

Environmental Management for the National Sustainable Development in Egypt; Case Study: Matrouh Governorate; Egypt

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Abstract: The North-West coast, NWC, of Egypt represents one of the longest coasts in the country; which extends from Alexandria in the east for 520 km to El-Salloum on the Libyan border to the west. The development plans have been lunched into the zone which is concerned with industrial, agricultural, mining, touristic, and environmental activities. The current study is concerned with studying the management of the different proposed development sectors in the coastal zones. A Strategic environmental assessment model, SEA, has been designed to formulate the correlation between the scoped factors of the study based on weighing forces of each on the other and on the whole process. The studied NWCZ has a fragile nature as a dryland and it is exposed to the deforestation phenomenon which may affect all the proposed future development plans. So, The agricultural and environmental proposed projects for the studied zone were found as the most positive projects for the area where they recorded 13 and 50 as numerical values; respectively. While; the industrial, mining, and touristic proposed activities, have recorded -38, -40, and -5, respectively.

INTRODUCTION

Environmentally, as a global interest, and in the light of the Convention to Combat Desertification (CCD), the world aims at enhancing the sustainable management and conservation of marginal drylands in Northern Africa. Also, the Egyptian' strategic plans aim at decentralizing the population out of the Nile Valley in order to maintain

the Egyptians' new community to meet the population increase and to add to the National Growth rate, NGR.⁽¹⁾

Drylands are particularly vulnerable due to climatic and human pressures, yet they constitute some of the world's largest land reserves in terms of space and natural resources. Their increased productivity, which becomes a necessity in times of

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exponential population growth, needs however to be embedded in wise practices that both respect the conservation of the environment, and provide improvement and alternative livelihoods for dryland populations.⁽²⁾

There are some international projects that will use a harmonized methodological approach for selected study sites in the countries involved to compare results and share knowledge, and Egypt is one of those countries of interest to the international organizations; UNESCO and International Centre for Agricultural Research in the Dry Areas (ICARDA). The North West Coastal Zone, NWCZ, in Matrouh Governorate; is one of the scoped regions in Egypt.⁽³⁾

Future plans for integrated coastal zones management, in Egypt, primarily rely on the implementation of an action plan entailing cooperation and smooth coordination between all concerned governmental bodies and authorities, on

the basis of well defined roles and responsibilities for these different entities, with the aim of ensuring their effective contribution, each in its field of competence.⁽⁴⁾

The North-West coast of Egypt represents one of the longest coasts in the country. The northern extremities of the Western Desert along the Mediterranean coast represent the so-called northwestern coastal zone, NWCZ, which extends from Alexandria in the east for 520 km to El-Salloum on the Libyan border to the west. The average width of the zone varies between 30 and 50 km overlapping with the limestone plateau of the Western Desert in the south.⁽⁵⁾

The national plans for the NWCZ has started, late of the 80's of the twenties' century, to impose the main artery of proposed communities there when a branch of the Nile river has been established to supply the inner 30- 50 km of the NWCZ with the Nile water as a

milestone for the life and the planned development.⁽⁶⁾

The NWCZ, during the last three decades has been exposed to mega touristic activities in the form of tens of resorts to cover mostly 50% of the coastal zone to the Mediterranean Sea, in Egypt. Even the back side of the coastal zone, during the last decade the expansion has reached the zone.

In the last decade of the last century, the development plans have been lunched into the zone. The development is concerned with industrial, agricultural, mining, touristic, and environmental activities. All these sectors will impact the NWCZ environmentally either positively, negatively, or will have no impacts on the zone.

The environmental assessment, EA, and impact assessment, EIA, are mile stones for the environmental management and securing the sustainable development for any human being activity. Where, the

environmental assessment tackles any current situation for the interaction between the human activities and the environmental, while the EIA is concerned with the studied of the changes in the current environment as a consequence of the proposed activity or activities.⁽⁷⁾

The current study is concerned with studying the management of the different proposed development sectors in the NWCZ, Matrouh Governorate, and proposing the different mitigation measures and alternatives in order to assure the sustainable environment and development.

MATERIAL AND METHODS

The preliminary activities of the research are divided into two sectors:

- a. Projects' classification
- b. NWCZ features: the physicochemical, biological, and socioeconomic ones, through a detailed environmental assessment regime.

