Heliyon 8 (2022) e12438

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Evaluation of the quality of environmental impact statements in Ethiopia

Gizaw Ebissa [a,c,*], Utant Debebe [b,c], Hailu Worku [c], Aramde Fetene [c]

[a] Green Environment Consultancy Service, Ethiopia
[b] Ethiopian Civil Service University, Ethiopia
[c] Ethiopian Institute of Architecture, Building Construction and City Development, Addis Ababa University, Addis Ababa, Ethiopia

ARTICLE INFO

Keywords:
Addis Ababa
Environmental impact statement
Evaluation criteria
Quality of EIS

ABSTRACT

Environmental impact statement (EIS) is rarely assessed for its quality and thus, poses challenges for rectifying the compromised qualities at earlier time. The objective of the study was to evaluate the quality of the Environmental Impact Statement (EIS) submitted to Addis Ababa Environmental Protection and Green Development Commission (AAEPGDC) in year 2020 and 2021. The article has evaluated the quality of 16 EIS for the year 2020 and 15 for the year 2021 using the modified Lee and Colley review package. The findings revealed that each of the evaluation criteria has shown various degrees of qualities with overall assessment that falls under satisfactory score of 66% (sum of grade A-C). Impact identification & description, monitoring plan and project setting and description were the most described sections of the EIS while baseline assessment and establishment, scoping, alternate consideration were otherwise. Inadequate baseline description was found resulting in compromising impact prediction. Though adverse impact identification and description was the best dealt with section of the EIS, it overlooked describing how impacts affect receptors, undermined occupation health & safety and disregarded project affected people by luring them with job opportunity. In terms of magnitude, positive impacts were presented pretty well than adverse impacts. How long the duration of the impacts last were not dealt by 39%, as to whether the impact were reversible or not were not dealt by 42% and the extent of coverage of the impacts were not discussed by 39% of the reviewed EIS. Energy use was one of the least described EIS section (64.5% score) with gaps of failing to recommend renewable energy for best energy use practices. Comparisons of the EIS quality for 2020 and 2021 using Mann-Whitney U-test had shown that there was no quality difference between them. We thus, generally recommend multi-stage review processes at least every five years to enhance the overall quality of the EIS.

1. Introduction

Environmental impact assessment (EIA) is a proactive methodical process (Anifowose et al., 2016) that is in line with objectives of Brundtland Commission (Haile, 2012). It is employed to investigate and predict the potential impacts (direct, indirect and cumulative) of a proposed project activities on impact receptors (Rathoure, 2021; European Commission, 2017) and offers mitigation strategies through environmental impact statement, EIS (Rathoure, 2021; Swangjang and Cumkhett, 2021) from project initiation to decommissioning phases (Heister, 2021) before making decisions (Toprak and Anis, 2017).

EIS, produced as part of an EIA process, is a key document for reporting anticipated impacts of a project (Anifowose et al., 2016; Badr et al., 2011), its mitigation and management plan (Andolina et al., 2020). For a project financed by international development partners (e.g. African Development Bank, European Bank, the World Bank and others), submission of EIS is part of environmental due diligence and is a pre-requisite (Lawler and Milner, 2005 in: Anifowose et al., 2016) and is too for a project in Ethiopia both by government and private banks. Yet, some countries are exempting some projects (e.g. oil and gas) of even significant environmental and social impacts from submitting EIS (Eilperin, 2010; The National Commission, 2011) and thus compromise the net benefits of a project (Rathoure, 2021). Even when EIS is produced for a project, it either is of poor quality or is missing parts that must be included (Peris-Mora and Velasco, 2015) due to poor participation or only selected stakeholders in the EIS process. In Ethiopia, stakeholders

* Corresponding author.
E-mail address: gizawibsa@consultant.com (G. Ebissa).

https://doi.org/10.1016/j.heliyon.2022.e12438
Received 30 March 2022; Received in revised form 12 August 2022; Accepted 9 December 2022

participation in a project is enshrined in the Constitution of the 1995 and proclamation no. 299/2002. Once the EIS is submitted, it in most cases is not assessed or rarely assessed for their qualities (Cannaos and Onni, 2019; Kamjo, 2017) and thus, pose challenges for rectifying the compromised qualities (WWF-UK, 2005; Glasson et al., 1999).

Studies on the evaluation of the EIS show that results are not satisfactory (European Commission, 2009), are often incomplete (Backlund, 2009) and impaired with technical and scientific processes (Badr et al., 2011) and thus, undermine the principle of caution and prevention applied to protect the environment (Cannaos and Onni, 2019).

EIS quality evaluation is useful as it identifies strengths and weaknesses (Anifowose et al., 2016) so that gaps can be rectified earlier while strength reinforced (Wilson et al., 2017) or generally enables EIS improvement in quality over time (Anifowose et al., 2016). EIS quality evaluation is used to share best practices to encourage consulting firms as well as project proponents produce quality EIS (Wilson et al., 2017). EIS quality evaluation was also used as quality control within EIA systems (Lee and Colley, 1991 in: Anifowose et al., 2016; UNEP, 2002; European Commission, 2009) as there is a strong link between EIA process and EIS quality (Zhang et al., 2013).

Sustainable development is the central theme of a project or program which Ethiopia has envisioned of achieving it through enshrining it in the Constitution (FDRE, 1995), enacting environmental policy (FDRE, 1997) and promulgating proclamation (FDRE, 2002). Among the others, EIA proclamation number 299/2002 urges mandatory submission of EIS of a project or program that induces impacts (FDRE, 2002). However, projects both in Addis Ababa and other parts of the country have caused damage to the environment and the society even though subjected to EIA (Haile, 2012) may be due to the poor quality of the EIS produced or not implemented as recommended (Haile, 2012). Damtie and Bayou (2008), have indicated that the quality of EIS report is challenged by the capacity of those preparing the report while Gebreyesus et al. (2017) have reported accountability and transparency during implementation are challenges for the implementation of EIS reports. Following the poor performance of EIS, Anifowose et al. (2016) recommended the quality of EIS to be evaluated every 3–5 years where this is a gap in Ethiopia. Based on the recommendation of Anifowose et al. (2016), we initially planned to evaluate the EIS from year 2017–2021; however, data constraint made the authors to work on what was available. The objective of the study is, therefore, to evaluate the quality of the EIS submitted to AAEPGDC in year 2020 and 2021 to understand whether the quality of the EIS submitted brought the mentioned adverse environmental impacts in Addis Ababa or this attributes to other factors. Specific objectives include: (i) to evaluate the project setting with respect to activities description, input use and production process; (ii) to evaluate the impact characterization and prediction; (iii) to evaluate the monitoring plan and compare the EIS quality over years.

2. Materials and methods

2.1. Study area

The study was conducted in Addis Ababa which is the capital city of the Ethiopia (Figure 1). Ethiopia is located on a land of 1.1 million square kilometers in East Africa and is the seat of African Union, African Economic Commission, and other international and regional organizations. Ethiopia is the second most populous country in Africa with over 115 million people by 2022 with annual growth rate of 2.1% (Cheever et al., 2011). Ethiopia has legal frameworks (such as the 1995 Constitution, the 1997 Environmental Policy, EIA proclamation no. 299/2002) and institutional frameworks (Federal and Regional Environment Offices) to instigate stakeholders contribute their parts in protecting the environment and implement policies respectively.

Addis Ababa is the industrial hub of the country as one-third of this is located here and contributes 17.1 per cent to the national GDP and service provision and agriculture contributing 6.4 and 0.1% to the GDP respectively. In Addis Ababa, joblessness has widespread with over one in five currently remain unemployed (FDRE, 2018). Addis Ababa is characterized by sub-tropical highland climate (Koeppen, 1936) with the highest elevation of 2355 m at Entoto Mountains.

2.2. Selection of study EIS

A total of 104 documents submitted to AAEPGDC were permitted to be accessed which were categorized as EIS, Environmental Management Plan (EMP) and non-relevant (document found mixed with EIA and EMP as well as EIS of projects implemented outside of Addis Ababa). Accessed documents were categorized by year and we found a total of 3, 31 and 30 EIS for the year 2019, 2020 and 2021 respectively (Table 1). Data inadequacy for the year 2019 and absence for 2018 and the previous years was found as the limitation to the study.

2.3. Sampling method

A categorical random sampling technique was used which ensures the inclusion of all projects in the sample (Anifowose et al., 2016). Because the number of documents found for the year 2019 is substantially few compared to the other two years, this was excluded from the study as it is not possible to make inferences as well as comparisons even if the total population is considered for the study. After the EIS were categorized by year (2020 and 2021), a random sample size of 50% for each year was taken for the study.

Random sampling ensures equal opportunity of being selected (Acher et al., 2021). Random sampling is used when the EIS were not put in any specified order (Anifowose et al., 2016) so that top, middle and lower EIS repository were picked (Anifowose et al., 2016).

We identified a total of 12 project types for year the 2020 and 10 types for the 2021 where 4 project types found falling in both years (Table 2).

2.4. Method of data analysis

There are several EIS quality evaluation methods (Table 3)which include the Lee and Colley review package, the European Commission Guidelines on EIS review, the Oxford-Brookes University EIS review package, the Guide to Technical Analysis of Environmental Impact Studies, cost-effective analysis method and cost-benefit analysis method (Machaka, 2020). Of these, the Lee and Colley review package is probably the most widely applied globally and consists of multiple criteria (Sandham et al., 2020). The Lee and Colley review package is a compressive as well as robust method (Anifowose et al., 2016) which enables it takes advantage for its prominent use over the others. Table 4 summarizes published manuscripts that evaluated EIS of different projects using different review methods.

For this study, the modified Lee and Colley review package that designates grades from A-F (Sandham et al., 2020) based on how the criteria of EIS evaluations performed was used (Table 5). According to the modified Lee and Colley review package, grade A–C falls under satisfactory score while D–F under unsatisfactory (Table 6). The data generated from the EIS using Lee and Colley package were converted to numerical values that can lead to statistical analysis. Thus, comparisons of the quality of the EIS was made using Mann-Whitney U-test that compares the distributions of scores on a quantitative variable from two (2) independent groups.

