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Assessment of the Environmental Impact of the Tangier Med Port by the Cause-Effect Method

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Abstract: *The city of Tangier is currently considered a prime economic growth pole. Significant investments in various business sectors bear witness to this. The Tangier region has 5 industrial zones.*
The Tangier-Med area, which is the subject of our study, occupies a special place for several reasons. We cite in particular:

- *Its economic, social and environmental importance compared to other regions.*
- *This is an ongoing project: the extension of Tangier-Med*
- *Environmental impact assessment is a very useful approach for understanding the current level of environmental performance.*

This methodology will consider the terms of "Law No. 12-03 on environmental impact assessments". It will assess the different effects that can affect the environment in different ways after the completion of economic and development projects. It will therefore make it possible to identify measures to eliminate, mitigate or compensate for the negative impacts.
First, a general description of the initial state of the site likely to be affected by the project will be the subject of a basic data report. In particular, the main biological, physical and human components, characteristics and stages of the project, the nature and quantities of raw materials, liquid, gaseous and solid discharges as well as the waste generated by the construction or operation of the project.
An analysis and evaluation of direct and indirect effects are then presented.
Finally, a proposal for an environmental management plan combining the measures envisaged to eliminate, mitigate or compensate for the harmful consequences of the project for the environment, as well as measures aimed at strengthening and improving the positive impacts of the project as well as a monitoring and surveillance of the project monitoring program for the execution, operation and development of the project
Key Word*: Port , Sustainability, Assessment , Methodology , Key, performance indicator.*

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I. Introduction

Environmental Impact Assessments[i] is considered a standard tool for decision-making in most countries. They are used around the world as management tools for assessing the types and extent of environmental impact likely to be caused by a given human action or activity on a species, habitat or ecosystem (and sometimes also the human environment).

EIA aims at integrating environmental considerations in the decision-making system, minimizing or avoiding adverse impacts, protecting natural systems and their ecological processes, and implementing principles of sustainable development. Frequently, they must also include cumulative impacts assessments (CIAs), which consider impacts of ancillary activities (e.g., the construction and prolonged presence of a road leading to the facility to be build) and often also other reasonably foreseeable future activities, that may or may not be directly associated with the project (e.g., the urban development of the local area along the road to the facility). Whether purely informative tools or backed by legislative requirements to select (or even reject) the least impactful option, EIAs need to be conducted early enough in planning stages that financial commitments have not been made and the project can be changed if needed. In accordance with various guidance EIAs are intended to guide environmentally responsible management practice through an impartial, objective, scientifically-based, thorough, comprehensive and up-to date description and discussion of: the baseline environment; current, planned and potential human activities; and the expected impacts of these activities individually and cumulatively. In this sense, EIAs are an important element of the rational decision-making process for authorities and environmental managers.

However, EIAs often fall short of this ideal for various reasons. In even the best circumstances the full extent of many of the impacts of human activities are not completely known or understood. Similarly, the

human activity may result in impacts that can interact in unpredictable ways to generate synergistic or antagonistic impacts, which can be greater or smaller than the sum of their parts. Furthermore, many standards written into law are undefined, especially within a scientific context. These problems are unavoidable obstacles for authors of EIAs, however documents that nonetheless incorporate the best available relevant knowledge and information will still provide management agencies with a tool to bound uncertainties, make appropriate decisions and to guide allocation of funding to fill data gaps. Regardless, it is possible (and desirable) to incorporate precautionary discussions to encapsulate at least some of this uncertainty into EIAs, although this practice is unfortunately not commonplace.

More problematic is when EIAs do not reach their intended potential due to more tractable issues. Despite the existence of regulations and guidelines mandating timeframes, minimums of included information and internal or public document reviews, many EIAs now suffer from an investment of insufficient time, funding, expertise and/or attention to detail. Many of the resulting issues have been noted before. However, little progress has been made. Some EIAs are even little more than exercises in copy-pasting, with some astonishingly obvious flaws that have passed through review processes, or if they were identified have remained unchanged and, on occasion, have even repeated at a later time.

