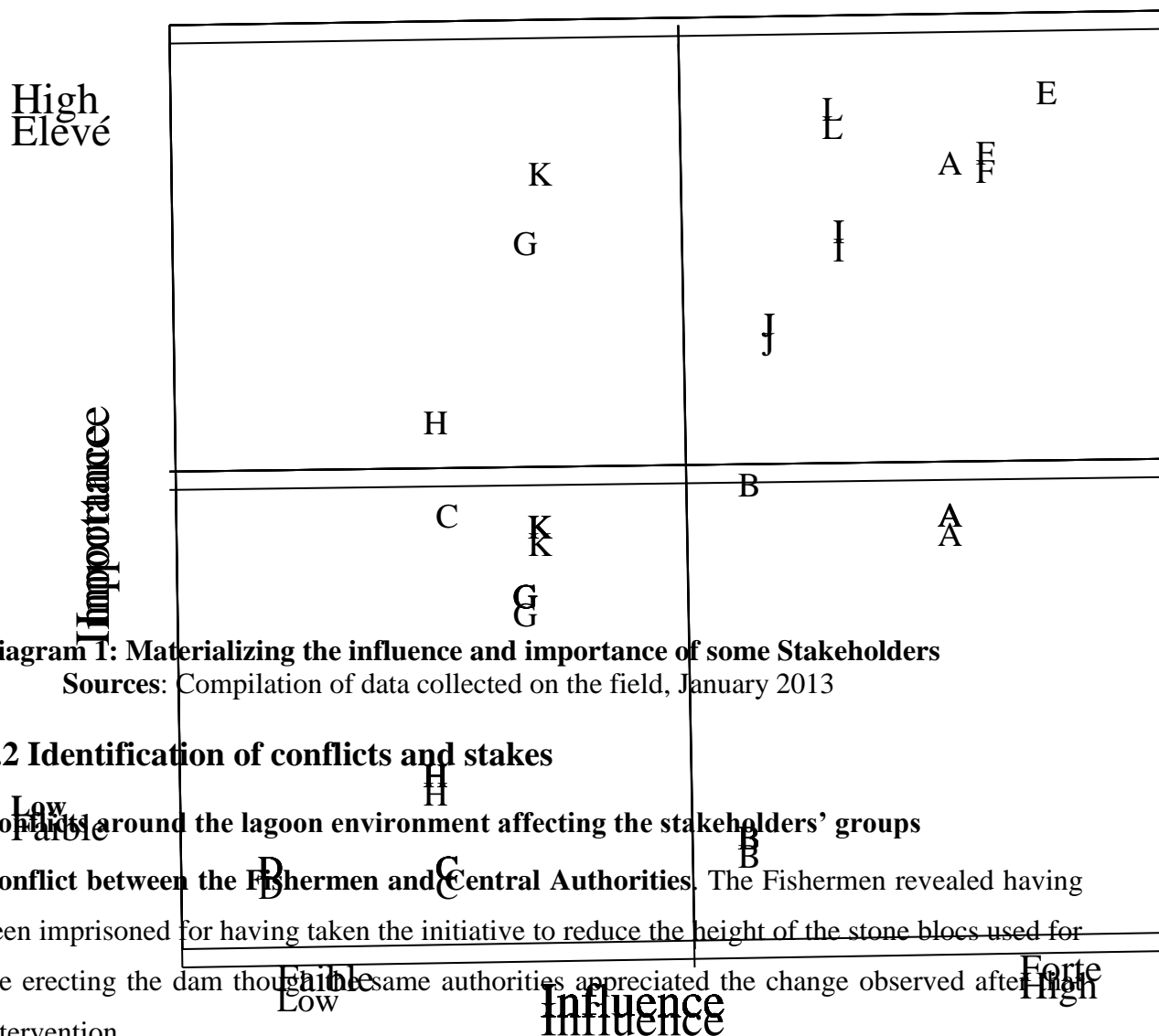


Diagram 1: Materializing the influence and importance of some Stakeholders

Sources: Compilation of data collected on the field, January 2013

4.2 Identification of conflicts and stakes

Conflicts around the lagoon environment affecting the stakeholders' groups
Conflict between the Fishermen and Central Authorities. The Fishermen revealed having been imprisoned for having taken the initiative to reduce the height of the stone blocs used for the erecting the dam though the same authorities appreciated the change observed after the intervention.

Conflicts between the riparian populations and the Ministry of Environment relating to the driving off beyond the 25 meters.

Conflicts between the Fishermen and the Ministry of Agriculture, Animal Husbandry and Fishing (MAEP) about the Decree stating prohibition of fishing activities in the channel and the Ministerial Order dated December 2008 deterring Pink Prawns fishing.

Conflict between the fishmongers and SOGEMA about the fishmongers place at Dantokpa market. SOGEMA (Market management Administration), had difficulty to allocate a non-

built space to the fishmongers who contributed money to build some hangars which SOGEMA dismantled while driving them off.

Conflicts between SOGEMA and the Ministry of Environment about the development of Gbogbanou domain.

5. The impacts: consensus reached on the discussed items

The impact of the risks pre-empted on the lagoon status; Since the past decades, the dam is not playing any more its role as the sea in no more flowing into the lagoon. The mouth is narrowing down, causing hunger, misery and abject poverty among the riparian populations who dispose waste in the lagoon, polluting, in so doing the shore and the channel. The channel water subsequently becomes muddy, viscous and unhealthy.

The impact of the observed risks on the riparian populations' activities During the period of water level rise the neighboring houses are flooded, increasing the risks of water-borne diseases along with the reduction of fishing and thereby the fishmongers' activities. That situation brought about a hike in the fishery products price, aggravating food insecurity and poverty, etc.

Historical profile of some impacts with a discussion on the causes and effects of the various changes

Year	Impact/Effect	Consequence
1885	Artificial opening of the channel to interconnect the Nokoué lake and the sea in order to prevent Cotonou town from disappearing due to floods	Widening of the trench into a channel which became an ecosystem with climatic, ecological, morphological, geological, socioeconomic and conflictual functions etc.
1970	Inception of Hotel construction by my father	Value addition to the shore
1975	Opening of the hotel to the guests	Development of hotel activities
	Construction of the dam which opened and closed up depending on the period of the year	Abundance and variability of fish species caught in the channel and Nokoué lake.
	Stop of the function of opening and closing of the dam	Depletion and disappearance of some fish species
1984	Opening of the mouthpiece	Fissuration of hotel building walls located near the shore
2010	Climatic pressure, flooding of the shore	Cessation of activities for at least three months during some periods
2012-2013	Ongoing studies in order to reinforce the pilling and protect the building against climate change impacts.	Huge Investment to be made

Source: Compilation of data collected during the consultations, January 2013

Historical profile of rose mallows prawns fishing in Benin

Year	Impact/Effect	Consequence
Avant 2002	We used to dispose the rose mallow prawns and keep the big prawns after fishing	Lack of knowledge about its taste and its nutritious function

2002	Discovery in Nigeria of the rose mallow prawns consumption during a trip carried out to Nigeria by some Beninese Fishermen	Revolution in the Fishermen's activities
2002	Training received from the Nigerians on the rose mallows prawns fishing and processing.	Capacities built, increase in the harvests, processing of the rose mallow prawns, promotion of sales
	Organization of the Fishermen and Fishmongers around the rose mallow prawns harvest	Better organization of «rose mallows » harvest
Dec. 2008	Enactment of Decree stating Regulation of rose mallows Fishing in Republic of Benin	Necessity to get an authority before fishing the rose mallows

Source: Compilation of data collected during the consultations, January 2013

5.1 Mapping the Climate change impact on the stakeholders

As such, graph 1 presents the Cotonou lagoon shores stakeholders' socioeconomic vulnerability. The reference resources used on that purpose are the five forms of basic resources characterizing the way of living, namely:

1. Natural resources (water, fishery resources, etc.);
2. Human resources (qualified labour, health, hygiene, etc.);
3. Physical infrastructures (markets, Health facilities, houses, etc.);
4. Financial resources (fishing products, employments, Micro-finance institutions, etc.);
5. Social and relational networks (participation in economic and social community organizations, etc.).