The studied projects' nature and the NWCZ's characteristics were been pulled

together to perform the second technique of the environmental management for the studied zone, the environmental impact assessment study. The EIA has been started with listing all the different affected environmental factors then they have been screened and scoped according to the nature of the studied area and the different projects.

A model has been tailored in order to correlate between the different environmental scoped factors and the proposed projects for the zone.

The data were collected through: references, field survey, sampling, lab works, interviews, and collected information about the studied zone and the projects. The field surveys covered the whole NWCZ and its depth, 30-50 km. The survey was concerned with the different physicochemical factors as water, land use, biomass, the different socioeconomic factors, endangered species,....,etc.

While the collected samples of the

different water sources, as potable water, ground water and surface water, and sea water; were collected , preserved and analyzed according to the Standard Methods for Water and Wastewater analysis techniques.⁽⁸⁾

The interviews with the Bedouins and administrative personnel were concerned with inspecting the native's point of views about the proposed and futures development and with the administrative personnel as a source for the documented data about the whole zone of the study.

A Strategic environmental assessment model, SEA, has been designed to formulate the correlation between the scoped factors of the study based on weighing forces of each on the other and on the whole process.

Based on the model, a numerical environmental matrix has been tailored to study all the impacts that have been scoped during the whole research. The different collected data from the field, lab,

statistical studies, and the published previous data about the studied zone were all pulled together to perform the numerical study for the scoped impacts of the different projects upon the different environmental sectors.

The matrix's results have been studied and the mitigation measures and alternatives have been stated to secure the sound sustainable environment and development for the NWCZ.

RESULTS AND DISCUSSION

The studied area, NWCZ, as Shown in figure (1), which has a major adverse feature of the whole studied area, is the fragility nature that is associated with the

speed deforestation, as proved using the GIS' studies.⁽⁹⁾

The main three local reasons that speed up the deforestation in the zone are, the land abuse which affects the biodiversity, increasing the land salinity as a result of the agricultural activities for the non-sustainable lands, and changing the slopes of the zone for scattered investment projects that are not integrated within the sustainable development plans.⁽¹⁰⁾

The whole area is divided into two main regions: Hammam-Fouka and Fouka-Saloum, the first is suffering of severe degree of deforestation while the second is a mild deforestation region.⁽¹¹⁾



Fig (1); The studied NWCZ map

The list of the expected impacts included more than 80 environmental factors, those were explored according to the nature of the projects and scoped into 30 factors to be categorized into three majors; physicochemical, biological, and socioeconomic.

Assessment of the current different studied factors:

Physicochemical factors:

One of the most scoped factors in the

studied area is the geomorphologic and land use which are the milestones on the deforestation and the fragile nature of the studied zone, which may impact adversely the whole sustainable development proposed plan. Five land categories can be identified in the NWCZ as follows:

The coastal strip extends from the coastline inward for about 2 km southward. The land is mostly flat with elongated ridges running sub-parallel to the coast.

These ridges are built of cross-bedded oolitic limestone and have an average elevation of 10 m. The land of this strip is the subject of intense land use competition. Traditional uses have been agriculture. New additional uses are the establishment of tourist villages as summer time resort, and the newly constructed Intercontinental highway.

The second strip consists of an alluvial plain that gradually slopes upward to an escarpment 3 to 8 km from the coast. The local population has traditionally learned since the Roman times to terrace the landscape of the wadis, and as such, despite centuries of erosion they still maintain thick soil cover. Stream channels of the wadis are filled with calcareous loamy materials derived from the northern plateau, which is mostly divided into alluvial fans.

The third strip is rather diffuse terrain extending for 15 to 20 km southward. Some wadis of the second strip run into

the studied area, and are often terraced for water harvesting and soil conservation.