In the following we try to illustrate some of the potential shortcomings of EIAs produced under the circumstances described above. To do this, we focus on a few specific examples from our combined experience to make our points, as we feel this is more revealing than a simple count of each type of issue following an extensive review of EIAs. This represents an attempt to raise awareness of the problems among scientist and policy practitioners, with a view to improving assessment and ultimately conservation, rather than an effort to single out any specific consulting companies whose reports we used for the various examples. Therefore, the references and some of the specific project details from assessments produced by private companies used in the examples below have been withheld. These details were, however, provided to the Editor at the time of submission. Examples from documents produced by government agencies have been provided intact as they do not have a financial stake in their reports. Accordingly, we attempted to focus on available, government-produced documents, where possible, for better reader access.

II. Material and Methods

The environmental impact assessment takes place in 3 stages:

- Step 1: establishment of basic data
- Step 2: analysis and evaluation of direct and indirect effects
- Step 3: proposal for an environmental management plan

The cause-effect methodology is applied to each element of the project. These are the matrices where we will find, on the one hand, the sources of impact (or project actions) and, on the other, the components of the environment likely to be affected.

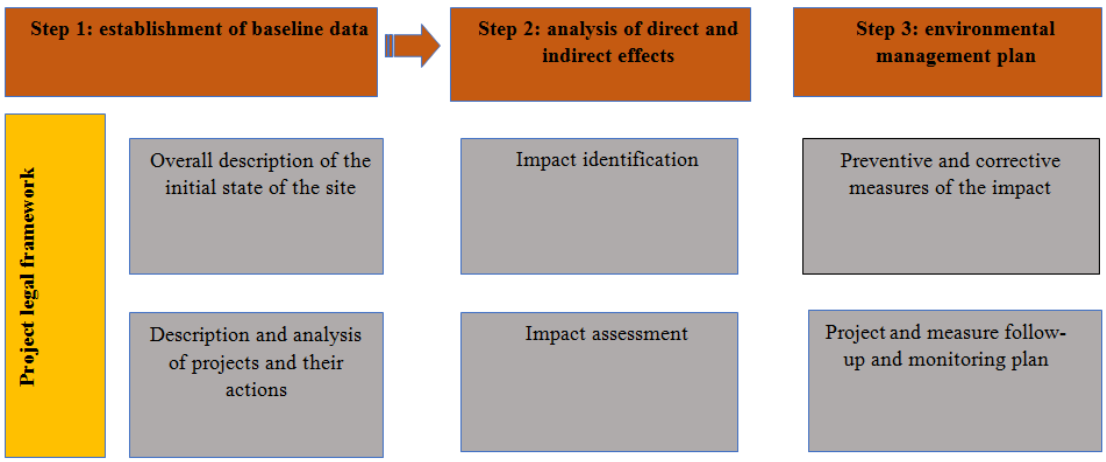

Figure No 1: Environmental impact assessment steps

III. Project Actions/Impacts inventory

a. Impacts inventory

i. Solid waste production

The Tangier-Mediterranean Project will assume an increase in the production of waste in the area, both in terms of household waste as well as industrial and inert waste. As for household waste, the realization of the PTM will suppose an increase of the population in the zone which will triple the production of urban waste in the year

2030 compared to what is currently generated in the zone and which rises at 121,011 t / year. In the medium term, according to forecasts for the area's population, waste production will double, producing 74,583 t / year. In the main localities of the Region of Tangier, 140,230 t / year are currently generated. At present, there is no infrastructure for the repository or organized waste collection systems in the area. The construction of infrastructure will generate a large amount of spoil. It is estimated that the surpluses could reach the figure of 37 million m3. It is recommended to use them to restore quarries; the surpluses must be deposited in suitable and properly stabilized places. The creation of free zones will also imply a significant increase in the generation of industrial and hazardous waste. The typology of waste will depend on the type of companies that will set up, and non-hazardous and organic type waste (generated by the food industry) will predominate; in any case, due to the fact that the area is currently highly rural, there are no industrial waste collection equipment or systems. It is expected that between 40% and 80% of the industrial waste generated is currently generated in the Tangier-Tetouan area. Hazardous waste should be checked and sent to authorized facilities. Similarly, the operation of the Port will require a significant increase in the production of waste for both household and hazardous waste, since the port will have a collection service for boats of oil and water mixed with oil. It will be necessary to provide a system for intermediate storage, pre-treatment and for the final solution of this hazardous waste.