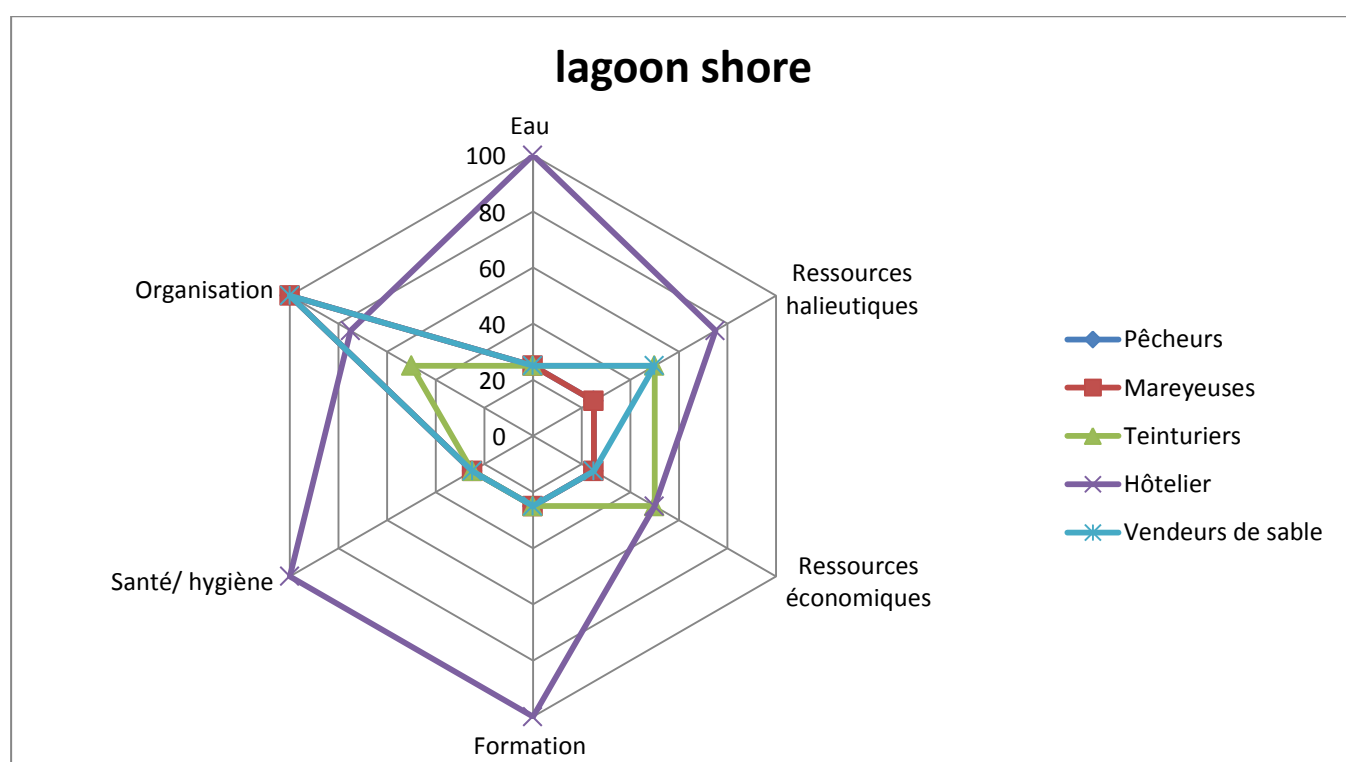


Figure 2: Vulnerability profiles

Source: Diagram drawn from the data collected on the field, January 2013

5.2 Synthesis of biophysical, socioeconomic and cultural risks

The synthesis of biological, socioeconomic and cultural risks is reported in table 8.

Table 8: biophysical, socioeconomic and cultural effects of the identified risks on the population

Target Sectors	Biophysical, socioeconomic and cultural effects		
	Climatic risk 1	Climatic risk 2	Climatic risk 3
Livelihood – Local, regional and national economy; Households' income; poverty level.	Reduction of the catches from the lagoon	Depletion and disappearance of some fish species from the lagoon (cocouin) Decrease of income Decline in the sales Increase of poverty level	Unproductive fishing
Food Security – production and supply of the foodstuffs, agricultural production, breeding, stock over of goods on the markets.	Decline of production	High price of prawns and fish on the market; Inadequacy of financial resources to procure foodstuffs	Increase of malnutrition within the populations
Water, hygiene and Sanitation – Water supply, sanitation systems, hygiene conditions	Pollution of the shore by waste heaps ; spread of skin diseases for those who swim in the channel	No potable water in the areas Source of water-borne diseases	Inexistence of latrines for the riparian populations
Shelters – camping, buildings, need in tentative shelter	Remoteness of the water body	Makeshift housing built with unsuitable local materials (straw, hurdles)	Non-respect of the security margin of the 25 meters
Health – health system, pandemics.	Lack of socio-sanitary facilities in the target areas	Malaria Water-borne diseases Avoidance of attending the neighboring health centers	No health facility in the riparian areas
Infrastructures – roads, buildings, electrical power grids, water supply systems and communication means.	Poor functioning of the dam Poor functioning of the gutters	Areas not divided into plots No roads No electrical power lines No potable water supply system No telephone lines	Floodable areas
Environment – land, water and other natural resources	The channel water becomes muddy when the channel is closed up Water Pollution by the disposed waste	Depletion and disappearance of some fish species from the lagoon (cocouin) Pressure on the water bodies	Loss of the biodiversity
Education – Disruption of courses and closing of schools	Lack or inadequacy of public schools in the riparian areas	High level of poverty	Illiteracy
Government – interruptions of the services provided by the local and national authorities; Political conflicts, impacts at the region level	Conflicts between some stakeholders and the markets administration bodies	Conflicts between the stakeholders and the ministries	Socio-political conflicts
Cultural context – inter-ethnic conflicts, violence, conflicts around access to water, land or other natural resources.	Depletion of the water bodies resources	Loss of biodiversity (disappearance of some species useful for the traditional ceremonies performance) could threaten some aspects of the local cultural context and generate conflicts between ethnic groups	Conflicts within the riparian population Conflicts between the riparian Population and public authorities

Target Sectors	Biophysical, socioeconomic and cultural effects		
	Climatic risk 1	Climatic risk 2	Climatic risk 3
Security and protection	Insecurity of persons and goods	Recurrent thefts	Rapes Children exposure to rapes, drop-out of the school system
Consequences for the women	Decline of the levels of income generating activities Decrease of the income	Increased poverty within the women Difficulty to meet the needs of the household	Spread of prostitution, Sexually-transmitted and communicable diseases including AIDS
Community vulnerability	Population exposure to various diseases and risks (insalubrity, promiscuity, fire)	Lack of solidarity within the community	Climate change
Men and women's Adaptation Strategies	Diversification of income generating activities	Redeployment of men in other activities (docker at the port) and the women into (fishmongers at the level of the fish importing companies)	Reduction of the number of daily meals

Source: compilation drawn from the data collected on the field January and February 2013

5.3 Synthesis of the impacts and adaptation measures

Based on the risks identified, the following impacts and adaptation measures have been put forth by the stakeholders. They are summarized in table 9 below.

