A proposed environmental indicator's system for assessing the environmental sustainability performance of Egyptian industrial zones Case study "Al-Tebeen City in Al-Saleb District"

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Abstract:

Industry development is becoming increasingly urgent for achieving its sustainable development goals. The paper proposes a framework for a comprehensive set of indicators for the identification of more sustainable environmental performance for industrial zones. The indicator system cover aspects of Environmental sustainability performance. The framework is applicable across industries; however, more specific indicators for different sectors have to be defined. Thus, it serves as a tool that can assist environmental planners and decision-makers in assessing their performance concerning the goals and objectives of sustainable development. The methodology developed to identify key indicators utilized for evaluating sustainable environmental performance consists of three basic steps to further strengthen the process of assessing sustainability and identifying adaption strategies. The key indicators restricting for industry development, and adaptation and recommendation policy forward to enhance industry development.

Keywords:

Environmental Performance - Assessment Index- Sustainable Industry- Industrial Zones- Environmental Sustainability.

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INTRODUCTION

Industry, as a major contributor to economic development, is the main source of environmental pollution. Sustainable Industry development is a continuous process of increasing industrial scale, eradicating poverty, and creating jobs, resulting in more sustainable production and consumption patterns (UNIDO, 2011).

The industrial sector plays a key role in the transition to a more environmentally friendly society. Industries need to measure and assess many areas of their environmental sustainability performance, such as their impact on climate change, material depletion, water conservation, and so on. The use of suitable indicators required to get the desired result. The term indicator used to describe both quantitative and qualitative components of a problem that must be examined and controlled (Tanzil and Beloff 2006). Indicators are being use more and more to assess the long-term sustainability of various systems. The numerous environmental issues that must be examined in order to effectively assess the environmental sustainability of industrial (Angelakoglou and Gaidajis 2015). Environmental sustainability is becoming a more essential issue in the modern world, involving all elements of development.(Shatokha V., Stalinskiy D…..(2017), Sustainable development requires comprehensive environmental performance assessments, forcing industry to expand its environmental responsibilities both locally and worldwide. The goal of this research is to look at some of the strategies that may be used by industries to help with assessment of their environmental resiliency. The main objective of this study is to establish indicators system that suits the state of the industrial zones in Egypt for assessing the environmental sustainability of industrial. Different from previous studies that only consider one index in evaluation of the industrial development level, this paper proposes an evaluation framework with Proposed indicator's system for assessing the environmental sustainability of industrial zones aims to help governmental policymakers to identify the problems and weak aspects and make policy decisions.

Research objectives

The main objective of this study is to identify how to evaluation of industry environmental performance by specific objectives so the study were to interested the following:

- Determine the study issues
- Identity tools and indicators that are concerned with determining the environmental performance of industries

- Determine environmental sustainable assessment stage for industrial zones
- Analysis of the environmental sustainability assessment for industrial zone (case study).

1. Methods of Environmental sustainability assessment for industrial zones

In this part, the idea of industrial environmental sustainability will be clarified (definitions, challenges and issues, importance), the basic methods and criteria for determining the appropriate system of indicators for the Egyptian case, and it appears in the following:

1.1 Industrial environmental sustainability (definitions, challenges and issues, importance)

Environmental sustainability can be defined as a state of balance, resilience, and interconnectedness that allows human society to meet its needs while not exceeding the capacity of its supporting ecosystems to regenerate the services required to meet those needs, nor reducing biological diversity through our actions.(Greenwood, Lisa, and Alexis Bliss, 2010)

Nowadays, substantial economic expansion observed over the last century has been accompanied by gains in material welfare in all parts of the world, thanks to technical advancements and global integration. Between 1995 and 2020, global GDP expected to grow by 75%, putting significant strain on natural and social resources. So, the Governments should be promoting sustainable development must figure out how to balance the risks and benefits of growth while also decoupling economic expansion from environmental concerns.

Given the global nature of many of the most important development challenges, such as climate change, countries must form strong coalitions to handle issues of common concern, as well as adapt their institutions and decision-making processes to the ever-increasing globalization (OECD, 2020).

Also Lopez et al. (Lopez, R.A.; 2016) confirmed on, research on the sustainability performance of industrial zones should focus on standard of measurements, while stakeholders should use indicators assessed at larger scales. The complexity of sustainability problems requires the development and implementation of effective tools and processes to aid decision-making [Gonzalez, E.D.R.S.; Sarkis…2015]. Closing the gap between theory and practice is currently one of the most difficult issues.(Moldavska, A.; Welo, T.,2015)

Because of negative effects of industrial activity, raise questions about how the techno sphere is conceived and constructed today. Since 1700, the volume of products sold worldwide has expanded by 800 times, while global industrial production has increased by more than 100 times in the previous ten years (Graedel and Allenby,2009).