ii. Liquid discharges

During the construction of the project, releases will be generated; however, the main impact will occur during the operation of the infrastructure. The growth of the population and the transformation of a rural environment into urban areas, which will be provided with drinking water supply, will suppose a significant quantitative increase as regards the discharges generated. In the year 2030, it is expected that 55,472 m3 / day of discharges will discharge, almost four times. The spill is currently carried out in Lost Wells or in the wads in the area. In industrial free zones, a significant amount of industrial waste will be produced. The type and quantity of these releases will depend on the type of industries that will set up, for which several scenarios have been planned. In all cases, the variety and the large quantity of discharges and the draft regulations concerning discharges recommend the installation of specific treatment plants for each enterprise, or for similar groups of enterprises. The study shows that the food industries generate releases which are very loaded with organic matter, that certain metal industries produce releases containing very dangerous pollutants such as mercury and other heavy metals and that the discharge of these substances into the wadis in the area or directly in the Mediterranean Sea will assume a great impact on the environment. The Port will also be a source of discharges from both employees and passengers arriving there, as well as from the wastewater [ii]collection service for ships and industrial activities that will take place in logistics areas. Infrastructures for the collection and treatment of all these discharges must be provided.

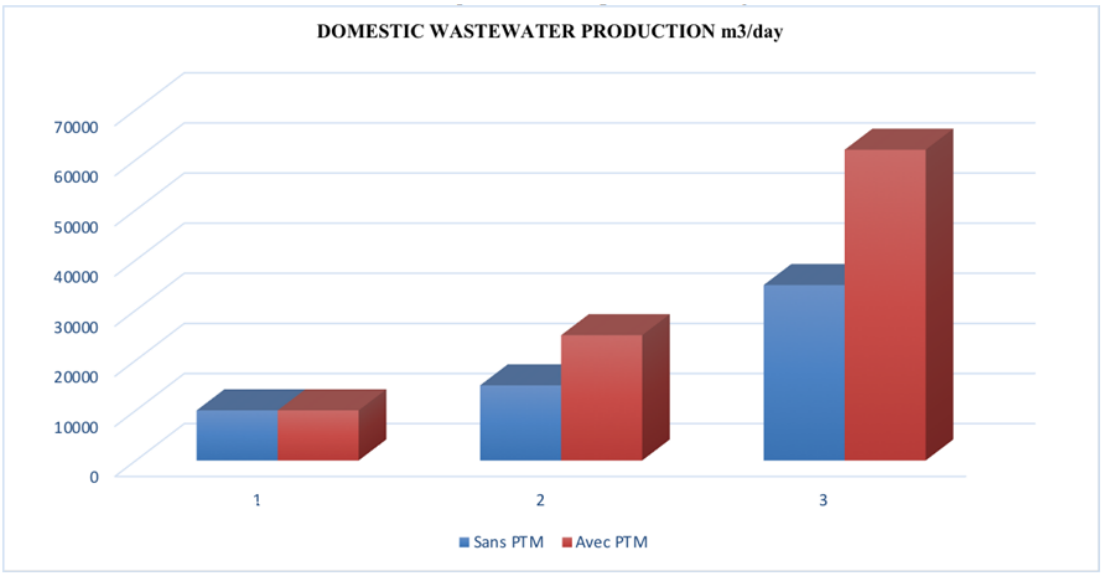

Figure No 2: Domestic wastewater production with/ without the project

iii. Tangier Mediterranean Project Emissions

The air quality control[iii] that is currently carried out in Morocco is limited to cities with significant traffic and to industrial zones such as Rabat and Casablanca, which means that there is no historical data in the area that can serve as a reference. However, as this is a non-industrial area with limited traffic, the air quality will most likely be good. During construction, the emission of dust particles is noted, which has serious effects on the vegetation, the landscape and harms the population and the workers themselves.

The fuel consumption and total CO2 emissions during operation are summarized below as the main gases that would be produced as a result of the PTM. For the realization of the scenarios, it was considered that for the year 2007 Melloussa 1 will not yet be in operation, for the year 2012 it is occupied at 70% of its capacity and for the year 2017, at 100%. For the year

2027, the industrial area Melloussa 2 was also included in the balance sheet. The balance sheet was calculated in Scenario 3 of alternative 1 (without natural gas).

