JOURNAL OF ENGINEERING AND APPLIED SCIENCE, VOL. 66, NO. 1, FEB. 2019, PP. 71-90
FACULTY OF ENGINEERING, CAIRO UNIVERSITY

TOWARDS APPLYING ECO APPROACHES IN DEVELOPING COUNTRIES CASE STUDY: CURITIBA CITY

T. A. ABOUL-ATTA[1] AND R. A. ALI[2]

ABSTRACT

Urbanization growth shows an unexpected increase during the last decades, since cities sprawled to fulfill their population growth needs, pollution and over-exploitation of resources are increasing too. Many solutions were introduced to decrease the impacts of pollution towards our planet, like using renewable and clean sources of energy, recycling of solid wastes, increasing people awareness, which isn't applicable everywhere. Eco cities were introduced as an integrated sustainable development approach towards the urban areas and their natural environment. This approach applied through many sustainable indicators in different European and American cities like Stockholm and San Francisco, but can Eco-cities be applied in developing countries? What did Curitiba city in Brazil do to be an eco-city? Discussions occurred towards the global warming as a result of increasing global urbanization rates, the main global sustainable city indicators, and an analytical study through selected indicators applied in Curitiba and ends with an analytical SPSS study for selected sample of cities and indicators to categorize the indicators according to their strength, and cities according their scores for their sustainability with analytical view towards developing countries.

KEYWORDS: Urban Growth - Developing Countries - Eco-Cities - Green Capital Cities- Sustainable Indicators- SPSS analysis.

1. INTRODUCTION

The expected percentage of the global urban population by the year 2050 is 72% which will lead to the population of 6.3 billion, the poorest countries will suffer from an increasingly polluted and degraded environment. Air and water pollution raising sharply in cities with lower and middle-income countries, water resources are

[1] Professor of Architecture and Regional Planning, Cairo University, Faculty of Engineering
[2] Masters in City Planning, Cairo University, Faculty of Engineering,
Email: Reham.abuelnaga@gmail.com

under threats from drawdown and polluted human wastes. In some regions, levels of heavy metals and other industrial chemical wastes which affect human and animal health, water supplies, and land, are increasing. Meanwhile, carbon dioxide emissions continue to rise, recorded an unprecedented increase in 2016 with a whole 1 degree making it more challenging to control the global temperatures rise [1, 2].

Eco-cities were introduced in the 90s as a holistic solution to the global warming effects in urban areas, they are cities that can produce their own energy, food, and water with the least impact towards its surrounding environment through their wastes, water pollution or air damage. Like living organisms, cities and their inhabitants explain systems for movement “transport”, sensitivity “responding to its environment”, growth “evolving”, reproduction “including education, planning and development”, excretion “outputs and wastes”, and nutrition “need for air, water, soil, food, materials”. The need to join the eco-city approaches is vital at the global level due to the increased pressure of climate changes. European cities took remarkable steps towards this approach, they created in 2008 the annual "Green Capital City Award" which declared from 2010 till now 10 eco-cities started with Stockholm 2010 to Oslo 2019 depending on 12 sustainable indicators including urban, infrastructure, energy and environmental aspects [3-6].

Can the succeeded eco approaches in developed countries be applicable to the developing ones? What challenges can face developing countries towards integrated eco approaches? How did Curitiba city overcome the common expected difficulties in the implementation of integrated eco approaches in developing countries?

Since eco cities' ideas are spreading in the developed countries in Europe and USA according to their higher economic standards, so cities in the lower income countries couldn't follow the same approach. The main objective of the paper is to determine the most valuable sustainable indicators which can be applied all over the world through Curitiba city approach which is the most inclusive applied eco approach in the developing countries. Discussion will start with the urban growth of the developing countries due to the high population growth rates and the severe effect towards the poor regions, followed by the different challenges facing those countries

to the world successful eco approaches. Many urban sustainable indicators around the world are used as a tools guiding city planners and policymakers towards the suitable eco approach. They will be mentioned in an analytical comparative study to reach to the main global effective indicators mentioned which tested first in Curitiba before and after implementing its plan.

To determine the most effective sustainable indicators applied to any city, the process need a statistical comparative analysis study using SPSS models through a large sample of cities "55 city" including 9 cities having the European Green Capital Award and indicators, Curitiba, and a sample of Egyptian Cities, "50 indicator" with great variance between cities and with inclusive sustainable indicators according to the main aspects of the global effective indicators study. Using the steps of the SPSS analytical tools the study results in a number of indicators which arranged according to their strength, in addition to categorized city sample according to the scores they got.