And existing industrial systems and infrastructure committed to production, distribution, and consumption face unprecedented challenges as a result of these dynamics. Indeed, by 2050, the global industrial system ispredicted to double its output while utilizing half of the existing resources and emitting 20% of the current CO2. In Allwood et al. (2011), a breakdown of global CO2 emissions shows that industry accounts for about 36% of total areas as shown in figure (1) (Flavio Tonelli,Steve Evans,Paolo Taticchi , 2013)

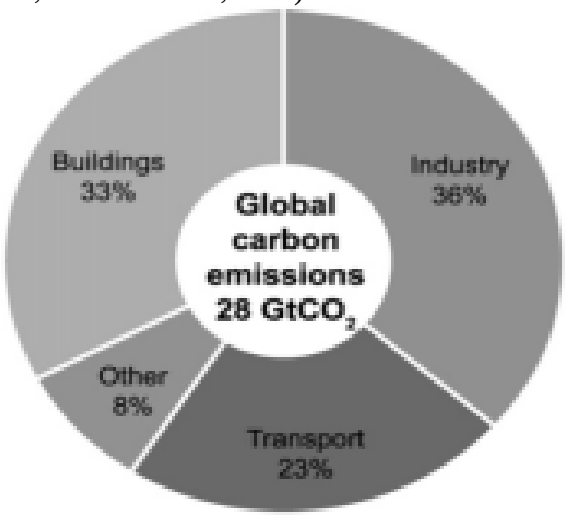

Figure (1): CO2 emissions around the world Source : Flavio Tonelli,Steve Evans,Paolo Taticchi, Industrial Sustainability: challenges, perspectives, actions , 2013.

The need to reduce or contain the ecological footprint of the industry will affect the whole industrial and environmental system so that we need proposed ecological indicator system for assessing the environmental sustainability performance of industrial zones, therefore Directing decision makers to industrial environmental assessment to reduce environmental loads Therefore, the research will be exposed to a group of methods interested in reducing industrial impacts and moving towards sustainability.

1.2 Environmental sustainability assessment of industrial zones methods

Composite indices' category includes methods that combine many indicators using a defined methodology into sub-indices to assess environmental sustainability (OECD, 2009). In order to obtain a composite index, normalization, weighting, and aggregation processes must be implemented. Stakeholders are increasingly using indices to analyses the long-term viability of various systems (Gasparatos et al., 2008; Krajnc and Glavic, 2005). The main methods concerned

with achieving industrial sustainability will be explained as follows:

- Life Cycle iNdeX (LInX) method (Khan et al., 2004) evaluates four (4) broad categories: a) environment, health, and safety; b) costs; c) technology; and d) sociopolitical issues. The environmental sustainability of a system is determined by eleven (11) parameters-subcategories that are evaluated during the course of the system's full life cycle. Every subcategory is given a score ranging from 0 to 10. (where higher values represent lower performance). With the application of the AHP approach, a weight is assigned to each parameter, and the aggregation of all parameters provides a final assessment index (Khan et al., 2004).
- Σwesh Plot (ΣWESH) method (Graedel and Greenville, 2005) is based on the idea that if the consumption rate/hazard/concern of each material/aspect, as well as its environmental impact potential, a simple matrix-type presentation may be constructed. In order to evaluate the environmental sustainability of an industrial facility, the method integrates four (4) levels of assessment. A quantitative scoring system using a scale of 0-100 points (where higher values reflect higher performance) is available.
- The Composite Sustainable Development Index (ICSD) technique (Krajnc and Glavic, 2005) evaluates the long-term viability of industries by calculating a composite index that considers all three axes of sustainability, including environmental viability. The goal of the ICSD is to give a readily understandable and quantitative expression of sustainability and to inform decision-makers about the industry's sustainability trends (Krajnc and Glavic, 2005).
- Composite Sustainability Performance Index (CSPI) method (Singh et al., 2007) provides guidelines to select key sustainability indicators and aggregate them into a final composite index. The evaluation is divided into five (5) categories, one of which is environmental sustainability.
- The AIChE Sustainability Index (AIChE SI) evaluates an industry's long-term viability based on seven (7) basic sustainability factors, including environmental viability (Sikdar et al., 2011, Institute for Sustainability, 2013), Every category is graded on a scale of 1 to 7, with the best available practises being used to compare the performance of the industry under consideration (Institute for Sustainability, 2013).
- The Compass Index of Sustainability (COMPASS) technique (Atkisson and Hatcher, 2001) divides and evaluates the industry's sustainability into four (4) categories: nature, economy, society, and well-being, which represent the four points of a compass (N-E-S-W) (2014, Atkisson)
- To present a summary of sustainability performance, the sub-indices can be combined into a final sustainability index.
- Sustainability Assessment Framework for Industries (SAFI) method (Labuschagne et al., 2005a) gives basic recommendations for identifying the aspects/criterion that should be reviewed by an industry in order to effectively assess its sustainability (both environmental and economic/social sustainability).
- The assessment of environmental sustainability is divided into four (4) thematic categories: a) air, b) water, c) land, and d) mineral and energy resources. The relationships between the various aspects/criteria have been further examined using data from industry (Labuschagne et al., 2005a).
- Sustainability Reporting Guidelines (GRI) method (GRI, 2011) was create by Global Reporting Initiative a non-profit organization specialized in sustainability reporting. The environmental sustainability is evaluated through the application of seventeen (17) main and thirteen (13) sub indicators.. A sustainability performance score is provided on a scale of A+ to C depending on the number of indicators to be assessed and their consistency check (external or internal) (GRI, 2011).
- Sustainability Assessment Framework for Industries (SAFI) method) (Labuschagne et al., 2005a) provides general recommendations for selecting the aspects/criteria that should be considered by an industry in order to effectively assess its sustainability.

