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Research paper



Selection of Impactful Environmental Parameters Using an Integrated Community Feedback System for Environmental Assessment

Mitra Shahsavar[1], Noor Ezlin Ahmad Basri[1]*, Behzad Nadi[1], Othman Jaafar[1]

[1] Smart and Sustainable Research Centre (SUTRA, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Malaysia
**Corresponding author E-mail:noorezlin@ukm.edu.my*

Abstract

Environmental assessment (EA) of metropolitan areas is an appropriate method for evaluating civil and environmental engineering problems. Assessing and identifying the environmental pollution in metropolitan areas is of crucial interest, as these are used in decision making for minimizing environmental pollution. The objective of this study is to select most impactful environmental parameters using an integrated feedback to improve decision-making process and management in metropolitan areas for an environmental assessment process. The study started with 71 environmental parameters that were selected from literature study on the basis of the environmental effects on the metropolis. Subsequently, questionnaires were prepared to select the most important (controlling) environmental parameters that affect the metropolis. These questionnaires were distributed to 300 respondents of three groups. Feedback obtained was from 110 respondents (80 citizens, 11 managers, and 19 experts) in metropolitan Tehran, Iran. Statistical Package for Social Science (SPSS) software was then used to analyze the collected data. Twenty-three environmental parameters were selected based on their effects towards the metropolitan areas as a result of the SPSS analysis. These parameters comprised of 3 physical and biological (PB) parameters, 7 operational and technical (OT) parameters, 9 social and cultural (SC) parameters, and 4 economic and political (EP) parameters.

Keywords: *Community feedback; environmental assessment; environmental parameters; urban pollution*

1. Introduction

A metropolis is usually a significant economic, political, and cultural center for some country or region, and an important hub for regional or international connections and communications. Today, cities around the globe need such interventions as never before given the escalating urban populations and increasing rates of land consumption [1]. Upon urbanization, environmental pollutions increase as well in such a way that endangers the health of humans in the metropolitan areas. Environmental analysis may be observed as an approach for reducing urban pollutions, especially in metropolitan areas. The main goal of assessment is to predict, recognize, and precisely analyze all the positive and negative impacts of the development plan on natural and human environment [2].

Urban development is one of the emerging problems of our time. Given the growth of populations, this problem is expected to continue wielding its associated impact on metropolitan areas. Metropolitan development is usually associated with pollution. In metropolitan Tehran, pollution has reasonably damaged the UE. Serious environmental pollution and health problems have been observed in metropolitan areas worldwide. These problems are largely due to air and sound pollution and traffic, resulting in a number of neural diseases [3].

The major social challenges observed are lack of public cooperation and effective supervision, insufficient information availability for officials and managers, and lack of collaborative efforts among citizens, experts, and managers for effective decision making. Increasing concern is evident over changes in environmental parameters in the metropolitan areas, for example, the deterioration of air quality in metropolitan Tehran [4]. As environmental parameters do not focus on urban structures or human activity, they are consequently not the best tools to use to achieve prioritization of environmental pollution reduction. Inefficiencies of screening methodologies and tracking approaches for point source pollution detection and environmental quality reports, which are insensitive to the effects of these pollutants, are the other factors that contribute to these failures [5].

Comprehensive environmental impact assessment (EIA) plans are conducted in metropolitan areas to minimize pollution caused by non-harmonized building development. The successful implementation of these comprehensive plans and strategies are supervised by environmental organizations that aim to decrease worldwide pollution levels. However, existing programs have been utilizing expertise set without the collaborative efforts of experts, citizens, and government managers for the purpose of improving knowledge to minimize pollution.

Tehran, a metropolitan area in Iran, is endangered due to increase of various pollutions. In particular, the citizens of Tehran are exposed to these pollutions. To minimize pollution, various solutions and plans have been proposed. The aim of this study is to calculate and evaluate the differences in values in choosing the important parameters before employing any Environmental Assessment tool to remove minimal or weak environmental impacts. Thus, by screening the positive factors and reducing the negative factors, precise Environmental Assessment is obtained. Subsequently from this study a community advice system is to be developed for an urban area. The system

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covers pollution control through the collaborative efforts of experts, citizens, and managers to hasten the decision-making process and the escalation of information to government managers.

