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A METHODOLOGY FOR SHIFTING EGYPTIAN PORTSINTO SUSTAINABLE GREEN PORTS

ASHRAF MANSOUR Civil & Architectural Department
National Research Centre, ashraf_mansour@fulbrightmail.org

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Abstract

Egypt has a capacity of more than fifteen ports, situated on both the Mediterranean and the Red sea, with a totalarea of around 518 Km2. They are either commercial, or specialized ports which includes Mining Ports ,Petroleum Ports, Tourist Ports, Fishing Ports and Berths. The main Egyptian commercial ports are Alexandria,El Dekheila, Damietta, El Arish, West Port Said, East Port Said, Suez, Petroleum Dock, Adabiya, Sokhna Port, Hurghada, Safaga, El Tour, Nuweiba and Sharm El Sheikh. Establishing a methodology for shifting Egyptian Ports into sustainable green ports is of a major benefit as it incorporates a balance between environmental, social and economic concerns. It establishes guiding principles to achieve long-term environmental, societal and economic benefits through resource conservation, waste reduction and pollution prevention. Applying Sustainable Green Port Policy achieves the Port's environmental sustainability goals through six key areas: water, energy, air, waste management, sustainable development and sustainable business practices. The main objectives should effectively: manage resources in an environmentally sensitive and responsible manner; minimize, environmental impacts directly attributable to operations on the Port's Bay and the tidelands; prevent pollution and improve personal, community, and environmental health and ensure a balance of environmental, social and economic development. This methodology could be considered a guideline to shift both the Middle East and Africa ports into sustainable green ports.

Keywords

Sustainability, Green Ports, Energy, Green performance indicators

A METHODOLOGY FOR SHIFTING EGYPTIAN PORTS INTO SUSTAINABLE GREEN PORTS

ASHRAF MANSOUR[1]
[1]Civil & Architectural Department, National Research Centre

ABSTRACT: *Egypt has a capacity of more than fifteen ports, situated on both the Mediterranean and the Red sea, with a totalarea of around 518 Km2. They are either commercial, or specialized ports which includes Mining Ports ,Petroleum Ports, Tourist Ports, Fishing Ports and Berths. The main Egyptian commercial ports are Alexandria,El Dekheila, Damietta, El Arish, West Port Said, East Port Said, Suez, Petroleum Dock, Adabiya, Sokhna Port, Hurghada, Safaga, El Tour, Nuweiba and Sharm El Sheikh. Establishing a methodology for shifting Egyptian Ports into sustainable green ports is of a major benefit as it incorporates a balance between environmental, social and economic concerns. It establishes guiding principles to achieve long-term environmental, societal and economic benefits through resource conservation, waste reduction and pollution prevention. Applying Sustainable Green Port Policy achieves the Port's environmental sustainability goals through six key areas: water, energy, air, waste management, sustainable development and sustainable business practices. The main objectives should effectively: manage resources in an environmentally sensitive and responsible manner; minimize, environmental impacts directly attributable to operations on the Port's Bay and the tidelands; prevent pollution and improve personal, community, and environmental health and ensure a balance of environmental, social and economic development. This methodology could be considered a guideline to shift both the Middle East and Africa ports into sustainable green ports.*

KEYWORDS: *Sustainability, Green Ports, Energy, Green performance indicators*

1. INTRODUCTION

Egypt has a very unique geographical location on the major trade routes between the Far East and Europe, bordered on the north by the Mediterranean Sea with major ports namely Alexandria, El Dekheila, Damietta, El Arish, West Port Said, East and Port Said, Suez,, and on the east by the Red sea and suez canal named Petroleum Dock, Adabiya, Sokhna Port, Hurghada, Safaga, El Tour, Nuweiba and Sharm El Sheikh. The Egyptian marine ports as one of the main transportation sectors are considered to be one of the main economic bases that support the production in Egypt. (Elzarka, 2014)

According to Marinetime transport sector statistics (2018), the total number of main Egyptian Ports are 15 Ports. The total lengths of Terminals of Commercial sea ports are 34.76 kms. The total area of Commercial sea ports are 518.84 km2. The total area in terms of watery is113.25 km2. The total area in terms of flooring is 405.59 km^2.