The primary categories that have a major association with the environmental issues of the industrial sector that are employed by the examined methodologies to measure environmental sustainability may be identified from the above. Energy usage, material consumption, emissions, waste, energy, water suppliers, and environmental performance are all factors to consider. The most commonly used environmental categories were biodiversity, land use and restoration, environmental impact and climate change, ecotoxicity and land use, ozone depletion, and resource consumption. Further examination of the findings revealed that the approaches examined are mostly concerned with concerns including environmental health, resources, and materials.

1.3 Environmental sustainability assessment of industrial zones criteria:

five (5) criteria were set for achieving efficient assessment of environmental sustainability in industrial zones are described below:

- Sustainability-oriented assessments, should not only evaluate the existing condition but also encourage desired behavior (Becker, 2004). An effective method for assessing environmental sustainability should be able to encourage actions that reduce environmental impact, improve corporate image and performance communication, increase resource and energy efficiency, and strengthen the identification of environmentally innovative products and processes.
- Environmental sustainability methods should include all of the data required to improve decision-making at all levels. The specific data should be able to assist in the identification of major environmental hotspots. (Azapagic,2004)
- Benchmarking can be greatly aided by aggregated environmental sustainability scores and visible results. If multiple parameters of environmental sustainability are to be analysed at the same time, data standardization, weighting, and aggregation techniques are required.
- The availability of analytical guidelines, supporting tools, and related software that can assist in the assessment (as in the case of life cycle assessment methodologies) is a cost-effective strategy to expand the method's application and accessibility of use.(Brunner, P.H., 2012.)
- Environmental sustainability assessment methodologies should take into account not only the industry's performance/accountability, but also the concern/impact at the regional, national, and international levels. When examining an industry's environmental sustainability, it's important to consider its special qualities. (Poveda, C.A., Lipsett, M.G., 2011)

From methodologies and criteria for assessing the environmental sustainability of industrial zones to environmental sustainability evaluation of industrial zones to reduce the environmental impacts of industrial regions and achieve environmental balance, a system of environmental indicators will be provided to quantify industrial performance that is designed for the case of Egyptian industrial zones

2. A proposed environmental indicator's system for assessing the environmental sustainability performance of Egyptian industrial zones

The methodology of the proposed environmental indicator system for assessing the environmental sustainability performance of Egyptian industrial zones divided into three stages of implementation. The first stage's implementation gives the information needed to determine environmental sustainability. The second contains all actions necessary for an accurate assessment of the facility's environmental sustainability. Stage results, in the development of a final comprehensive environmental score as well as the identification of environmental “hot spots” that require attention. The third stage contains all actions necessary for strategic adaptation and mitigation.

As a result, the proposed framework serves a dual purpose. It has the ability to act. Both as a means of developing new assessment methods (or improving old ones) and as a ready-to-use tool as shown in figure (2).