As observed for the year 2027, the largest contribution is that of Road and maritime diesel. The weight of the industry is also important (30% of total fuel consumption)

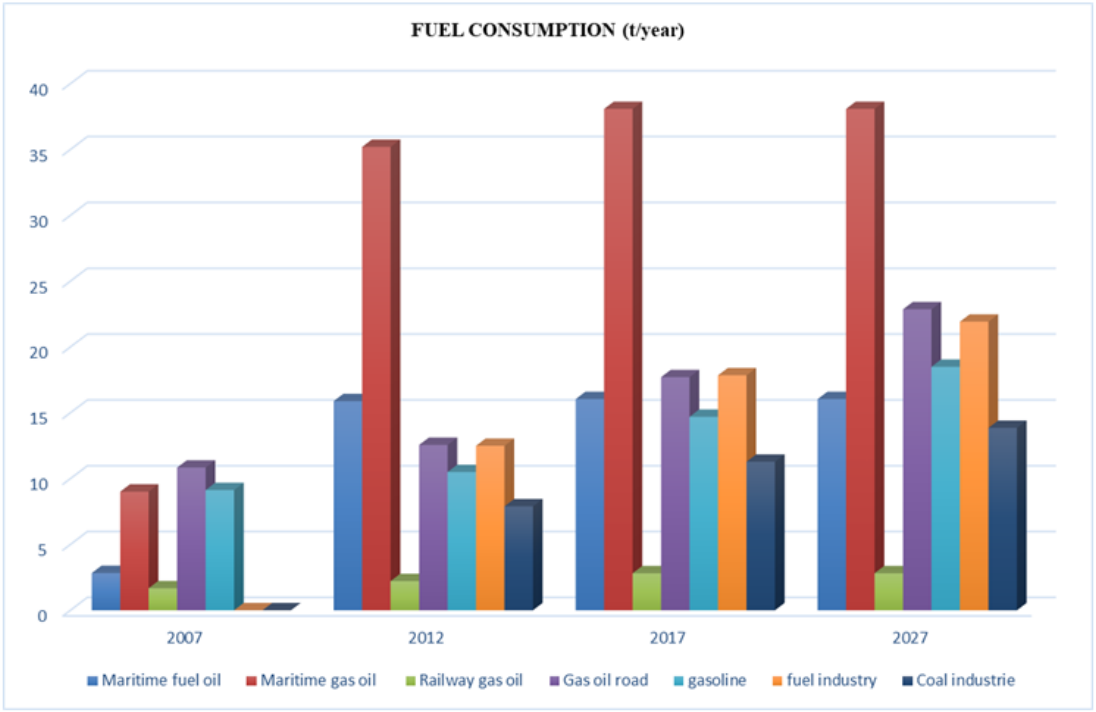

Figure No 3: Fuel consumption

iv. Noise

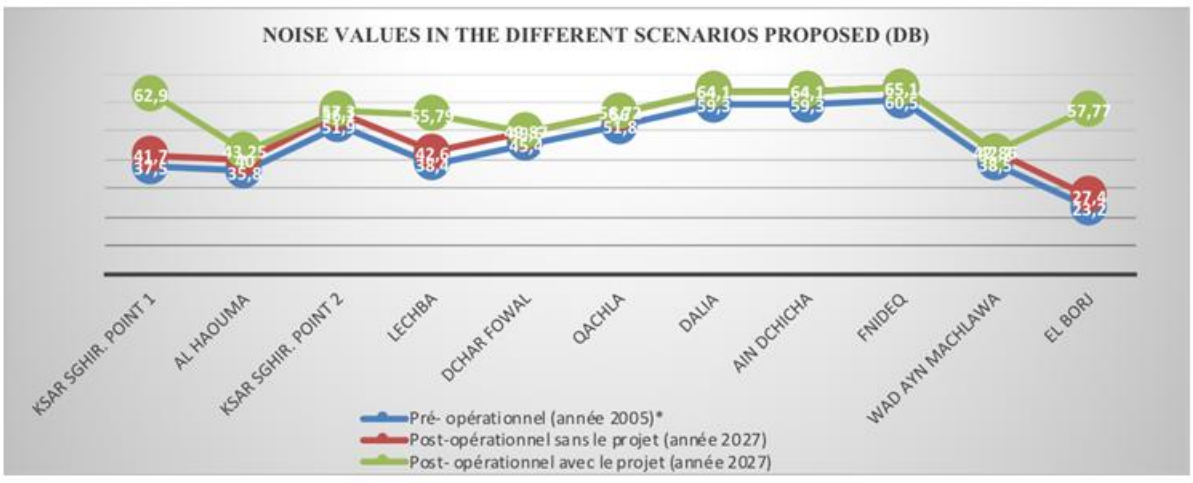

Figure No 4: Noise values in the different scenarios proposed

When making a comparison between the noise[iv] levels in the pre-operational state (without the works being implemented) and the noise levels in the year 2027 (with or without the development of the project) , the following results were obtained (Cf. illustration above).