The rainfall is rather limited, and as such agricultural activities are limited. Barley is grown mostly as animal feedstock, and farmers harvest barley during years of plentiful rain, but use their fields for grazing when output is insufficient to warrant harvesting. In addition, there are widely scattered orchards in small depressions where the soil is deep enough to allow adequate water accumulation or in localized slopes where water can be collected in cisterns. These cisterns are cut into limestone, as a traditional inheritance from the Roman times. Water is stored in the cisterns for the whole season without requiring waterproofing;

The fourth strip extends from 20 to 40 km inland, and is used mainly as rangeland. Intermittent streams draining the tableland might have induced intensive water erosion, and thus initiating the formation of depressions. Wind erosion

could have contributed to sedimentation in the depressions, which appears as hummocky surface characterized by coarse textured materials. Barley may be grown in the depressions or along slopes where sufficient water can be harvested. The vegetative cover of the land is very sparse, and consequently, population settlements are widely dispersed.

The fifth strip extends beyond 40 km and consists of a high plateau with elevation above 200 m, except for a number of depressions. The surface of the plateau is covered by calcareous rocks in alternating beds of limestone and clays with occasional sandstones. The surface of this tableland is not rough and thus has developed into typical desert. Thus, the small number of population in the neighborhood is nomadic, supported economically by breeding and grazing small herds, camels in particular.⁽⁵⁾

Up to a distance of 20 km from the coastline, winter rainfall ranges from 200 to

170 mm, averaging about 130 mm per annum. Further inland, up to a distance of 40 km, rainfall is about half as much reaching 60 to 70 mm. The relative humidity ranges between 63% in March and 73% in July. Evaporation is highest in August at 9.7 mm/day and lowest in December at 6.6 mm/day.⁽¹²⁾

Akhtar, *et al.*, 2007, have proved that rainwater cisterns in NWCZ are efficient means of water harvesting and storage for domestic uses and supplemental irrigation. Because of small catchment areas and limited suitable location for their construction, they don't affect the overall balance at watershed scale.⁽¹³⁾

There are more than 2500 manmade cisterns, Roman and Arabian ones, which are used for collecting the rain water. The collected rain water is used for irrigation and bedouin usages. This collected rainwater needs water management techniques to maximize the collection, storage, and usage. Dew water is

estimated to be more than 50 million m³/year, and it is not neither collected nor used.⁽¹³⁾

The water quality for the samples that have been collected from several points of the studied zone has proved wide variations. The water quality depends on two main factors the seasonal variation, and the soil and geological nature.

During the study duration, 9 months, the pH results varied from 7.2 to 8.7 while the total dissolved solids, TDS, have recorded a range between 1,056 and 18,430 mg/l. The alluvial sediments' water has recorded an average of 3,230 mg/l. In the coastal dunes, water quality is even better than the inner zones where the TDS has recorded an average of 1,000 mg/l. Water quality from the structural cisterns, both the Arabian and Roman types, has recorded an average TDS 1,120 mg/l.

From the other side, the total potable water supply for the NWCZ is almost 175,130 m³/d, while the average water

usage is 200,000 m³/d and that reveals that there is a water shortage about 25,000 m³/d. The potable water is supplied for the whole zone through Alexandria water treatment plants; Al-Manshia and Al-Noubaria water plants. ⁽¹⁾

It was found that all over the studied zone there is no wastewater treatment unit but only in the Matrouh city. The Matrouh City wastewater treatment plant with a capacity of 25,000-50,000 m³/d, and the governorate is proceeding to expand the whole wastewater collection, transportation, and treatment systems to serve the city and the close resort areas. The treated water will be reused as a source for irrigation.⁽³⁾

While for solid wastes, there are no defined collection systems for the majority of the studied area but the city of Matrouh and exist in the very well established resorts.

Biological factors:

Of the total number of plant species

recorded in Egypt, 50% occur in this region. The composition of plant growth forms in the region expresses a typical desert flora. The majority of species are drought evaders and drought enduring. In most cases, animals are confined to plant canopies where they are protected from wind and radiation and where food is available.