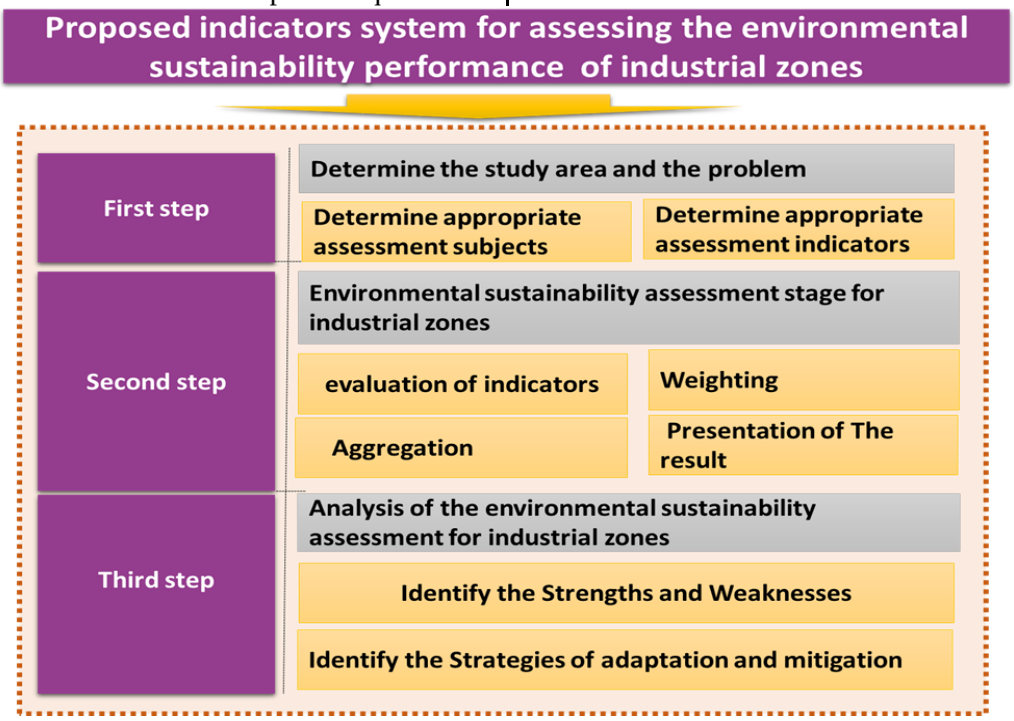

Figure (2): practical framework

2.1 Criteria for determining appropriate standards and indicators for the Egyptian case

- Availability of standard data and indicators to measure the availability of data, the availability of the body responsible for monitoring the indicator, the frequency of the indicator, compatibility with environmental plans and strategies, a questionnaire for a group of experts, and criteria for achieving sustainable development in cities through compatibility with the integrated management plans for the industrial sector (2017-2050) And alignment with the objectives of the 2030 strategy related to moving towards environmental industries, which aims to guarantee the rights of future generations, achieve rational and sustainable management of resources and reduce negative environmental impacts.
- A system for assessing the environmental sustainability of industrial zones will be proposed after an interview conducted with 16 concerned parties related to the research topic, including academics at Cairo University, engineers in the Cairo City Council in the urban sectors, officials of the Slum Development Fund, a member of the city's People's Assembly and members of civil and private associations, responsible In the main hospitals, specialists in the Industrial Development Authority to identify the main topics and indicators for assessing the environmental sustainability of the Egyptian industrial zones to determine and propose the proposed system of indicators suitable for the specificity of the Egyptian case from the previously recognized global tools and indicators.

The proposed system of indicators can identify the strengths and weaknesses to determine the environmental strategies achieved for the sustainable environmental management of the urban environment. The evaluation system includes a set of environmental topics and within each environmental topic there is a set of indicators, and the environmental sustainability index for industries calculated by calculating the environmental sustainability index for each topic Where the indicators of each topic collected and divided by their number, and to calculate the final sustainability index, all sectors collected and divided by their number, and these are sectors in the subject of water, energy, waste, emissions, environmental performance, land, and climate.

2-2Environmental indicator's system for assessing the environmental sustainability performance: Case study "Al-Tebeen City in Al-Saleb District"

2-2-1 Definition of case study area

Figure (3) show that ,the Al-Tebeen City in Al-Saleb District located in El-Tebeen district in Cairo governorate. It is home to the Egyptian Steel Company, which is the largest steel company in Egypt with an area of 1,407 acres. There is also El-Nasr Company. It contains a coke factory, a tar distillation plant, a nitrate factory, a multi-purpose unit factory and a forging company that manufactures auto parts -manufactures railway parts Al-Hadid has a population of about 73,385

Figure(3) : location of the study area

The fundamental issue in the research area is the worsening of the air environment as a result of an increase in harmful gas emissions, as indicated in Figure (4), and their concentration exceeding the legal limit (State of the Environment Report, 2016). Suffocation and chest ailments are caused by nitrogen dioxide, while public health disorders are caused by carbon dioxide.

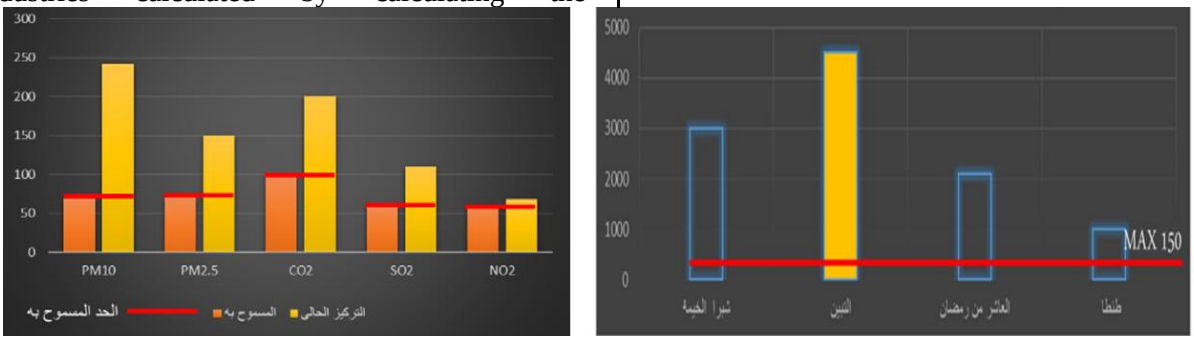

Figure (4) Rates of emissions and particulate resulting from industries in Al-Tebbin district compared to the permissible limit, Source: State of the Environment Report, 2016

The water environment was also polluted as a result of industrial pollution in the Nile River, with

phosphate salts increasing 114 times the permissible limit, organic carbon increasing at a rate ranging from 27 to 36 times the permissible limit figure(5) , and dissolved substances increasing 23 times the permissible limit (State of the Environment Report, 2016).