According to what has just been explained, it is interesting to note that the models used predict the non-fulfillment of the recommendations of the reference regulation in the following cases:

- Noise levels above 60 dB in residential areas in the pre-operational state, due to construction work in the localities of Qachla, Dalia and Ain Dchicha.
- Increase in noise levels above 3 dB in the pre-operational state, due to construction work, in all the localities studied.
- Noise levels above 60 dB in residential areas in the post-operational state in the localities of Ksar Sghir (Point 1), Dalia, Ain Dchicha y Fnideq.
- Increase in noise levels higher than 3 dB (from 4.2 to 4.8 dB) in the post-operational state without the development of the project, due to the annual growth of traffic on already existing roads, in all localities studied.
- Increase in noise levels greater than 3 dB (from 4.3 to 34.57) in the post-operational state due to the development of the project in all the localities studied, and particularly and significantly for the following places: Ksar Sghir - Point 1- (25.4 dB), Lechba (17.39 dB) and El Borj (34.57 dB).
- It is interesting to note that for the sampling point of Fnideq, it is estimated a value greater than 60 dB in the pre-operational state without work implemented.

b. IMPACTS IDENTIFICATION

Land use	**Dredging**	**Land movement**	**Solid waste**	**Construction work**	**Loans and discharges**	**Deforestation**	**Resource consumption**	**Gases and contaminants in the atmosphere**	**Noise generation**	**Job creation and economic growth**
LU	Dred	LM	SW	CW	L&D	Def	RC	G&CITA	NG	JC and EG

Environnemental factor/Actions	**CONSTRUCTION PHASE**										
	LU	Dred.	LM	S W	CW	L&D	Def.	RC	G& CITA	NG	JC and EG
Air quality and noise		·	·		·	·			·	·	
Continental waters			·	·	·	·		·			
Marine waters		·	·	·	·	·					
Geology	·	·	·			·		·			
Soils and marine sediments	·	·	·	·	·	·	·				
Vegetation	·	·	·	·	·	·	·				
Wildlife	·	·	·	·	·	·	·			·	
Soil uses	·		·		·	·	·	·		·	·
Landscape	·	·	·	·	·	·	·	·		·	
Protected areas		·			·	·	·				
Heritage											
Local infrastructure and equipment	·				·	·		·		·	·
Socio-economy and quality of life of the population	·				·			·		·	·

Table No 1: Impacts in the construction phase

Environnemental factor/Actions	**OPERATING PHASE**										
	LU	Dred.	LM	S W	CW	L&D	Def.	RC	G& CITA	NG	JC and EG
Air quality and noise		·			·	·	·	·			
Continental waters			·	·							·
Marine waters		·	·		·	·					·
Geology		·		·							
Soils and marine sediments		·	·		·	·					
Vegetation		·	·	·	·	·	·				·
Wildlife	·	·	·	·	·	·		·			·
Soil uses			·	·				·	·		
Landscape	·	·	·	·	·	·		·			
Protected areas					·						
Heritage											
Local infrastructure and equipment	·		·	·	·			·	·	·	
Socio-economy and quality of life of the population	·			·					·	·	

Table No 2: Impacts in the operating phase

IV. Results and discussion

a. Impacts evaluation

As previously commented on for impact assessment, an impact assessment algorithm was applied for each of the environmental factors likely to receive impacts, for each category of infrastructure that makes up the Tangier Med project (roads, rail, ports and free zones) and for the entire project. Each application framework was formulated for each framework considered (frames 0, 1, 2 and 3), so that specific assessments and a general assessment were obtained for each frame. In addition, special cases, which were not sufficiently defined in the general assessment, were considered for each of the environmental factors.
The results obtained are as follows:

Frame 0 without project

In Box 0, the impacts considered correspond to changes in environmental factors in the places occupied by each of the infrastructures. These alterations or these impacts will not have been produced by the project infrastructure, object of the study (since in Frame 0, we assess the future situation without the development of the project), but by other actions of the human (overexploitation of natural resources, urbanization, etc.). It is foreseeable that even without the construction of the planned infrastructure, human development will have a long-term impact on the environment.