2. Research methodology

The first step of this study was identifying available environmental parameters in relation to urban space as well as the demographic, socioeconomic, political instability parameters and their trends at the metropolis and state level. Seventy one environmental parameters were selected from literature on the basis of the environmental effects on the metropolis [6].
Environmental Parameters Questionnaires (EPQs) were prepared to select the most important environmental parameters that affect the metropolitan areas. The questionnaires were distributed three important groups of relevant stakeholders, which are the citizens (C), experts (E), and managers (M) with a total of 300 respondents in metropolitan Tehran, Iran. Citizens were selected from public areas such as parks, restaurants and shopping malls of Tehran Region 1. Managers were selected from the municipalities and governmental offices. Experts were selected from the municipalities and universities. SPSS software was then used to analyse the collected data.
The study area is Region 1 in Tehran metropolitan area of Iran. This area is the most affected by air and noise pollution. The population of this town is approximately 500,000. The land area is about 210 km^2. It is among the most desirable districts of Tehran for its natural resources and cultural and historical heritage. Tehran Region 1 consists of 10 areas as shown in Figure 1.



Fig. 1: Ten areas of Tehran Region 1

2.1. Selection of environmentally impactful parameters for metropolis (SEIPM)

Data for this step were gathered through the review of previous literature and directly through a set of questionnaires. The questionnaires were aimed at determining the general ideas, views, perception, understanding, knowledge, and experience of the three categories of respondents (citizens, experts, and managers) with reference to Tehran. The questionnaires were distributed to persons involved in urban decision making and urban structural construction and civil engineering for metropolitan development. Useful information was retrieved through answers from the questionnaires. While for designing the questionnaires, it was ensured that the questions were in the form of tables, so they would be easily understood and not touch on any sensitive subjects.

2.1. Environmental parameters questionnaire (EPQ)

A questionnaire survey was carried out for the three categories of respondents in the Tehran metropolitan area using a cross-sectional survey. The purpose of a cross-sectional survey is to gather large amounts of information in a short time. It is useful when collecting data on phenomena that cannot be directly observed. The advantage of this mutual sectional survey is that the dominance of the outcome of interest is estimated, because the sample is usually taken from the whole population and many outcomes and risk factors are assessed [7].
Figure 2 shows the process of preparing the EPQ, which includes questions preparation and selection of appropriate environmental parameters. Questionnaires were distributed to the respondents from three groups, i.e. citizens, managers and experts. Modifying, sorting, and selecting data; screening [8]; and setting up of a questionnaire comprising of the best-parameter questions were used for data collection. The data for this study were analysed in two parts. In the first part, the demographic information shows the age, gender, and educational attainment of the sample. An independent sample EPQ was employed to determine the best environmental parameters for the metropolitan areas. The EPQ was used to determine if the scores of the three groups differ on a single variable.

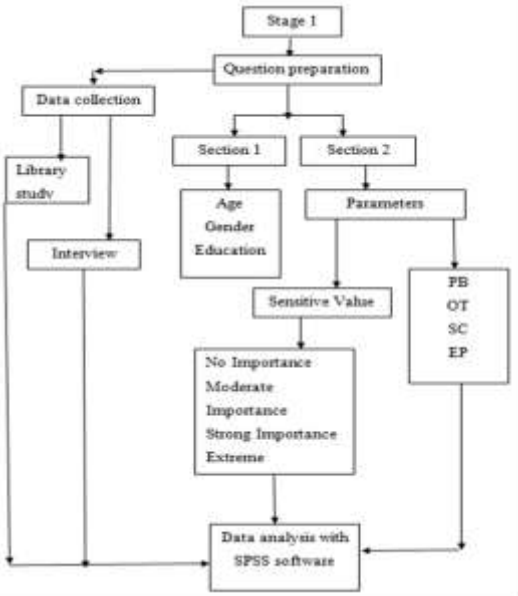


Fig. 2: Process of preparing the EPQ (PB = physical and biological, OT = operational and technical, SC = sociological and cultural, EP = economic and political)

The questionnaires are then used to developed criteria and choose the environmental parameters. A set of questionnaires required the respondents to respond by choosing answers from a scale of 1 to 4, usually in terms of agreement or not with the given statements. Each scale from points 1 to 4 represents ranking. The important parameters were determined using the following scale: 1 = no importance, 2 = moderate importance, 3 = strong importance, and 4 = extreme importance. The EPQ study was divided into three sections as follows:

2.1.1. Environmental impactful parameters

The data collected was for the years 2010 to 2012. The research was carried out in Tehran Region 1. Using the question factor analysis method, the major criteria were selected and were in turn divided into four factors in the questions. The main parameters, physical and biological (PB), was selected for the environmental parameters of the metropolitan areas. The remaining three parameters, namely, operational and technical (OT), sociological and cultural (SC), and economic and political (EP), were also selected [9]. The environmentally important parameters were selected as follows:

a) Physical and biological parameters (PB)

The values of the physical, chemical, and biological parameters [10] represent an important monitoring tool for the ecological status and the urban quality, including non-renewable natural resources and degradation of the environment in the metropolitan areas through pollution. It also includes surface water, groundwater, air quality, temperature, noise, soil, topography, green space, flora, fauna, protected areas, habitat, house sanitation, and sewage intrusion [11].

b) Operational and technical parameters (OT)

The impact of the OT environment on the efficiency of urban utilities modifying the operational environment in studies of performance measurement is very important. Technical and operational factors are given and the processes are designed for urban areas. The OT parameters include infrastructure, transport networks and traffic [12], industrial sites, military operations, gateways, military missions, sidewalks, and pedestrian bridges [13].

c) Sociological and cultural parameters (SC)

This parameter includes all human aspects of the UE, including social subjects that affect the characters and the communities; while the cultural aspect includes heritage management and metropolitan development. It also encompasses population, facilities, partnership, partnership, expectations of citizens, stability of social behaviour, land use, sex, age, education, aesthetic and human resources, safety measures, culture and values, density of residential population, and religion [13].

d) Economic and political parameters (EP)

The EP consequences of environmental change in the metropolitan areas are qualitatively identified as temporary and permanent. The management difficulties of the projects are also inside the context of the activity project. It also includes occupation, property values, economic constraints, political involvement, standards, municipal laws, public policy, defense, decision-making structure, ownership of urban politics, exchange and currency, and taxes [14]

2.1.2. Questionnaires preparation

The questionnaire survey comprised of two sections, including the demographic information section and selected environmentally important parameters in the Tehran metropolitan area various parts of the questions have a space at the end for comments. For the purposes of this study, only four question tables specifically related to the evaluation of environmental parameters were investigated. The answers were given with scales ranging from no importance (1) to extreme importance (4) (Table 1). A sample of 150 people describes a population of 15 million with virtually the same degree of accuracy with 30 questions [15]. On this basis, given the tax-paying population in

Tehran metropolitan area, it was determined that somewhere between 110 and 150 respondents are usable responses for the 11 million population of Tehran desired for this study.

Table Error! No text of specified style in document.**1:** EPQ classification

Judgments (Oral Judgment)	Numerical Quantity
No importance	1
Moderate importance	2
Strong Importance	3
Extreme Importance	4

2.1.3 Application of SPSS software

This step provides the screening analysis of characteristics and the response rate of the participants. In this study, questionnaires were distributed to 300 respondents of the three groups, i.e. citizens, managers, and experts.

3. Results and Discussion

3.1. Environmental Impactful Parameters

In developing EPQ, seventy-one relevant environmental critical parameters were selected from the literature study based on their effects on metropolitan area as shown in Table 2.