3. Results

Summary of the 2020 and 2021 results for all the 36 criteria for the evaluation of quality of EIS that fall under 12 themes was presented in

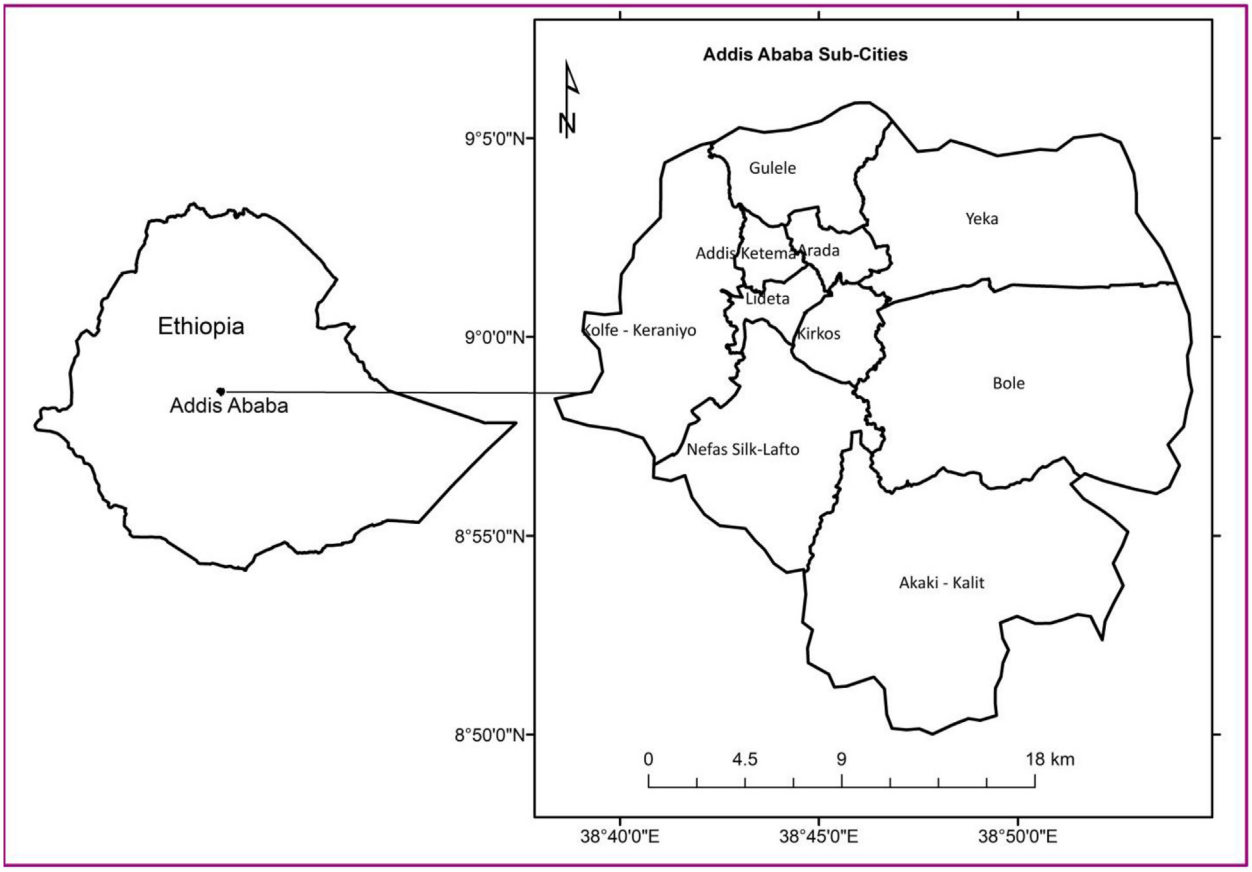

Figure 1. Map of the study area.

Table 6. Average satisfactory (grade A–C) and unsatisfactory (D–F) scores per thematic evaluation area is presented in Figure 2.

3.1. Evaluation area 1: screening

All the EIS reviewed were dealing with the type of projects that must undergo screening as per the EIA Guideline of AAEPGDC. However, none of the evaluated EIS has dealt with screening except mentioning it is an important step in the EIA process. While screening in the EIS process is used to determine whether a proposed project requires an EIS or not, the reviewed EIS directly engaged in the full write-up of the EIS report.

3.2. Evaluation area 2: scoping

Scoping in the EIS process is used to determine whether the potential impacts of a project are relevant to assess and agree on the methodology for the methodology of assessment. There are two key issues desired to be addressed in the scoping section of the EIS process: scoping report and terms of reference (ToR) of a project. Results have indicated that 71% and 3% of the reviewed EIS dealt with the scoping and ToR of projects respectively.

Table 1. Type and number of documents accessed.

Year	Document type and no. accessed				
	EIA	EMP	Not relevant	Double	Sample of EIA
2019	3	2	0		
2020	31	6	0	1	16
2021	30	26	1	4	15
Total	**64**	**34**	**1**	**5**	**31**
Grand Total	**98**		**1**	**5**	**31**

3.3. Evaluation area 3: project setting and description

Under the project setting and description, AAEPGDC demands the descriptions of project activities, production processes and production

Table 2. Project type by year.

Types of project	No. of projects by year (no.)	
	2020	2021
Abattoir	-	1
Candle factory	-	1
Compost, biogas production and electricity generation facility	1	-
Concrete batching plant	1	-
Elastic & non-elastic narrow woven products plant	1	-
Fruits and vegetables processing	1	-
Garment & textile	1	3
Liquor factory	-	1
Metal product manufacturing	1	-
Mixed use building	1	1
Motel and fuel station	3	1
Paints, chemicals and packaging products manufacturing	1	-
Pharmaceuticals	-	1
Plastic	2	-
Quarry	2	4
Sewer line	-	1
Tannery	-	1
Warehouse	1	-
Total project type	12	10
Project type found in both years	4	

Table 3. EIS quality analysis methods.

Model/approach	Effectiveness evaluation	Focus
Lee and Colley	Procedural	Quality of EIS
European Commission Guidelines on EIS review	Procedural	Quality of EIS
The Oxford-Brookes University EIS review package	Procedural	Quality of EIS
The Guide to Technical Analysis of Environmental Impact Studies	Procedural	Quality of EIS
Cost-effective analysis method	Transactive	More empirical measure of the effectiveness of EIA systems
Cost-benefit analysis method	Transactive	More empirical measure of the effectiveness of EIA systems

rates where results on the same were found 94, 90 and 94% respectively. Quarry, chemical production, garment & textile, warehouse, metal manufacturing, motel & fuel station and mixed use building were projects considered for the study. There are few numbers of the EIS that described project activities, production processes and production rate either in-exhaustively (12%) or shallowly (15%) or totally overlooked (3%). Unsatisfactory descriptions of project activities, production processes and production rates generally accounts for 6, 10 and 6% respectively.

3.4. Evaluation area 4: alternatives consideration

Under the alternate analysis, three important issues which include analysis of alternatives, selection of alternatives and reasons for selecting the best alternative are required to be dealt with. In line with these requirements, all the EIS has discussed about alternates at various degrees. Analysis of alternatives, selection of alternatives and reasons for selecting the best alternative were addressed at 74%, 77% and 87% respectively. Various project alternate options such as alternative site, schedule, designs, and inputs were described in the reviewed EIS.

With respect to energy use as input, result has revealed that 65% of the EIS has stated the amount and sources of energy for the projects including alternate and environmental friendly sources of energy (such as solar, biogas and biomass) or own energy means of production while the balance failed to do the same.

Of all the evaluated EIS, 78% has recommended the use of diesel energy, which is a fossil fuel and not among the re-director to non-cleaner production. While the government is sensitive to power saving, none of the EIS stipulated strategy or simple actions destining to that end such as switching off running funs and light bulbs when not needed or leaving office (off-work-hour) and use of power efficient bulbs.

Table 5. Explanation of score (grade).

Grade	Explanation
A	Relevant tasks well performed, no important tasks left incomplete
B	Generally satisfactory and complete, only minor omissions and inadequacies
C	Satisfactory despite omissions and/or inadequacies
D	Parts are well attempted but must, as a whole, be considered just unsatisfactory because of omissions or inadequacies
E	Not satisfactory, significant omissions or inadequacies
F	Very unsatisfactory, important task(s) poorly done or not attempted
N/A	Not applicable. The review topic is not applicable, or it is irrelevant in the context of the statement

Table 4. Summary details of published evaluation of EIA report/EIS quality (1985–2017).

#	Author(s)	Country of study	Period covered	No. of EIS examined	Method used/adapted	Statistical analysis	Nature of projects
1	Anifowose et al. (2016)	Nigeria	1998–2008	19	Lee and Colley	Descriptive and inferential, Mann-Whitney	Oil and gas
2	Badr et al. (2011)	Egypt	2000–2007	45	Lee and Colley	Descriptive and inferential	Various/Mixed
3	Badr (2010)	Egypt	2000–2007	40	Quality review package	Descriptive and inferential	Water
4	McGrath and Bond (1997)	UK, Ireland	1988–1993	44	Lee and Colley	Descriptive	Various/Mixed
5	Cannaos and Onni (2019)	Italy	2012–2017	116	Procedural effectiveness of EIA deliberation	Descriptive and inferential	Various/Mixed
6	Caro-Gonzalez et al. (2021)	Colombia	Not given	131	Effectiveness Index of Methodologies (EIM)	Descriptive and inferential,	Various/Mixed
7	Fernández et al. (2018)	Brazil	2005–2015	49	Lee and Colley	Descriptive and inferential, Kruskal-Wallis and linear regression	Various/Mixed
8	Haile (2012)	Ethiopia	2006–2011	160	Lee and Colley	Descriptive and inferential	Various/Mixed
9	Kamijo and Huang (2016)	Japan	2001–2012	120	Lee and Colley	Non-parametric tests (Kruskal–Wallis test or Spearman's correlation coefficient)	Various/Mixed
10	Kamijo (2016)	Developing countries	1985–2016	82	Quantitative text analysis (QTA).	Descriptive and inferential	Various/Mixed
11	Larsen et al. (2018)	Denmark	1991–2014	67	Not defined	Descriptive and inferential	Infrastructure
12	Loomis and Dziedzic (2018)	World	1996–2016	64	Procedural effectiveness	Descriptive and inferential	Various/Mixed
13	Otienoc et al. (2017)	Kenya	Not given	13	Smith Scheme of Public participation	Descriptive and inferential	Various/Mixed
14	Peris-Mora and Velasco (2015)	Spain	1990–2002	40	European Review Checklist	Quality scale	Road
15	Sandham et al. (2020)	South Africa	1997–2017	24	International EIA report quality review package	Descriptive and inferential	National Parks
16	Ulibarri et al. (2019)	America	2012–2017	27	text mining	Descriptive and inferential	water and energy
17	Wylie et al. (2018)	South Africa	Not given	13	Lee and Colley	Non-parametric Kruskal Wallis test	Tourism related infrastructure

Table 6. Evaluation result for 2020 and 2021.