The Egyptian government policy since the year 2000 aimed at promoting exports and attracting a greater share of regional and international markets for container handling, transient and transshipment (Abbas and Mokhtar, 2003). Maritime transport and related logistics services play an important role in Egypt's economy and international trade. For example, Egypt's maritime ports handle more than 65 percent of Egyptian exports (Al Tony 2005)

From the other hand, transportation has been recognized as one of the major logistics activities that negatively impact the environment and it is one of the prime elements in greening supply chains. (Elzarka, 2014)

Environmental protection new trend, as emerging regulations on environmental issues, requests that port logistics should be green. (Mengying Feng et al, 2012) Developing ports without an adequate environmental and ecological preservation policy could hurt both the residents and fauna and flora close to the port. (Taih-cherng, 2013) According to Denktas-Sakar and Karatas-Cetin (2012), sustainable port operations refer to the 'business strategies and activities that meet the current and future needs of the port and its stakeholders while protecting and sustaining human and natural resources'.

Establishing a policy for transforming Egyptian Ports to green ports is of a major benefit as it focuses on incorporating a balance of environmental, social and economic concerns. It establishes guiding principles to achieve long-term environmental, societal and economic benefits through resource conservation, waste reduction and pollution prevention. Applying Green Port Policy achieves the Egyptian Port's environmental sustainability goals through six key areas: water, energy, air, waste management, sustainable development and sustainable business practices. The main objectives are to effectively: manage resources in an environmentally sensitive and responsible manner; minimize, environmental impacts directly attributable to operations on Egyptian Ports Bay and the tidelands; prevent pollution and improve personal, community, and environmental health and ensure a balance of environmental, social and economic development.

2. MATERIALS AND METHODS

This study is based on analysis of bibliography survey, investigating the integration and adaptation of the environmental considerations, in order to suggest improvements to move towards the idea of the perfect Green Ports in Egypt. This paper first introduces the idea of the green port and the measures that need to be made and taken in order to turn them into Green ports.

According to literature review, some performance measurement systems (that have been proposed to evaluate and improve ports' green performance) are highlighted. This is through key green port performance indicators (KPIs). The relative importance weights of the key selected green port performance indicators have been determined for three different authors. Consequently, these KPIs are categorized according to the Port's environmental sustainability goals six key areas: water, energy, air, waste management, sustainable development and sustainable business practices. Subsequently, the weight for each item of the Port's environmental sustainability goals six key areas are added for each author. The proposed systems would support ports' authorities in assessing priorities of their green performance, defining the areas that would need improvement and ultimately allocating the necessary fund to develop and improve its green performance.

3. RESULTS

A port cannot be sustainable without its community's support. Port authorities should make every effort to protect the port and its neighborhood from any type of pollution threat. Several literature reviews proposed a performance measurement system to evaluate and improve ports' green performance. Frankel (1987) suggested that a port design and development plan should include the issues indicated in table 1. According to (Taih-cherng, 2013), "to obtain the relative importance of the 17 sub criteria, a pairwise comparison and decision-support technique, namely, the AHP; (The AHP technique was first developed by Saaty (1977); it is used to prioritize and rank alternatives. In other words, it is a multicriteria decision-making technique that can combine qualitative and quantitative indicators to evaluate the overall performances of all alternatives. Saaty combined several previously existing but unassociated concepts and techniques, such as hierarchical structuring of complexity, pairwise comparisons, redundant judgments, an eigenvector method for deriving weights, and consistency considerations, to develop the AHP technique), technique, is employed. With the relative weight of importance of these 17 sub-criteria obtained from the AHP survey, the port stakeholders can then decide how they should allocate their limited resources to improve their green performance on a certain criterion."

