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Secondary data-associated challenges for environmental assessment in developing countries; case of Egypt

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Abstract

Assessing environmental major development projects requires using advanced levels of environmental secondary data (ESD). This is particularly challenging in developing countries. Hence, a systemic literature review was performed. Along with structured interviews and online questionnaire designed for professional planners and researchers were used to investigate the factors affecting secondary data collection and processing for environmental assessment systems in Egypt as an example of developing countries revealing potentials and challenges. The results pinpointed critical problems for ESD associated with poor sufficiency, availability, relevance, and accuracy of data. Thus, using these four defined criteria, an assessment framework was developed to evaluate the status of ESD for development projects. This provides guidelines for establishing an integrated data collection and management system to support the environmental assessment process. This is further applied to 'Elqattara depression national development project' to investigate the environmental impact of various desalination development scenarios. This case study project pinpointed problems for the ESD used related to both relevance and sufficiency.

Keywords: Environmental secondary data; Environmental data sharing; Assessment of Environmental Secondary Data; Qattara Depression.

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1. Introduction

The goal of the environmental assessment process is to give a thorough explanation of how the building, project, strategy, or policy will affect the environment (Partidário, 2000). It is a methodical practice of identifying, predicting, evaluating, and mitigating the potential impacts resulting from a proposed project or activity to its surrounding environment (Greenhoot and Dowsett, 2012). On this subject, environmental assessment studies is considered mandatory for mega construction projects that may disturb natural ecosystem, energy, surrounding land site, water, raw materials, as well as potential pollution causes like emissions and waste production (SWERI, 2011). This necessitates the existence of an efficient data collection and processing system (Ortiz, Castells and Sonnemann, 2009; Morgan, 2012; Momtaz and Kabir, 2013). The data needed should help assess the current present situation and future-what-if scenarios after project development. Hence, the data should include extended time frame and the database should be context oriented to analyse climatic and microclimatic conditions. Nevertheless, The UNESCO highlighted problems associated with the environmental secondary data (ESD) collection in developing countries in terms of limited availability, relevance, accuracy and sufficiency of data (UNESCO, 2009). This is coupled with the poor influence of environmental institutions and environmental-related directives (Salheen and El Khateeb, 2010). In light of this, this paper examines the advantages and difficulties associated with the collection and processing of environmental secondary data (ESD) for large-scale construction projects in developing nations, including Egypt. Accordingly, this paper examines the advantages and difficulties associated with the collection and processing of environmental secondary data (ESD) for large-scale construction projects in developing nations, including Egypt. Hence, the study performs a qualitative research method including designed questionnaires and structured interviews among local planning professionals and researchers to investigate critical aspects for ESD shown by the literature. Furthermore, the study investigates the environmental impact of various desalination development scenarios of a major construction case study project ‘Elqattara depression’. Hence, this study recommends establishing a data collection and management system which would make use of cumulative and additive benefits of operating under a consistent integrated environmental assessment framework. Key concepts and definitions include defining environmental data, environmental data sharing and environmental secondary use of data.

2. Literature review

The search for ESD according to Scopus indexed scholarly output for the past years (2018-2022) revealed a total of 137 publications. Common keywords include sustainable development, environmental impact assessment, life cycle, environmental impact and environmental management. These were analyzed in terms of trends in publication years, countries, Scopus sources, subject areas, active institutions and publication types as shown in Fig. (1). It is noted that Italy comes as the first country with publication output (19 publications); this indicates its robust environmental laws and legislations, followed by the United States (17 publications), then both China and the United Kingdom (16 publications each) and then Brazil (10 publications). The number of publications is almost steady with a slight increase observed in 2022 (31 publications); these are mostly journal articles (81 publications) followed by conference papers (41 publications). The most active Scopus source

is the Journal of Cleaner Production (28 publications); bringing together an array of multidisciplinary sciences in the field of engineering (136 publications), environmental science (55 publications), energy (44 publications), business, management and accounting (41 publications) as well as computer science (16 publications). The most active institutions are the university of Parma in Italy (5 publications), KU Leuven in Belgium (3 publications), University of Johannesburg in South Africa (3 publications), National University of Singapore (2 publications) and Universiti Teknologi Malaysia (2 publications). This indicates an accelerating research in the last 5 years, nevertheless, the share of MENA region countries does not exceed 3% of scholarly contributions.