No.	Evaluation criteria	Score (number)						Satisfactory score (A-C)		Unsatisfactory score (D-F)	
		A	B	C	D	E	F	Number	%	Number	%
1.	**Screening**										
1.1	Screening						31	0	0	31	100
2.	**Scoping**										
2.1	Scoping report	7	13	2	2	4	3	22	71	9	29
2.2	EIA ToR	1					30	1	3	30	97
3.	**Project setting and description**										
3.1	Description of project activities	14	12	3	1	1		29	94	2	6
3.2	Description of project production processes	15	12	1	1	2		28	90	3	10
3.3	Description of project rate of production	15	12	2	1		1	29	94	2	6
4. Alternate consideration											
4.1	Analysis of alternatives	9	11	3	2		6	23	74	8	26
4.2	Selection of alternatives	9	10	5	1		6	24	77	7	23
4.3	Reasons for choosing the best alternative	3	9	15		1	3	27	87	4	13
5.	**Baseline**										
5.1	Metrology/Climate	17	10	1			3	28	90	3	10
5.2	topography/landscape	17	10	1			3	28	90	3	10
5.3	Geology and soil	12	6	4			9	22	71	9	29
5.4	Land use and land cover	9	8	9		1	4	26	84	5	16
5.5	Water resource and water quality measurement at least at three points	2					29	2	6	29	94
5.6	Ambient air quality measured at different points	1					30	1	3	30	97
5.7	Noise level measurement at least at three points	1					30	1	3	30	97
5.8	Fauna and flora of project area	11	5	11	1		3	27	87	4	13
5.9	Socio-economic conditions	17	10	2	1		1	29	94	2	6
6. Legal and institutional framework review											
6.1	Policy and legal framework within which the project operates		6	20	4	1		26	84	5	16
7.	**Impact identification and description**										
7.1	Impact identification and description	9	20	1	1			30	97	1	3
8.	**Impact characterization and prediction**										
8.1	Estimate the magnitude of each potential impacts	1	7	13	7	1	2	21	68	10	32
8.2	Impact is reversible or not	3	4	11	1	4	8	18	58	13	42
8.3	Duration of the impact (short, medium & long term)	3	4	12	3	1	8	19	61	12	39
8.4	Zone of influence of the impact	1	4	14	3		9	19	61	12	39
9.	**Environmental management plan**										
9.1	Summary of impact	7	23		1			30	97	1	3
9.2	Description of proposed mitigation measures	6	22	2	1			30	97	1	3
9.3	Schedule for implementation of mitigation measures	1	11	18		1		30	97	1	3
9.4	Estimate cost of mitigation measures	4	26				1	30	97	1	3
9.5	Responsible body to implement mitigation measures	4	25	2				31	100	0	0
9.6	Staffing and training requirements to implement the EMP	4	9	7	3		8	20	65	11	35
10.	**Monitoring plan**										
10.1	Parameters/activities to be monitored	11	16	1			3	28	90	3	10
10.2	Responsible body for monitoring	8	19	1			3	28	90	3	10
10.3	Schedule/frequency for monitoring	6	21	1	1		2	28	90	3	10
10.4	Proposed reporting procedures	3	21	3			4	27	87	4	13
11.	**Review and decision making process**						31	0	0	31	100
12	**Project implementation and integration with EMP**						31	0	0	31	100

3.5. Evaluation area 5: baseline establishment

Multiple issues are needed to be addressed in baseline data of a project. Results of each of these required baseline data are described below.

- *Climate data*: were described in 90% of the reviewed EIS.
- *Topography and landscape*: were described in 90% of the reviewed EIS.
- *Geology and soil*: were described in 71% of the reviewed EIS.
- *Land use and land cover (LULC):* were described well in 84% of the reviewed EIS.
- *Water resource description and water quality measurement*: is required to be tested at three points around the project area where only 6% of the reviewed EIS were found complying with the requirement.
- *Ambient air quality measure*: is required to be measured at different points surrounding the project area where only 3% of the reviewed EIS were found complying with the requirement.
- *Noise level measure*: is required to be measured surrounding the project area at least at three points where only 3% of the reviewed EIS were found complying with the requirement.
- *Fauna and flora*: were identified and described by 87% of the reviewed EIS.

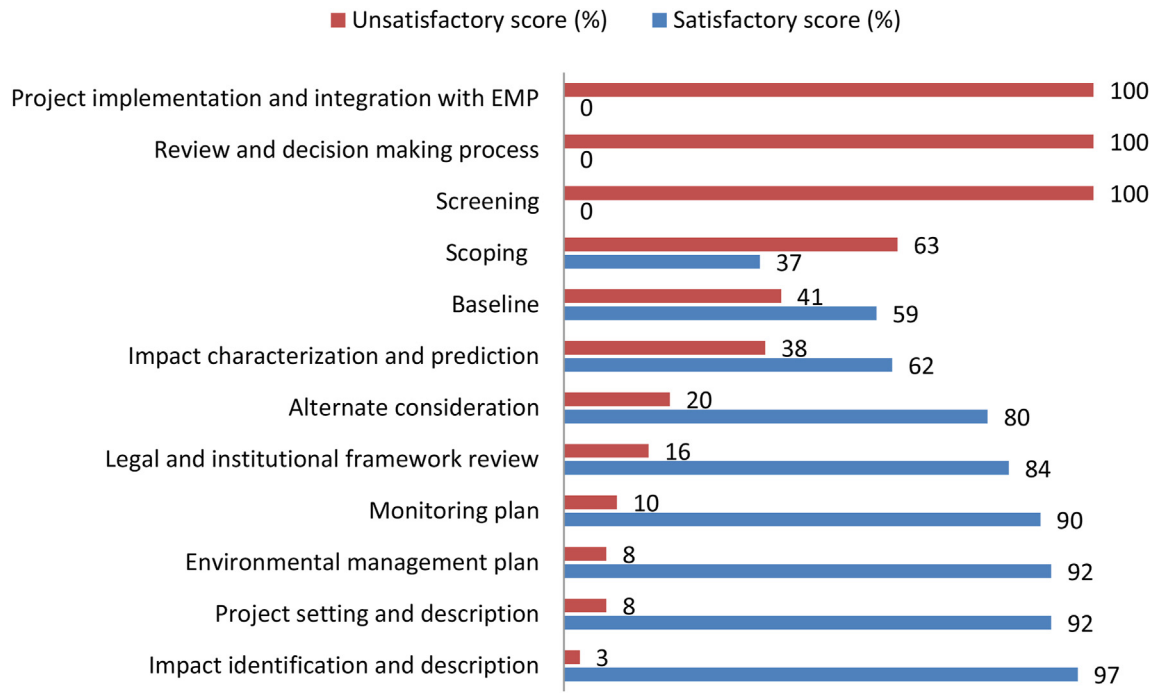

Figure 2. Average score by thematic evaluation criteria.

- *Socio-economic conditions*: of the project area were described by 94% of the reviewed EIS.

3.6. Evaluation area 6: legal and institutional framework review

Legal and institutional framework review was described by 84% of the reviewed EIS. Legal and institutional frameworks were one of the most described sections of the EIS but without indicating how projects under consideration were related to and affected by the international, national and regional legal frameworks stated in the EIS. It was found that 55% of the EIS described an obsolete (repealed) labour proclamation no. 377/2003 instead of the extant proc. no. 1156/2019 while 26% totally overlooked to deal with labour issues.

3.7. Evaluation area 7: impact identification and description

Result for Identification and description of impacts indicates that it is the most dealt section of the EIS with a score of 97%. Impact identification was mainly based on expert judgment method at the proposed project sites and at operation phase. Impact identification using consultation method was rarely combined with expert method. The EIS were constrained by identifying impacts at different phases of the projects such as design, construction and decommissioning. Result indicated that there was un-parallelism among the number and types of impacts identified and proposed mitigation measures.

3.8. Evaluation area 8: impact characterization and prediction

Under impact characterization and prediction, four important sub-criteria such as magnitude, reversibility/irreversibility, duration and zone or extent of the adverse impacts are sought to be dealt with. Magnitude, reversibility/irreversibility, duration and zone or extents of the adverse impacts have score values of 68, 58, 61 and 61% respectively.

3.9. Evaluation area 9: environmental management plan (EMP)

Under the EMP, six criteria which include summary of impact, description of mitigation measures, schedule for implementation of mitigation measures, estimate of cost of mitigation measures, responsible body for implementing mitigation measures and staffing & training requirements to implement the EMP are required to be dealt with. The mean score of all these requirements was 92% while the detail for each of the scores was presented in Table 6.

3.10. Evaluation area 10: monitoring plan

Four sub-criteria which include parameters to be monitored, responsible body for monitoring, schedule/frequency of monitoring and reporting procedure are desired to be indicated in the EIS. Results indicated that parameters to be monitored, responsible body for monitoring, schedule/frequency of monitoring and reporting procedure have a score value of 90, 90, 90 and 87% respectively with overall mean score of 89%.

3.11. Evaluation area 11: review and decision making process

In AAEPGDC, there is EIS team who reviews the EIS and avail the report to the decision makers. However, no information provided how reviews and decision making processes were carried-out. The role of key stakeholders in reviewing the EIS and decision making were also not mentioned.

3.12. Evaluation area 12: project implementation and integration of EMP with the project

The requirement for a project implementation is explicit presentation of budget (capital and recurrent) against each mitigation measure outlined in the EMP. Though budgets were presented in each of the EIS, no information provided how project implementation and EMP integrates.

3.13. Evaluation area 13: comparison of EIS quality between years

Four thematic evaluation criteria have scored better in the year 2020 (Figure 3) while five thematic evaluation criteria have scored better in 2021 (Figure 4). In both years, 3 thematic evaluation criteria have scored equal. Overall satisfactory scores for the year 2020 and 2021 were 55 and 59% respectively (Figure 4) where there was no statistical significance

difference between the two values (the two years) evaluated using non-parametric independent test for Mann-Whitney U-test both at 99 and 95% confidence interval (where n1 = n2 = 12) (see Figure 5).

The critical values for the Mann-Whitney U-test (Wilcoxon Rank Sum Test) at n1 = n2 = 12 and confidence limit (CL) of 99% and 95% were 37 and 27 respectively while the calculated U value for the year 2020 and 2021 were 65.5 (U1) and 78.5 (U2) respectively. In this case, the smaller of the two values is used to test against the critical value at a given confidence levels. Table 7 summarizes the statistical computation for the year 2020 and 2021 while Figures 6 and 7 depict two independent sample Mann-Whitney U-median and histogram maps respectively.

4. Discussions

4.1. Evaluation area 1: screening

As indicated in the result section, there is no EIS that has dealt with screening except mentioning it is one of the important steps in the EIA process. A reference to the AAEPGDC's guideline on screening (Haile, 2012) has revealed that all the reviewed EIS were found among the projects that should undergo full EIA. Our finding indicated that there is no EIS that has dealt with screening except mentioning it as one of the important steps in the EIA process. Thus, there is no evidence with respect to screening in the submitted EIS which is useful for decision makers. According to Weston (2011), screening in the EIA process determines whether a project needs subjecting to EIA or not and then at what level the assessment should occur when subjected to EIA. Wood and Becker (2005 in: Weston, 2011) have indicated that screening in the EIA process could lead to decision making and/or EIA process.

4.2. Evaluation area 2: scoping

Analyses of the EIS have revealed that 71% and 3% of the EIS dealt with the scoping and ToR of projects where the latter was one of the least dealt with section of the EIS. Both scoping and ToR preparation never included public involvement to solicit in depth impacts of the projects. Our finding indicated that there was confusion of *impact scoping* or *scoping report* of the EIA process with a scope of a project where the formers refers to process of identifying important and high-priority issues of a proposal (Kennedy and Ross, 1992) while the later refers to limit or extent or boundary of a project study. Scoping report of the EIS was found referring to preparation of EIS report and project management plan. It even found sharply narrowed and overlapped with the objective of a project and sometimes referring and listing down of project activities.