Table 2: Relevant environmental parameters from literature study

Environmental parameters	Sub-parameters and Coding
Physical and Biological Parameters (PB	Surface water (PB1), Groundwater (PB2), Air quality (PB3), Temperature (PB5), Noise (PB6), Soil (PB7), Topography (PB8), Green space (PB9), Fauna (PB9), Flora (PB10), Protected areas (PB11)
Operational and Technical Parameters (OT)	Infrastructure (OT1), Transport networks and traffic (OT2), Solid waste (OT3), Gateways (OT4), Power (OT5), Medical facilities (OT6), Organizations (OT7), Military operations (OT8), Military missions (OT9), Parking (OT10), Industrial sites (OT11), Sidewalks and pedestrian bridges (OT12
Sociological and Cultural Parameters (SC)	Population (SC1), Housing (SC2), Facilities (SC3), Food (SC4), Lifestyle (SC5), Schools and cultural services (SC6), Transport (SC7), Sense of community (SC8), Partnership (SC9), Local and national pride (SC10), All languages (SC11), Hospital and medical services (SC12), Sports clubs and services (SC13), Urban resort(SC14), Stress (SC15), Expectations of citizens (SC16), Freedom of choice (SC17), Stability of social behavior (SC18), Sex (SC19), Age (SC20), Land use (SC21), Education (SC22), Aesthetic and human resources (SC23), Safety measures (SC24), Density residential (SC25), Culture and values (SC26), National parks (SC27), Monuments (SC28), Religion (SC29
Economic and Political Parameters (EP)	Occupation (EP1), Opportunities (EP2), Services (EP3), Property values (EP4), Distribution patterns (EP5), Economic constraints (EP6), Political involvement (EP7), Tax (EP8), Standards (EP9), Administrative management (EP10), Municipal laws (EP11), Public policy (EP12), Legal restructuring (EP13), Defense (EP14), Requires the participation of civil (EP15), Decision-making structure (EP16), Ownership of urban political (EP17), Exchange and currency (EP18), Oil prices and subsidies (EP19)

3.2. Environmental parameters questionnaire (EPQ)

The feedback was obtained from 110 of the respondents (80 citizens, 11 managers, and 19 experts) out of 300 respondents from the Tehran metropolitan area selected for data analysis. Descriptive analysis of demographic characteristics of the participants was performed as demonstrated in Table 3, all respondents in this study were from Tehran Region 1.

Table 3: Frequency of EPQ participants

EPQ participants	Frequency	Percent	Cumulative Percent
Citizens	80	72.7	72.7
Managers	11	10.0	82.7
Experts	19	17.3	100.0
Total	110	100.0	

Table 4 describes the statistics based on gender and ethnic group of the respondents. The number of male participants is 46.4%, which is slightly less than the female participants (53.6%). This table demonstrated that 37.3% of the participants are between 31 and 40 years old. Table 3 demonstrates the distribution of EPQ respondents based on education. Bachelor and lower degrees have a great portion on the questionnaire survey.

Table 4: Error! No text of specified style in document. Distribution of EPQ participants according to age, gender, and education

EPQ participants		Frequency	Percent	Valid Percent	Cumulative Percent
Age	20-30	21	19.1	19.1	19.1
	31-40	41	37.3	37.3	56.4
	41-50	28	25.5	25.5	81.8
	Over 50	20	18.2	18.2	100.0
Gender	Male	51	46.4	46.4	46.4
	Female	59	53.6	53.6	100.0
Education	Bachelor	38	34.5	34.5	34.5
	Master	28	25.5	25.5	60.0
	Ph.D.	16	14.5	14.5	74.5
	Others	28	25.5	25.5	100.0

3.3. EPQ for environmental impactful parameters

This step is to calculate and evaluate the differences in values in choosing the important parameters before employing any Environmental Assessment tool. This will ensure removal of minimal or weak environmental impacts. Thus, by screening the positive factors and reducing the negative factors, precise environmental assessment is obtained. The goal of this stage is to focus on the analyses of the research questions and provide clarifications.

Table 5: Feedback from EPQ respondents

EPQ participants	Intensity of importance	Colors	Valid Percent
Citizens	1	Blue	72.7
Managers	2	Red	10.0
Experts	3	Green	17.3

Table 5 shows feedback from the three groups of respondents with a total of 110 (80 citizens, 11 managers, and 19 experts) Respondents are assigned with colors range for easy identification in the software analysis. The intensity importance for citizen is a single rating. While the intensity importance for manager respondents is double rating and the expert respondents considered as triple rating.

3.3.1. Physical and biological parameter (PB)

There are four parameters in this study, one of which is PB. This parameter has 11 sub-parameters. Each sub-parameter has been coded for easy analysis of the software system. These parameters were given a score by the respondents (citizen, manager, and expert), and the results were obtained. According to the EPQ questionnaire survey on PB, three parameters, including air quality (PB3), noise (PB5), and green space (PB8), are suggested by citizens, managers, and experts. The values are 3.48, 3.15, and 3.39 for PB3, PB5, and PB8, respectively. The three parameters are more important than the other PB parameters, which are considered to have "strong importance" for the increase or decrease of pollution in Tehran Region 1. Consequently, air quality (PB3 = 3.48), noise (PB5 = 3.15), and green space (PB8 = 3.39) are selected as the strongest environmental parameter predictor for Tehran Region 1 (Figure 3).