Table 1: Green performance indicators according to Frankel (1987), weights and Categorization according to Port's environmental sustainability goals
References: Frankel (1987) Taih-cherng (2013) and the author

	Green performance indicators	**Indicator Weight (W) %**	**Categorization according to Port's environmental sustainability goals (by Author)**
1.	" Fuel spilling contingency plan"	4.63	Water
2.	" Solid waste dumping management"	4.48	Waste management
3.	"Liquid cargo spilling control and prevention "	4.35	Water
4.	" Wetland and marine habitat preservation "	4.31	Water
5.	"Sewage treatment "	4.27	Waste management

6.	"Ballast water pollutant prevention"	4.21	Water
7.	"Using recyclable resources and reducing energy	4.19	Energy
8.	"Ecological preservation and environmental	4.15	Sustainable development
9.	"Air pollution avoidance (toxic gas emission	4.15	Air
10.	"Using substitute energy and energy-saving device"	4.13	Energy
11.	"Port entrance sediment and coastal erosion"	4.10	Water
12.	"Encouraging use of low-sulphur fuel"	3.92	Energy
13.	"Avoiding the dust pollutants during port	3.81	Air
14	"Reducing vessel speed after landfall (reducing fuel	3.69	Energy
15.	"Using electrically powered equipment (to replace	3.60	Energy
16.	"Noise control (regulation on noise and vibration	3.52	Sustainable development
17.	"Aesthetic interference/visual impact/improving city	3.13	Sustainable business

As per Lirn et al (2013), a critical review was conducted to identify the key green port performance indicators. 32 indicators were found to be the key green port performance indicators as illustrated in Table 2.

Table 2: Green performance indicators according to Lirn et al (2013), weights and Categorization according to Port's environmental sustainability goals
References: Lirn et al (2013), and the author

	Green performance indicators	**Indicator Weight (W) %**	**Categorization according to Port's environmental sustainability goals (by Author)**
1.	"Sediment of port entrance & coast erosion"	1.82	Water Sustainable development
2.	"Marine biology preservation & protection"	2.77	Water Sustainable development
3.	"Oil spill contingency plan"	4.48	Water
4.	"Solid waste dumping management"	4.30	Waste management
5.	"Liquid cargoes spilling contingency plan"	4.32	Water
6.	"Spill prevention during disconnection of cargo pipeline"	3.95	Water
7.	"Regulation on noise & vibration from unloading equipment"	1.77	Sustainable development
8.	"Avoid decreasing community real estate value due to the existence of cargo pipelines"	1.61	Sustainable development
9.	"Regulation on noise & vibration from discharging equipment"	1.75	Sustainable development
10.	"Ballast water pollutant prevention"	4.02	Water
11.	"Sewage processing and water resource control"	3.86	Water
12.	"Air pollution avoidance (toxic gas regulation)"	4.14	Air
13.	"Reducing vessel speed after landfall (reducing fuel consumption & pollution)"	2.55	Energy
14	"Cold ironing (on-dock power supply)"	1.77	Energy
15.	"Use of electrically powered equipment (to replace diesel equipment)"	4.14	Energy
16.	"Encouraging use of low-sulphur fuel"	1.79	Energy
17.	"Using substitute energy and energy saving device"	3.98	Energy
18.	"Aesthetic interference/visual impact/ improving city scenery"	1.80	Sustainable business practices

19.	"Avoiding the dust pollutant during loading & discharging"	2.57	Air
20.	"Biology impact avoidance/reducing infrastructure disturbance to marine biology density"	2.45	Sustainable development
21.	"Reducing road vehicles CO2 emission "	4.18	Air
22.	"Ecology preservation & environment protection training"	2.81	Sustainable business practices
23.	"Port maintenance & pollution avoidance"	4.25	Air Water
24.	"Flood impact & control"	1.82	Water
25.	"Improving willingness to reuse recyclable resources"	3.82	Sustainable business practices
26.	"Avoiding disturbance to community during infrastructure construction & demolishment'	1.75	Sustainable development
27.	"Infrastructure impact avoidance"	1.77	Sustainable business practices
28.	"Encouraging public transport mode development"	3.95	Sustainable development
29.	"Dredging sediment disposal"	1.89	Waste management
30.	"Ship bilge discharge management"	1.89	Waste management
31.	"Hazardous cargo management"	4.14	Waste management
32.	"Using recyclable resource, and reduce energy consumption"	4.34	Energy