Also, the discharge of industrial effluents in the Ghamazah desert, which affects the aquifer that reaches Al-Imran, where the amount of industrial wastewater represents 45077.7 m3/day (Industrial Wastewater Guideline, 2018) Figure(6)

Figure (5) Concentrations of industrial pollution in the waters of the Nile River
Source: State of the Environment Report, 2016

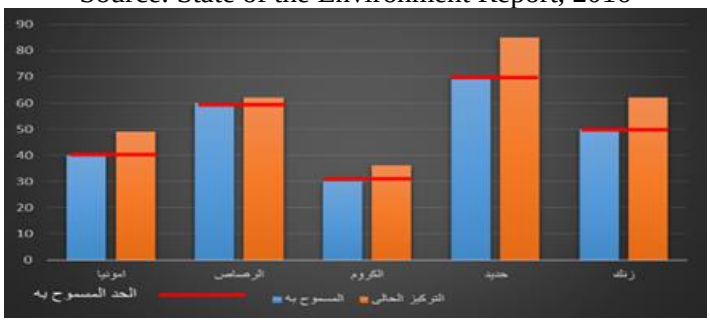

Figure (6) Concentrations resulting from the discharge of industrial liquid waste in the desert backs
Source: State of the Environment Report 2017, Annual Bulletin of Environmental Statistics 2018, Helwan Governorate Status Report 2008, Guidelines for Industrial Wastewater, Handling Samples and Pollution Loads, 2018

The overlap between industrial areas and urbanization is a figure (7), which increases the exposure rate to industrial pollutants, as shown in the figure. For the slums in Al-Tebbin district represented in the areas of Hekr Al-Tebbin, Al-Tebbin Al-Bahriya, Al-Tebbin Al-Qibliya, and Al-Tebbin popular dwellings with a percentage of 10% of the area of the neighborhood (the current status report of Helwan Governorate, 2008, the Slum Development Fund, 2020), the deterioration of public health and the increase in the number of people infected with diseases Air pollution, so the number of people infected with respiratory diseases with lung cancer, chest allergies and bronchitis is 16,769 (Ministry of Health 2020) (Helwan Governorate Status Report / 2008, Ministry of Health 2020). Energy consumption in addition to the lack of optimal exploitation of resources such as dolomite, marble, granite, and sand. Hence, the main objective of the research is to assess the environmental sustainability of the industrial zones in Al-Tebbin area to reach the mechanisms of adaptation and mitigation to achieve sustainable environmental management of urbanization.

Figure(7) Overlap between industrial and urban areas

2.2.2 Determine environmental indicator's system

The primary environmental challenges identified at the outset. In terms of the main sustainability assessment topics, which are water, energy, waste, emissions, environmental performance, land, and climate, the evaluation system identified five major environmental issues that are appropriate and expressive of the specificity of Egyptian industrial cities and the state of El-Tebbin city.

Then, as indicated in Table (1), those indicators and subjects identified to be expressive of each of the sub-goals of the major goals according to each of the five topics, and the research relied on two types of indicators:

- Data from numerous sources, including the current status report for Helwan Governorate 2008, the Helwan Environmental Action Plan 2010, the Environmental Affairs Agency 2020, and the Geotechnical Encyclopedia, are among the digital indicators that can be acquired from secondary data. Indicators for the governorate, the Republic, and a few international indicators on average.
- Descriptive indicators, in which the research was based on a questionnaire form for a set of questions for indicators that indicate the sub-objectives for each of the five subjects in the instance of the city of Tabbin. For each A question of questions, the city of Cairo in the urban sectors, officials of the Slum Development Fund, a member of the city's People's Assembly, members of civil and private associations, officials in major hospitals, and researchers asked each official to answer questions with a value of (none - very weak - weak - average - good - very good). The research converted it to an ordinal variable whose value is from zero to none, 3 average to 5 very good, and the average values of indicators were calculated for the 12 officials on each indicator for the sub-objectives.