The scoping report stated in the EIS was purely carried out by experts (consulting firms) without public involvement; however, Borioni et al. (2017) have recommended it should be done by experts and stakeholders to maintain a balance of interests between stakeholders and decision-makers. Information from the stakeholders is important for informed decision making (Ulibarri et al., 2019; Cashmore et al., 2014). Scoping exercise results in the preparation of the terms of reference (ToR) for the EIA which is always project and site specific (Moduying, 2001).

All the EIS have essentially failed to include ToR in the EIS depicted by the fact that only 3% of it has included. It was also found that texts in the EIS read ToR were annexed while there were no such annexure. ToR is key to address concerns (NCEA, 2017) and determine the content and scope of the work to be undertaken in the EIS (Moduying, 2001).

4.3. Evaluation area 3: project setting and description

Project setting and description under the AAEPGDC requirement is based on three themes which include project activities, processes and description of production rate which this requirement is in par with the amended European Union (EU) Directives 2014/52/EU Guidance on the preparation of the EIA report (European Union, 2017). On average, 93% of the evaluated EIS has described project setting and description and has scored grades between A-C which is categorized under satisfactory score.

4.3.1. Activities description

With respect to project activity descriptions, our finding indicates that 94% of the evaluated EIS has defined project activities which enable them to achieve their set objectives (Sampietro, 2016) and entail whether these activities induce adverse impacts or not (Rathoure, 2021). Results also indicate that 7% of the EIS has poorly or not clearly described activities but given clearance against the principle of first hand project acceptance after proof of no significant adverse impacts from its activities (Ehrlich and Ross, 2015). Activities relevant to quarry production were mostly described than activities of other project type such as chemical production, pharmaceuticals and buildings. It was also found that there was one EIS without having description of activities for a project.

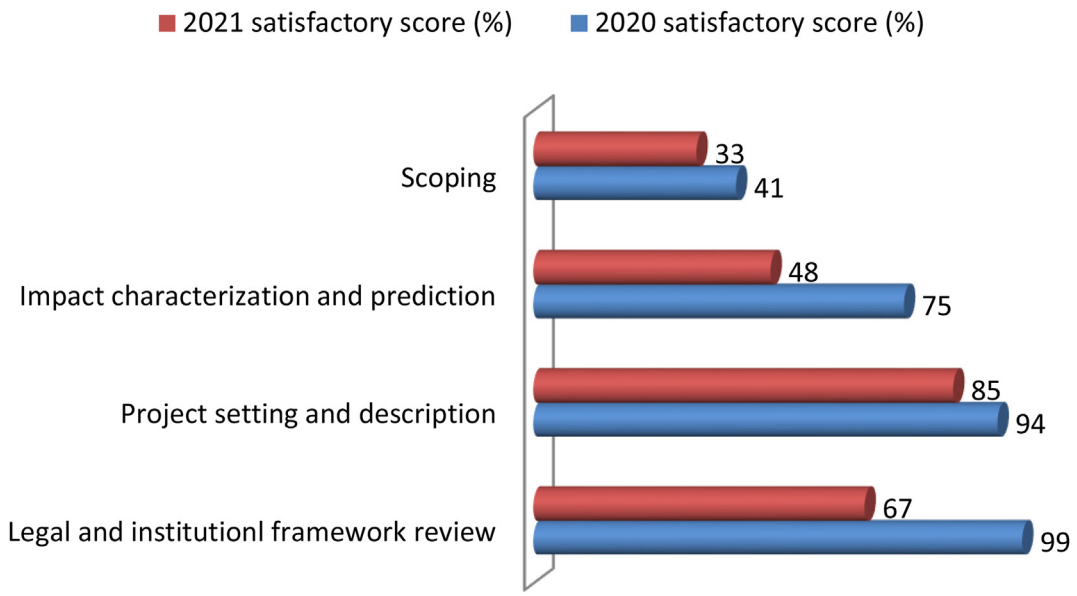

Figure 3. Better score area of 2020 over 2021.

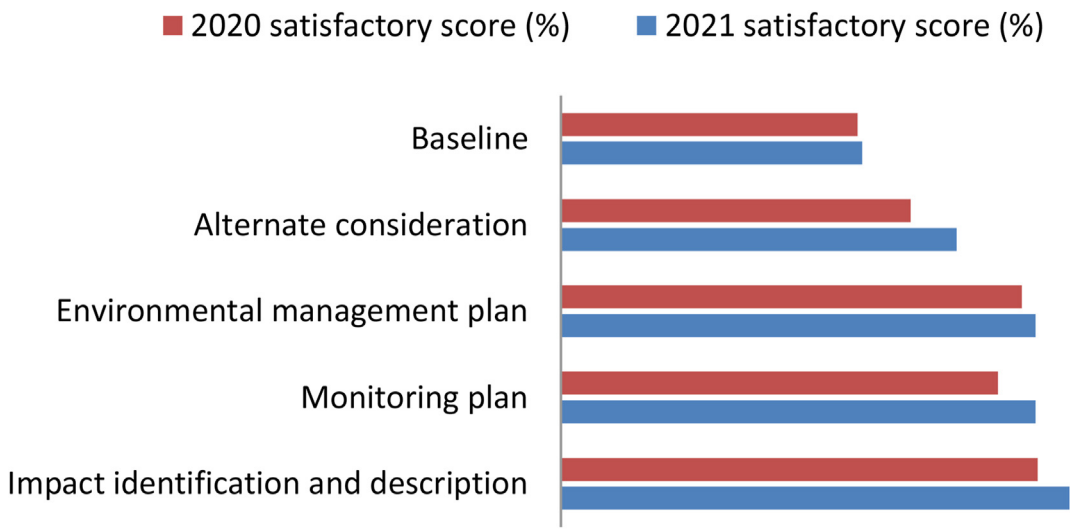

Figure 4. Better score area of 2021 over 2020.

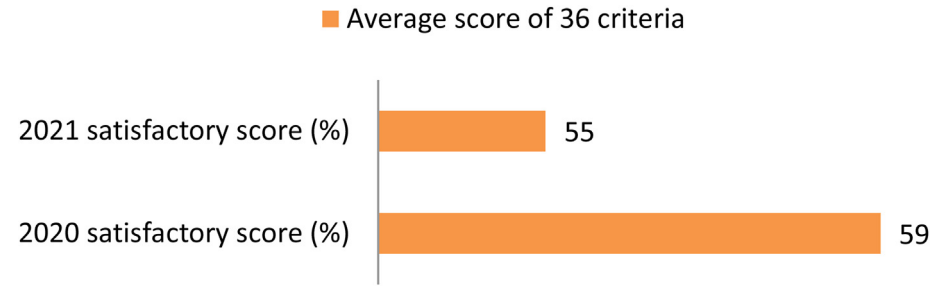

Figure 5. Average EIS quality score for years 2020 and 2021.

4.3.2. Production processes description

Our finding indicates that 90% of the evaluated EIS has described projects production process ranging from a very well to marginal description while the balance overlooked it which is in line with the recommendation of Wylie et al. (2018). Understanding the nature of production processes is key as it reveals which steps is inducing impact. As per Glasson et al. (1999), production process description needs to be accompanied by the type and quantity of materials used where this is found as a gap in our case though most of them described production processes of the respective projects. Production processes were presented in separate chapter without correlating them with production process. Projects such as hotels and fuel supplying services did not include production process in the EIS as they practically do not have production but service provision. Production processes were mostly presented in descriptive way followed by schematic flow chart and rarely without flow chart.

4.3.3. Production rate description

The rate of production was described by 94% of the EIS in relation to the machines' capacity from year 1 operation onward progressively, particularly for quarry projects. However, there are cases where the production rate not described as in the case for the pharmaceutical industries of the reviewed EIS. Of course, some of the projects when they do not have production would not be expected to report the rate of production as in the case of service providers (e.g. fuel station, hotel and lodge) for instance.

Production rate varies among project types where we found even similar or the same projects (e.g. quarry, textile) were described of having different production rates which could be due to the capacity of the machines deployed, limited resource availability as determined by geographical location of the project, budget allocated for production, seasonal limitations and weather (Jeong et al., 2019).

Understanding the rate of production of a project is of paramount importance as it dictates the quantity or volumes of input use, product, by-product and waste generation (Shahbazi, 2015). Stating the rate of production by time (season or year) is also desirable because management approach (for production, waste management) and supply (input including labour requirement) varies with time (seasons) and hence need different mitigation measures than what is stated as mitigation measures (Shahbazi et al., 2013) recommended as one fits all.

4.4. Evaluation area 4: alternatives consideration

In alternate consideration, three key issues such as alternate analyses, alternate selection and reasons for selecting the best alternatives are sought to be addressed where 74%, 77% and 74% were addressed respectively.

Though various project alternatives such as alternatives to location, schedule, designs and inputs were described in the EIS, no consulting firm recommended a project being located in other place or adapting different schedule or changing design or using different inputs or alternate product or technology than originally proposed to minimize/prevent adverse impacts.

Use of energy as one of the input was described along with the alternate energy sources where 68% of the evaluated EIS stated energy use in one way or the other. They stated all the projects access power from the national grid which is an indication that projects were based on the clean energy supply (GRK, 2020; Shahbazi et al., 2013) or were the type of clean development project (Toprak and Anis, 2017) and hence have no or minimum carbon-foot print (ADB, 2017) which is in line with

Table 7. Mann-Whitney U-test result.

Description	2020	2021
Sample size (n)	12	12
Sample average ($\bar{x}$)	33	30
Sample SD (S)	31.12	30.10
Median	24.50	22
Skewness	0.65	0.85
Skewness Shape		
Normality	0.11	0.08
Rank	156.50	143.50
U	65.50	78.50

the 2012 Energy Policy of Ethiopia that strives to attain 60% access to renewable energy sources by 2040 (Khan and Singh, 2017). All the EIS stated that projects rely on diesel when electricity is black-out which is against the Environmental Policy of Ethiopia (FDRE, 1997) that encourages use of renewable energy as well as the Energy Policy of Ethiopia (FDRE, 2012) which encourages the use of energy efficient machineries & processes and continuous improvement of energy efficiency of systems and operations. Majority of the EIS failed short of mentioning renewable and environmental friendly alternate sources of energy recommendations such as solar, biogas and biomass (Khandare et al., 2015 in: Toprak and Anis, 2017). Energy saving mechanisms such as switching of running funs and light bulbs when not needed or leaving office (off-work-hour) were not stated as well in the majority of the evaluated EIS.

According to Longueville et al. (2015), alternate analysis is perceived as the 'heart-and-soul' in EIA as it is the purest form of impact avoidance i.e. no mitigation measures need as it avoids impacts. Longueville et al. (2015) further explain that impact avoidance through alternatives prevents environmental cosmetic surgery in addition to saving or protecting resources in their natural areas.