In frame 0, in the long term and without the project, it is estimated that the impacts on the natural elements are insignificant, since the natural areas are not occupied by the new infrastructures and there will not be very different genes current genes (overexploitation of natural resources, dispersed urbanization, etc.) on wildlife or on protected areas.

The long-term impacts produced by the production of waste or residual water, even without the PTM project, will be considerable and negative since an urban and coastal population is expected to increase and there is a huge shortage of sanitation infrastructure in this area.

Frame 1

During the construction phase, the largest (most severe) impacts focus on geology, particularly those deriving from the construction of roads, railways and free zones. The easily eroded areas will increase and the relief morphology will deteriorate considerably. The impact of the Port is described as severe because it occupies one of the existing beach areas on the Detroit coast.
The impacts on the heritage can be severe if adequate preventive measures are not taken.
With regard to vegetation, the impacts were qualified as being moderate since there are no large areas occupied by vegetation, qualified as being of high quality, or by pine forests, nor large areas, that this either for each component, in particular or as a whole.
Regarding fauna, there are no large areas occupied by high quality habitats, however a severe impact will occur, due to the large number of important species affected, particularly emphasizing a possible impact on cetaceans.
As for protected areas, the impacts are moderate, due to the small area occupied, because they will be affected simply by the splitting of the road.
The impacts on infrastructure are slight in each component, but they can be considered to be severe if judged as a whole, since a large number of communication routes will be affected.
The impacts on the landscape will be relevant in the case of ports and roads (due to the section of the duplication).
As far as land uses are concerned, the most significant impacts will occur in agriculture due to the construction of free zones, due to the surface areas occupied.
Other impacts such as the production of urban waste or the generation of emissions into the atmosphere, during construction, will not be severe, especially because of their temporality; however, it will also be necessary to take preventive measures to avoid inconvenience to the population or damage to the vegetation. However, the production of cuttings will have a very high impact due to its large quantity.

Frame 2

In the first phase of exploitation, the impacts on continental and marine waters will be severe due to the discharge of residual water into the beds of watercourses and due to the enormous increase in maritime traffic; ports, free zones and population growth associated with all this constitute the main actions, causes of these impacts. This impact, despite being considered to be severe, with adequate corrective measures, such as the creation of a sanitation plan and infrastructure for the treatment of residual water, will be compatible since the percentage of discharges of untreated water will be reduced considerably. The situation will even improve compared to the current situation, since this area currently lacks such infrastructure.

The generation of waste will generate a severe impact, indicating the need to apply and develop a management system for so-called waste. As with residual water, this impact can improve significantly, thanks to the implementation of waste collection systems and infrastructure for the elimination or treatment of this waste.

Noise during operation will have a one-time impact in areas where infrastructure is closest to housing. For the points where we pass

60 dB during the day, the impact is severe and it will be necessary to take corrective measures. Due to the creation of new agglomerations, it is necessary to monitor noise during operation, in order to identify sensitive areas.

Emissions to the atmosphere are considered to be moderate, which does not justify the implementation of reduction measures, such as renewable energies or the implantation of natural gas in businesses.

The impacts on wildlife will be particularly significant, due to the presence of ports, since the huge increase in maritime traffic will seriously affect the cetacean community of the Strait of Gibraltar, if adequate preventive and corrective measures are not taken. It is also worth emphasizing the barrier effect of linear infrastructure, especially when crossing forest areas or the SIBE JBEL MOUSSA. For this, it will be necessary to provide corrective permeability measures.

In the case of geology, severe impacts will occur, due to the actions of maintenance and dredging of the port. Significant impacts are not expected to occur on the coastal dynamics, due to the typology of the seabed which is hard and also due to the particular coastal morphology, sea currents and the great depth of the platform. marine form; therefore, there is no significant sediment transport.

As far as land uses are concerned, the most significant changes will occur, due to the fact of the presence of free zones which will imply great changes in the local economy considerably affecting agriculture not only because of the areas occupied but also due to rising labor prices and the attraction of the population to other sources of employment with higher incomes. There will be a phase during which the rural population, particularly that of Melloussa and the surrounding area, will be negatively affected by expropriations in agricultural areas and will not have the alternative means of earning a living. It will be necessary to monitor the affected population more directly in order to offset these effects.