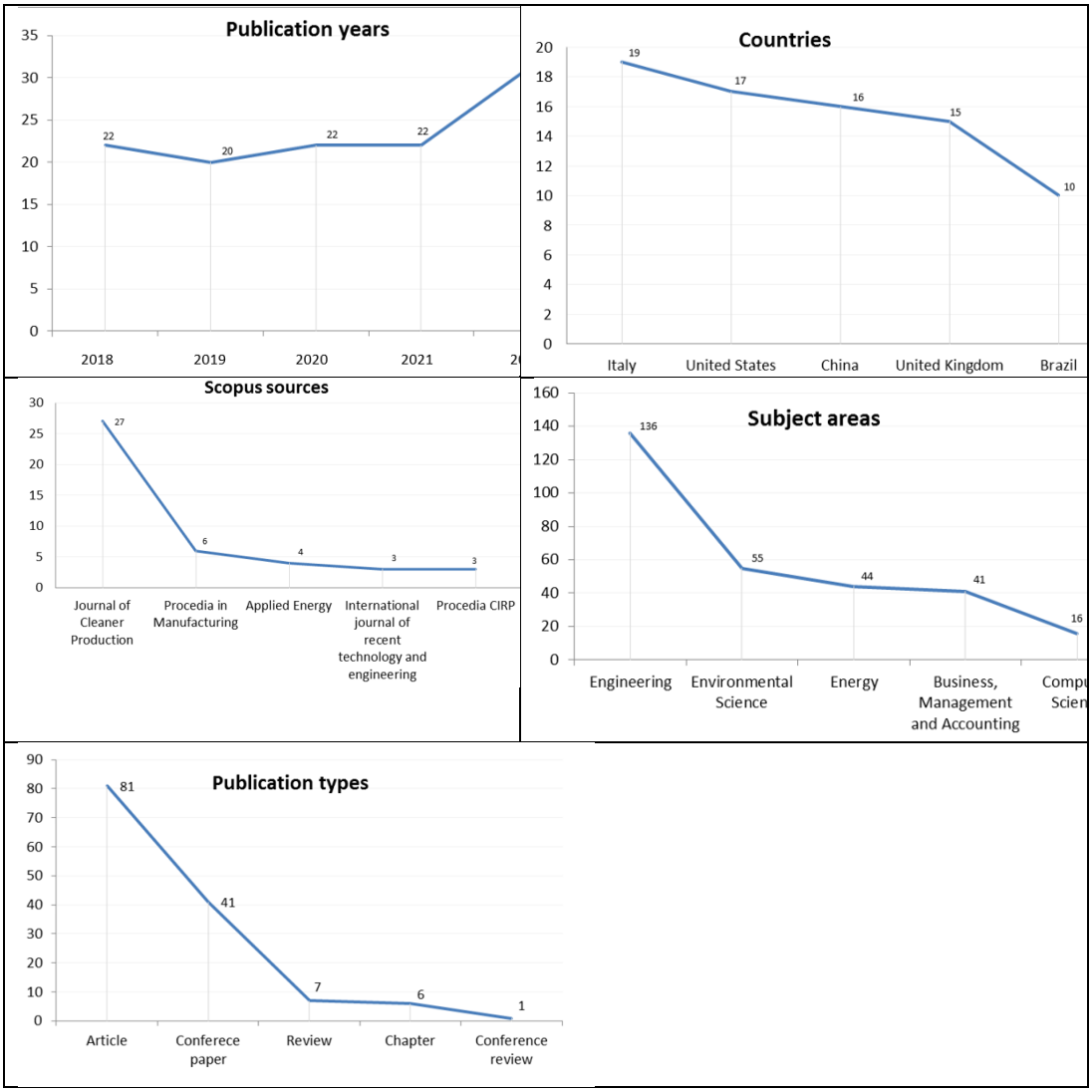

Fig. 1. Recorded publications for ESD, Scopus directory of research publications, last updated 20 November 2022, and exported 26 November 2022