Our findings revealed that selection of alternatives culminated in favor of the project proponent by opting for low cost technology which indirectly means a project should operate at the cost of environment and community. Persuading through magnifying the benefits of a project for the country and local community (mostly through job opportunity) and absence of environmentally sensitive areas (such as parks, archeological sites) in areas where a project proposed to be implemented were reasons for overlooking alternatives and just embark on the originally proposed project as it is. Kamijo and Huang (2016) have shown that public involvement in the evaluation of alternatives analysis improved the quality of EIS.

Though alternatives discussed, they were not opted for and thus impaired the benefits *alternatives* offer to the environment which this finding is in line with the work of Kamijo and Huang (2016) who reported consideration of alternatives analysis was less in their review of the quality of EIS.

4.5. Evaluation area 5: baseline establishment

Multiple issues are needed to be addressed in baseline data of a project. Results of each of these required baseline data are described below.

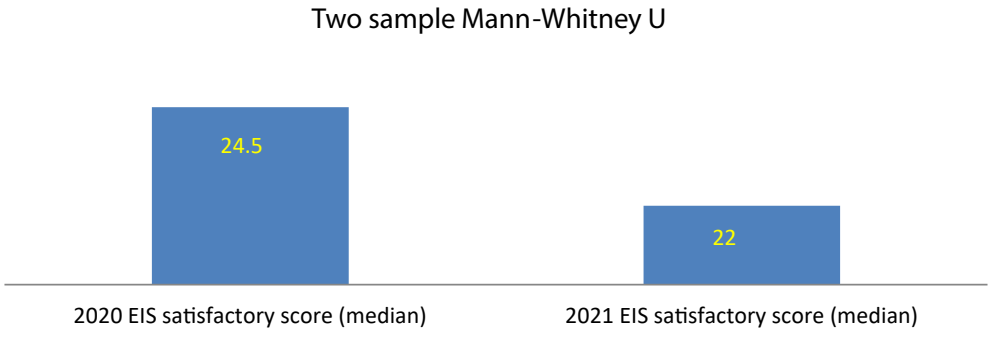

Figure 6. Median score of Mann-Whitney U-test.

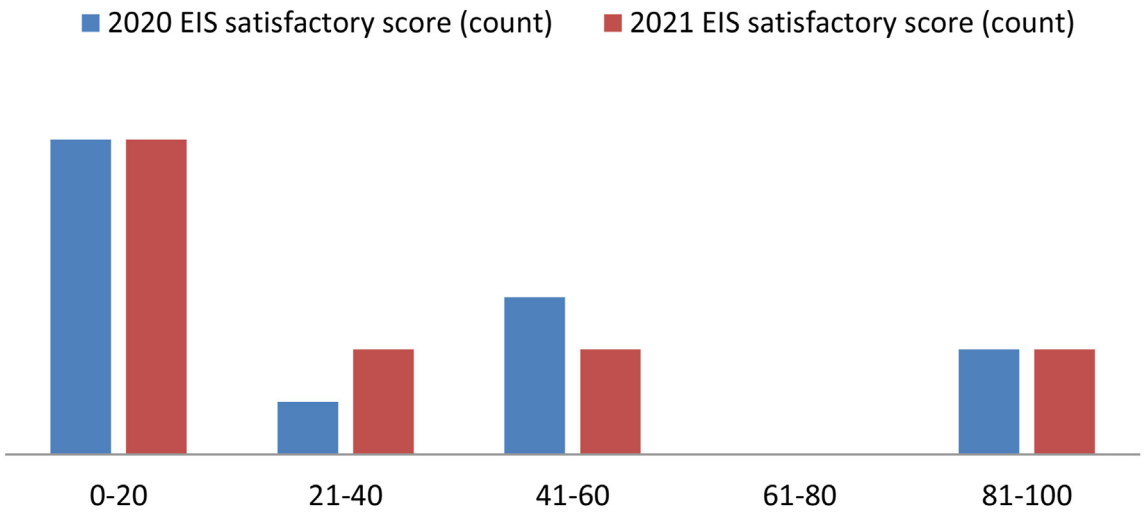

Figure 7. Histogram distribution of Mann-Whitney U-test.

4.5.1. Climate data

Result has indicated that 90% of the EIS described climate condition of project area while 10% attempted it but not satisfactorily. When climate is described well, it included the meteorological data of the very area or the nearest point but as a whole that of Addis Ababa when poorly addressed. Wind speed and direction, peak wet and dry seasons including maximum, minimum and mean rainfall amount as well as temperature were included in those EIS described well while one or more of these were missing when poorly described. IISD (2021) recommended the need for the inclusion of trends in climate change for better idea of the rate of biodiversity loss as well as any extreme changes in climate. Gao (2018) has indicated that mainstreaming climate issue in EIA helps to translate global or national mitigation and adaptation targets of climate change to project and plan levels of decision-making.

4.5.2. Topography and landscape

Result has indicated that topography or landscape of the project areas were described in 90% of the reviewed EIS while 10% attempted it but not satisfactorily. Though 90% described topography in the EIS, it was interchangeably and/or synonymously used with watershed, slope and altitude. It was also found none has mentioned how land-use land-cover change affects the topography or landscape of the area and how project activities especially construction and operation (particularly for quarry) changes topography or landscape of the area. Construction and operation phases of projects, particularly quarry, affect terrain stability and induce accelerated erosion which may end with change in topography or landscape of a project area. Change in landscape composition, structure and pattern due to project bring changes in biodiversity (Rehbein et al., 2018). There is weakness in assessing the impacts of change in landscape due to project where Gagne et al. (2015) has reported it as a gap in using it in decision-making.

4.5.3. Geology and soil

Geology and soil of the project areas were described in 71% of the reviewed EIS while 29% did it unsatisfactorily. Texts for describing geology of project areas were copied from academic books and thus were mostly discussing regional geology instead of local. They typically overlooked including information on seismicity and stability as well as maps for geological formation, geological hazards and geological resources such as soil. This finding coincides with that of Bilaro (2019) who reported that projects were mostly failed integrating geological and geotechnical aspects in their EIS. Bilaro (2019) has also indicated the presence of very limited studies that had been published integrating geological and geotechnical aspects in EIS. EFG (2003) has indicated decision makers override geological information partly because it is not presented or poorly understood when presented and thus recommended their participation in the EIS study.

4.5.4. Land-use and land-cover (LULC)

Land-use land-cover of the project areas were described in 84% of the reviewed EIS but 16% attempted it unsatisfactorily. Well described LULC included agriculture, forest, aquatic, developed (settlement), barren and open. On the other hand, when LULC was not described well, it missed mentioning whether the proposed project is allocated in and is in line with the local land-use development plan as given in the master plan of the Addis Ababa City Administration. Overview of the previous history, existing and proposed land use in project areas were other issues overlooked to be discussed. It was also found that LULC is scaled down to land-occupation or tenancy by institutions such as training center, tyre repair service center and factory. There were EIS that presented LULC of project areas using only snap-shots (photographs) instead of maps or GIS assisted by field observation. LULC have great impacts on environmental and socio-economic sustainability of communities (Yuan, 2008) and thus must be critically dealt with. Simplistic approach and presentation of LULC impair its use for environmental management and planning (Jie et al., 2010; Yuan, 2008).

4.5.5. Water resource description and water quality measurement

Water resource description and water quality measurement at three points in a project area are requirement by AAEPGDC where only 6% of the reviewed EIS were found complying with the requirement of water source description while only 3% with test requirements. Moran (2004) has pointed the importance of identifying water resources and quality test results inclusion in the EIS.

Intermittent streams, municipal water lines and water stored in a tanker were mentioned as water sources of the 'area' and project as ell while ignoring ground and surface water as points of water sources. Pollution of the project area from point and non-point sources of North and central Addis Ababa were concerned with than the actual pollution emanate from the projects.

Water quality need for a particular project, volume used per given time, volume use per unity of product type produced, volume of wastewater generates, treatment and management mechanism of wastewater (re-use or recycle or safe disposal) were areas poorly dealt with. Badr (2010) has reported that 60% of the EIS they reviewed has potential impacts on water environment.

4.5.6. Ambient air quality measure

AAEPGDC demands ambient air quality of a project area to be measured at different points where only 3% of the reviewed EIS were found complying with the requirement. There could be air contaminants already in the area that should be measured ahead of project launch which this was not the case in our finding. Projects may also emit contaminants that need to assess based on developed ToR to avoid disagreement with the proponent (DiGiovanni and Coutinho, 2017). Though 3% of the EIS tried to include ambient air quality measures, this was even not exhaustive as it failed to include potential contaminants which DiGiovanni and Coutinho (2017) generally recommended that includes suspended matter, particulate matter (PM, PM10 and PM2.5), sulfur dioxide (SO_2), volatile organic compounds (VOCs), odor and others depending on project type.

4.5.7. Noise level measure

Measurements of noise level at least at three points in a project area and its surrounding are required by AAEPGDC where only 3% of the reviewed EIS were found complying with the requirement. Though there was no baseline data measure on noise pollution, all the EIS mentioned there could be noise pollution from projects that should be abated from operating machines during daytime, using silencer, using personal protective equipment (PPE) and sensitizing workers on noise impacts. However, the implementation of these abatement methods themselves could be affected by the background noise pollution which was failed to be reported. This background noise could magnify when coupled with noise from the proposed projects that may impair health of workers and neighborhoods including hearing. Vandana et al. (2020) have indicated that projects, particularly quarries, induce high noise pollution that damage human health.

4.5.8. Fauna and flora

Lists of plants and animal species found in project area were described by 87% of the reviewed EIS. Fauna description entirely focused on larger animals and no case found where presence of micro-organisms reported. Flora descriptions have manly emphasized exotic species (such as eucalyptus and coniferous species) and grass in generic. There were cases when fauna and flora descriptions closed by a couple of word such as *the area is devoid of flora and fauna*.

Descriptions of terrestrial and aquatic flora and fauna by seasons as well as assessing critically endangered, endangered or vulnerable species based on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species were missed in the reviewed EIS. According to CEA (2006), development projects need thorough assessments for their impacts (both positive and d adverse) on biodiversity using EIA as a key instrument for the conservation, sustainable use and equitable

share of biodiversity as indicated in Convention on Biological Diversity (CBD).

4.5.9. Socio-economic conditions

Socio-economic conditions in project area were described by 94% of the reviewed EIS while 6% poorly described. Issues addressed under socio-economic description included social issues (demography, religion and tradition), infrastructure (road, health service, school, and communication) and economic (means of livelihood, major economic activities) conditions.

While the socio-economic condition of the project area, mostly for quarries, described agriculture as a means of livelihood for the community members who lost land to the project, they were predominantly mentioned as the beneficiaries of the project through job opportunity. This presumably undermined agriculture as if it is not a job opportunity in a country of predominantly agro-based economy that offers job opportunity for well over 80% or equivocally means being hired in a project as a labourer is better than being a farmer.

Andrew (2010) has reported that socio-economic issues in EIA has uncertain status in EIA, guidance on their assessment is limited and their treatment is often partial and of poor quality. Thus, AGIP KCO (2004) has indicated that socio-economic impact assessment needs to be supported by appropriate rules and standards in the national legislative base which is a gap in Ethiopia.