Fauna and flora

Ayyad (1995), stated that the western coastal region is floristically and faunistically one of the richest phytogeographical regions in Egypt. Plants species are estimated by more than 60 in Matrouh's desert along with natural protectorates in El- Omaid and Siwa regions.⁽⁵⁾

Ayyad, 1995 stated that the studied zone is considered as one of the richest phytogeographical regions of Egypt with about 1,000 plant species representing some 50 percent of the total number of plant species in Egypt. It is argued that the

coastal sand dunes ranging between the sea shore and the Mariout salt marshes are characterised by more humid environment, more friable soils and dense vegetation, have a richer fauna.⁽⁵⁾

Socioeconomic factors:

The governorate covers an area of 170,000 km², representing 16.5% of the Republic's total area. It comprises 8 Marakz, 8 cities, 56 rural local units annexed by 98 villages, and 241 hamlets. According to the preliminary results of the 2006 census, the population has reached 322.3 thousand people; 70.3% of them are concentrated in urban areas, and 29.7 % in rural areas, and the population natural growth rate has stood at 25 per thousand.⁽¹⁾

Socioeconomic surveys identified people's adaptation and traditional knowledge in coping with adverse dryland conditions. Also, they identified the management approaches that promote economic sustainability and resource

conservation, in particular of soils and water, and it will foster the rehabilitation of degraded drylands using community-based approaches.

It is reported in some statistics on the relative contribution of job alternatives to family earning. In areas close to sea resorts and other tourist facilities, only 25% of the population depends on farming and grazing as a principal source of income. In areas far from tourist activities, such as Sidi Barrani, 70% of the populations rely on farming and grazing for most of their income. The proportion of income from livestock increases gradually southward to the rangeland area away from the shoreline.

The characteristics of the NWCZ qualify it to contribute larger proportion to the socio-economic activities of the country. The ambient environment of the area affords several alternative human activities including agriculture, fishing, mining, and tourism. It enjoys milder

climatic conditions, compared to the rest of the country.⁽¹⁴⁾

The proposed projects:

The general vision of the development plans are all focused on the sustainable development of the NWCZ. The plans are initiated based of the facts of the importance of the zone that represents almost 20% of the country area, the rich natural resources in the area that serve the different plans for industries that will serve the different community sectors and will maximize the use of the natural resources there.

The rich coastal zones of the area will add to the national touristic values of the country. While, the agricultural projects will optimize the natural fertile lands, maximize the wasted rain water' values, and will support the global plans of delaying the deforestation of the fragile lands.

All the proposed projects will enhance the manpower supportive national plans and all will pool the National Growth Rate

upward. All the proposed projects are planned in parallel to the environmental projects that will secure the sustainability of the whole national plans for the NWCZ.

There are proposed projects for the NWCZ, which are 5 industrial, 6 mining , 13 agricultural, 6 environmental, and 10 for tourism sector. The mega industrial projects can be categorized into: Fiber glass project, petrochemical compound, natural clay production compound, poultry, prefabricated houses, production of solar united , livestock, medical planting and processing, enhancing the use of the rain water as reservoirs, touristic projects,...,etc. Also, there are some other supportive industries on medium and large scales. The added manpower is expected to be 86,000 jobs. The proposed touristic activities will turn the current use of the zone from seasonal usage to an annual one. While, the agricultural ones will focus on the medical plants, wheat, and livestock. The whole details of the

proposed projects have been studied thoroughly against the zone features, resources, and infrastructure.

The environmental assessment model

As an environmental management tool, the designed environmental assessment model, as shown in figure (2); is tailored to be as a baseline for designing the numerical matrix for the study. It is correlating and linking the different environmental factors to each other and to the whole studied strategic environment assessment technique. The different environmental factors, which are categorized into the physicochemical, biological, and socioeconomic ones, and detailed in some backbone factors as water resources and water and wastewater treatment are all studied in accordance with some other environmental infrastructure factors as; the environmental laws, environmental awareness and education. All these environmental factors and their infrastructure ones are all

assembled with the different studied projects and their infrastructure supportive planes, and as shown in the figure (2) some of these factors are affecting the whole strategic plan and the other studied factors, as primary and secondary impacts while others are effecting and impacting with one and other of the studied

factors, and projects

Out of the designed model, the numerical environmental matrix has been established to study individually the different project categories and to estimate the cumulative impacts upon the NWCZ; either positively, negatively, or no effect.