2. URBAN GROWTH IN THE DEVELOPING COUNTRIES

Urban areas around the world are growing very fast, between 1975 -2015 cities with a population greater than 20 million increased from 1 to 8 cities. Between 2007 and 2025, the annual urban population rate in developing regions expected is 2.27%, compared to 0.49% in developed regions. Asian and African urban areas are increasing rapidly, as for Asia it will increase by 60% before 2025 and many Asian cities are ill-equipped to provide their growing populations the safe water and sanitation required. As a result of the unplanned sprawling, slums reached 43% of the urban population of south-central Asia and 62% of sub-Saharan Africa. This rapid growth of urban slums and squatter settlements which reached 32% of the world's current urban population. Millions of tons of human waste in many cities disposed in watercourses especially in the developing world, the lack of drainage facilities and the awareness lead to pollution of both the ground and surface water resources. The planning and leadership of urban areas present major challenges, the most obvious of them with the eco approach is that it has failed to accommodate the ways of life of the majority of

inhabitants in rapidly growing and largely poor and informal areas which require immediate action and focus [7-9].

3. CHALLENGES FACE ECO-APPROACHE IN DEVELOPING COUNTRIES

The Environment Strategy 2012-2022 recognizes notable progress in reducing global poverty, but significantly less progress in managing the environment sustainably. Rapid urban growth is now occurring in unplanned peri-urban areas, as poor urban dwellers in the cities, where they can escape the costs and threats of urban land regulations, and where there is a possibility of combining urban and rural livelihoods. The main challenges can be stated as follow: [10-13]

3.1 Global Challenges

- Urban sprawl which is related mainly to the pricing of land.
- Economic development, poverty, inequality, and weak infrastructure. Cities became in terms of economic and social resources exposed to environmental degradation and different threats to human health.
- Environmental aspects like the conservation of biodiversity, water conservation, and waste reuse/recycling do not acquire significant attention.

3.2 Institutional Challenges [3, 10, 13]

- Limited resources and misinformation by importing technologies found in the majority of western cities rather than relying on local culture and ecology .
- Institutional barriers and locked-in relationships between public and private institutions locked into inappropriate technologies, that the existing facilities remain oversized and may become economically unviable.

4. SUSTAINABLE INDICATORS

"Urban sustainability indicators are tools that allow city planners and policymakers to gauge the socio-economic and environmental impacts and the diagnosis of problems and pressures through good governance and science-based

responses. They also allow cities to monitor the success and impact of sustainability interventions." For using crucial indicators, some considerations must be clear to the decision maker; good data based on monitoring, performance measures that targets require, decided a period of time, indicators must, therefore, be able to take into account different locations, people, cultures, and institutions [14].

4.1 Global Sustainable Indicators

Many global organizations determined different groups of sustainable indicators, one of the most inclusive indicators is the European Green Capital Award. The Award is the result of an initiative taken by 15 European cities on 15 May 2006 in Tallinn, Estonia. The initiative was launched by the European Commission in 2008 to recognize cities that are leading the way with environmentally friendly urban living. The award enables cities to inspire each other and share examples of good practices.

World Bank Program has developed a framework for analyzing economic and ecological sustainability of developing cities around the world named The Eco^2 Cities Initiative which provides advice and a decision-support system for developing cities. Green Cities Program “OECD” is another indicator which is one of the promising international project that has developed its own set of indicators for evaluation of policies in cities and urban areas. However the project is still in progress and the indicator sets are not publically available. Meanwhile “BREEAM” Communities is the most widely-used international tool for evaluating the sustainability of large developments and communities, it promotes developments that are good for the environment, pleasant to live in and economically feasible.

Indicators are used to provide information about the functioning of a specific system, for a specific purpose, main global sustainable indicators from different organizations can be summarized in Table 1 which related to cities' sustainable performance [14-16]. In general each indicator is determined mainly according to its objectives, tools, budget, domain and decided the period of time. It should be reliance, monitorable, adjustable and can be repeated within different time and locations since most of them are applicable in cities of developed countries especially Europe. Since

all of the indicators mentioned above were created in countries applied eco approaches in their strategies and policies, in addition to the capability of applying those indicators, but for developing countries the issue is different. Indicators should be selected according to their development strategies, priorities and needs.

Table 1. Sustainable Indicators [14-16].