4.6. Evaluation area 6: legal and institutional frameworks review

Our finding indicates that legal and institutional frameworks were one of the most dealt sections of the EIS which is in line with the findings of Caro-Gonzalez et al. (2021). However, our finding is different as it had found cases where repealed laws such as labour proclamation no. 377/2003 were discussed instead of the extant proc. no. 1156/2019 in relation to projects. Failure to properly align legal and institutional frameworks with the EIS led to the overlook of identifying key concerns of occupation health and safety (OHS) issues as well as description of workers' rights and obligations. Caldwell (1988) has indicated how underutilization of legislation affects environment which our finding aligns with this.

Though the legal frameworks of 22 Sub-Saharan Countries reported of needing revisiting with respect to enhancement of the role and degree of public participation (Bekhechi and Merder, 2002), the legal frameworks of Ethiopia (such as proc. no. 1/1995, proc. no. 299/2002) encourage active public involvement at the different phases of a project where this was indicated clearly in the evaluated EIS. In line with the public participation, minutes were exhibited in the EIS for community participation in project impacts evaluation. However, George et al. (2020) have reported that there are gaps between law and practice attributed to different factors among others which include political interference and institutional capacity (Cashmore et al., 2014).

There is good institutional arrangement at City and district levels that regulate the implementation of the EIA though number of staff members and composition by professions are not adequate where these were not described by all the evaluated EIS. This regulatory institution has indicated community members should report when they encounter anybody or organization violating environmental legal requirements. Reports from the EIS and its process were recommended to be made part of the EIS policy (Caldwell, 1988).

4.7. Evaluation area 7: impact identification and description

All the EIS have identified and described adverse impacts using professional judgment and their past experiences as a method without using other methods (such as checklists, matrices, networks and overlays) and subsequent critical analysis to destine at an option of a project with least or nil adverse environmental impacts. According to Anifowose et al. (2016) and Green Circle Inc. (2018), failure to couple models (Geographical Information System/GIS, simulation) with other methods of impact identifications impairs full-fledged impact identification and description and thus identifying of a project with no or least adverse impacts. Though technology (GIS, simulation) assists in averting adverse impacts, it often excludes stakeholders and public involvements who are key in predicting impacts that may not be captured using technology (Glasson et al., 2005 in: Anifowose et al., 2016; Weston, 2004 in: Anifowose et al., 2016). Worku (2018) has indicated that public involvement in a project is useful in achieving envisaged development goals and successful implementation of plan.

Other than technology (Anifowose et al., 2016), adverse impacts can be averted or minimized or compensated with location option (Vandana et al., 2020; Padash and Ataee, 2019), input type used (Li et al., 2019), product type produced (Wu et al., 2019) or combination of any of these where none of the evaluated EIS proposed different location or input type use or product type characterization or technology than originally proposed even when the impacts were deemed higher.

Adverse impacts of a project should clearly indicate how receptors (land, water, air and ecosystem) are affected (Appannagari, 2017) where the finding in our case is in line with this recommendation but essentially constrained of looking into ecosystem and often proposed shallow mitigation measures. For instance, health impacts from water-borne (Chanda-Kapata, 2020) or water related disease (ANU, 2018) or life threat to children swimming in or livestock topple-off to water deposited in quarry pits were poorly dealt with. On top of this, occupation health and safety (OHS) of workers as well as their rights were the most overlooked areas due to the fact that 55% of the EIS stated or described an obsolete labour proclamation no. 377/2003 that was repealed instead of the extant 1156/2019 while 26% totally overlooked dealing with labour issues. Again, project affected peoples (PAP), particularly those lost their lands to the projects, were among the least addressed or even ridiculed that job opportunity at the loss of land is better for them.

Adverse impacts at the construction and operation phases of the projects were the most described parts with only few of the EIS stating pre-construction and decommissioning phases impacts.

4.8. Evaluation area 8: impact characterization and prediction

Impact characterization and prediction have focused on impact magnitude, reversibility or irreversibility, duration and extent where only one EIS was found fully complying with these requirements while the rest missed either one or more of these. Inadequate characterization and prediction of impacts would imply poor information availability for decision making (Baker and Rapaport, 2005), presence of greater proportion of unaddressed mitigation measures (Kamjo, 2017), higher environmental impacts of a project due to unabated adverse impacts (Larsen et al., 2018) and subsequent high monitoring cost (EU, 2017). A project that concurrently characterizes and predicts nature, magnitude, timing, and duration of impacts is given environmental clearance certificate (Ehrlich and Ross, 2015) which this was not the case in our finding as there were projects given environmental clearance without having reasonable characterization and prediction of impacts concurrently in terms of magnitude, reversibility or irreversibility, duration and extent.

Inadequate baseline description was found where this was reported of resulting in compromising impact prediction (Anifowose et al., 2016). AAEPGDC for instance demands tests of ambient air, noise and water quality as baseline for impact prediction and later uses for monitoring where only one project out of the evaluated 31 had carried out these tests. Non-testable, non-auditable, non-monitor-able predictions were found where similar result was reported by Anifowose et al. (2016).

4.8.1. Estimate of the magnitude of each potential impacts

Results indicated that 68% of the EIS had described the magnitude of potential impacts where the balance failed short of describing it. Job opportunity for the community was the most estimated and described

positive impact where the result for the adverse impacts had fallen short. On top of this, there was no clear method of estimating the magnitude of the impacts and then present the results quantitatively which our finding is parallel with that of Sandham et al. (2020). Short of correctly and accurately identifying the magnitude of the potential impacts end-up with their in-alignment with mitigation and compensation measures and subsequently non-implementation of the measures (Larsen et al., 2018). Magnitude is one of the criteria to evaluate significance of an impact and may directly or indirectly affects impact receptors (EU, 2017), its interaction with timing and duration affects receptors resilience and is related to activities, inputs and outputs (Li et al., 2019; EU, 2017). The higher the magnitude of the adverse impacts, the wider may be the extent of coverage and higher environmental impacts (EU, 2017). Wood (2008), however, recommended that it is important to move beyond magnitude of impact and value to understand how impact receptor is sensitive and ensure alignment of significance assessment and impacts.

4.8.2. Indicate whether the impact is irreversible or reversible

Satisfactory score (A–C) with respect to describing as to whether the identified impacts were reversible or not was 58% while 42% of it did not say anything on the issue. Though impacts were described in terms of reversibility-irreversibility, none of them had stated the presence of irreversible impact. A project with a serious environmental threat causing a damage or irreversible adverse impact is deemed to be abandoned or opted for alternate ones (Machaka, 2020).

4.8.3. Duration of impacts

Duration of impacts was described by 61% of the reviewed EIS documents. Duration of impacts is characterized as short, medium and long terms for impacts that last for less than 5, between 5 and 10 and more than 10 years respectively (AACSWMA, 2020). When the duration of an impact lasts for long, it challenges the resilience of the impact receptor(s) and may end with irreversibility (SPREP, 2016) which is a signatory of the precautionary principles of environmental protection. Precautionary principles of environmental protection has become an important issue in EIA after the Rio Declaration on Environment and Development (Nwachukwu, 2021) which is quoted as-*lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation where there are threats of serious or irreversible damage*.

4.8.4. The zone of influence of the impact

The zone of influence of impacts was described by 61% of the reviewed EIS. The zone of influence of impacts is characterized as low, medium and high when impacts are site specific, contained within the project site and beyond the project site respectively (AACSWMA, 2020). The essence of characterizing and predicting zone of influence of impact is to contain impacts within site which this can be achieved succinctly through assessing baseline (Anifowose et al., 2016) and in advance scoping assessment (EU, 2017). Zone of influences of the impacts identified in the EIS was among the least dealt with sections i.e. 39% poorly dealt with it.

4.9. Evaluation area 9: environmental management plan (EMP)

All the reviewed EIS had environmental management plan (EMP) but constrained by non-congruency of impacts identified with proposed mitigation measures and management plan, failure to assign cost for mitigation of identified impacts, assigning mitigation costs for impacts not stated in the impact identification & prediction section and lump-sum cost assignment without clear calculation. AAEPGDC has given EMP template to maintain consistency across the board; however, consulting firms were found using different templates and/or modified versions of the given template. As a result, information needed by AAEPGDC was either missed or unnecessary information added.

Identified impacts, proposed mitigation measures, indicators, responsible institutions, time frame and estimated cost of impact mitigations were mentioned by the reviewed EIS which are in line with the report of Worku (2017). According to Worku (2017), there is systematic underestimation of mitigation costs as well as difficulties of establishing intrinsic social and environmental costs stemming from the projects.

4.10. Evaluation area 10: monitoring plan

Our finding indicated that 7% of the evaluated EIS had no monitoring plan in spite of the fact that AAEPGDC has developed monitoring plan format to be used consistently across the board. However, monitoring plan is a necessary tool that enforces the stringent implementation of mitigation measures (Donelly et al., 1998) and should constitute the content of EIS (Rathoure, 2021). The contents of the monitoring plan provided with include parameters or activities to be monitored, responsible body for monitoring, schedule or frequency for monitoring and proposed reporting procedures where some of the EIS were found using different variants than provided to them and also modifying it which consequently resulted in omission of one or more of the required data or addition of new or more information beyond the requirement of AAEPGDC. The new variant or modified monitoring plan used by consulting firms who prepare the EIS bear additional information not requested by AAEPGDC such information *monitoring plan standard or guide, legal framework, objective of monitoring, sites of monitoring* and *supervisor*. Uses of new variant or modified monitoring plan may result in undermining the quality of the EIS needed by AAEPGDC.

With respect to parameters to be monitored, there are few cases of unparallelism among the adverse impacts identified vis-à-vis proposed mitigation measures vis-à-vis monitoring plans while responsible body for monitoring is one of the best and most described section with only few cases of missing mentioning multiple relevant responsible body for monitoring as well as designating profession instead of institutes (e.g. biodiversity expert instead of biodiversity institute).

Schedule or frequency of monitoring was observed of being confused with phases of monitoring (construction, operation and decommissioning) and described by time unspecific words such as *regularly* or *continuously* or *throughout*.

None of the EIS had included reporting procedure in the monitoring plan section when this is key for getting feedback on the implementation of the mitigation measure (Bianco, 2021) and rectifying any adverse impacts at earlier phase possible (Kilajian and Chareonsudjai, 2021).

4.11. Evaluation area 11: review and decision making process

There was no information available how review and decision making process carried-out. However, there is an EIA team in AAEPGDC who reviews the EIA documents for decision making as to whether the project is given environmental clearance certificate or refuse or return to the consulting firm for improvement. There was no public or stakeholders involvement in review and decision making process to ensure the democratic process of EIS decision making (Cashmore et al., 2014) and confirm whether the information they provided to consultant during consultation process was correct and unbiased (Worku, 2017) and make regulations more effective (Otienoc et al., 2017). Ulibarri et al. (2019) are questioning the participation of stakeholders as they found no difference between the draft and final EIS. On top of this, the pluralism in EIS (development issue and environmental concern) was found as a challenge for the leaning of decision makers towards development, particularly in developing countries. However, substantive results in the EIS should be the reason for decision making (Loomis and Dziedzic, 2018) and ensure sustainability (Cashmore et al., 2014).