2.1. Secondary data for environmental assessment

Secondary data includes sources other than primarily collected by the main group of researchers (Church, 2002; Vartanian, 2011). Environmental secondary data analysis has several different definitions in the literature, many of which have little differences, which collectively imply that there is no agreement on what is meant by this term. For instance, a simple definition of the environmental secondary analysis was stated by Núñez Reiz, Armengol de la Hoz and Sánchez García, 2019 as the gathering of environmental data for different projects and topics other than those that the rely on the environmental analysis and surveys (Rajagopal, Priya and Senthil, 2023). Other researchers defined environmental secondary data by emphasizing on its effectiveness for determining new research questions. Silva Martins (2018) added that environmental secondary data is used for the study of particular issues through analysis of already-existing data that were initially gathered for another purpose or through additional analysis of an existing dataset to address a research question other than the one for which it was initially gathered, leading to novel contributions and conclusions (Rajagopal, Priya and Senthil, 2023). However, the potential of secondary analysis in the context of the environment, which can reanalyse existing environmental information with theoretical approaches or fresh statistical methods, seems to be overlooked by all of the aforementioned classifications. Secondary data analysis in this context refers to the reanalysis of data with the aim of addressing the research questions using the same data that was previously used for other research purposes. (Núñez Reiz, Armengol de la Hoz and Sánchez García, 2019). Yet there appears to be general agreement among those seeking a definition of environmental secondary analysis that it should include the study of data that has already been collected by another researcher and is open to further investigation (Li and Wang, 2022). Other professionals and researchers highlight the environmental secondary analysis's ubiquity as a set of research endeavours that make use of existing resources rather than a particular regime of analytical techniques or statistical technique (Nault et al., 2020). Nevertheless, other researchers point out how environmental secondary data analysis requires the use of innovative analytical techniques to data that has already been obtained by others, which distinguishes it from primary data analysis, which involves both data collection and examination (Li and Wang, 2022). Regardless the definition used, secondary data analysis should involve conducting empirical research on previously acquired or prepared data (Generowicz et al., 2022). This could involve the use of unique or novel research topics, statistical techniques, and theoretical frameworks, and it might be carried out by the first researcher or somebody else entirely.

The ESD includes the information gathered by governmental institutions, censuses, organizational data and records (vital registration systems, libraries or internet searches, Global Positioning System (GPS), remote sensing and km progress reports, case studies and literature reviews) (Elsayed and Ismaeel, 2019). ESD analysis is cost-efficient and time-saving; hence, it is mostly used for quantitative-based research and environmental analysis (Hogan, 2005;). Associated challenges are related to data accuracy, accessibility, availability, reliability, validity, update and irrelevance references (Hogan, 2005; Vartanian, 2011; Silva Martins, 2018; Núñez Reiz, Armengol de la Hoz and Sánchez García, 2019). This is in addition to the difficulty to have free access for administrative data in developing countries (Hogan, 2005). The problem escalates with the lack of a systematic process for data collection. Nevertheless, it is encouraging to note that ESD is becoming a common concern to facilitate

more advanced environmental assessment process (Church, 2002; Vartanian, 2011; Greenhoot and Dowsett, 2012b). It can comprise data from systematic reviews, results from documentary analysis, and findings from huge datasets, among a wide range of other empirical forms. Environmental data can be described in a variety of ways, including their format (numerical or non-numeric), how the methods used to produce or collect them (simulation, observation, or experiment), their quality level , the size or organisation of the databases that hold them, and the sort of assistance (private or public, local or global) that was employed (Jensen, Gutierrez and Pedersen, 2014).

2.2. Environmental Data Sharing

Environmental data sharing is a way of ensuring that everyone can have acces s to the environmental data they need (Yeo and Yee, 2014). It's a way of getting data in the hands of those who need it most, and making sure that everyone has access to it. It can be shared after querying the requester from the passive to active stages where data can be shared. ESD is the ideal augmentation of mixed method approaches (de Barros, Ezzedine and Rubin, 2012; Huertas-Olivares and Norris, 2013).There are lot of benefits accredited to Environmental data sharing, in addition to the political, legal, social demands, and scientific, that have in return lead to different mechanisms of sharing data. For Example electronic data archives, digital libraries, national and international Environmental initiatives that rely on on data access of both private and governmental institutions (Huertas-Olivares and Norris, 2013).