Indicator	Date	Main aspects	Comments
European Green Capital Award	2008	Environment-infrastructure-urban-buildings – wastes	Overlooked social and economic dimension of convergence in level between cities
International Eco-city Framework and Standards	2010	Environment-biodiversity- quality of life-capacity- energy-resources – economy	social and economic dimension, urban and environmental aspects, also the possibility of dividing them according to the strength of its impact on the city.
European Urban indicators	2003	Environment - social -economy	The subsidiary indicators objectives are common and they need policies, plans
Habitat Agenda and Millennium Development Goal	2000	Is an obligation of the world towards the poor and they are 40 index	Two sets of indicators: 1. field surveys such as the population census 2.Varied sources of government, official and experts
Green Cities Program (OECD	1960	indicators are divided into two main groups, 1-pollution issues 2-natural potential	Main objective: assess urban policies for 35 cities from America and Europe
BREEAM Communities	1990	Energy-health-land uses-management-pollution-wastes-water - transportation	leader in environmental assessment of buildings, infrastructure projects, urban planning, used in Europe, parts of Africa and the Middle East.
The Eco^{2} Cities Initiative	2015	indicators for short and long term goals-buildings-services and transportation	the World Bank created framework for analysis of economic and environmental aspects in the developing countries, providing support
SIEMENS Indicators for Green City Index	2009	16 quantitative indicators and 14 qualitative indicator. (127 city)	Measures environmental performance based on the size and importance of the city as capital cities with large population and business centers.

Comparison and results in the table are deducted by the researcher

4.2 The Main Effective Aspects In The Global Sustainable Indicators

From the previous analysis, some indicators showed distinct influence to determining the eco city performance and play an important role in the most inclusive indicators like European green capital city and Green city index "Siemens". These indicators can be stated in 5 main groups including environment, urban, social and health, economic, infrastructure aspects from which the most common used and available subsidiary indicators are as follows:

- Environment: "ambient air- biodiversity- solid wastes management....."
- Urban: "land uses- slums- upgrading areas, percentage of open green spaces....."
- Social and health: "life expectancy for men and women- birth death rate- expenditure on education and health from GDP- enrollment in school- literacy rate....."
- Economic: "unemployment rate- GDP per capita, national poverty line....."
- Infrastructure: "transportation "commuters % for private cars, buses, bicycle, walking"- total road length - energy consuming and coverage- water and sanitation coverage- waste water treatment- using clean energy supplies..... "

However, it is not relevant for poor and degraded cities facing significant economic and social problems to apply the same sustainable indicators in Stockholm or Hamburg or any other high income cities. The choice for Curitiba city for the indicator primary test was for its great and continuous achievement which had changed to an eco-city using limited budget but with new ideas, it began with the master plan in 1966 controlled current and future city expansion which was obvious along the strategic axes, in which the city encouraged high-density commercial and residential development linked to the city's integrated master plan and land use zoning, for example, Bus Rapid Transit construction now is applied in more than 300 cities around the world, the best evidence to show this success is the 30% decline of the traffic despite the 100 % increase in population.

5. CURITIBA SUSTAINABLE APPROACH AND THE MAIN INDICATORS THAT REVEAL CURITIBA'S SUCCESS

Curitiba with area 432 km^2, population 1.83 million where public transportation frequency are critical, planned and well organized. The main problem in the city faced was high urban growth rates required new transportation system, Fig. 1 [19, 20].