4.12. Evaluation area 12: project implementation and integration of EMP with the project

No information provided in the reviewed EIS on how to integrate EMP and project implementation. However, Worku (2017) has indicated

that project impact mitigation measures along with other elements of EMP are integrated into project for their implementation and supervision as per the obligations stipulated in EIA proc. no. 299/2002 (FDRE, 2002).

4.13. Evaluation area 13: EIS quality comparison between years

Though EIS quality is loosely defined in the literature (Bond et al., 2018), the quality of EIS has been reported since 1970 (Fernández et al., 2018). Anifowose et al. (2016) stated that the quality of EIS improves over years which our finding was against of such report. The deviation of our result from the others could be due to the involvement of fewer numbers of consulting firms in the preparations of the EIS where for instance both in 2021 and 2020, the same consulting firm had prepared 27% and 25% of the EIS respectively. However, our findings may lay a foundation that the quality of EIS may not improve over time due to various reasons including capacity of the firms engaged in the preparation of EIS, involvement of the same consulting firm in the preparation of several projects year after year, capacity of competing agency to cull-out poor EIS during review processes and lack of frequent review of the quality of the submitted EIS itself among others.

5. Conclusions

The qualities of the EIS varied among the selected criteria of evaluations. Activities of the projects and rate of production were areas best described, yet there are differences among them where quarries were most addressed than others. In general, production processes were described good but without including the input type and quantity. Duration of each of the identified impacts, zone of influence of the identified impacts and monitoring plans were areas least dealt with. Inadequate identification of the zone of influence of the identified impacts entails knowledge gaps to whether the impacts are contained within the site or spill-over to neighboring areas. The overlook of the monitoring plan format provided by AAEPGDC to be used across the board by consulting firms who prepare EIS and uses of its variant or modified ones resulted both in omission and addition of un-necessary data. EIS have mostly failed recommending on-site sourcing of alternate energy for proponents. Legal and administrative framework from the perspective of labour and management relations was another area overlooked that was revealed by the fact that some of the evaluated EIS had dealt with repealed labour law than the extant one. Consequently, dealing with the duties and obligations of parties (workers and project proponent), among which occupational health and safety (OHS) is key, were neglected. On top of this, compensation proclamation and comparative analysis of land loss to the project vis-à-vis compensation (as job or monetary or in-kind) were the areas most neglected. Overall, analysis of the quality of EIS for the year 2020 and 2021 using non-parametric Mann-Whitney U-test has revealed their qualities are similar at different confidence interval test levels.

Therefore, project identification, description of project activities along with input supply, and adhering to the use of monitoring plan format provided by AAEPGDC could improve the quality of the EIS. Moreover, multi-stage EIS quality review at least every five years may enhance the quality of the EIA and contributes to the betterment of environment.

Declarations

Author contribution statement

Gizaw Ebissa; Utant Debebe: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Hailu Worku; Aramde Fetene: Analyzed and interpreted the data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no competing interests.

Additional information

No additional information is available for this paper.

References

AACSWMA (Addis Ababa City Solid Waste Management Agency), 2020. Environmental and Social Impact Assessment Report for Integrated Compost, Biogas Production and Electricity Generation Facility in Addis Ababa City. Addis Ababa, Ethiopia.

Acher, M., Perrouin, G., Cordy, M., 2021. BURST: a bench-marking platform for uniform random sampling techniques. In: 25th ACM International Systems and Software Product Line Conference Volume B (SPLC'21), September 6–11, 2021, Leicester, United Kingdom. ACM, New York, NY,USA, p. 5.

ADB (Asian Development Bank), 2017. Guidelines for Estimating Greenhouse Gas Emissions of Asian Development Bank Projects: Additional Guidance for Clean Energy Projects. Mandaluyong City, Philippines.

AGIP KCO, 2004. Regulatory Basis of Environmental Impact Assessment. Current Environmental Status Methodological Aspects of Environmental and Socio-Economic Impact Assessment.

Andolina, C., Signa, G., Tomasello, A., Mazzola, A., Vizzini, S., 2020. Environmental effects of tourism and its seasonality on Mediterranean Islands: the contribution of the Interreg MED BLUEISLANDS Project to build up an approach towards sustainable tourism. Environ. Dev. Sustain. 23 (2021), 8601–8612.

Andrew, Chadwick, 2010. Socio-economic Impacts: Are They Still the Poor Relations in UK Environmental Statements?.

Anifowose, B., Lawler, D., van der Horst, D., Chapman, L., 2016. A systematic quality assessment of Environmental Impact Statements in the oil and gas industry. Sci. Total Environ. 572, 570–585.

ANU (The Australian National University), 2018. Between the Plough and the Pick informal, Artisanal and Small-scale mining in the Contemporary World. Lahiri-Dutt, Kuntala (ed.).

Appannagari, R.R., 2017. Environmental Pollution Causes and Consequences: A Study. North Asian International Research Journal of Social Science & Humanities. Vol. 3, Issue 8, Aug. 2017.

Backlund, A., 2009. Impact assessment in the European Commission – a system with multiple objectives. Environ. Sci. Policy 12, 1077–1087.

Badr, El-S.A., 2010. The consideration of water resources within environmental impact assessment process in Egypt. CATRINA 5 (1), 31–39.

Badr, El-S., Zahran, A.A., Cashmore, M., 2011. Benchmarking performance: environmental impact statements in Egypt. Environ. Impact Assess. Rev. 31 (2011), 279–285.

Baker, D., Rapaport, E., 2005. The Science of Assessment: Identifying and Predicting Environmental Impacts. In: Kevin, S. Hanna (Ed.).

Bekhechi, M.A., Merder, Jean-Roger, 2002. The Legal and Regulatory Framework for Environmental Impact Assessments. A Study of Selected Countries in Sub-saharan Africa.

Bianco, L., 2021. The creation narrative in 'genesis' a case of environmental monitoring and audit. Europ. J. Sci. Theol. 17 (2), 113–124.

Bilaro, Anna G., 2019. Geological and Geotechnical Considerations in EIA Studies of Geohazards Susceptible Projects: A Review. Paper ID: ART20203824.

Bond, A., Retief, F., Cave, B., Fundingsland, M., Duinker, P.N., Verheem, R., et al., 2018. A contribution to the conceptualization of quality in impact assessment. Environ. Impact Assess. Rev. 68, 49–58.

Borioni, R., Gallardo, A.L.C.F., Sanchez, L.E., 2017. Advancing scoping practice in environmental impact assessment: an examination of the Brazilian federal system. Impact Assess. Proj. Apprais. 35 (3), 200–213.

Caldwell, L.K., 1988. Environmental impact analysis (EIA): origins, evolution, and future directions. Impact Assess. 6 (3-4), 75–83.

Cannaos, C., Onni, G., 2019. A methodological approach on the procedural effectiveness of EIA: the case of Sardinia. In: City Territory Archit (2019), p. 6.

Caro-Gonzalez, A.L., Toro, J., Zamorano, M., 2021. Effectiveness of environmental impact statement methods: a Colombian case study. J. Environ. Manag. 300 (2021), 113659.

Cashmore, M., Gwilliam, R., Morgan, R., Cobb, D., Bond, A., 2014. The interminable issue of effectiveness: substantive purposes, outcomes and research challenges in the