ESD used in national projects depend mainly on the technical mechanism of data sharing. This mechanism includes data organization, importing and exporting data across multiple technological platforms (STDF 2011; Abel, 2004). The common methods of describing data and transferring it across many systems are necessary for sharing ESD. Reused data must be accessible in a format that can be traded, altered, and described in a way that makes sense to a secondary user (Silva Martins, 2018). The cost of making ESD accessible through the aforementioned mechanisms is high, and almost all data sharing agreed that there are significant expenses associated with maintaining and preparing data for secondary use (Greenhoot and Dowsett, 2012a). Many of these debates also mention the expenses incurred by both the consumer and the data source, such as the time needed to fully comprehend and utilise the data. The provider's primary costs are those associated with organising, maintaining, and supporting the use of data (Laxmi Ramasubramanian, 2017).

Furthermore, previous researches encountered some challenges that may face the secondary data users' as follows; unreliable internet access, low rates of response, unreachable physical locations of environmental organizations, legal and political restrictions, financial and time management challenges, cultural and religious barriers, poor telecommunication networks, transport networks, lack of administrative and political support for self-directed research, and unorganized secondary data (Jensen, Gutierrez and Pedersen, 2014; Laxmi Ramasubramanian, 2017).

The sharing of ESD is regarded as a crucial and necessary procedure despite all the challenges, including the high costs that enables agencies and organizations to work together as well as the researchers to help them make informed decisions. Sharing ESD improves the collaboration between different organization and researchers (Núñez Reiz, Armengol de la

Hoz and Sánchez García, 2019). It increases the productivity of reliable scientific researchers, enables accurate and better decision making. Benefits for the ESD includes reinforcing its open inquiry, increasing its accuracy & availability (Núñez Reiz, Armengol de la Hoz and Sánchez García, 2019). It also provides verification, refutation, of original results for ESD and promotes new researches through using existing data. Further, it improves the measurement and data collection methods of ESD and develop the theoretical knowledge and analytical technique of ESD (Waters, 2002). Multiple perspectives of other secondary data are also encouraged besides the environmental ones. Additionally, it promotes the use of more appropriate empirical data in the creation and evaluation of policies and offers organisations and researchers relevant and adequate ESD (Silva Martins, 2018).

The use of secondary data makes a lot of promises. Because it enables data to be analysed and replicated from various perspectives, access to data on a scale that researchers could not hope to replicate first hand, technical expertise involved in developing good surveys and good datasets, and data of the highest quality, it can present opportunities for the discovery of serendipitous relationships not taken into account in the primary research. (Maantay, Ziegler and Pickles, 2006; Yeo and Yee, 2014). Because it would be erroneous to suppose that all secondary data is error-free, it should be highlighted that all data are likely to include errors. Based on (Hogan, 2005; Vartanian, 2011; Silva Martins, 2018; Núñez Reiz, Armengol de la Hoz and Sánchez García, 2019) four main important factors are required to evaluate the secondary data which are the Accuracy, availability, relevance and sufficiency.

Environmental and Agency, 2002 defined ESD collection technique is only beneficial if it is done by qualified researchers. Ministries, 2007 stated that even an experienced researcher may find the size of the data to be overwhelming. Ismaeel and El-Sayed, 2018 claimed that if the researcher is using data where he had no control over in the gathering procedure, so there is a concern with data accuracy. Furthermore Therivel, 2004 stated that the sources of the data could not be related to the research issue.

2.3. The status of environmental secondary data in developing countries, case of Egypt

In developing countries, secondary data gathering technique in environmental research is facing many critics (Hogan, 2005). It should only be used by researchers with substantial experience, according to one of the primary critiques. ESD analysis is nevertheless a helpful data collection technique for all types of research, not just in the environmental sciences, despite these drawbacks. (Silva Martins, 2018).

There are many sources of data used for ESD in developing countries. The source mainly depend on the type and focus of the research (Waters, 2002; Dragićević, Lai and Balram, 2015; Yeo and Yee, 2016). Statistics provided by the relevant governmental or non-governmental organisations are used in research aimed at understanding the causes of environmental changes. (Ortiz, Castells and Sonnemann, 2009). National survey research organisations are another source of ESD. These organisations' data collection efforts typically result in sources of ESD that are adequate, accurate, and relevant (Reform, 20017). Another perfect example in Africa where secondary data are used to offer clues for constructing mega projects. Census data is a valuable source of ESD (Reform, 20017), The majority of

environmental researchers undertake both strategic and environmental impact assessment studies using census data to investigate how development projects affect the environment.