Table 9: Matrix of the impacts and adaptation measures to the identified risks

Community exposure to the identified risks	Climatic risk 1		Climatic risk 2		Climatic risk 3	
	Impacts	Adaptation Measures	Impacts	Adaptation Measures	Impacts	Adaptation Measures
Means of livelihood – Local, regional and national economy; Households' incomes; level of poverty.	Reduction of the catches from the lagoon	Poisoning of the lagoons Diversification of the sources of incomes generating activities (AGR)	Depletion and disappearance of some fish species from the lagoon (cocouin) Decline of the sales Increase of poverty level	Resizing and maintenance of the dam; Grant of micro credits to the women to boost the incomes generation activities (IGA)	Unproductive fishing	Redeployment of the Fishermen into other sectors of activities
Food Security – production and supply of foodstuffs, Agricultural production, Breeding, stock-out of goods on the markets.	Decline of the production	Putting in place of fish-holes Diversification of the sources of Incomes (IGA)	High price of the prawns on the market Inadequacy of financial resources to procure foodstuffs	Enhancement of the fishing techniques; compliance with the fishing regulations	Increase of malnutrition cases within the community	Putting in place of a supportive program intended for the Fishermen and boosting fishing activities
Water and sanitation – Water supply ; sanitation systems, hygiene conditions	Pollution of the shore by the heaps of waste ; Spread of skin diseases for those who swim in the channel	Revitalization of waste collection structures Sensitization program on water, hygiene and sanitation	No potable water in the areas; Source of water-borne diseases	Division of the areas into plots and opening of access roads and extension of the Water distribution Network to the riparian areas.	Lack of toilets for the riparian populations	Division of the areas into plots and opening of access roads ; Construction of appropriate public toilets
Shelters – camping	Distance separating the	Relocation of the populations	Makeshift houses built with	Divide the areas into plots in	Non-respect of the margin of the	Relocation of the populations

Community exposure to the identified risks	Climatic risk 1		Climatic risk 2		Climatic risk 3	
	Impacts	Adaptation Measures	Impacts	Adaptation Measures	Impacts	Adaptation Measures
equipment, buildings, needs of provisional accommodation	water body	driven off while respecting the margin of the 25 meters	unsuitable local materials (straw, hurdles)	order to enable the populations to build definite houses	security 25 meters	driven off while respecting the margin of the 25 meters
Health – Health system, pandemics.	Lack of socio-sanitary facilities in the target areas	Division of the areas into plots and opening of access roads, construction of health centers in the neighboring Town sections	Malaria ; Water-borne diseases ; Non-attendance of the health centers of the neighboring areas	Distributions of mosquito nets to the populations, putting in place of preventive health programs; encourage the attendance of health centers.	Lack of health facilities in the riparian areas	Division of the areas into plots and opening of access roads, construction of health centers in the riparian areas.
Infrastructures – roads, buildings, electrical power lines, water supply systems, communication means.	Poor functioning of the dam; poor functioning of the gutters	Dredging and removal of sand from the dam ; Reconstruction of the dam, regular sewer and gutters cleaning	Areas non-divided into plots ; no roads ; no electrical power transmission lines ; no potable water supply system; no telephone lines	Division into plots and opening of access roads, then Extension SONEB and SBEE networks in the riparian areas	Floodable areas	Develop a preventive program and ensure the populations preparedness
Environment – Land, water and other resources	The channel water becomes muddy when the channel is closed up due to the pollution by waste disposal in the water	Revitalization of the structures collecting waste, Community sensitization, Operationalizing the water release and pumping system at the dam level	Depletion and disappearance of some fish species from the lagoon (cocouin) Pressure on the water bodies	Drainage and reconstruction of the dam; Compliance with the fishing regulation,	Loss of biodiversity	Preserving biodiversity
Education – interruptions of the course and closing up of schools	Lack or inadequacy of public schools in the riparian areas	Division of the area into plots and opening of access roads, construction of school facilities, support to the schooling of children	High level of poverty; high rate of school drop-out and failure	Accompagnment of the households through the grant of micro credits	Illiteracy	Putting in place of a literacy program
Government – interruptions of the services provided by the local and national authorities; Political conflicts, impact at the region level	Conflicts between some stakeholders and the markets Administration bodies	Resettlement of the women Sellers relocated from GBOGBANOU onto another appropriate site; Rehousing the populations driven off the lagoon shore	Conflicts between the stakeholders and the ministries	Comply with the governing legislations	Socio-political conflicts	Awareness campaign
Cultural context – Conflicts between ethnic groups, violence, conflicts for access to water, land or other natural resources.	Depletion of water bodies	Enforcement of the law prohibiting fishing in the channel while putting in place social supportive measures (poisoning, surveillance of the water bodies and their periodical	Loss of biodiversity (the depletion and disappearance of some fish species useful for the traditional ceremonies performance) could threaten some aspect of the local cultural	Preservation of the biodiversity	Conflicts between the riparian population Conflicts between the riparian Population and public authorities.	Awareness campaigns

Community exposure to the identified risks	Climatic risk 1		Climatic risk 2		Climatic risk 3	
	Impacts	Adaptation Measures	Impacts	Adaptation Measures	Impacts	Adaptation Measures
		opening for regulatory fishing activities)	context and could be source of conflicts between ethnic groups.			
Security protection	Insecurity of persons and goods	Organize frequent patrols	Frequent rapes	Reinforce security	Rapes of exposed children Children's exposure to rapes, drop-out of school system and malnutrition	Reinforce security, promote children rights
Consequences for the women	Decline of the income generating activities level along with the decrease of incomes	Diversification of the income generating activities	Higher poverty level among the women; Difficulty to meet the needs of the household	Grant of micro credits to women	Increase and spread of prostitution Sexually-transmitted and communicable diseases including AIDS	Promoting Income Generating Activities (IGA)
Community vulnerability	Population exposure to various diseases and risks (insalubrity, promiscuity, Fire)	Awareness campaigns intended for the Communities	Lack of solidarity within the community	Reinforcement of solidarity move	Climate change	Development of climate-proofing mechanisms
Men and women's adaptation strategies	Diversification of the incomes generating activities	Diversification of Incomes Generating activities	Redeployment of men (docker at the port) and women (fishmongers at the level of the fish importing companies)	Redeployment of men (docker at the port) and women (fishmongers at the level of the fish importing companies)	Reduction of the number of daily meals	Reduction of the number of daily meals

Source: compilation from the data collected on the field, January and February 2013.