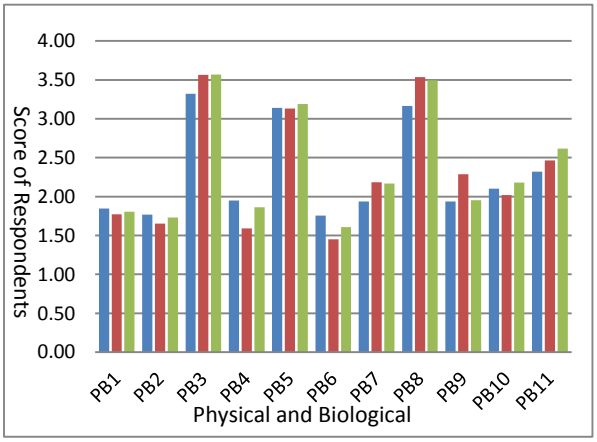


Fig. 3: Evaluation of EPQ participants according to PB (Citizens = Blue, Managers = Red, Experts = Green)

3.3.2. Operational and technical parameters (OT)

Seven OT parameters from the main parameters were selected, which are considered to have "strong importance" in Tehran Region 1. The results of the evaluation from the respondents vary (Figure 4) such that "strong importance" indicated that infrastructure OT1= 3.36, solid waste OT3 = 3.36, organizations OT7 = 3.27, military operations OT8 = 3.27, car parking OT10 = 3.18, and industrial sites OT11 = 3.45, were selected by the managers. On the other hand, transport networks and traffic OT2 = 3.21, solid waste OT3 = 3.36, car parking OT10 = 3.18, and industrial sites OT11 = 3.45 were selected by the experts as "strong importance".

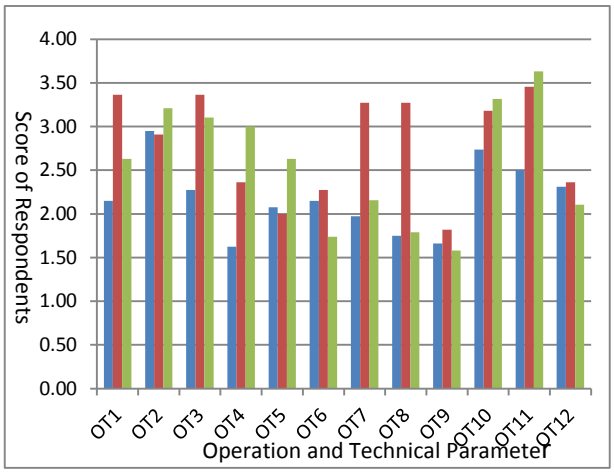


Fig. 4: Evaluation of EPQ participants according to OT (Citizens = Blue, Managers = Red, Experts = Green)

3.3.3. Sociological and cultural parameter (SC)

SC parameters (Figure 5) were the most significant variables to indirectly pollute the urban environment. The parameters population (SC1) = 3.22, housing (SC2) = 3.05, lifestyle (SC5) = 2.29, partnership (SC9) = 2.56, stability of social behaviour (SC18) = 2.31, age (SC20) = 2.61, residential density (SC25) = 2.60, cultural values (SC26) = 2.02, and religion (SC29) = 2.61 affect the urban environment in Tehran Region 1. All the values were obtained from software analysis. In this study, nine parameters for SC with higher values were selected.

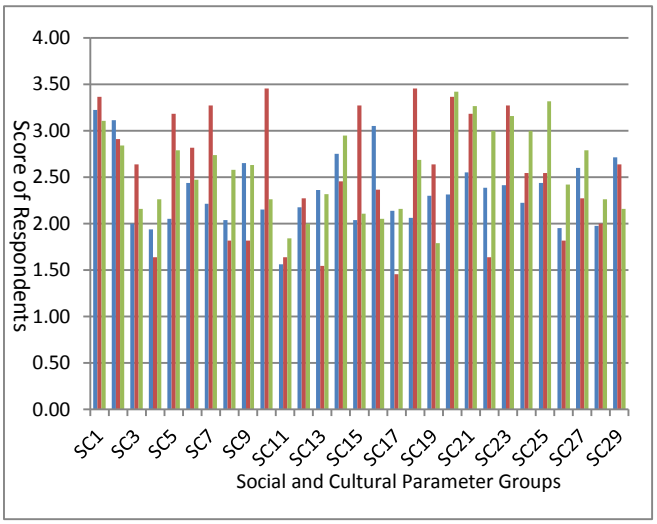


Fig. 5: Evaluation of EPQ participants according to SC (Citizens = Blue, Managers = Red, Experts = Green)