Another important source where developing countries depend on is the scholarly journals, which are reliable source of ESD (Reform, 20017). They include information from original studies conducted by environmental specialists. According to Seale (2004), journal data is valuable since it is reliable and accurate. Data is credible since it has undergone peer review before being published in journals (Elsayed and Ismaeel, 2019). Additional sources for secondary data analysis include reference books, trade publications, and technical studies.

For conceptual and substantive reasons, the use of ESD is regarded as one of the most significant sources that researchers in developing nations use, as secondary data may be the only data accessible for some research topics (El-Sayed, 2017). Methodological explanations are then given because ESD offers chances for replication. This is crucial for research since findings that emerge in several studies give them more credence (Javadian, Shamskooshki and Momeni, 2011). The cost of collecting primary research data and the difficulty in obtaining finance are the final two justifications. Given the high expense and effort required to obtain primary data, researchers will opt for a less expensive and time-consuming strategy (Mason-Jones D.R., R., & Towill. (2017). Quantitative analysis of Six Sigma et al., 2012). Even when ESD is accurate, readily available, pertinent, and sufficient, researchers in developing countries greatly benefit from using the secondary data analysis. The researcher must be aware of these shortcomings and devise solutions to them. (Georgy and Soliman, 2007). It is possible to lessen the risks provided by the shortcomings through careful consideration to the relevant data-availability, accuracy, and sufficiency issues prior to data collection.

In Egypt, there are some national institutions responsible for archiving and developing secondary data required for environmental assessment. The Housing and Building National Research Center (HBRC) develops building codes and specifications, activities related to research about building materials and products as well as managing quality control and constructions permissions (GOPP, 2017), the Egyptian Environmental Affairs Agency (EEAA) regulates the application of the EIA in support of the Competent Authorities (CAs) and district/city level units (EMU) (EEAA, 1982; Environment, 2015; Saied El Sharkawy, 2017).

The EEAA, GOPP, is an outstanding repository of qualitative data that has been archived and offers enormous potential for environmental secondary research in Egypt. Governmental environmental organisations provide access to in-depth and semi-structured interviews, field notes and observations, personal records, and other data sources (GOPP, 2017). The range of information that is suitable for environmental secondary analysis includes impacts on land use and terrestrial ecosystems, marine life, natural disasters and casualties, biodiversity loss, and hydrogeological environmental impacts (Salim and Elbeih, 2009; Elsayed and Ismaeel, 2019).

3. Method

The research method adopts a mixed approach related methodology through a series of designed questionnaires and structured interviews carried for a period of six months; April 2022 – October 2022. These were carried out on a sample of 150 practitioners-working in national institutions in Egypt (EEAA, HBRC, CAs, EMU and GOPP). This is in addition to a number of academics and researchers who were chosen based on a purposive sampling technique and snowball sampling due to their rich experience and track record of relevant work in the field. This investigation aimed at assessing a number of criteria for evaluating the ESD for environmental assessment in the local context. Based on the previous literature review, four criteria were indicated as follows;

- Availability of the ESD or else primary data is used.
- Relevance; considering consistent measurement and functional unit, benchmarking base and the existence of updated data.
- Accuracy of data addressing the specification and methodology used; this should determine the marginal error and reliability of sources used for assessment.
- Sufficiency considering the adequacy of available data to suit the aim and scope of the study.

Table (1) shows the deducted indicators for the reliable ESD

	Accuracy	**Availability**	**Relevance**	**Sufficiency**
Deducted Standards	50%	82%	90%	75%

As a prior step for the research method, the interviewees were asked to determine a score-weighting percentage for the importance of the aforementioned criteria. The majority (84%) stated that they are not equally important. Then they were presented the questionnaire which was designed as a Likert scale of 1-5 balanced responses and a neutral midpoint. Then, a score-based percentage was applied following the work of (Chew and Das, 2008). Accordingly, an evaluation matrix is developed to indicate practitioners' point of view in terms of the potentials and challenges of acquiring and using the ESD in Egypt as follows;

- Less than 20% indicated poor evaluation; many existing challenges which may hinder the entire environmental assessment process
- 20-40% showed limited evaluation; challenges should be defined and overcome to be able to streamline the assessment process
- 40-60% pointed out average evaluation; ESD status is developing to overcome existing challenges
- 60-80% indicated good evaluation; the environmental assessment process can be carried out with good status of ESD
- More than 80% showed very good evaluation; the environmental assessment process can be conducted systemically and yield reliable results

The following table (2) shows the aforementioned deducted indicators for the reliable ESD that have been concluded from the literature review and the structured interviews with the professionals to be applied on the Qattara Case study to be able to evaluate the secondary data

used in this project. The criteria in each indicator is scored by either 2 or 1, where "2" refers to high quality, accessibility, availability, and sufficiency of data. However, "1" refers to moderate and low quality, accessibility, availability, and sufficiency of data.