Commitment condition The Sellers wish SOGEMA moved them back to Gbogbanou before committing into the project as they are not well known at their new location (PTT). As for the Fishermen, they wish the victims of the driving-off operation from the shores were re-housed.

Each stakeholder's commitments All the different stakeholders committed to supporting the project as according to some, it will awake and raise their awareness. By way of conclusion those stakeholders suggested that the heads of Town section put in place some monitoring committees.

Conclusion

During this study, the stakeholders of the Cotonou lagoon shores development project were identified and have massively participated in the required consultations for the elaboration, implementation and success of the project. The stakeholders' vulnerability was examined. Those stakeholders have some relative powers and can influence in one way or the other the project implementation. The risks they are exposed to have been summarized based on the available means of livelihood. The impacts related to those risks and the desired adaptation measures were also revealed. The resources impacts on the stakeholders were mapped. The

Fishermen, Fishmongers, hotels operators, managers of restaurants and leisure places located along the lagoon shore, the Local authorities are the positive stakeholders, while the Dyers, the owners of the fish traps (acadja) set on Nokoué Lake, the Fishermen operating on the lake and SOGEMA are the stakeholders to be carefully monitored for the success of the project. While implementing the project, it is important to study its impact on the owners of the acadja set on Nokoué Lake and the Fishermen operating on the Lake. The stakeholders have, through the commitments signed by them, expressed their intention for their involvement in the project execution, activities monitoring and evaluation as well as the sustainability of its results.

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Schedule 1: Table 10: Riparian areas and populations

Town sections	Areas	Total Inhabitants	Riparian Areas	Riparian Population
3 rd	Adjegounle, AdogletaGbenonkpoHlacomeyKpankpanMido mboSegbeya-Nord Segbeya-Sud, AgbatoAgbodjedoAyelawadje I Ayelawadje II Fifatin	59, 830	Adogléta	5,500
			Gbenonkpo	3,171
			Hlacomey	1,552
			Kpankpan	5,637
			Midombo	5,476
			Agbato	6,143
Sub/total1				27,479
4 th	EnagnonFifadji-HoutoSodjatinme- Centre,Sodjatinne-Est Sodjatinne-Ouest, Abotcodji-Centre Abokicodji-Lagune DedokpoGbedjeuinMissessin Ohe	39, 012	Abokicodji Centre	3,088
			Abokicodji lagune	1,455
			Dedokpo	5,042
			Enagnon	11,792
Sub/total2				21,377
5 th	Wlacondji plage, TokpaHoho, Missèbo, Bocossitokpa Nouveau pont GuinkomeMifongouZongo-EhuzuZongo-Nima Dota Gbeto,Avlekete	32, 864	WlacodjiKp odji	603
			Wlacodji plage,	6,103
			TokpaHoho	1,899
			Missèbo,	1,539
			Bocossitokp a	1,799
			Nouveau pont	1,324
Sub-total 3				1,3267
6 th	Dantokpa, Aïdjèdo 3,Hindé 1 Hindé2, Djidjè 1, Djidjè 2, Ladji Aïdjèdo 1,Aïdjèdo 2 Ahouansori Agata AhouansoriToweta 1 AhouansoriToweta 2 JerichoVossa	71, 085	Dantokpa,	2,396
			Aïdjèdo 3,	5,037
			Hindé 1	4,795
			Hindé2	4,157
			Djidjè 1,	4,117
			Djidjè 2,	4,637
			Ladji	6,075
Sous total 4				31,214
		General Total		93,337

Schedule 2: Vulnerability of the Lagoon shores stakeholders

From the socio-economic view point, a social group is regarded as vulnerable within an environment when it is incapacitated to have access to the entire resources required to fully meet its fundamental needs.

I. The major social groups using the Cotonou lagoon shore

The most representative groups along the Cotonou lagoon shore are as follows:

- Fishermen
- Fishmongers
- Dyers
- Hotel operators
- Traders

II. The Major basic resources of the social groups

- Water resources (potable water, water body)
- Fishery resources and others (fish, prawns, other water body foods)
- Economic and financial resources ()
- Community Organizations (social and relational networks);
- Social services (health, education, etc.);
- Training.

III. Major Income Generating activities

- Fishing,
- Petty trade,
- Agri-food Processing,
- Transportation.
- Services provision.

IV. Vulnerability Indicators

Table 11: Access to and availability of resources for the target social groups

Resource Availability	Access to resources			Resources
	Unlimited	Average	Restricted	
In abundance	Hotel Operator			Eau
				Fishery resources
				Financial resources
	Hotel Operator			Training
	Hotel Operator			Health /Hygiene
	Fishermen Fishmongers Sand sellers			Organization
Average			Dyers, Sand sellers	Water
	Hotel Operator	Dyers Sand Vendors		Fishery resources
		Hotel Operator, Dyer	Sand sellers	Financial resources
				Training
				Health /Hygiene
	Hotel Operator			Organization
Little			Fishermen Fishmongers	Water
			Fishermen Fishmongers	Fishery resources
			Fishermen Fishmongers	Financial resources
			Fishermen Fishmongers Dyers Sand sellers	Training
			Fishermen Fishmongers Dyers Sand sellers	Health /Hygiene
				Organization

Table 12: Vulnerability Indicators

	Natural	Natural	Financial	Human	Human	Social
	Water	Fishery Resources	Economic Resources	Training	Health/hygiene	Organization
Fishermen	25	25	25	25	25	100
Fishmongers	25	25	25	25	25	100
Dyers	25	50	50	25	25	50
Hotel Operator	100	75	50	100	100	75
Sand sellers	25	50	25	25	25	100

Source: Data collected on the field, January 2013

Schedule 3 : Table 13: Synthesis of power relations and influence of the stakeholders

Stakeholder	Major Interests	Project impact on the interests	Influence on the project	Importance regarding the project
Primary				
Fishermen,	Fishing all year long Increase of their activity scope Increase of incomes	+ + +	4	2
Fishmongers	Increase the scope of their activity Increase of incomes	+ +	4	1
Lagoon mined sand sellers	Stop sand selling	-	2	1
Dyers,	Displacement Building institutional capacities	- +	1	1
Municipal Authority	Enhancing the riparians living conditions Sanitizing the shores Restocking the channel	+ + +	5	5
Hotels and Restaurants Operators	Attracting shores Large inrush of customers and tourists High-level profit Less damages on their infrastructures	+ + + +	5	4
Association of traders and vendors of various products.	Building institutional capacities Knowledge about the rights and duties	+	2	2
Dantokpa Market Traders and Vendors,	More adjacent space Clean, tidy and attracting shore Buying / selling of several categories of goods	- + +	2	1
Fishermen Associations	Participation in the Project management Building institutional capacities Knowledge about the rights and duties	+ + +	4	3
Fishmongers Association	Building institutional capacities Knowledge about the rights and duties	+ +	4	2
Lagoon mined sand sellers Association,	Building institutional capacities Knowledge about the rights and duties	+ +	2	2
Secondary				
SOGEMA	Conflicts of interest with the project Conflicts and MEHU (Ministry of Environment) Conflicts with Fishmongers Associations	- - -	5	3