3.3.4. Economy and politic parameters (EP)

For the analysis of the EP parameters, four parameters, including municipal laws (EP11) = 2.75, urban participation requirement (EP15) = 2.77, decision-making structure (EP16) = 3.15, and ownership that relate to urban politics (EP17) = 2.93 were selected by the respondents as ranking between "moderate importance" and "strong importance".

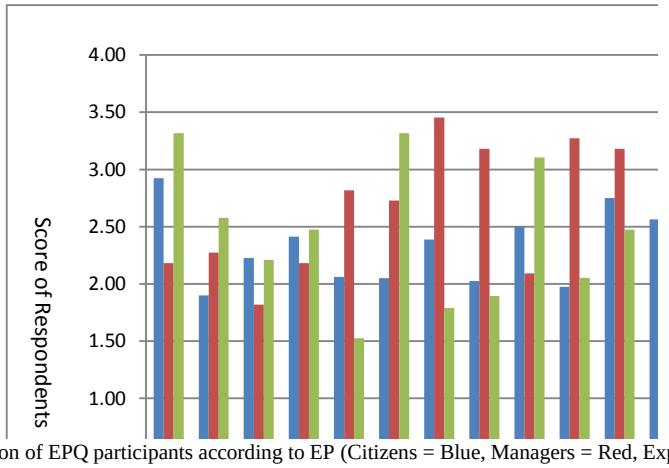


Fig. 6: Evaluation of EPQ participants according to EP (Citizens = Blue, Managers = Red, Experts = Green)

From Figure 6, four parameters were selected as more important by the managers. The results of this stage selected the important parameters. Environmental parameters were selected based on their metropolitan effect as a result of the SPSS analysis.

3.3.5. Overall selection of environmentally impactful parameters for metropolis (SEIPM)

A total of 23 environmental parameters are selected based on their effects on the metropolitan area as a result of the SPSS analysis. These parameters comprised of 3 physical and biological (PB) parameters, 7 operational and technical (OT) parameters, 9 sociological and cultural parameters, and finally, there are 4 economic and political (EP) parameters (Table 6).

Table 6: Selected environmental impactful parameters

Environmental parameters	Sub-parameters and Coding
Physical and Biological Parameters (PB)	Air quality (PB3), Temperature (PB5), Topography (PB8)
Operational and Technical Parameters (OT)	Infrastructure (OT1), Transport networks and traffic (OT2), Solid waste (OT3), Organizations (OT7), Military operations (OT8), Parking (OT10), Industrial sites (OT11)
Sociological and Cultural Parameters (SC)	Population (SC1), Housing (SC2), Lifestyle (SC5), Partnership (SC9), Stability of social behaviour (SC18), Age (SC20), Density residential (SC25), Culture and values (SC26), Religion (SC29)
Economic and Political Parameters (EP)	Municipal laws (EP11), Requires the participation of civil (EP15), Decision-making structure (EP16), Ownership of urban political (EP17)

3. Conclusion

An integrated feedback inter-community system in a metropolitan area was applied to specifically minimize pollution by managing the power of the connection efforts between three groups of people, i.e. the citizens, managers and experts. The main advantage of this study is inclusivity of public participation in a timely manner to identify the most impactful environmental parameters for an environmental assessment process. In developing environmental parameters questionnaire, 71 environmental impactful parameters were taken from the literature study based on their effects on metropolitan area. Questionnaires survey was then distributed to respondents from the three groups. From the result of the SPSS analysis, a total of 23 environmental parameters are selected based on the intensity of importance made by the respondents on the environmental impactful parameters. Thus, the values obtained can aid in choosing the environmental impactful parameters before employing any environmental assessment tool to remove weak environmental impacts. By screening the positive factors and reducing the negative factors, precise environmental assessment is then can be made and thus, reducing the time required for decision making.

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