Table (2) shows the deducted indicators for the reliable ESD

Assessment of ESD		
Availability		
A	Accessibility	
	Available for free on the internet	2
	Accessible for free through governmental organization (GOPP, EEAA, EMU, ECT…)	2
	Available with certain cost through governmental organization (GOPP, EEAA, EMU, ECT…)	1
B	Data format	
	For use with computer software to help with data organising, coding, and analysis, available in digital format.	2
	Available as hard copy	1
C	Source of data	
	Environmental data sets include information gathered from a single source.	1
	Environmental data sets include information gathered from variety of sources	2
D	Data ready for direct use	
	Availability of the most appropriate environmental data sets once chosen, contains key information.	2
	Availability of the most appropriate environmental data sets once chosen, needs analysis to extract data	1
E	Data editing	
	Data access enables editing and controlling ESD	2
	Data access is restricted to viewing data solely	1
Relevance		
A	Context	
	Proximity to the area of interest generates reliable results	2
	Far from the area of interest needs further analysis to get reliable results	1
B	Scope	
	Scope-oriented to the aims of the study	2
	Scope-oriented to the objectives of the study	2
C	System boundary	
	Within system boundary inputs and outputs	2
	Outside system boundary inputs and outputs	1
D	Basic data covered	
	Basic categories of information covered	2
	Requires further data collection and investigation	1
E	Time-span	
	Relevant temporal track record of data set	2
	Non relevant temporal track record of data set provides insights to transform to further prediction analysis	1
F	Unit of analysis	
	Directly use relevant Unit of analysis	2
	Unit of analysis requires analytical transformation to the relevant unit	1
G	Sample size	
	Relevant sample size to generate data set	2
	Sample size not relevant to generate data set require further investigation	1
H	Coordinate system	
	Using relevant Egyptian coordinate system	2

	Using relevant global coordinate system	2
I	Database	
	Cross-sectional database	2
	Longitudinal database	2
Accuracy		
A	Temporal	
	Recent no later than 10 years ago	2
	Later than 10 years	1
B	Data coding	
	Non-coded digital datasets or coded with terms of reference	2
	Coded digital datasets without terms of reference	1
C	Data source	
	Data sets include information gathered from variety of sources and accurate citation	2
	Data sets include information gathered from a single source and accurate citation	1
D	Types of variables	
	Data includes dependent variables	2
	Data includes independent variables	1
E	Data perpetuation	
	Potential of following-up with data collection and analysis	2
	Following up with data collection and analysis is not possible	1
F	Data authorization	
	No authorization required	2
	Require authorization to obtain and share data e.g. national security or political concerns	1
G	Dealing with clean database	
	Clean database with minor assumptions	2
	Database with major assumptions and significant percentage of error	1
H	Objectivity of information	
	Unbiased information	2
	Biased information obtained from sponsors with particular agendas	1
Sufficiency		
A	Quality of acquired data	
	Having enough data for organizing, coding and performing the required analysis	2
	Insufficiency of data	1
B	Quantity of acquired data	
	Having enough data for organizing, coding and performing the required analysis	2
	Insufficiency of data	1
C	Data generalization	
	Possibility to generalize obtained results	2
	Results are specific and cannot be generalized	1
D	Data replication	
	Possibility to replicate obtained results in other contexts and timeframes of policy changes	2
	Results are specific and cannot be replication in other contexts and timeframes of policy changes	1
E	Data interpretation	
	Data can be transformed into useful information	2
	Data is insufficient to create useful information	1

3.1 Application on a case study of Elqattara project

EIA study has been conducted for the Qattara site using GIS environmental secondary database. Based on the aforementioned table, the secondary data used in this study will be evaluated to assess the ESD used in this project. The following table (3) is filled out by "1" and "0", where "1" means that the data in this feature class met the fore mentioned criteria in the previous table and "0" means that it doesn't meet the criteria