Legend and Symbols used in table 13**Legend**

Importance	Influence
I=Unknown	I = Unknown
1= Less / Not important	1= Less / No influence
2=Little importance	2=Little influence
3=moderate Importance	3= Moderate Influence
4=Very Important	4=Significant Influence
5=Major Stakeholder	5=Highly influential

Sigle

Major Stakeholders	Symbol	Influence on the project	Importance regarding the project
Fishermen,	A	4	2
Fishmongers	B	4	1
Lagoon mined sand sellers	C	2	1
Dyers,	D	1	1
Municipal Authority	E	5	5
Hotels and Restaurants Operators	F	5	4
Various products Sellers Association	G	2	2
Dantokpa Market Traders and vendors,	H	2	1
Fishermen Associations	I	4	3
Fishmongers Association	J	4	2
Lagoon mined sand sellers Association,	K	2	2
SOGEMA	L	5	3

Table 14: Extreme poverty distribution in the Town sections

Town section	Rests of rich households	Number of poor households	Overall households	Town sections proportion of poor households	Precedence Hierarchy
1	9,391	2,785	12,176	9	7
2	10,534	2,200	12,734	7.1	8
3	10,247	3,121	13,368	10.1	4
4	5,892	3,046	8,938	9.9	5
5	6,741	1,021	7,762	3.3	9
6	13,832	2,805	16,637	9.1	6
7	8,221	189	8,410	0.6	12
8	8,681	550	9,231	1.8	11
9	11,566	3,152	14,718	10.2	3
10	8,349	1,186	9,535	3.8	10
11	7,600	542	8,142	1.8	11
12	12,787	5,385	18,172	17.4	1
13	9,631	4,892	14,523	15.8	2
Total	123,472	30,874	154,346	100	

Source: Figures resulting from the RGPH3 (3rd General Operation of Population and Housing Census)

Schedule 4: Evidence of Stakeholders' commitments (Letters of intent)

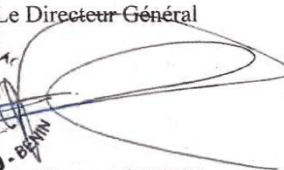
LETTRE D'INTENTION

Faisant suite aux concertations organisées pour l'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou aux changements climatiques, destiné au Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, la Direction Générale de l'HOTEL DU LAC (Cotonou) exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

L'HOTEL DU LAC de Cotonou souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de la vie économique et sociale qui en dépend.

Cotonou, le 25 janvier 2013

Le Directeur Général



HOTEL DU LAC
H.L.
COTONOU - BENIN

Hassan El DORR

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**


LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier ADOGLETA exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier ADOGLETA souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



HOUNGOU Nestor Joseph

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier Nouveau Pont exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier Nouveau Pont souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



Blaise AMOUSSOU

Projet d'adaptation des berges lagunaires de Cotonou au changement climatique

LETTRÉ D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier Enagon exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier Enagon souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



SEWA NAZAIRE

Projet d'adaptation des berges lagunaires de Cotonou au changement climatique

LETTRÉ D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier MISSEBO exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier MISSEBO souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



Y. B. AMEGNAGLO

Projet d'adaptation des berges lagunaires de Cotonou au changement climatique

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier DJIWJE I exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier DJIWJE I souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013



Le Chef de Quartier,

Klotof Jean-Baptiste
KLOTOF Jean-Baptiste

Projet d'adaptation des berges lagunaires de Cotonou au changement climatique

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier DENOKPO exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier DENOKPO souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,


HOUNSOUFA H. Emile

Projet d'adaptation des berges lagunaires de Cotonou au changement climatique

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier DJIDJE II exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier DJIDJE II souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,




N'TCHALA C. Daniel

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier KPANI KPANI exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier KPANI KPANI souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

L Président ,

ZANNOU Nathanael

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier HINDE II exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier HINDE II souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



Bocco Ange Dmatien

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**


LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier HINDE IV exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier HINDE IV souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

L Président ,


SAMEY Edith

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier Jéricho I exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier Jéricho I souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



Blaise A. KOUKOYI



**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier TOKPA - XOXO exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier TOKPA - XOXO souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



FELIHO S. Patrick

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier ABOKICODJI lagune exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier Abokicodji lagune souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



ABOKI B. K. FAUSTIN

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier MIDOMBO exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier MIDOMBO souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,

AGBLEMON Timothée Koko

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier Bocossi Tokpa exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier Bocossi Tokpa souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,



Basile Gnansourou

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Chef du Quartier HINDE I exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Les populations du Quartier HINDE I souhaitent la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Chef de Quartier,


HOUNSA Jacob

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier _____
ADOGLETA exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier ADOGLETA
_____ souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président ,


Jossou Z. Philippe

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier 11^r FELIXO HAHATHIEL exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier FDK PA - 10 x 0 souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président ,

P.O. [Signature] le 10/02/2013
Monsieur FELIXO HAHATHIEL

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier _____
Djadjé II exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier Djadjé II
_____ souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président ,



SOHOUDE Daniel

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier Midombo exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier Midombo souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

L Président ,



Mariano. Edouard.

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier Ni Sèbo exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier Ni Sèbo souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président ,

Q. Simon

Quenum J. Simon

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier Enagnon exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier Enagnon souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président ,



AHOVANSINOU Henry

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier DJINSEI exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier DJINSEI souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

L. Président,

P.O


Bossamindu Selémir

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**


LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier Nouveau Pont exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier Nouveau Pont souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président ,


James Emile

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**


LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier _____
BOCOSSI TOKPA exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier BOCOSSI TOKPA
_____ souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

L Président


Abantou CAKPA

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Président du Comité de Développement du Quartier _____
Deedokpo exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

Le Comité de Développement du Quartier Deedokpo
_____ souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président ,



Arouzoun Alexis

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**


LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Conseil d'Administration de l'Association Groupement des exploitants artisans et vendeurs de sable Lagunaire (GEAVSL) exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

L'Association Groupement des exploitants artisans et vendeurs de sable lagunaire souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président


A. H. DAN SARA KAN

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION


Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Conseil d'Administration de l'Association des Jeunes
pour le développement Solo gleta

exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

L'Association des Jeunes pour le
développement
souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président


Zinsou. Herbert

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Conseil d'Administration de l'Association des Pêcheurs de Crevettes exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

L'Association des Pêcheurs de Crevettes souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président



Godonou Samuel MONTY

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Conseil d'Administration de l'Association New Leader

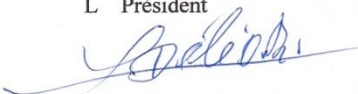
exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

L'Association New Leader

souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

L. Président


Sandjiron Delé

**Projet d'adaptation des berges lagunaires de Cotonou au
changement climatique**

LETTRE D'INTENTION

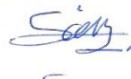
Suite aux séances de concertation organisées dans le cadre des travaux d'élaboration du document final du Projet d'adaptation des berges lagunaires de Cotonou au changement climatique, à soumettre au financement du Fonds d'Adaptation de la Convention-Cadre des Nations Unies sur les Changements Climatiques, le Conseil d'Administration de l'Association des Pêcheurs de crevettes Roses Marins

exprime son adhésion aux objectifs du projet et son intention de s'impliquer dans l'exécution, le suivi et l'évaluation des activités, ainsi que dans les mécanismes de durabilité des acquis.