Table(1) of the main topics and indicators that fit the assessment of industrial environmental performance in the Egyptian case

Topics	Indicators
water and energy	The amounts of industrial wastewater dumped in the desert
	The amount of water consumed from the public network
	The amount of recycled water 16700 m3 of the total water consumption
waste emission	PM2.5. Suspended matter concentration
	concentration SO2
	Nitrogen dioxide concentration NO2
	CO2 concentration
	PM10. Concentration of suspended matter
	general health of the population
improve environmental performance	Reduction in the incidence of respiratory diseases in children
	Reduction of air pollutants resulting from industrial pollution
	Further improvement of the sewage service ratio
	Reducing the percentage of lands exposed to desertification
land	Topography Most of the area is in low land
	Most of the area located on flat land
climate	Wind speed
	solar radiation
	The temperature reaches 34 degrees Celsius in the summer and 9 degrees Celsius in the winter

Source: The results of the ordinal questionnaire D: Ordinal Data, which was carried out by the researcher for 15 officials from the stakeholders in the city of Al-Tebeen

2.2.4 Applicable environmental sustainability assessment stage for industrial zones: Case study "Al-Tebeen City in Al-Saleb District"

In this step, the main indicators for each of the five topics are determined, then the evaluation is done through the indicators specific to each topic that are appropriate to the case of Al-Tebbin city, and then the final evaluation is given to assess the environmental sustainability of the industries based on Table.(1)

The stage of evaluating the environmental sustainability performance of these environmental topics aims to identify the strengths and weaknesses of these main topics. The evaluation process takes place with a rating of 1:5, 1 indicates that the sector's performance is very weak, 2

indicates that it is weak, 3 indicates that it is meduim, 4 indicates that it is high, and 5 indicates that it is high. Then a final indicator of sustainability is produced and the results of environmental issues are presented, and then a decision is made and environmental strategies are determined to enhance the performance of environmental sustainability and achieve sustainable environmental management for urbanization, as shown in Table

Table 2: The application of the indicators system to the case study in order to assess the industrial zone's environmental

topics	Indicators	Measure	Indicator reference	Data source	Evaluation from (5)	performance	Percentage (%)
water and energy	The amounts of industrial wastewater dumped in the desert	175000 m3/year	zero	Industrial Development Authority 2020	1	very weak	20%
	The amount of water consumed from the public network	334000 m3/year	1512000 m3/year	Environmental Action Plan 2010	4	high	80%
	The amount of recycled water 16700 m3 of the total water consumption	5%	100%		1	very weak	20%
	Total Sustainability Index for Water Study				2	weak	40%
waste emission	PM10. Concentration of suspended matter	240mg/m3	PM10=70mg/m3	Environmental Statistics Annual Bulletin 2016 (issued in April 2018)	1	very weak	20%
	PM2.5. Suspended matter concentration	150mg/m3	PM2.5=70mg/m3		2	weak	40%
	concentration SO2	110mg/m3	SO2=60mg/m3		2	weak	40%
	Nitrogen dioxide concentration NO2	70mg/m3	NO2=60 mg/m3		3	medium	60%
	CO2 concentration	200mg/m3	CO2=100mg/m3		1	very weak	20%
	Total sustainability index for studying emissions and waste				2	weak	40%
	general health of the population	16885 person	zero	Annual county census2017	1	very weak	20%
improve environmental performance	Reduction in the incidence of respiratory diseases in children	5%	100%	Environmental Action Plan 2007	1	very weak	20%
	Reduction of air pollutants resulting from industrial pollution	10%	100%		2	weak	40%
	Further improvement of the sewage service ratio	60%	100%		2	weak	40%
	Reducing the percentage of lands exposed to desertification	10%	100%		3	weak	60%
	Total sustainability index to study initiatives to improve environmental performance				2		40%
land	Topography Most of the area is in low land	50m	50m	GIS/Environmental Characterization	4	high	80%
	Most of the area located on flat land	>4%	>4%		4	high	80%
	Total Sustainability Index for the Land Study				3	medium	60%
	Wind speed	12 km / hour			2	weak	40%
	solar radiation	Kwh/m2/day 7:7.3	Kwh/m2/day 9		3	medium	60%

climate	The temperature reaches 34 degrees Celsius in the summer and 9 degrees Celsius in the winter	(9-34) Celsius	25Celsius	meteoblue	3	medium	60%
	Total Sustainability Index for Climate Study				2.6	medium	52%
The total environmental sector performance					2.3	weak	46%

2.2.5 Discussion

From the analysis of the indicators' values, a set of weaknesses found that hinder the achievement of the flexibility of the main objectives of the environmental sustainability of the industrial areas and the achievement of sustainable urban management in those areas. It is clear from the assessment that there are a number of major environmental issues in the study area:

- Deterioration of the quality of the air environment: the risk of air pollution and emissions from factories that lead to environmental pollution and their excess of the permissible limit. Industries (PM10-PM2.5-(CO2-NO2-SO2) Increase carbon dioxide emissions due to the overlap of transport With the movement of transportation (State of the Environment Report 2016 (2017 edition) / State of the Environment Report in Egypt 2017 Annual Bulletin of Environmental Statistics 2016 (April 2018 issue)
- Pollution of drinking water sources, where the risk of pollution of the Nile water and an increase in the concentration of materials above the permissible limit for organic carbon, solids and dissolved materials), due to the presence of factories and dumping their wastes in the Nile waters. The quantity of industrial wastewater estimated at 175000 m3/day. Factory wastes dumped in the desert, where a large amount estimated at 3184 tons/year dumped, which leads to the pollution of the aquifers, the weakness of the urban structure (the current status report of Helwan Governorate 2008, the guideline for industrial wastewater and the handling of samples and Pollution Loads (January 2018)
- The urban deterioration in the area of Al-Tebbin and the increase of slums in it for 46% of the total residential area, traffic congestion and noise pollution due to heavy transport movement on the Corniche.
- The overlap between industry and urbanization: the percentage of industrial use is higher than 43% of the percentage of uses in the region and the presence of most heavy industries in the heart of the region at 33% of the total industries, which increases pollution. The overlap between urbanization and the industrial area, which led to an increase in pollution in the area less than 10 m Uniform Building Code.
- Increasing energy consumption and not relying on renewable energy: Increasing energy consumption and dependence on fossil fuels and not exploiting waste (slag) in power generation The Tabbin area located in an area with high solar radiation from 7:7.3 KWH/m2/day unused in generating new energy and renewable (meteoblue)
- The deterioration of the environmental health of the population, the deterioration of the general health of the population: the number of people with respiratory diseases and chest allergies increased by 16,769 cases, the increase in pollution rate (Ministry of Health 2020)

However, there are a set of strong points in the region that enable it to achieve sustainable development for the industrial zone, such as the presence of a desert backwater estimated at an area of 2544 acres that can set up factories for reuse of waste, in addition to the possibility of transferring polluting factories to the Nile in the back, with the presence of a distinct Nile destination that can be used in non-active regeneration Environmentally polluted, in addition to the possibility of benefiting from slag in power generation instead of throwing it in the desert, the possibility of benefiting from industrial wastewater and reusing it.

Conclusion

The research proposed a collection of processes and important mitigation and adaptation strategies that help decision makers as shown in figure(8) , stakeholders, and relevant parties achieve sustainable environmental management of industrial zones, including:

- Establishing industries based on those resources, such as using sand in the manufacture of glass and granite in building materials with an area of 150 acres, establishing industries based on limestone, sand, gravel and clay with an area of 280 acres, and establishing complementary factories for the iron and steel industries estimated at 380 acres to exploit the existing materials and resources
- Establishing complementary factories for the iron and steel industry to take advantage of the available resources and materials
- Increasing awareness about the use of raw materials to control industrial pollution

Waste and Emissions:

- Adopting the idea of green roofs above homes with an area of 200 acres, through which polluting emissions are absorbed and environmental sustainability is achieved
- Establishing factories based on recycling emissions and waste polluting the environment, with an estimated area of 20 acres, and based on reducing polluting emissions and using them in other industries to benefit from them instead of polluting the environment.
- Establishment of waste recycling industries that are used to generate energy resulting from the steel industries (slag).
- Establishing an intermediate station for industrial waste and setting laws to reduce pollution
- Creating a green buffer zone to separate the industrial areas from the residential areas to purify the polluted air 150 acres and reduce the negative impact on the residential area of jojoba and jatropha trees that are specially planted in order to separate the industrial areas and any non-polluting uses of the environment
- Developing factories that pollute the environment and relying on modern techniques to reduce pollution and raise awareness about the use of raw materials to control industrial pollution at the source with an area of 5 acres
- Isolating a power station from the residential area with a green belt to reduce pollution from fossil fuels

water and energy:

- Establishment of solar power plants in the desert hinterland with an area of 450 acres to reduce use of fossil fuels
- Recycling of industrial waste (slag) in power generation for factories
- Establishing an industrial wastewater treatment plant and reusing it in industrial activity

Environmental Health - Environmental Performance:

- Setting requirements and laws to preserve the safety of the population and limit high speeds. Develop infrastructure networks and set a budget to achieve development in urban deteriorated areas. Construction of 2 handicap dams, a steering barrier, an industrial channel, in addition to two lakes.
- Increasing awareness about the use of raw materials to control industrial pollution
- Temporarily transferring residents to 93 acres of vacant land until those areas are re-planned. Re-planning the Hokr al-Tebbin and al-Tebbin marine area 400 acres. Re-planning the area on the Nile Corniche and benefiting from it in the establishment of recreational and commercial activities on an area of 150 acres. Separating the movement of transport for industries with the movement of passenger transport. Raising the efficiency of roads and making them green hubs
- Creating a green buffer zone to separate the industrial areas from the residential areas to purify the polluted air 150 acres and reduce the negative impact on the residential area of jojoba and jatropha trees that are specially planted in order to separate the industrial areas and any non-polluting uses of the environment

Figure (8): mitigation and adaptation strategies that help decision makers

References

1. Lopez, R.A.; Ceballos, J.D.; Montiel, I. Deconstructing corporate sustainability: a comparison of different stakeholder metrics. J. Clean. Prod. 2016, 136, 5–17.
2. Gonzalez, E.D.R.S.; Sarkis, J.; Huisingh, D.; Huatuco, L.H.; Maculan, N.; Torres, J.R.M.;