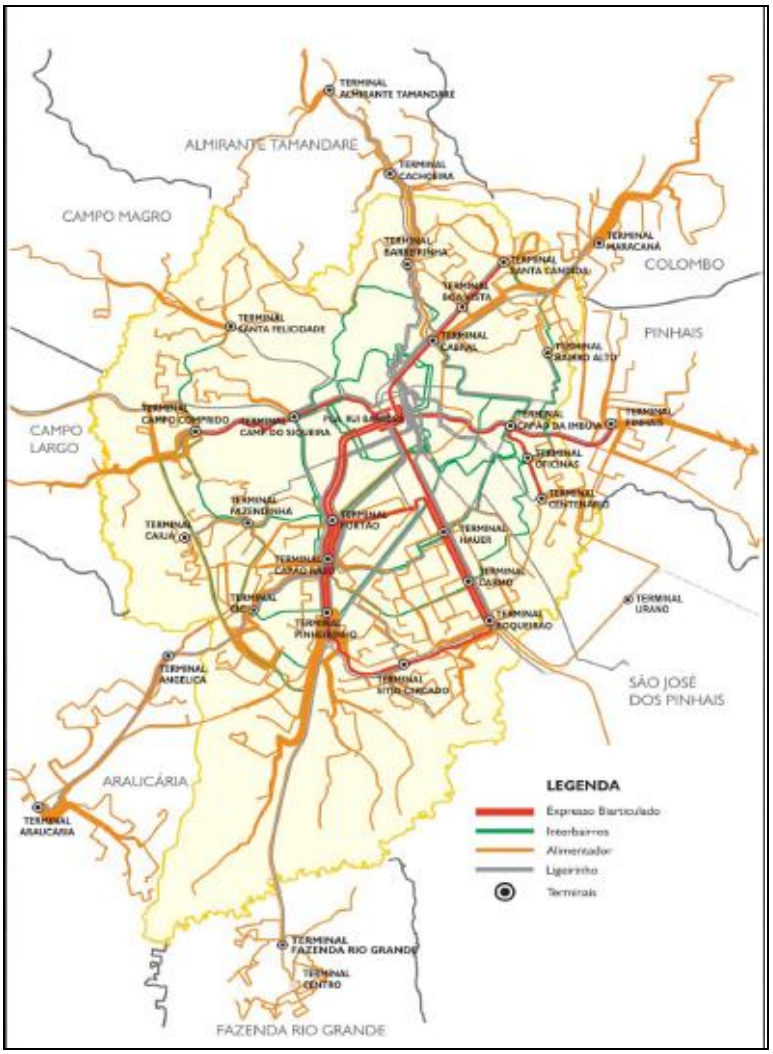

Fig. 1. Curitiba City [17].

5.1 Infrastructure Indicators

Integrating public transportation system, road network development and land use along the structural. The system is used by more than 1,600,000 passengers daily, the greater carrying capacity resulted in 50 percent less energy consumption. Despite

the high percentage of the car ownership in Curitiba but people prefer to use the buses at 46% of all trips and 28% non motorized modes, and 26% for private cars [18-23].

5.2 Urban indicators: "Percentage People in Slums- Open Green Spaces Per Capita"

The city green spaces have been remarkably increased, in 1970 there were less than 1 m^2 per person, the rate reached 64.5 m^2 per person compared to the World Health Organization's recommended area of 16m^2. Natural drainage systems, helped the ecosystem to be preserved naturally preventing environmental hazards and diseases especially in slums which were flood-prone area, now slums "favelas" represent 10% of the city population compared to 22% in Brazil [18, 23].

5.3 Environmental Indicators

Few traffic jams and a low household expenditure on transport, the annual GHG emissions 3 Mt CO_2e resulting in 25% lower carbon emissions than the average for Brazilian cities. A waste management system involves the collection, transportation, treatment, disposal and monitor of all waste produced. The plan created a program for schools, homeless, alcohol rehabilitation to increase their awareness towards the environment, nearly 70% of city residents participate in the recycling program, around 22.6% of wastes were recycled [13, 23].

5.4 Social and Health Indicators

In 1991 the Green Exchange Program was created to promote recycling and keep the city clean and help the poor population of the slum areas which were inaccessible to waste collection vehicles, offering bus tickets and vegetables to people who brought garbage to neighborhood centers [19, 23].

6. EFFICIENCY OF CURITIBA PROPOSED SUSTAINABLE INDICATOR

According to the sustainable indicators relevant the eco approaches, through the most effective global sustainable indicators resulted from the study "mentioned above" which were applied and promoted in Curitiba approach, shown in Table 2, by

comparing Curitiba before and after sustainability in order to evaluate and determine the most applicable and effective sustainable indicators in Curitiba approach as a successful role model for other cities in developing countries. Indicators referred to transportation and socioeconomic aspects were too progressive in the city which led to positive impacts on polluted gases emissions. Unless the success of Curitiba's approach but it couldn't be enough to decide the most applicable sustainable indicators in developing countries but it could be a start towards inspiring other cities.

Table 2. Global Sustainable Indicators Applied in Curitiba Approach [17-23].

Indicator		Eco approach	
		Before	After
Infrastructure	% of trips by public transport	٧%	46%
	Pedestrian-bike paths (Km)	Less than 100	400
	Buses passenger per day	677 000	1879355
	Average life of buses	10	3.5
	Access to Piped Water	96.4	99
	Access to Electric Energy	98.5	99.9
	access to sewage systems	46.5	90%
	Consumption of electricity (MWh)	2,041,596	4,415,373
Urban	open green spaces per capita	0.5 m²	64.5 m²
	% of slums population	30%	10%
Social and health Economic	Average per capita income (R$ in 2000)	451	619.8
	Mortality till 1 year of age (per 1000)	30.2	20.9
	Life expectancy at birth	68.7	71.6
	Illiteracy rate	6.7	4.1
	Proportion of Poor %	9.3	9.1
	Gini index	0.55	0.59
	HDI	0.708	0.856
Environment	GHG emission	25% more	3 Mt CO_2e
	SO_2 ug/m^3	77	6.6
	Pm_{10} ug/ m^3	120	31
	% Garbage collection	97.5	99.5
	solid wastes Kg/capita/yr	179.2	322.5
	% recycled solid wastes	0	22.6%

Indicators' comparison in the table are determined according to Curitiba's approach

6.1 Towards Generalized Results Of Sustainable Indicators

Since indicators in this case study can't be generalized to reach the paper objectives towards valuable sustainable indicators which can be applied all over the world, the sample “cities- indicators” required should be widened using the suitable

analysis tool, a statistical analytical study was held towards a sample of 55 city from all continents showing variance from all the world continents with 50 indicators using SPSS analytical program.