L'Association des Pêcheurs de crevettes Rose et Marins
souhaite la mise en œuvre effective du projet dans l'intérêt du système lagunaire et de ses membres.

Cotonou, le 26 janvier 2013

Le Président



Ayivodji S. Antoine

Schedule 5: Attendance Sheets

NATIONAL ENVIRONMENT FUND

Additional study for developing the final Project Document in view of the Cotonou Lagoon shores adaptation to Climate Change.

Consultation Meeting with the stakeholders: ___ Officials of Town sections 4 and 5_____

DATE : JANUARY 25TH, 2013 VENUE : Community Hall of Town section 4

N°	Names	Institution/Organisation	Position	Phone number	E-mail
1	DANDJINOU Désiré	Councillor	Retailer	9749 89 65	
2	GODO Adolphe	Councillor	Retired	97549344	
3	AHOUANHOU H moubarack	Marine sand Manager	Fisherman	97089667	
4	AYIVODJE Antoine		Fisherman	97680549	
5	GUEDENON.M ; Cyprien	Student	Tour Manager	95590020	guedenonmindessou@yahoo.fr
6	HOUEDJI Christophe	Councillor	Fisherman	66279984	
7	DOSSOU M . Krystel	Consultant	OFEDI	97146564	Krystod@gmail.com
8	GNONLONFIN yasmine		Student		
9	DJEBENOU Romuald	Student		96071611	Robogad1@yahoo.fr
10	HEGNON Bienvenu	Student		666400579	Bidoss014@yahoo.fr
11	GODO Dossa Martin	Teacher		97143171	Godod.martin@live.fr
12	BIAOU Mathieu	FNE/MEHU	DMRF	97608219	biaoumathieu@yahoo.fr
13	KOUDJO Denis	MCOT / Town section 4	CA4	97082494	Madenik@yahoo.fr
14	AGBAHOLOU sévérin	MCOT / Town section 5	CA5	95957715	Sévérinagbaholou@yahoo.fr

N°	Names	Institution/Organisation	Position	Phone number	E-mail
15	BABADANKPODJI Pascaline	Lecturer-Researcher	Consultant	95868818 66411597	pasbabad@yahoo.fr
16	GNOLONFIN Lazare	Port and Coastline Engineer	Consultant	95866054	gnolonfin@yahoo.fr
17	GNONSE A.jonas	Fisherman		97637989	
18	ZANNOU Félicien	Fisherman		97597871	
19	MOTTI Samuel	Chairman APCL of Town section 4		97256481	
20	HEOUENOU Kocou	Fisherman		97641309	
21	TOFFI Mathias	Consultant FNE	Lecturer- Researcher	97898914	dtofffi@hotmail.com
22	ADJAGBA Dominique	Riparian		97640472	
23	AGBOTON Joel	FNE		96034738	Jgagboton@yahoo.fr
24	GOVOU Bello	Trader	97044626		
25	AHO Nestor	UAC	Consultant	97328931	ahonestor@yahoo.fr

NATIONAL ENVIRONMENT FUND

Additional study for developing the final Project Document in view of the Cotonou Lagoon shores adaptation to Climate Change.

Consultation Meeting with the stakeholders: ___Businessmen_____

DATE : JANUARY 25TH, 2013

VENUE : Community Hall of Town section 4

N°	Names	Institution/Organization	Position	Phone number	E-mail
1	CODJA CHRISTIAN	FLY	DG	97747478	CODJIA.CHRISTIAN@YAHOO.FR
2	HEESE Volker	Restaurant Berlin	DG	95950708	Volker heese@hotmail.de
3	TOFFI Mathias	Consultant FNE	Lecturer- Researcher	97898914	dtofffi@hotmail.com
4	Bio David J	C/SAF/SOGEMA	C/SAF	95424292	biodavidjoseph@yahoo.fr
5	KODJO Z Emmanuel	C/DTE/SOGEMA	SOGEMA	95052421	
6	DOSSOU M . Krystel	Consultant	OFEDI	97146564	Krystod@gmail.com
7	GNONLONFIN yasmine		Student		
8	DJEBENOU Romuald	Student		96071611	Robogad1@yahoo.fr
9	HEGNON Bienvenu	Student		666400579	Bidoss014@yahoo.fr
10	GODO Dossa Martin	Teacher		97143171	Godod.martin@live.fr
11	BIAOU Mathieu	FNE/MEHU	DMRF	97608219	biaoumathieu@yahoo.fr
12	BABADANKPODJI Pascaline	Lecturer-Researcher	Consultant	95868818 66411597	pasabad@yahoo.fr
13	AHO Nestor	UAC	Consultant	97328931	ahonestor@yahoo.fr
14	EL DOOR Hassan	Hotel du lac	MD	97066666 21331919	hoteldulac@hotmail.com

NATIONAL ENVIRONMENT FUND

Additional study for developing the final Project Document in view of the Cotonou Lagoon shores adaptation to Climate Change.

Consultation Meeting with the stakeholders: Sellers and Officials of Town section 4 and 5

DATE : JANUARY 26TH 2013

VENUE: Community Hall of Town section 4

N°	Names	Institution/Organisation	Position	Phone number	E-mail
1	TOFFI D Mathias	FNE/consultant	Lecturer-Researcher	97898914	dtofffi@hotmail.com
2	ATODJINOUE Bienvenue	Chairman of CDQ (Area Development Committee)	Fisherman	963010-63	Adonai2006@yahoo.fr
3	AWLE Dossa		Fisherman	97847807	
4	YEHOUENOU Emmanuel		Fisherman	97376918	
5	YEHOUENOU Moussa	Fishmonger		663132	
6	AGONYE SELA		Prawn Seller	96209765	
7	ABOKI Béatrice		Prawn Seller		
8	MONTI Minnensin		Prawn Seller	97189886	
9	GOVOU Rose	Association GBENOKPO(SG)	Prawn Seller	67454417	
10	HOUSSOU Dorcas	Association GBENOKPO(OG)	Prawn Seller	97502017	
11	TOGBE Rachelle	Association GBENOKPO(OGA)	Prawn Seller	97247653	
12	VODONNON Philomène	Association GBENONKPO(chairman)	Prawn Seller	97734657	