Table (3) shows the evaluation of the ESD used in Qattara Project

	Accuracy	A	B	C	D	E	F	G	H	total
Loss of biodiversity	endangered species & protected areas	1	1	1	0	0	1	1	1	6/8
	migratory birds	0	1	0	0	0	1	0	1	3/8
										9/16 56%
The hydrogeological environmental impact	Aquifers' productivity	1	1	1	1	0	0	1	1	6/8
	Top and bottom water level	1	1	1	1	0	0	1	1	6/8
										12/16 75%
The land use and the terrestrial impact	Lithology type	1	1	1	1	0	1	1	1	7/8
	Land use map	1	1	1	1	0	1	1	1	7/8
										14/16 87%
The impacts on the marine life	Intake point	1	0	0	0	0	1	1	1	4/8
	Marine life, natural habitat & local fishing activities	1	1	1	1	0	1	1	1	7/8
										11/16 68%
Natural disasters' effects and casualties	Fault lines	1	1	1	1	0	0	1	1	6/8
	Earthquakes' epicenters	1	1	1	1	0	0	1	1	6/8
Total										12/16 75%

Verification on a case study project in Egypt to verify findings and investigate the marginal difference between the value characteristics of data as investigated and on specific case study

- Total accuracy of this data was 72%
- The same process was repeated for other characteristics as follows;
- Availability 88%

- Relevance 85%
- Sufficiency 56%

The following table (4) and figure (2) shows the comparison between the deducted standards and the ESD used in the Qattara Project.

Table (4) shows the comparison between the deducted standards and the ESD used in the Qattara Project

	Accuracy	**Availability**	**Relevance**	**Sufficiency**
Deducted Standards	50%	82%	90%	75%
Data used in Project	72%	88%	85%	56%

Figure (2) shows the comparison between the deducted standards and the ESD used in the Qattara Project

4. Results

Based on a series of designed questionnaires and structured interviews, interviewees' responses were analysed to assess the ESD according to the four defined criteria shown in Table (1). It was found that the relevance of reliable ESD used for the environmental assessment level scored the highest percentage, followed by the availability, then sufficiency and finally the accuracy. Then, a cross-comparison was carried out for the four defined criteria of assessing ESD data

In Qattara Project, across the four defined criteria, data availability scored the highest place while noting that data could be available but not for free access and research use across the three levels of assessment. This was followed by the relevance of ESD data which scored the second highest percentage. This was owing to the consistent measurement and benchmarking held by the national organisations to assess the environmental impact of major construction projects. Data assumption made due to the limited sufficiency of resources and accordingly, this affected its accuracy. This is used to determine the marginal error for the data which does

not always reach up to the required level. The results show that the ESD standards used in Qattara project exceeds the deducted standards in both the accuracy and availability, while it scored less than the deducted standards in both the relevance and sufficiency.

Additionally, local practitioners indicated some concerns for the status of ESD. This included the need for experienced practitioners to integrate the array of multidisciplinary sciences. Engineering, environmental science, energy, business, management, and accounting, as well as computer science, were all covered in this. They also highlighted the role of the political contexts to secure free access to research sites and avoid political and legal restrictions. This is in addition to the poor appreciation of data importance, challenges for sharing data-particularly in public institutions, time management and financial challenges.

5. Discussion

This study pinpointed an urgent topic considering the quality of ESD through literature review and interviewing local researchers and practitioners. This discusses the benefits and challenges associated with secondary data management and processing for environmental assessment of major construction projects in Egypt. This is an increasing research trend with several publications in international peer-reviewed journals and several active institutions; nevertheless, the lack of research in the Arab region is noticed in spite of its active construction market. Extant literature was used to define the challenges associated with the environmental assessment. This included the poor influence of environmental institutions and environmental-related directives which added cost and time overhead to the project's budget. This is in addition to data-related challenges which were summarized into the following criteria: data availability, accuracy, reliability and sufficiency. Practitioners and researchers' opinions was used to develop a cross-comparison for the four defined criteria of assessing ESD data. In this regard, interviewees indicated challenges that faced the collection and processing of the ESD in the local context. The legal position determines the availability of local database. The status of implementation (whether mandatory or not) affects data availability. Institutional bodies (HBRC, EEAA, CAs, EMU and GOPP) This determines whether data is available for free access. Existence and access to review studies determines the reliability of data as well as results obtained and the quality of the review procedure. Access to undertaken projects' data describes success stories and case studies to promote more innovation in design and regional priority considerations. Quality of the review process provides the organisational, technical and legal frameworks. Determining the existing challenges facing the ESD draws directions for developing the required tools, expertise and accreditation as well as creating a communication channel with the required expertise. It also integrates multidisciplinary sciences.