The impacts on the landscape will focus on the coastal areas, occupied by the ports. In the case of infrastructure, we observe a phenomenon of synergy, similar to that described during the construction phase, but which may have a higher impact, since these are impacts that are not temporary. The greatest impact will be that produced by the isolation of populations.

Frame 3

During this exploitation phase, the impacts on waters (continental and marine) occur similarly to the previous case, but more markedly, due to the increase in waste and maritime traffic.

The effects on geology are evaluated, more significantly than in the previous case, since we considered the effect of the construction of a third port and the Melloussa 2 free zone. For the same reason, the impact will be severe on marine soils and sediments.

In terms of wildlife, the impacts will focus especially on the cetacean community, both during the construction phase of the third port and during the exploitation phase.

Land uses will continue to undergo drastic changes as progress is made in the development of the Tangier-Med project, particularly due to the influence of the free zones. As for the landscape, the impacts on the coast will be increased with a synergistic effect, produced by the increase in the area of coast affected.

In the case of infrastructure, the situation is similar to Box 2 with the continued isolation of built-up areas, if no necessary corrective measures are applied. It is expected that during this phase, the generation of waste will be particularly important, due to the increase in population and the increase in the rate of waste that will be produced due to the rise in living standards.

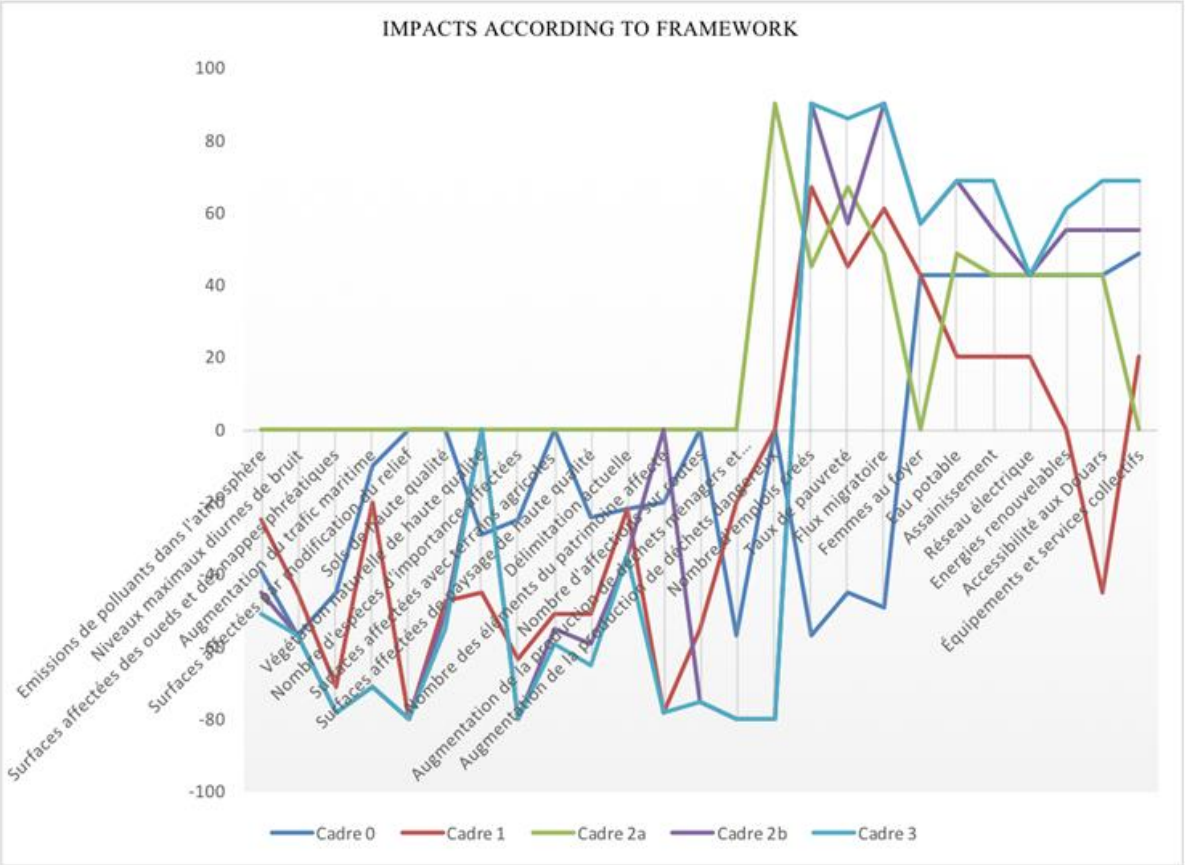

Figure No 5: Impacts according to framework

Interpretation

During this phase, the negative impacts, derived from the operation of infrastructure and new agglomerations, such as the production of waste and discharges, will mainly manifest themselves. However, with proper monitoring a treatment of these, these impacts can be reduced by applying corrective measures.

Emphasis is placed during this phase on the possible negative impact on cetaceans and on the barrier effect of infrastructure, which will also have to be reduced through the application of various measures.

Agriculture, which is currently in the process of recession, will be negatively affected, having to move towards a type of agriculture with higher productivity or that is centered on more profitable products, if it is not to be wiped out.

Finally, it is worth highlighting the positive impacts on the rural economy in the long term, derived from the diversification of the economy and the creation of jobs. Compensation should also be provided for the rural population in the intermediate phase, when agriculture will already be affected and economic growth will not yet have manifested for the rural population.

The Tangier-Mediterranean Integrated Project implies a significant transformation of the territory due to the construction of numerous infrastructures, which will have several negative impacts on the environment. The more severe impacts are manifested due to the large production of waste and discharges, deriving from the operation of these infrastructures which currently do not have adequate systems for their collection or treatment. However, these impacts can be reduced considerably through the application of corrective measures, which will aim to modify existing management systems and build infrastructure for the treatment or elimination of these spills.