N°	Names	Institution/Organisation	Position	Phone number	E-mail
13	GOVOU Virginie	Association GBENONKPO	Prawn Seller	97775289	
14	ADANCON Colette	Association Agbondjedo Alodo	Prawn Seller		
15	Monti Samuel		Chairman APCL	97256481	
16	Ahouanhoun Houguèvou Moubarack		Chairman APCL (Lagoon mined sand sale) Fisherman	97089667	
17	MONTI Janvier		Fisherman	97058948	
18	ABOKI Léandre		Driver	97732685	
19	ABOKI Donatien Zinsou	Présidente ADAL	Retailer	97222120 95065619	
20	YEHOUEYOU Hontou		Seller		
21	SENOU Germaine		Seller	96000051	
22	AKAKPO Assanan		Seller		
23	NOUKONNOU Rose		Seller		
24	KPADONOU Marie		Seller	95570880	
25	HASSANOU Yahotcha		Seller	66433086	
26	ZANNOU Félicien		Fisherman	97597871	
27	GNONSE Jonas		Fisherman	97637989	
28	HEGNON Bienvenu	Student		95045742	Bidoss014@yahoo.fr
29	GUEDENON M.Cyprien	Student		95590020	guedenonmindessou@yahoo.fr
30	HANTO Alice		Fishmonger	97058670	

N°	Names	Institution/Organisation	Position	Phone number	E-mail
31	YEHOUENOU Leon Ménivoh	(SG) Fishermen Association	Teacher- Fisherman	97837985	
32	AYIVODJI Antoine	Président Association crevette de mer	Fisherman	97680549	
33	DANDJINOUE Délé	Président/vice new leader andesport	Councillor	97498965 90928888	
34	ABOTI Faustin		Chief of Aboki codji Area	97249053	
35	Aboki Héloïse		Retailer Aboki codji	97034814	
36	HOUSSINOUE Martine		Trader	97544937	
37	DEGBENON Romuald	Etudiant	Assistant Consultant	96071611	Robogad1@yahoo.fr
38	GOMINA Farouck		Commercial Agent	66302055	
39	AHO Nestor	Consultant		97328931	
40	Kristel M.R Dossou	OFEDI	Consultant	97146564 90010162	krystod@gmail.com
41	Mariano Edouard	CDQ Midembo	Chairman	97704355	
42	N'TCHALA O.Daniel	C Q/DJIDJE	CQ	96243484 95255890	
43	ZANNOU Mathias	CDQ KPANKPAN	Chairman	98245419	
44	KLOTOE Jean Baptiste	CQ/DJIDJE	CQ	96258447 95810846	
45	SOHOUNDE Daniel	CDQ/Didjè2	Chairman	96442074	
46	SOSSOMINOUE Séverin	CDQ Didjè 1		96956237	
47	SAMEY Edith	CDQ Hindé 2	Chairperson	97932596	
48	TODJINOUE Léopold	CDQ Hinde 1	Vice chair	97064148	

N°	Names	Institution/Organisation	Position	Phone number	E-mail
				95207412	
49	AMEGNAGLO BASILE Yaovi	CQ Missebo	CQ	97321950	
50	GANDONOU K .Faustin	CQ Aboki codji lagoon	CQ	97244253	
51	HOUMHOUI H Joseph	CQ	CQ	97395194	
52	DOSSOU Philippe	Chairman of the Development Committee		979879876	Baba.sala1@yahoo.fr
53	AGBLEMON Timothée K	CQ	CQ Midenbo	97932093	
54	LOGBO Salako Romain	CQ	CQ KPANKPAN	97377781	
55	HOUNSOU FA H Emile	CQ	CQ DENOKPO	98982374 93049201	
56	FELIHO.s Patrick	CQ	CQ TOKPA XOXO	97378548	
57	FELIHO HATIAMIER	Pr CDQ Treasurer		97084314	
58	AMOUSSOU Blaise	CQ /New	CQ	95561103	
59	KOUKOYI Blaise	CQ Jéricho 1	CQ	95714037	
60	BOCO Ange Donatien	CQ HINDE 2	CQ	97601095	
61	HOUNSA Jacob	CQ HINDE 1 (Adviser)	CQ (Adviser)	97940878	
62	ZINSOU Herbert	Chairman of the Youth Development Association	Chairman	98746456	

NATIONAL ENVIRONMENT FUND

Additional study for developing the final Project Document in view of the Cotonou Lagoon shores adaptation to Climate Change.

Consultation Meeting with the stakeholders: ____Sea-water Pink Prawn fishermen

DATE : _29 /01 /2013

VENUE: _Abokicodji lagune

N°	Names	Institution/Organisation	Position	Phone number	E-mail
1	HOUNSOU Z DAMIEN	Sea-water Pink Prawn Fishermen Association (APCRM)	Secretary General (APCRM)	97267338	hounds@yahoo.fr
2	AYIVODJI S Antoine		Chairman (APCRM).	97680549	
3	SOKENOU Gérard		Fisherman	97057124	
4	AHOUANHOU HOUGUEVOU Moubarack		Fisherman	97089667	
5	SOGINOU David		Fisherman	97782272	
6	HOUEDJI Christophe		Fisherman	66279984	
7	DJANBA Lassis			66041190	
8	AHIMAKIN Iréné		Fisherman	95828651	
9	HOUGUEVOU Razack			97848325	
10	MEHINTO Badirou			97942991	

N°	Names	Institution/Organisation	Position	Phone number	E-mail
11	HOUGUEVOU Lamanou			98360315	
12	ZOSSOU Raoul			97070501	
13	DJISSOU Moussa			96956509	
14	HOUNGUEVOUN Mounirou			97924239	
15	KRYSTEL M R Dossou	OFEDI	Consultant	97146564	krystod@gmail.com
16	AYAH D. Nicolas		Reporter Photographer	97689916	

NATIONAL ENVIRONMENT FUND

Additional study for developing the final Project Document in view of the Cotonou Lagoon shores adaptation to Climate Change.

Consultation Meeting with the stakeholders: _____ Markets Administration Company

DATE : _____ February 4, 2013 PLACE: _____

N°	Names	Institution/Organisation	Fonction	Phone Number	E-mail
1	Arouna Imorou	SOGEMA	DGA	94003242	Arounaim72@yahoo.fr
2	Simon G. Koba	SOGEMA	DE.	95742728	iretiko@yahoo.fr
3	David Bio	SOGEMA	c/SAT	95424292	biodavidjoseph@yahoo.fr
4	DEGUENON Christiane épouse capo chichi	SOGEMA	C /SAH	95358739	christianedeguenon@yahoo.fr
5	KODJO Z Emmanuel	SOGEMA	C /DTE	95052421	
6	KRISTEL MR Dossou	OFEDI	CONSULTANT	97146564	Krystod7@yahoo.fr krystod@gmail.com
7	BIAOU Mathieu	FNE/MEHU	DMRF	95572590	biaoumathieu@yahoo.fr
8	AHO Nestor	UAC	Consultant	97328931	ahonestor@yahoo.fr
9	TOFFI Mathias	Consultant FNE	Lecturer Researcher	97898914	dtofffi@hotmail.com

Schedule 6: Terms of reference of the study

The purpose of this study is to:

- ✓ Organize consultation meetings with all the stakeholders (local authorities, Riparian Areas Development Associations, Private Business Operators, Youths and Women Associations) with a view to exchanging on the economic activities of the populations riparian to the Lagoon, the risks incurred, their magnitude and variation lines (floods, minimum flows, fierce winds, exchange of water between the Ocean and Nokoué Lake, fluctuation of water salinity, proliferation of floating plants, fish and prawn stocks variations, etc.), the impact of the risks observed on the lagoon status and the riparian populations activities, the adaptation measures taken, implemented or envisaged projects, the deliverables of this lagoon shores adaptation project, the assets or best practices drawn from previous projects into which this one could tap, the interest of the project components for the stakeholders, the needs and modalities for the stakeholders' participation in the project;
- ✓ Identify the most at-risk social groups (men, women, youths, etc.) and their resilience capacity (mostly women);
- ✓ Identify the economic and social knock-on-effects that the stakeholders could benefit from this project;
- ✓ Identify the social groups for whom this project outcome will be the most profitable while underscoring women's position within those groups;
- ✓ Identify the stakeholders likely to ensure the project technical, financial, institutional, socio-cultural and environmental sustainability;
- ✓ Examine the modalities for involving the private sector operators in the sustainability mechanisms (SOGEMA, CRUSTAMER, HOTEL DU LAC);
- ✓ Identify the breakwaters structures and other port infrastructures affecting the Cotonou lagoon mouthpiece;
- ✓ Examine the climate-proofing modalities in terms of lagoon shores protection, rehabilitation /development of socio-community infrastructures as well as solid and liquid waste management as pinpointed in the project identification sheet, and identify others;
- ✓ Lead stakeholders to formally commit themselves to getting involved in the project execution, monitoring and evaluation of activities and sustainability of the outcome;

At the completion of the study, the following documents shall be produced:

- One study report presenting (i) the synthesis of consultation meetings between the consultants and the stakeholders, (ii) the consensus reached on each items considered with all the stakeholders categories, and (iii) the table of past and current relevant initiatives along with the expected synergies and complementarities of the project and / or best practices emanating from it.

- Stakeholders' commitment documents on the project implementation, monitoring and evaluation.

Schedule 4: Evidence of Stakeholders' commitments (Letters of intent)

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Management of HOTEL DU LAC (Cotonou) expresses his adhesion to the project objectives. Moreover, he underscores his intention to get involved in the implementation, monitoring and evaluation of activities, as well as in the assets sustainability mechanisms.

The Cotonou HOTEL DU LAC longs for the effective implementation of the project in the interest of the lagoon system and of the economic and social life depending on it.

Cotonou, this January 25, 2013.

The Managing Director
Hassan EL DORR
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of ADOGLETA Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The ADOGLETA Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
HOUHOU Hector Joseph
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of NOUVEAU PONT Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The NOUVEAU PONT Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
Blaise AMOUSSOU
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of ENAGNON Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The ENAGON Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
SEWA Nazaire
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of MISSEBO Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The MISSEBO Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
Y. B. AMEGNAGLO
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of DJIDJE I Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The DJIDJE I Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
KLOTUE Jean-Baptiste
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of DENOKPO Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The DENOKPO Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
HOUNSOUFA H. Emile
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of DJIDJE II Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The DJIDJE II Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
N'TCHALA O. Daniel
-Signature & stamp-

The Cotonou Lagoon shores Adaptation

to Climate change

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of KPANKPAN Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The KPANKPAN Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
ZANNOU Mathias
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
 to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of HINDE II Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The HINDE II Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
BOCCO Ange Donatien
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairperson of HINDE II Area Development Committee, hereby expresses her adhesion to the project objectives. Moreover, she undertakes and expresses her intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The HINDE II Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairperson,
SAMEY Edith
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of JERICHO I Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The JERICHO I Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
Blaise A. KOUKOYI
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United

Nations Framework Convention on Climate Change, the Head of TOKPA-XOXO Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The TOKPA-XOXO Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
FELIHO S. Patrick
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of ABOKICODJI Lagune Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The ABOKICODJI Lagune Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
ABOKI G. K. Faustin

-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of MIDOMBO Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The MIDOMBO Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
AGBLEMON Timothée Kokou

-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of BOCOSI TOKPA Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The BOCOSI TOKPA Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
Basile GNANSOUNOU
-Signature & stamp-

The Cotonou Lagoon shores Adaptation to Climate change

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Head of HINDE I Area, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The HINDE I Area populations long for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Head of Area,
HOUNSA Jacob
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of ADOGLETA Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The ADOGLETA Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
DOSSOU I. Philippe
-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Area Development Committee Chairman, *Mr. FELIHO Nathaniel* hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The TOKPA XOXO Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman, and by order,

Mr. FELIHO Nathaniel

-Signature-

this February 2, 2013

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of DJIDJE II

Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The DJIDJE II Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
SOHOUNDE Daniel
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of MIDOMBO Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The MIDOMBO Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairperson,
MARIANO Edouard

-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of MISSEBO Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The HINDE II Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairperson,
QUENUM J. Simon

-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of ENAGNON Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The ENAGNON Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
AHOUANDJINOU Henry
-Signature-

The Cotonou Lagoon shores Adaptation to Climate change

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of HINDE I Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The HINDE I Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
TODJINOU Léopold
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of DJIDJE I Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The DJIDJE I Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman, and by order,
SOSSAMINOU Séverin
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of NOUVEAU PONT Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The NOUVEAU PONT Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
JAMES Emile

-Signature & stamp-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Chairman of BOCOSI TOKPA Area Development Committee, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The BOCOSI TOKPA Area Development Committee longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
Martin CAKPO
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Board of Directors of the Association of the Grouping of Lagoon Artisanal Mined Sand Operators and Sellers (GEAVSL), hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The Association of the Grouping of Lagoon Artisanal Mined Sand Operators and Sellers longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
AHOUANHOUN H. Moubarakar
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Board of Directors of the Youth Association for ADOGLETA Area Development, hereby expresses his adhesion to the project objectives. Moreover, he undertakes and expresses his intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms. The Youth Association for ADOGLETA Area Development longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
ZINSOU Herbert
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Board of Directors of the Prawns Fishermen Association, hereby expresses its adhesion to the project objectives. Moreover, it undertakes and expresses its intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The Prawns Fishermen Association longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
Godonou Samuel MONTY
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Board of Directors of NEW LEADER Association, hereby expresses its adhesion to the project

objectives. Moreover, it undertakes and expresses its intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

NEW LEADER Association longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
DANDJINOU Délé
-Signature-

**The Cotonou Lagoon shores Adaptation
to Climate change**

LETTER OF INTENT

In furtherance with the consultations organized as part of the process of the final Project document elaboration for the Cotonou lagoon shores ecosystems and human communities' adaptation to climate change to be submitted to the United Nations Framework Convention on Climate Change, the Board of Directors of the Sea Pink Prawns Fishermen Association, hereby expresses its adhesion to the project objectives. Moreover, it undertakes and expresses its intention to get involved in the implementation, monitoring and evaluation of the activities, as well as in the assets sustainability mechanisms.

The Sea Pink Prawns Fishermen Association longs for the effective implementation of the project in the interest of the lagoon system and its members.

Cotonou, this January 26, 2013.

The Chairman,
AYIVODJI S. Antoine
-Signature-