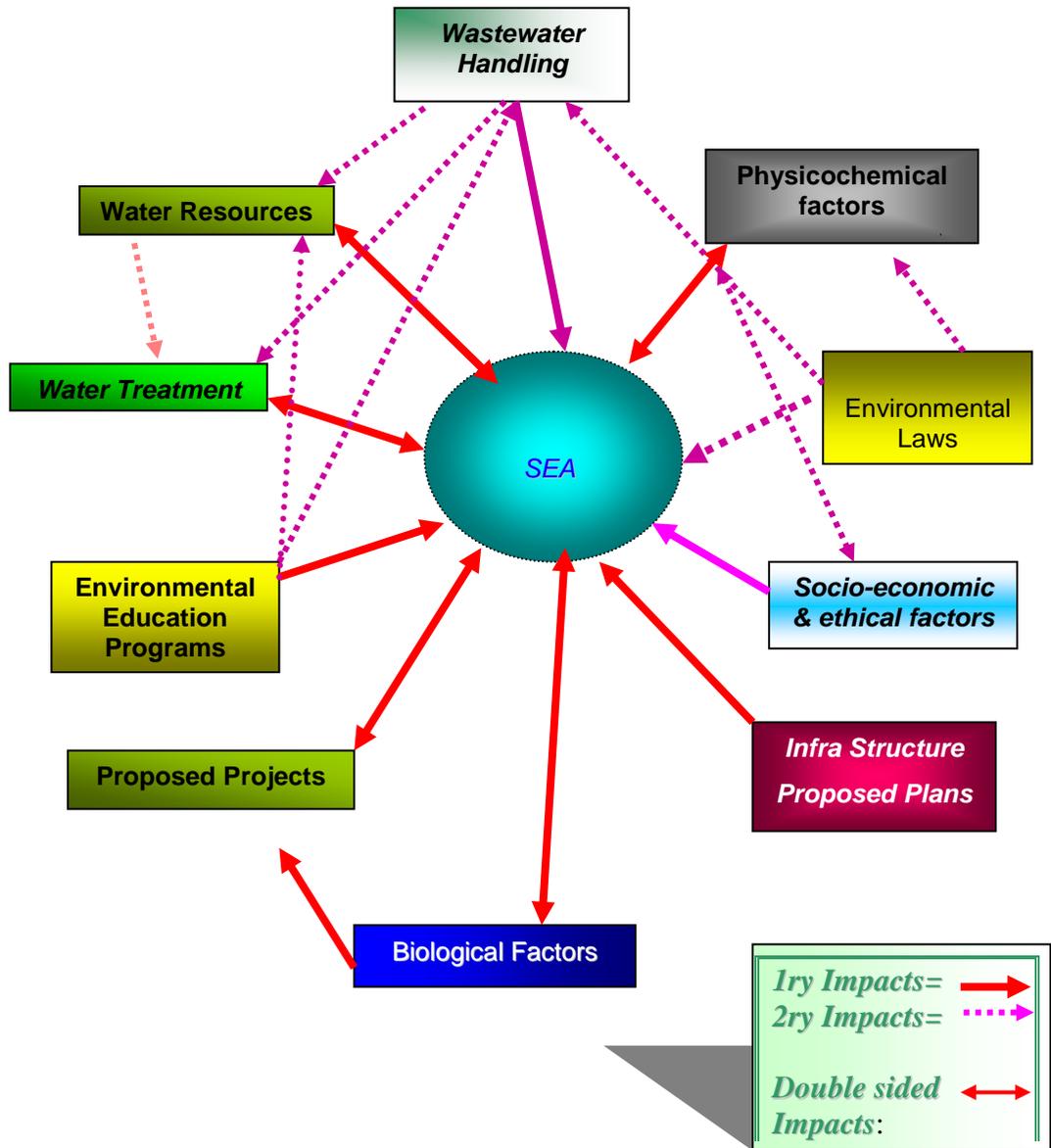


Fig. (2): A Model for the different Factors affecting the Strategic Environmental Assessment, SEA

The numerical matrix

Since 1990th, the Egyptian planners used geographic information systems to enhance their planning process and to provide an objective approach to their planning decisions. For integrated planning in Egypt, a master plan should be considered for the Northwestern Coast and Inland Development Project (NWCID, 2003).⁽⁶⁾

The numerical matrix, as shown in table (1), is projecting the different project categories that were studied against the scoped different environmental factors and its impacts, using the numerical values which were ranged between +3 and -3 , as positive and negative impacts values , respectively, passing by the zero value that represents the no impact.