7. GLOBAL ANALYTICAL STUDY FOR APPLYING ECO CITIES' INDICATORS ACCORDING TO A SELECTED SAMPLE

As a result of the previous analyzes, a set of indicators has been identified, Table 3, which have been divided into groups to reach an integrated model to measure the city's ability to be an eco city. In order to reach the current size of this sample, the study underwent several stages of revision. The numbers of proposed indicators and cities were larger but due to differences between countries the required data for each indicator in all cities should be detailed, accurate which were limited since city level data in global databases like World Bank and United Nations are available to selected cities and indicators.

7.1 Obstacles Faced the Analytical Study

Advanced data for cities in Europe and America facing primitive database in low income countries, for example based on sustainable indicators for services “transportation- open green area” coverage within 300 m from home, public green per capita, percentage of commuters using different means of transportations, infrastructure coverage and ambient air emissions which are likely available in European cities while not mentioned easily in many other countries due to the limited resources for measuring tools. Those problems were overcome by wide, detailed and long time search in different accredited references, statistical data, videos, reports, projects, journals which spent great effort and longtime to be collected, tested, sorted, filtered, and sometimes estimated and calculated.

The availability of data in the time period “2005-2012”, which was determined after several attempts because of the difficulties towards collecting data for all sample, which can be summarized as follows:

- It started with an attempt in the year 2000, but it was not acceptable for our research.

- The decision was taken first for the period 2005-2010, but the difficulty of the availability of adequate data for all the cities of the sample required to widen the sample which was finally decided by the period 2005-2012 .

Through all the mentioned steps and attempts many cities and indicators were abandoned, besides in order to reach a comprehensive view we decided to add some indicators at the country level within the city is located, which varies from one country to another and was clear on comparing developed countries with others.

Table 3. The selected indicators for SPSS statistical study.

		Indicator City level		Indicator Country level
Economic and Social	1	Total area	26	% urban population
	2	Population	27	Urban population growth
	3	Population density	28	GDP growth rate
	4	Population growth rate	29	GDP per capita
	5	% of country urban population	30	Infant mortality less than 5 y
	6	Unemployment rate	31	Combined gross enrolment ratio for primary, secondary and tertiary schools
Environmental	7	CO_2 per capita	32	% agriculture employment
	8	SO_2 ug/m^3	33	% industrial employment
	9	NO_2 ug/ m^3	34	% services employment
	10	PM2.5 ug/ m^3	35	National poverty line
	11	PM10 ug/ m^3	36	Life expectancy women
	12	% collecting wastes coverage	37	Life expectancy for men
	13	solid wastes Kg/capita/yr	38	Adult Literacy rate %
	14	%Recycled wastes	39	% Health expenditure GDP
Urban	15	green spaces per capita	40	GINI per capita in US
	16	% of slums population	41	Income level
	17	%Access to Piped Water	42	Ecological footprint
Infrastructure	18	%Access sewage systems	43	Environmental performance index
	19	% Treated water	44	Renewable energy from total
	20	%Access Electric Energy	45	HDI Rank
	21	% private cars trips	46	% Forest area
	22	%public transportation trip	47	annual rainfall
	23	%motorcycle trips	48	% Population in degraded land
	24	% non motorized trips	49	Road traffic deaths per 100,000
	25	% trips by other means	50	Total road length

7.2 Steps of the Sample Selection

Indicators will be applied and tested on a range of different cities of the world with a focus on a package of European environmental cities, and the reasons for sample selection will be discussed as follows:

7.2.1 Basis of selecting the sample

1. To collect the sample that achieves diversity among the current eco cities in accordance with the international indicators and standards of the European cities that are awarded the Green Capital Award and other cities suffering from environmental, social and economic problems.
2. The sample should include cities from developed and developing countries.
3. Include an economic diversity of cities in terms of average per capita income and unemployment rates.
4. Variance in population sizes, area and density.
5. Variance in environmental approaches and implementation.
6. Diversity in the cultural aspect and the level of education and health.
7. Diversity in city locations from the six populated world continents for an inclusive evaluation and to achieve more accurate results.

7.2.2 Main considerations affected the sample

There are other elements affected the selected sample all over the world and can be explained as follows:

1. Cities located in major industrial countries such as USA and China and had significant contribution in the world climate changes, so have been selected four to five cities in both countries.
2. Selection of models of Egyptian cities in order to identify and compare the major environmental problems in Egypt with other cities.
3. Cities with successful experiences such as the city of Curitiba, Brazil.
4. Diversity in cities, capitals and non-capitals, which reflect the influence of the city.
5. Famous touristic cities in the world such as Paris and London.