Elzarka, 2014 set up a set of comprehensive green performance indices for a port before it can improve its green performance is becoming increasingly important. The relative importance weights of the key selected green port performance indicators have been determined among the Egyptian ports. Table 3 indicates the Relative Importance Weights of the Selected Key Green Performance Indicators.

Table 3: Green performance indicators according to Elzarka, 2014, weights and Categorization according to Port's environmental sustainability goals
References: Elzarka, (2014), and the author

	Green performance indicators	**Indicator Weight (W) %**	**Categorization according to Port's environmental sustainability goals (by Author)**
1.	"Air pollution avoidance (toxic gas regulation)"	17.8	Air
2.	"Oil spill contingency plan"	15.3	Water
3.	"Reducing road vehicles CO2 emission"	14.9	Air
4.	"Hazardous cargo management"	13.2	Waste Management
5.	"Sewage processing and water resource control"	6.89	Water Waste Management
6.	"Solid waste dumping management"	4.56	Waste Management
7.	"Port maintenance & pollution avoidance"	4.28	Sustainable development
8.	"Spill prevention during disconnection of cargo pipeline"	3.84	Water Waste Management
9.	"Use of electrically powered equipment (to replace diesel equipment) "	3.75	Energy

10.	"Using recyclable resource, and reduce energy consumption"	3.19	Energy
11.	"Using substitute energy and energy saving device"	3.04	Energy
12.	"Liquid cargoes spilling contingency plan"	2.85	Water
13.	"Improving willingness to reuse recyclable resources"	2.5	Sustainable business practices
14	"Encouraging public transport mode development"	2.47	Sustainable development
15.	"Ballast water pollutant prevention"	1.42	Water

After categorizing the KPIs, according to the Port's environmental sustainability goals six key areas: (water, energy, air, waste management, sustainable development and sustainable business practices), the weight for each item of the Port's environmental sustainability goals six key areas are added for each author . See Table 4.

Table 4: Priorities of Port's environmental sustainability goals according to Frankel (1987), Lirn et al (2013) and Elzarka, 2014. References: The author

Port's environmental sustainability goals	Indicator Weight (W) % per **Frankel (1987)**	**Priorities according to Frankel (1987)**	Indicator Weight (W) % per **Lirn et al (2013),**	**Priorities according to Lirn et al (2013),**	Indicator Weight (W) % per **Elzarka, 2014**	**Priorities according to Elzarka, 2014**
Energy	9.98	4th	18.57	2nd	19.53	2nd
Water	30.3	2nd	31.29	1st	25.29	1st
Sustainable business practices	2.5	6th	10.2	6th	3.13	6th
Sustainable development	6.75	5th	17.87	3th	11.77	4th
Air	32.7	1st	15.14	4th	11.88	3th
Waste Management	28.49	3rd	12.22	5th	8.75	5th

4. DISCUSSION

As per the KPI's analysis, it is obvious that water, air and energy are considered the first priorities for transferring the ports to green ones

Regarding Water,

The port is expected to improve water quality in the Port's Bay and reduce the Port's water usage to preserve Port's water supply, by reducing the Port's operational water use to beyond local regulations. According to S. Kallas, 2012, it is important to establish a water management plan and develop and implement a water conservation strategy:

- Setting targets on reducing own direct water usage and indirect consumption within the estate infrastructure using available technologies (e.g. continuous monitoring of water demand to identify leakages, spray nozzles on water taps, sensor operated flows, dry basins.
- Conducting a sustainable landscaping project at a Port park.
- Establishing spill monitoring and proven emergency response procedures for both land and marine operations.
- Replacing plumbing fixtures in Port buildings with water efficient fixtures.
- Ensuring that own cargo handling equipment is in line with best environmental practice that minimize spillages.
- Employ environmentally landscape practices:
    - Eliminate the use of potable water for irrigation by designing the landscape with drought tolerant native / indigenous plants.
    - Exploring opportunities to introduce Smart Irrigatio System.