The driving forces and the relative importance matrix for each project and the different factors, respectively; where the baselines for evaluating the different numerical values of the different impacts. To estimate the weight of driving

force, the relative importance matrix is used.

It is proved, as in figure (3), that the proposed agriculture and environmental projects, +13 and + 50 respectively, have recorded the highest positive impacts values upon the different scoped studied environmental factors. The highest records for the environmental projects are justified by the very positive impacts of these projects upon most of the studied factors as shown in the numerical matrix. While the agricultural project recorded the second expected positive projects, even with some expected negative impacts of the project but as all one of the most additive impact of both the environmental and the agricultural project is the defensive nature of such project against the Desertification phenomenon, in addition to all the other economic values that will be added out of such projects. Even with all these calculated positive impacts, some mitigation measure should be applied and enforced during the different phases of the

projects to secure the sustainable development of the proposed projects.

On the other side; the touristic activities recorded, -5 values, even with their positive impacts upon the social welfare and the landscape of the studied zone, which will affect positively the desertification nature of the zone. From the economical point of view they will add positive economic values for the NWCZ plus the ethical values for the whole region. While the mining and the industrial proposed projects have recorded -38 and -40, respectively, cause of their adverse

impacts on most of the scoped studied environmental factors. These projects, the five major industries and the other 6 mining projects are affecting severely the current poor infrastructure of the studied zone, as well as the geological formation from a side and the whole biodiversity from another side. Moreover, both the industrial and the mining projects will add more upon the fragility nature of the NWCZ, from the desertification phenomenon point of view; which was one of the major reasons for the international and local organization to invest in the studied zone.

Table (1): The numerical matrix analysis for the studied factors in the proposed projects for the NWCZ

Factors	INDUSTRY (5)	MINING (6)	AGRI- CULTURE (13)	ENVIRON- MENTAL (6)	TOURISM (10)
I. Physical/Chemical Factors					
Flow and water table alteration	0	0	-3	0	-1
Interaction with surface drainage	-1	0	-2	0	-1
Water quality changes	0	0	-2	2	0
Potable Water Usage	-3	0	0	3	-3
Drainage characteristics	-3	-2	0	0	-2
Flow rate variation	-2	0	0	0	-2
Water Quality Changes	0	-3	0	3	-2
Soil quality (fertility)	-3	-3	3	3	3
Soil structure	-3	-3	3	3	-3
Compatibility of land uses	0	0	3	3	3
Landscape characters	3	-2	3	3	2
Geological resources	-2	-3	0	-1	0
Slope stability	-2	-2	2	0	0
Air quality	-3	-3	3	3	0
Noise	-3	-3	-1	0	0
Litter/Debris/Dust	-3	-3	-1	0	-1
Odor	-1	-1	1	3	0
Landscape modification	-1	-2	2	3	2
Visual obtrusion	-1	-1	2	2	0
New landscape features	-2	-2	3	3	2
II. Biological Factors					
A. Terrestrial Ecology					
Flora	-3	-3	-1	2	-2
Fauna	-3	-3	-2	2	-2
B. Aquatic					
Flora	0	0	-2	0	-1
Fauna	0	0	-2	0	-1
C. Habitats and communities					
Fragmentation	0	0	-2	0	-2
Loss	-3	-3	-2	3	-2
III. Socioeconomic factors					
Public health	-2	-1	2	3	3
Safety	-2	-2	1	3	2
Social welfare	2	2	2	3	3
Economic welfare (jobs)	3	3	3	1	2
Total impacts / Industry	-38	-40	13	50	-5