6. Cities characterized by natural forests and others with vast deserts.

The cities will be covered by the sample of the study shown in the following Table 4 through the indicators selected previously and identified. There are nine eco cities (shaded in the table below) each city is characterized by its superiority according to the Green Capital Award Indicators (discussed in the indicators study), the importance of tracing those cities is to guide us towards a valuable evaluation to the final results of the paper.

Table 4. The Sample of Cities for SPSS Analytical Study.

City sample according to the world continents					
Africa	Asia	Latin America	North America	Europe	Australia
Alexandria	Bangkok	Bogota	Boston	Essen	Melbourne
Cairo	Beijing	Guadalajara	Los Angeles	Hamburg	
Aswan	Hong Kong	Curitiba	New York	Nuremberg	
Elkanater Elkairia	Shanghai	Rio de Janeiro	San Francisco	Amsterdam	
Esmailia	Taipei	Mexico City	Washington DC	Copenhagen	
Addis Ababa	Jakarta		Toronto	Helsinki	
Cape town	Delhi			Ljubljana	
Johannesburg	Mumbai			London	
Casablanca	Seoul			Bristol	
Tunis	Singapore			Paris	
Dar es Salam	Osaka			Nantes	
Lagos	Tokyo			Stockholm	
Nairobi	Istanbul			Tallinn	
				Zagreb	
				Barcelona	
				Vitoria- Gasteriz	
				Valencia	

Selected city sample according to the statistical analysis

8. STEPS OF THE ANALYTICAL STUDY ACCORDING TO THE PROPOSED INDICATORS BY USING THE STATISTICAL ANALYSIS PROGRAM SPSS

The aim of the analytical study is to arrange the selected indicators according to their strength and influence towards eco cities, in addition to a clear order of cities in the sample according to their capacity to achieve eco city approach.

8.1 Factor Analysis Run 1

The aim of this step is to reduce the factors to one factor that reflects them all and is done through data entry for 55 cities plus 50 indicators in correlation matrix to study the relationship between them using a factor analysis “Run1”. The result of the change for the factor analysis for all 50 factors shows that the largest of these values are the 12 factors. The first factor explains 42.147% of the degree of change, which is a significant difference from the second factor, which explains 7.9% of the change.

8.2 Factor Analysis Run 2

The result of the change for the factor analysis of Run 2 for 38 factors, the largest of these values are only seven factors and the first factor explains 53.745% of the degree of change, a significant difference from the second factor, which explains 8.961% of the change. The components matrix in Table 5 illustrates the indicators according to their strength representative towards the eco cities. The values in the table represent the degree of influence of each of the 33 variables that were introduced in each of the seven factors. The degree of influence by making a change of up to 50% or more and therefore from the table can be through the first factor, as it explains 53.745% of change and finds that the variable HDI Rank is the highest 0.974.

8.2.1 Sustainable indicators strength according to the analytical study

The results can be stated as follows:

- The higher components represent the economic and social indicators while the environmental and infrastructural indicators were represented with the lowest ones. which means that for the city to be sustainable, this should be through a strong and stable economic base which lead to a better standard of living and providing good services in health and education, that was clear in the indicator of enrolment ratio for schools which was one of the highest values (0.922) in the matrix, and the Infant mortality indicator with its strong negative influence too.
- The polluted emissions with negative values except for the CO_2 indicator which emphasize the deep responsible of the high income industrial countries of producing

it while other gases reflected the unhealthy ambient air around low and middle income countries with suspended articulated particles due to unpaved streets, old vehicles, high traffic jam, and lack of adequate infrastructure services.

Table 5. The Components Matrix for Run 2.

Indicator (variables)	Component
HDI Rank (Human Development Index)	0.974
Income level	0.929
Combined gross enrolment ratio for primary, secondary and tertiary schools %	0.922
GDP per capita	0.893
Ecological footprint for county	0.889
GINI per capita in US dollars	0.88
National poverty line	0.873
Infant mortality less than 5 y	-0.87
Life expectancy for women	0.869
Life expectancy for men	0.86
% services employment	0.848
% country urban population	0.835
Annual urban growth rate	-0.834
% population in slums	-0.83
Adult Literacy rate %	0.812
% agriculture employment	-0.807
Environmental performance index (EPI)	0.777
Road traffic deaths per 100,000 population	-0.756
% Health expenditure GDP	0.742
CO_2 per capita	0.695
% of collecting wastes coverage	0.69
% Access to sewage system	0.689
Population growth rate	-0.686
Population living in degraded land	-0.668
PM10 ug/ m^3	-0.665
% Recycled	0.636
% water treatment	0.625
Renewable Energy From Total Energy Supply	-0.619
% access to piped water	0.615
PM2.5 ug/ m^3	-0.613
SO_2 ug/ m^3	-0.61
country GDP growth rate	-0.608
solid wastes Kg/capita/yr	0.597
% private cars trips	0.47

8.2.2 The order of the cities in the sample according to the analytical study

Through the previous study, we can arrange the selected cities in the sample according to their scores as shown in Table 6 which reflected great support with the results of the famous Green Capital Award -shaded cities in Table 6- since they gained most of the highest scores.