This is a pioneer study considering the challenges for ESD data collection in developing countries as discussed by (Hogan, 2005). The interview design and language followed the work of (Hogan, 2005). It was also noted that a number of interviewees indicated regional experience; hence, the findings of this research can be replicated for other regional countries. This may also promote developing a common ESD database for environmental assessment and promote knowledge exchange. The findings of this study can be very useful to guarantee a high level of data integration through a consistent analytical interdisciplinary methodological framework as discussed by (Ismaeel and Elsayed, 2018). This is also

important to assess the environmental and social impacts for major construction projects in developing countries as previously discussed by (Elsayed and Ismaeel, 2019). This looks into the process' complexity and multidisciplinary character, encompassing engineering, environmental science, energy, business, management, and accounting, among other fields.

6. Conclusion

Data quality and completeness are a main concern to support the decision-making process. This is of main importance regarding environmental concerns noting that they mainly depend on secondary data which act as the key transition between primary sources on one hand and decision-makers' interpretations on the other hand. This creates a justified argument for the importance of this research. Hence, this study investigated the status of ESD in developing countries pointing out challenges associated with data acquisition and sharing which in turn jeopardize the quality of obtained ESD and create obstacles to carry further assessments.

Hence, the research defined four main criteria based on literature review which act as a pillar to assess ESD; accuracy, availability, relevance and sufficiency. The selection of these four criteria was validated using questionnaires and interviews. Further, sub criteria were defined for each criterion to enable developing a scoring checklist-based assessment system for the benefit of practitioners and researchers. Hence, these four criteria can act as a base to develop future management and assessment frameworks for sustainable projects. Based on a series of designed questionnaires and structured interviews, interviewees' responses were analysed to assess the ESD according to the four defined criteria. Then, a cross-comparison was carried out for the four defined criteria of assessing ESD data applied on a local case study for a major construction project. The case study application showed how to employ the defined criteria to assess the ESD obtained and stand on its drawbacks to be able to report findings in a transparent and consistent manner. This could be integrated as part of an Environmental Assessment report required by the Egyptian Environmental Affairs Agency.

Looking at the case study provided, it was noted that, data availability and sufficiency received the least score which indicated an urgent problem to address and acknowledge before carrying significant analysis. Nevertheless, practitioners indicated that they had to use data assumption due to the limited sufficiency of resources and accordingly, this affected its accuracy. Some of the data was more on a strategic level, hence, its accuracy and relevance were the highest concern to guarantee a robust decision-making process. Its sufficiency was dependent on other political institutions; nevertheless, detailed data was not available for free access due to political concern. Further data was provided for building materials and products based on national research database. This ensured a high level of accuracy followed with sufficiency due to the limited research projects carried in this regard but it was noted that in some cases the data was not publicly available. This is used to determine the marginal error for the data which does not always reach up to the required level.

These challenges should be considered and overcome upon planning for any major construction project. Accordingly, collaborated effort is needed on both the national and local levels; governmental and non-governmental organisations to create active channels between practitioners, researchers and academicians. In this regard, national institutions should put more effort into ESD through providing a wide platform for ESD to facilitate carrying environmental studies, and similarly, this shall enable adopting strategic environmental decisions. This is in addition to the need for experienced practitioners to integrate the array

of multidisciplinary sciences. Engineering, environmental science, energy, business, management, and accounting, as well as computer science, were all covered in this. They also highlighted the role of the political contexts to secure free access to research sites and avoid political and legal restrictions. This is in addition to effort to overcome the poor appreciation of data importance, challenges for sharing data-particularly in public institutions, time management and financial challenges. The research recommends creating a wide platform for environmental studies which accordingly shall streamline the process and enhance the accuracy and sufficiency of ESD for further levels of assessment.

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