Almeida, C.M.V.B. Making real progress toward more sustainable societies using decision support models and tools: introduction to the special volume.J. Clean. Prod. 2015, 105, 1–13.
3. Moldavska, A.; Welo, T. On the applicability of sustainability assessment tools in manufacturing. Procepedia Cirp 2015, 29, 621–626. [CrossRef]
4. Shatokha V., Stalinskiy D., Coole T., De Lepeleer G., Karpash M., Kruhlenko L., Petrenko A., Saey P., Shvets I.(2017), Environmentally sustainable industrial development, Academic Council of the National Metallurgical Academy of Ukraine.
5. Greenwood, Lisa, and Alexis Bliss,(2010), "An Exploration of Disparate Missions Served by the Sustainability Manager." Sixth Environmental Management Leadership Symposium: From Environmental to Sustainability Management.
6. Philip Sutton,2004,A Perspective on environmental sustainability, Victorian Commissioner for Environmental Sustainability
7. Dr.A.R.Nithya, 2016A study on Environment Sustainability by Satisfying Rural requirements in Agriculture and food processing via Urban solid waste treatment, , Saveetha Engineering college)
8. Tanzil D, Beloff BR (2006) Assessing impacts: overview on sustainability indicators and metrics. Environ Qual Manag. doi:10.1002/tqem.20101
9. Angelakoglou K (2015) Development of a methodological framework for assessing the environmental sustainability of industrial facilities and processes. PhD Thesis, Department of Production Engineering and Management, Democritus University of Thrace, Supervisor: Ass. Prof. Georgios Gaidajis (in Greek)
10. Gasparatos, A., El-Haram, M., Horner, M., 2008. A critical review of reductionist approaches for assessing the progress towards sustainability. Environ. Impact Asses. 289, 286-311.
11. Krajnc, D., Glavic, P., 2005. A model for integrated assessment of sustainable development, Resources, Conservation and Recycling. 43 (2), 189-208.
12. OECD, 2009. Eco-innovation in industry – Enabling green growth, Chapter 3: Tracking performance: indicators of sustainable manufacturing, pp. 95-144. Organization for Economic Co-Operation and Development (OECD), OECD publishing, 2009, ISBN 978-92-64-07722-5.
13. Brunner, P.H., 2012. Substance flow analysis – A key tool for effective resource management. J. Ind. Ecol. 16 (3), 293-295.
14. Azapagic, A., 2004. Developing a framework for the sustainable development indicators for the mining and minerals industry. J. Clean. Prod. 12, 639-662.
15. Becker, J., 2004. Making sustainable development evaluations work. Sustain. Dev. 12, 200-211.
16. Poveda, C.A., Lipsett, M.G., 2011. A review of sustainability assessment and sustainability/environmental rating systems and credit weighting tools. J. Sustainable Dev. 4 (6), 36-55.
17. Khan, F.I., Sadiq, R., Veitch, B., 2004. Life cycle iNdeX (LInX): a new indexing procedure for process and product design and decisions making, J. Clean. Prod. 12, 59-75.
18. Graedel, T., Howard-Greenville, J., 2005. Greening the Industrial Facilities. New York: Springer Science and Business Media.
19. Krajnc, D., Glavic, P., 2005. A model for integrated assessment of sustainable development, Resources, Conservation and Recycling. 43 (2), 189-208
20. Singh, R.K., Murty, H.R., Gupta, S.K., Dikshit, A.K., 2007. Development of composite sustainability performance index for steel industry. Ecol. Indic. 7, 565–588.
21. Sikdar, S., Schuster, D., Tanzil, D., Beloff, B., 2011. AIChe Sustainability Index, measuring sustainability in the real world: industry experiences. Institute for Sustainability, AIChe, Online, Available at: http://e2s2.ndia.org/schedule/Documents/Abstracts/12726.pdf
22. GRI. 2011. Sustainability reporting guidelines, V 3.1., Global Reporting Initiative, Amsterdam, The Netherlands
23. Labuschagne, C., Brent, A.C., Claasen, S.J., 2005b. Environmental and social impacts considerations for sustainable project life cycle management in the process industry. Corp. Soc. Responsib. Environ. Mgmt. 12, 38- 54
24. Mancini, L., Lettenmeier, M., Rohn, H., Liedtke, C., 2012. Application of the MIPS method for assessing the sustainability of production-consumption systems of food. Journal of Economic Behavior and Organization. 81 (3), 779-793..
25. Report of the current situation of Helwan Governorate, 2008
26. Guidelines for Industrial Wastewater, Handling Samples and Pollution Loads (January 2018)
27. Flavio Tonelli,Steve Evans,Paolo Taticchi . (2013). Industrial Sustainability: challenges,

perspectives, actions. International Journal of Business Innovation and Research, 144-145.
28. OECD. (2020). Sustainable Development: Critical Issues - free overview of the report. OECD.org.