Table 6. Cities Order according to SPSS.

City	Score	order	City	Score	order
San Francisco	1.08933	1	China	-0.03127	29
Helsinki	1.08909	2	Guadalajara	-0.13889	30
Melbourne	1.04397	3	Curitiba	-0.18134	31
Washington dc	1.04205	4	Mexico city	-0.18274	32
Stockholm	1.04159	5	Bogota	-0.22527	33
Amsterdam	1.03833	6	Rio de Janeiro	-0.2342	34
Los Angeles	1.03337	7	Istanbul	-0.45776	35
New York	1.02107	8	Taipei	-0.58854	36
Toronto	1.00738	9	Casablanca	-0.62498	37
Boston	1.00717	10	Cape town	-0.64312	38
Nantes	0.96915	11	Tunis	-0.65033	39
Copenhagen	0.96275	12	Johannesburg	-0.77016	40
Essen	0.9217	13	Shanghai	-0.77523	41
Hamburg	0.912	14	Beijing	-0.82706	42
Nuremberg	0.89115	15	Ismailia	-0.83164	43
Paris	0.85679	16	Alexandria	-0.849	44
Vitoria-Gasteriz	0.85203	17	Bangkok	-0.86313	45
Osaka	0.84753	18	Cairo	-0.8699	46
Valencia	0.84108	19	Aswan	-0.8799	47
Bristol	0.82197	20	Elkanater Elkairia	-1.03153	48
London	0.81287	21	Jakarta	-1.04203	49
Tokyo	0.79423	22	Mumbai	-1.57139	50
Barcelona	0.71793	23	Delhi	-1.67692	51
Ljubljana	0.61087	24	Nairobi	-1.88536	52
Seoul	0.59667	25	Addis Ababa	-2.069	53
Tallinn	0.57368	26	Dar es Salam	-2.10334	54
Singapore	0.49425	27	Lagos	-2.19307	55
Zagreb	0.30711	28			

Curitiba order “31” in the sample reflected the great efforts implied in the progress in the economic and social indicators mentioned above in Table 2 which support the eco approach that the city followed. On the other hand, most of the cities with the lowest score found in Africa including with some Asian ones, which proved

that the strongest the economic and social development base for the city the more sustainable it is.

The Egyptian cities found within the lowest 10 cities in the sample according to the indicators' analysis, which reflected the deep problems our cities are suffering from especially Cairo as the capital city and Alexandria due to the great pressure on them as the main cities in Egypt with the centralized distribution for services and increasing population with high growth rates and severe traffic jam with a complicated transportation system.

9. CONCLUSION

- Social and Economic indicators are the base of any eco city around the world, cities should be developed first in order to be sustainable.
- The main results of the paper are supported by European Green Capital indicators which were obvious in the final cities' order.
- Sustainable development approaches are no longer far from developing countries unless following the right steps towards the most effective solutions and managing their priories.
- Egyptian cities can benefit from the lessons mentioned above since their surrounding ecosystem varies from north to south, that is the surrounding ecosystem should lead the city main objectives.
- Dealing with slums as a productive urban area is an applicable idea in Egypt since most of them are internally homogenous and sometimes specialized in a certain product or industry which could be managed to provide the suitable area for them to live and work.
- Finally, when there is a will there is a way; any city could improve its own indicators in any environmental, social, institutional and economic aspects through planned steps on the local, national and international levels.

REFRENCES

1. Klemedtsson, A., Milver, A., and Seftigen, K., "Sustainable Development: Comparison of four cities, Project Management for Sustainable Development",