- Employ zone irrigation, drip irrigation and rain-water detectors to minimize water consumption in the landscape.
- Budget water resources to match project and site sources, including reuse of treated wastewater or rainwater for irrigation. (M. White, 2018) and (A.Despina,2011).

Regarding Air,

The port is expected to reduce greenhouse gas contributions and other air emissions from Port Operations. This is through implementation of a carbon footprint management and Clean Air program.

- Definition and publicly register the carbon footprint of Port operations, and establish goals to maintain or reduce this footprint.
- Exploring ways to assist tenants in measuring and reducing their carbon footprint.
- Monitor the success of the Vessel Speed Reduction Program..
- Implement a tenant-owned cargo handling equipment retrofit and/or replacement program that maximizes available/potential funding.
- Investing in low emission and fuel efficient own fleet (vehicles and vessels);
- Making use of state of the art own terminal equipment (e.g. movable and non-movable cranes)
- Using low emission fuels (sulphur, carbon, PM) in operating own fleet (cars, trucks, service vessels) and terminal equipment (e.g. movable and non-movable cranes);
- Investing in projects demonstrating the feasibility of new technologies that reduce air pollution. (S. Kallas, 2012)

Regarding Energy,

The port should be able to Conserve energy and maximize energy efficiency of Port operations. This is through:

- Reduction of the Port's operational energy use;
- Assessment of various energy efficiency technologies;
- Limitation of nonrenewable energy resources and transferring it to renewable energy where possible for port authority operations and producing renewable energy in the port area. Installing photovoltaic systems on the Administration and Services Buildings.
- Managing own energy consumption systematically (e.g.passive/low energy office buildings, use electric vehicles) and improving energy efficiency;
- Calculating the carbon footprint of the port authority and setting reduction targets towards carbon neutrality;
- Adopting the World Ports Climate Declaration; (A.Despina,2011) and (S. Kallas,2012)

Regarding Waste Management,

The generated waste imposes four penalties:

- Depletion of natural resources;
- Energy involved in disposal;
- Increasing pressure on land for waste disposal;
- Pollution arising from landfill disposal. (A.Despina,2011)

The port is expected to reduce waste from Port operations through material reuse, recycling and composting. The ports' challenge in this work is to contribute to a reduction of waste in a safe and efficient manner by:

- "Waste prevention: To reduce the amount of waste generated and also reduce the presence of dangerous substances in products. Waste prevention is very closely linked with improved manufacturing methods and also with influencing the consumers demand. Ensure that waste from any refurbishment building work is minimized."
- "Recycling and reuse: As many as possible of the materials should be recovered, preferably by recycling."

- "Improving final disposal and monitoring: Waste that cannot be recycled or reused should be safely incinerated while landfill should only be used as a last alternative. Both methods need close monitoring" (S. Kallas, 2012)

Regarding Sustainable Development,

The port is expected to enhance the environmental performance of Port buildings while maximizing long-term economic benefits. This is through adopting a Sustainable Building Policy and Enhancing the environmental performance of Port buildings.

The purpose of the Sustainable Building Policy is to ensure all port facilities, planning, designing, constructing, managing, renovating, operating, and demolishing is carried out: in a sustainable manner.

Acquire LEED certification for the Port administration and services buildings.

The port authorities with the engineering department should establish the minimum number of credits required in each of the LEED categories so that port projects and buildings demonstrate performance in all categories. (USGBC, 2018)

Educate key Port employees on sustainable building principles.