Other impacts of a severe negative character, which it is impossible to correct and which will require the application of compensation measures, are those which affect the relief and the landscape, in particular the destruction of the coast in its natural state, due the construction of ports and which will be severe in the long term if the third port is built. One of the severe impacts that will have to be reduced by the application of measures, such as revegetation, is the increase in areas with erosion problems due to the new embankments of the infrastructure.

Impacts on wildlife and vegetation can be greatly reduced through the application of wildlife remedial measures, reducing the barrier and revegetation effect of slopes. It should be noted that one of the most severe impacts that we must try to reduce through the application of measures is that affecting cetaceans (sperm

whales). The impacts on JBEL MOUSSA are not severe and can be reduced even further by the application of preventive and corrective measures.

As far as land uses are concerned, the most affected activity is agriculture, due to the fact that a large part of the area occupied corresponds to agricultural land. Added to other factors, such as the increase in the workforce or the high price of land, which will also have repercussions on the agricultural economy. Even if the current agricultural situation is not good and the income produced by the population is low, it is still the main source of income for the area and the population will have to be compensated until new jobs in other sectors are created.

Emphasis is also placed on the need to establish transit systems for the population in order to reduce the barrier effect produced by infrastructure. These measures, added to a local road and path improvement program, will improve accessibility in the project area. One of the main problems facing people living in rural areas is accessibility and communication.

V. Conclusions and recommendations

The tangier-med integrated project involves a significant transformation of the territory due to the construction of numerous infrastructures, which will have several negative impacts on the environment. The more severe impacts are manifested due to the large production of waste and discharges, deriving from the operation of these infrastructures which currently do not have adequate systems for their collection or treatment. However, these impacts can be reduced considerably through the application of corrective measures, which will aim to modify existing management systems and build infrastructure for the treatment or elimination of these spills. Other impacts of a severe negative character, which it is impossible to correct and which will require the application of compensation measures, are those which affect the relief and the landscape, in particular the destruction of the coast in its natural state, due the construction of ports and which will be severe in the long term if the third port is built. One of the severe impacts that will have to be reduced by the application of measures, such as revegetation, is the increase in areas with erosion problems due to the new embankments of the infrastructure. Impacts on wildlife and vegetation can be greatly reduced through the application of wildlife remedial measures, reducing the barrier and revegetation effect of slopes. It should be noted that one of the most severe impacts that we must try to reduce through the application of measures is that affecting cetaceans (sperm whales). The impacts on jbel moussa are not severe and can be reduced even further by the application of preventive and corrective measures. As far as land uses are concerned, the most affected activity is agriculture, due to the fact that a large part of the area occupied corresponds to agricultural land.

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