University of Gothenburg Department of Earth Sciences Spring Term 2014- http://gmv.gu.se/digitalAssets/1522/1522775_sustainable-development---comparison-of-four-cities--corrected-report.pdf, (accessed 7 April 2018).
2. NASA, NOAA Data Show 2016 Warmest Year on Record Globally https://www.nasa.gov/sites/default/files/thumbnails/image/2016gistempupdateblack.gif, (accessed 12 May 2018).
3. World Bank Group, "Toward a Clean, Green, Resilient World for All" http://www.worldbank.org/en/topic/environment/publication/environment-strategy-toward-clean-green-resilient-world, (accessed 25 April 2018).
4. Vercillo, K., "Ecocities: Rebuilding Cities In Balance With Nature", 2012 http://hubpages.com/travel/Ecocities-What-They-Are-And-Where-To-Find-Them
5. Ecocity Builders, (accessed 25 April 2018).
6. "European Green Capital Award", http://ec.europa.eu/environment/europeangreencapital, (accessed April 2018).
7. Bilsky, E., Ciambra, A., Guérin, M., and Terren, L.,"Co-Creating The Urban Future The Agenda Of Metropolises, Cities and Territories", https://www.uclg.org/sites/default/files/gold_iv_executive_sumary.pdf, UCLG 2016, (accessed 12 June 2017).
8. UN-Water Decade Program on Advocacy and Communication (UNW-DPAC),"Water and Cities Facts and Figures" http://www.un.org/waterforlifedecade/swm_cities_zaragoza_2010/pdf/facts_and_figures_long_final_eng.pdf, (accessed May 2017).
9. UN-Habitat, "Planning Sustainable Cities, Global Report On Human Settlements" 2009, London, VA, https://unhabitat.org/books/global-report-on-human-settlements-2009-planning-sustainable-cities/, (accessed April 2018).
10. World Bank, "Eco 2 Cities, Ecological Cities as Economic Cities" http://siteresources.worldbank.org/Inturbandevelopment/Resources/336387-1270074782769/Eco2_Cities_Book.pdf ,accessed Dec 2017.
11. DESA of the United Nations, "World Economic and Social Survey 2013 Sustainable Development Challenges" https://sustainabledevelopment.un.org/content/documents/2843WESS2013.pdf, (accessed April 2018).
12. Keiner, M., Zegras, C., Schmid, W., and Salmeron, D., "From Understanding to Action Sustainable Urban Development in Medium-Sized Cities in Africa and Latin America" https://link.springer.com/content/pdf/10.1007%2F978-1-4020-2921-9.pdf, accessed April 2018.
13. ILO regional Research Conference, "Integrated Planning and Sustainable development: Challenges and Opportunities"http://www.ilo.org/public/english/bureau/dgo/speeches/somavia/2008/g8paper.pdf , (accessed May 2018).
14. European Commission, "Science for Environment Policy In-Depth Report: Indicators for Sustainable Cities" Nov 2015 No. 12, http://ec.europa.eu/environment/integration/research/newsalert/pdf/indicators_for_sustainable_cities_IR12_en.pdf, (accessed March 2018).
15. European Green Capital Award "About EGCA", http://ec.europa.eu/environment/europeangreencapital/about-the-award/#, (accessed April 2018).

16. Böhringer, C., and Jochem, P.,"Measuring the Immeasurable: A Survey of Sustainability Indices", http://ftp.zew.de/pub/zew-docs/dp/dp06073.pdf, (accessed March 2018).
17. Barth, B., "Curitiba: the Greenest city on Earth", 2014", http://www.theecologist.org/green_green_living/2299325/curitiba_the_greenest_city_on_earth.html, (accessed April 2018).
18. Adler, D., "The Guardians, Story of cities 37: how radical ideas turned Curitiba into Brazil's green capital"-https://www.theguardian.com/cities/2016/may/06/story-of-cities-37-mayor-jaime-lerner-curitiba-brazil-green-capital-global-icon 2016, (accessed May 2018).
19. Geo Factsheet, "151 Sustainable City Management - Case Study of Curitiba, Brazils Ecological capital", www.curriculumpress.co.uk, (accessed May 2018).
20. Curitiba, "City Profile", www.curitiba.pr.gov.br, (accessed May 2018).
21. IPPUC, www.ippuc.org.br, (accessed May 2018).
22. Goodman, J., Laube, M., and Schwenk, J., "Curitiba Bus System is Model for Rapid Transit", http://reimaginerpe.org/node/344, (accessed May 2018).
23. "City Mayors Transport" 20, January 2010, http://www.citymayors.com/transport/brt-latin-america.html, (accessed June 2018).

نحو تطبيق النهج الإيكولوجية فى البلدان النامية دراسة حالة: مدينة كوريتيبا

دراسة تحليلية شاملة لتطبيق مؤشرات المدن البيئية

يناقش البحث آثار الاحترار العالمى نتيجة لزيادة معدلات التحضر العالمى، والمؤشرات الرئيسية فى المدينة المستدامة العالمية، ودراسة تحليلية من خلال مؤشرات مختارة مطبقة فى كوريتيبا وتنتهي بدراسة تحليلية إحصائية لعينة مختارة من المدن والمؤشرات لتصنيف المؤشرات وفقا لقوتها، والمدن حسب درجاتها لاستدامتها مع وجهة نظر تحليلية تجاه الدول النامية.