The port authorities should maintain a Sustainable Building Team, consisting of representatives of Business Units involved in environmental and sustainable building practices, to provide input into reviewing and updating the Sustainable Building Policy, helping provide technical expertise on specific sustainable building issues and coordinating sustainable building knowledge and LEED (or other assigned rating system) training. The Sustainable Building Team is also responsible for assisting project managers to understand and apply The Policy and to help determine the most appropriate rating system and level. (ILO, 2011)

Regarding Sustainable Business Practices,

Sustainability practices in port operations are critical issue to achieve port sustainability involving economic, social and environmental issues. The port should give equal weight to environmental, economic & social concerns in the decision-making process. This is through increasing opportunities for employees and the public to participate in the Green Port Program to learn about ways to be more sustainable.

- Increase outreach efforts as part of the Green Port Education Program.
- Expand the use of environmentally-friendly products used in Port operations. (Dalwon, 2017)

5. CONCLUSION

Egyptian Ports play an important role in the global transport of goods. It deals with several parties as ship companies, truck companies, logistics companies, local authorities, citizens, etc. Its heavy traffic has a direct impact on the natural environment .

Adopting and applying the idea of a Green port would be a great achievement, while there will be a direct influence on all the involved parties to create an overall Green behavior and respect the environment. This paper presents suggestions of how to transform the Egyptian ports into a Green ports. Some of these suggestions needs funding for advanced technology, while others are cost-efficient and do not need special skills for application. Some performance measurement systems are highlighted and categorized according to the Port's environmental sustainability goals six key areas: water, energy, air, waste management, sustainable development and sustainable business practices.

Research results indicate that "water pollution management", "air pollution management" and "Energy" were the most important dimensions influencing the green ports, green performance, followed by "Waste Management", "Sustainable development" and finally "Sustainable business practices".

Transforming Ports to a Green one would be considered a step towards healthier future for our whole Globe and could be considered a guideline to shift both the Middle East and Africa ports into sustainable green ports.

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REFERENCES

- Despina, K. Stavros and S. Chrysosto mos, (2011). How will Greek ports become Green ports?, *Geo-Eco Marina Journal, 17/2011, pp*. 73-80, 2011
- Abbas, Khaled and Mokhtar, Mahmoud (2003). Logistics chain analysis of Alexandria Container Handling Company in Egypt: A basis for assessing and improving services. Proceedings of the European Transport Conference (ETC) 2003 Held 8-10 October 2003, Strasbourg, France
- Al Tony, Fathy. (2005). Transport cargo services and their impact on the competitiveness of Egyptian exports. Egyptian *Review of Development and Planning, 13 (1), Institute of National Planning, June*.
- Denktas-Sakar, G., & Karatas-Cetin, C. (2012). Port sustainability and stakeholder management in supply chains: A framework on resource dependence theory, *The Asian Journal of Shipping and Logistics, 28 (3):* 301-319.
- Dalwon Kang and Sihyun Kim, (2017). Conceptual Model Development of Sustainability Practices: The Case of Port Operations for Collaboration and Governance, *sustainability Journal.*
- Elzarka, Sara and Sara Elgazzar, (2014). Green Port Performance Index for Sustainable Ports in Egypt: a Fuzzy AHP Approach , *The 7th International Forum on Shipping, Ports, and Airports (IFSPA 2014), Hong Kong, China*
- Frankel, E.G. (1987). Port Planning and Development, Wiley, New York, NY
- ILO, International Labour Office (2011). A Skilled Workforce for Strong, Sustainable and Balanced Growth A G20 Training Strategy, *Geneva*
- Lirn, T. C., Wu, Y. C. J., & Chen, Y. J. (2013). Green performance criteria for sustainable ports in Asia, International Journal of Physical Distribution & Logistics Ma.agement, 43(5): 5-5 .
- M. White, (2018). Sustainable Port of San Diego, Green Port Program, *The Port of San Diego*
- Marinetime transport sector, http://www.mts.gov.eg/en
- Mengying Feng, John Mangan, Chandra Lalwani, (2012). Comparing port performance: Western European versus Eastern
- Asian ports", *International Journal of Physical Distribution & Logistics Management, Vol. 42 Issue: 5*, pp.490-512