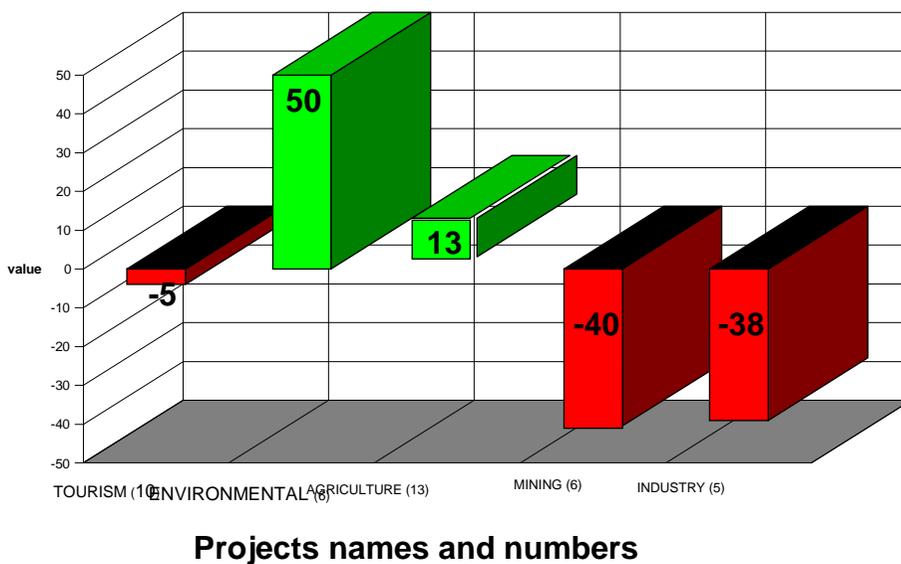


Figure (3): The numerical impact assessment values for the different proposed projects

The mitigation measures:

- 1- Water supply, studying to increase the pumped potable water and maximize the use of the ground water and the collection and use of the rain water.
- 2- Solid waste, residential, commercial and industrial. A. Different landfills should be involved in the master plan of the whole studied area. Also, a professional collection firm has to be assigned from the very early stages of the whole project. This activity will secure many environmental resources in the area and will attain the expected sustainable development.
- 3- Major wastewater systems, collection, transporting and treatment have to be studied, prior to the implementation of the whole project and to be allocated in the different regions of the whole project. While, it will be recommended to have different small scale treatment

units which are more specified for the different regions.

- 4- A general master plan for the whole region and enforcing this plan to avoid any unplanned human activity that may affect the fragility of the whole area.
- 5- Enforcing the detailed environmental study during every projects' phases.

The alternatives:

The 1st Alternative: In this alternative the study recommends the exclusion of both the industrial and mining projects of the studied area. This alternative will maximize the nature of the area from many point of views: it will add economically to the area of study and it will be of a unique nature to be marked globally as a green zone. Plus the previous studied positive impacts of these Kinds of projects

2nd alternative is: enforcing the needed detailed environmental studied prior to each project of the industrial and mining ones. Also, all the treatment and

wastes infra structure for both kinds of projects should be applied and monitored.

Those applications will minimize dramatically the expected negative impacts of both on the water resources and the air quality.

3rd Alternative, Excluding the industrial activities and allowing those mining project in the remote areas of the NWCZ that will not be impacted adversely from the geological, water resources, and air quality aspects. Also, enforcing all the environmental studies prior and during the mining projects

CONCLUSIONS

From the study the following could be concluded:

- The studied NWCZ has a fragile nature as a dryland and it is exposed to the deforestation phenomenon which may affect all the proposed future development plans.
- The agricultural and environmental proposed projects for the studied zone

were found as the most positive projects for the area where they recorded 13 and 50 as numerical values; respectively.

- The studied zone has a great deficiency in most of the infrastructure facilities, which is hindering the progress of the zone development.
- The zone is considered as one of the richest phytogeographical and faunistically regions in Egypt.

RECOMMEDATIONS:

- Thoroughly detailed studies for many factors which will majorly affect the proposed plans have to be carried out before lunching the project. Those factors could be briefed in: the water supply as potable and natural, the wastewater treatment plants, the solid waste handling, the endangered species and more conservation zones is strongly recommended.
- The medical plantation is highly recommended for the agricultural

zones

- The most appropriate development for the studied area to be globally unique is, to be free of any industrial activity and to focus on the environmental, agricultural, and touristic projects. That will add to the economic value of the whole area.
- A general Master Plan for the governorate is strongly recommended to maximize the project goals and to minimize any violation to the sustainability of the proposed development.
- Encouraging the public participation before applying the proposed projects.

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