advancement of environmental impact assessment theory. Impact Assess. Proj. Apprais. 22 (4), 295–310.
CEA (Commission for Environmental Assessment), 2006. Biodiversity in EIA and SEA. Background Document to CBD Decision VIII/28: Voluntary Guidelines on Biodiversity-Inclusive Impact Assessment. Compiled and edited by Slootweg, R., Kolhoff, A., Verheem, R. and Hoft, R.
Chanda-Kapata, P., 2020. Public health and mining in East and Southern Africa: a desk review of the evidence. In: Zambia Ministry of Health with Training and Research Support Centre in the Regional Network for Equity in Health in East and Southern Africa (EQUINET). EQUINET DISCUSSION PAPER 121, April 2020.
Cheever, M., Graichen, K., Homeier, D., Howell, J., Kefauver, O., Kimball, T., 2011. Environmental Policy Review: Key Issues in Ethiopia 2011. Colby College Environmental Policy Group.
Damtie, M., Bayou, M., 2008. Overview of Environmental Impact Assessment in Ethiopia: Gaps and Challenges. Addis Ababa, Ethiopia.
DiGiovanni, F., Coutinho, M., 2017. Guiding Principles for Air Quality Assessment Components of Environmental Impact Assessments. International Association for Impact Assessment.
Donelly, A., Dalal-Clayton, B., Hughes, R., 1998. A Directory of Impact Assessment Guidelines. 2nd Russell Press, UK, pp. 44–164.
EFG (European Federation of Geologists), 2003. Advice document to the European commission on environmental impact assessment implementation and practice. EFG submission on the EIA process. Rue Jenner 13, 1000 Brussels.
Ehrlich, A., Ross, W., 2015. The significance spectrum and EIA significance Determinations. Impact Assess. Project Apprais. 33 (2), 87–97.
Eilperin, J., 2010. U.S. Exempted BP's Gulf of Mexico Drilling from Environmental Impact Study. Available online: http://www.washingtonpost.com/wp-dyn/content/article/2010/05/04/AR 2010 050404118.html.
EU (European Union), 2017. Environmental Impact Assessment of Projects Guidance on the Preparation of the Environmental Impact Assessment Report.
European Commission, 2009. DG ENV. Study Concerning the Report on the Application and Effectiveness of the EIA Directive. COWI, Denmark, p. 198.
FDRE (Federal democratic Republic of Ethiopia), 1995. Proclamation No.1/1995. In: Federal Negarit Gazetta, the Constitution of the Federal Democratic Republic of Ethiopia. Addis Ababa, Ethiopia.
FDRE (Federal Democratic Republic of Ethiopia), 1997. The 1997 Environmental Policy the Federal Democratic Republic of Ethiopia. Addis Ababa, Ethiopia.
FDRE (Federal Democratic Republic of Ethiopia), 2002. Environmental Impact Assessment Proclamation No. 299/2002, Federal Negarit Gazetta. Addis Ababa, Ethiopia.
FDRE (Federal Democratic Republic of Ethiopia), 2012. The 2012 Energy Policy of the Federal Democratic Republic of Ethiopia. Addis Ababa, Ethiopia.
FDRE (Federal Democratic Republic of Ethiopia), 2018. Enhancing Economic Development and Job Creation in Addis Ababa: the Role of the City Administration. Addis Ababa, Ethiopia.
Fernández, G.M.R., de Brito, L.L.A., Fonseca, A., 2018. Does size matter? An evaluation of length and proportion of information in environmental impact statements. Environ. Impact Assess. Rev. 73, 114–121.
Gagne, S.A., Eigenbrod, F., Bert, D.G., Cunnington, G.M., Olson, L.T., Smith, A.C., Fahrig, L., 2015. A simple landscape design framework for biodiversity conservation. Landsc. Urban Plann. 136, 13–27.
Gao, Qi, 2018. Mainstreaming climate change into the EIA procedures: a perspective from China. Int. J. Clim. Change Strat. Manag. 10 (3).
Gebreyesus, A.T., Koskei, S., Shen, Y., Qian, F., 2017. Review of EIA in East Africa: challenges and opportunities in Ethiopia and Kenya. Earth Sci. 6 (4), 44–50.
George, T.E., Karatu, K., Edward, A., 2020. An Evaluation of the Environmental Impact Assessment Practice in Uganda: Challenges and Opportunities for Achieving Sustainable Development.
Glasson, J., Therivel, R., Chadwick, A., 1999. Introduction to Environmental Impact Assessment, second ed.
Glasson, J., Therivel, R., Chadwick, A., 2005. In: Introduction to Environmental Impact Assessment, third ed. Routledge, London. Anifowose et al., 2016.
Green Circle, Inc., 2018. Draft Environmental Impact Assessment Report for Manufacturing of Textile Auxiliaries. Gujarat, India.
GRK (Government of the Republic of Korea), 2020. 2050 Carbon Neutral Strategy of the Republic of Korea: towards a Sustainable and Green Society.
Haile, S., 2012. Quality and Effectiveness of Environmental Impact Assessment Reports: the Case of Addis Ababa City Administration. Presented in Partial Fulfillment of the Requirements for the Degree of Master of Art in Development Studies. Environment and Development.
Heister, C.M., 2021. Examining the tradeoffs of green infrastructure for stormwater management: ecosystem services vs. Environmental and human health impacts. In: Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Sustainable Systems Department of Sustainability Golisano Institute for Sustainability Rochester Institute of Technology.
IISD (International institute for Sustainable Development), 2021. EIA Online Learning Platform. http://www.iisd.org/learning/eia. Accessed: 10 November 2021, 4:06PM.
Jeong, H.D., Chau Le, Ch., Devaguptapu, V., 2019. Effective Production Rate Estimation Using Construction Daily Work Report Data. www.intrans.iastate.edu.
Jie, L., Jing, Y., Wang, Y., Shu-xia, Y., 2010. Environmental impact assessment of land use planning in Wuhan city based on ecological suitability analysis. Proc. Environ. Sci. 2 (2010), 185–191.
Kamijo, T., 2016. How to improve EIA system in developing countries? A quantitative literature review. In: IAIA17 Conference Proceedings, 37th Annual Conference of the International Association for Impact Assessment.
Kamjo, T., 2017. How to improve EIA system in developing countries? A quantitative literature review. In: IAIA17 Conference Proceedings | IA's Contribution in Addressing Climate Change 37th Annual Conference of the International Association for Impact Assessment.
Kamijo, Tetsuya, Huang, Guangwei, 2016. Improving the quality of environmental impacts assessment reports: effectiveness of alternatives analysis and public involvement in JICA supported projects. Impact Assess. Proj. Apprais. 34 (2), 143–151.
Kennedy, A.J., Ross, W.A., 1992. An approach to integrate impact scoping with environmental impact assessment. Environ. Manag. 16, 475–484.
Khan, B., Singh, P., 2017. The current and future states of Ethiopia's energy sector and potential for green energy: a comprehensive study. Int. J. Eng. Res. Afr.
Khandare, R.V., et al., 2015. Microbial Degradation Mechanism of Textile Dye and its Metabolic Pathway for Environmental Safety, pp. 399–439. Toprak and Anis, 2017.
Kilajian, A., Chareonsudjai, P., 2021. Conflict resolution and community engagement in post-audit EIA environmental management: lessons learned from a mining community in Thailand. Science Direct, Environ. Chall. 5 (2021), 100253.
Koeppen, W., 1936. The Geographical System of the Climate, Handbook of Climatology. Borntraeger, Berlin. Bd. 1, Teil. C.
Larsen, S.V., Kornov, L., Christensen, P., 2018. The mitigation hierarchy upside down – a study of nature protection measures in Danish infrastructure projects. Impact Assess. Proj. Apprais. 36 (4), 287–293.
Lawler, D., Milner, A., 2005. Sakhalin II Pipeline Project: River Crossings Report - Initial Review, Report to AEA Technologies, 21 October 2005, p. 31. Anifowose et al., 2016.
Lee, N., Colley, R., 1991. Reviewing the Quality of Environmental Statements: Review Methods and Findings. In: Occasional Paper Number 24 (Second Edition 1992). EIA Centre, Department of Planning and Landscape, University of Manchester, Manchester M13 9PL.
Li, H., Deng, Q., Zhang, J., Olanipekun, A.O., Lyu, S., 2019. Environmental impact assessment of transportation infrastructure in the life cycle: case study of a fast track transportation project in China. Energies 12 (2019), 1015.
Longueville, A., Whitten, P., Carlman, I., 2015. Can We get "alternatives analysis redux" please?. In: 35th Annual Conference of the International Association for Impact Assessment.
Loomis, J.J., Dziedzic, M., 2018. Evaluating EIA systems' effectiveness: a state of the art. Environ. Impact Assess. Rev. 68 (2018), 29–37.
Machaka, R.K., 2020. The Improved model of the method, rights, and resources (MRR) for the evaluation of the EIA system: revising the sustainability indicators. In: Energy Efficiency and Sustainable Lighting - A Bet for the Future..
McGrath, C., Bond, A., 1997. The quality of environmental impact statements: a review of those submitted in Cork, Eire from 1988–1993. Proj. Apprais. 12 (1), 43–52.
Moduying, Vitalis Justin, 2001. Environmental Impact Assessment (EIA) System in Sabah. In: 6 th SITE Research Seminar.
Moran, Robert E., 2004. New Country, Same Story: Review of the Glamis Gold Marlin Project EIA, Guatemala. Water Quality/Hydrogeology/Geochemistry Golden, Colorado, U.S.A.
NCEA (Netherlands Commission for Environmental Assessment), 2017. Review of Scoping Report and Terms of Reference for the Environmental and Social Impact Assessment for the East Africa Crude Oil Pipeline in Uganda. Reference 7228..
Nwachukwu, S.N., 2021. The trajectory towards achieving the UN sustainable development goals in the Nigerian oil and gas environment. Int. J. Sci. Eng. Res. 12 (Issue 2), 2021.
Otienoc, V.N., Irandu, E.M., Moronge, J., 2017. Public involvement in environmental decision making in nairobi county, Kenya. Int. J. Educ. Res. 5 (10/2017). www.ijern.com.
Padash, A., Ataee, M., 2019. Prioritization of environmental sensitive spots in studies of environmental impact assessment to select the preferred option, based on AHP and GIS compound in the gas pipeline project. Pollution 5 (3), 671–685.
Peris-Mora, E., Velasco, L.V.F., 2015. The quality of the environmental impact assessment process for public road projects: a case study in Spain. J. Civil Environ. Eng. 5 (2015), 6.
Rathoure, A.K., 2021. Environment impact assessment (EIA) studies for developmental activities in India in context with EIA 2020. Oct. J. Environ. Res. 9 (1), 21–45. http://www.sciencebeingjournal.com.
Rehbein, Ch., Brklacich, M., Mitchell, S., 2018. Landscape analysis in EIA: a biodiversity ally? IAIA 18 conference proceedings environmental justice in societies in transition. In: 38th Annual Conference of the International Association for Impact Assessment.
Sampietro, M., 2016. Project team members and project goals and objectives. PM World J. V (VIII). August 2016.
Sandham, L.A., Huysamen, C., Retief, F.P., Morrison-Saunders, A., Bond, A.J., Pope, J., Alberts, R.C., 2020. Evaluating Environmental Impact Assessment report quality in South African national parks. Koedoe 62 (1), a1631.
Shahbazi, S., 2015. Material Efficiency Management in Manufacturing. Malardalen University, Sweden.
Shahbazi, S., Kurdve, M., Bjelkemyr, M., Jonsson, Ch., Wiktorsson, M., 2013. Industrial waste management within manufacturing: a comparative study of Tools, policies, visions and concepts. In: Proceedings of the 11th International Conference on Manufacturing Research (ICMR2013.
SPREP (Secretariat of the Pacific Regional Environment Programme), 2016. Strengthening Environmental Impact Assessment: Guidelines for Pacific Island Countries and Territories.
Swangjang, K., Cumkhett, S., 2021. Mitigation Hierarchy; an Effectiveness of Project Control Mechanism: Handbook of Advanced Approaches towards Pollution Prevention and Control. In: Rahman, R.O.A., Hussain, C.M. (Eds.).

The National Commission, 2011. Deep Water: the Gulf Oil Disaster and the Future of Offshore Drilling. Report to the US President on the BP Deepwater Horizon Oil Spill and Offshore Drilling.
Toprak, T., Anis, P., 2017. Textile industry's environmental effects and approaching cleaner production and sustainability, an overview. J. Text. Eng. Fashion Technol. 2 (4), 2017.
Ulibarri, N., Scott, T.A., Perez-Figuero, O., 2019. How does stakeholder involvement affect environmental impact assessment? Environ. Impact Assess. Rev. 79 (2019), 106309.
UNEP (United Nations Environmental Programme), 2002. Topic 9 – review of EIA quality. In: EIA Training Resource Manual, second ed.
Vandana, M., John, Shiekha E., Maya, K., Sunny, Syam, Padmalal, D., 2020. Environmental impact assessment (EIA) of hard rock quarrying in a tropical river basin—study from the SW India. Environ. Monit. Assess. 192 (2020), 580.
Weston, J., 2004. EIA in a risk society. J. Environ. Plann. Manag. 4 (2), 313–325. Anifowose et al, 2016.
Weston, Dr. Joe, 2011. Screening for environmental impact assessment projects in England: what screening? Impact Assess. Proj. Apprais. 29 (2), 90–98.
Wilson, J., Hinz, Sh., Coston-Guarini, J., Maze, C., Guarini, J.-M., Chauvaud, L., 2017. System-based assessments—improving the confidence in the EIA process. Environments 4 (2017), 95.
Wood, G., 2008. Thresholds and criteria for evaluating and communicating impact significance in environmental statements: 'See no evil, hear no evil, speak no evil'. Environ. Impact Assess. Rev. 28 (2008), 22–38.
Worku, Hailu, 2017. Mainstreaming environmental impact assessment as a tool for environmental management in Ethiopia: current challenges and directions for future improvements balancing environmental impacts with economic development to achieve sustainable development. Environ. Qual. Manage 26 (2017), 75–95.
Worku, H., 2018. Environmental and socioeconomic impacts of cobblestone quarries in Addis Ababa and implication for resource use efficiency, environmental quality, and sustainability of land after-use. Environ. Qual. Manage 27 (2017), 41–61.
Wu, L., Ye, K., Gong, P., Jinding, X., 2019. Perceptions of governments towards mitigating the environmental impacts of expressway construction projects: a case of China. J. Clean. Prod. 236, 117704.
WWF-UK, 2005. Risky Business – the New Shell: Shell's Failure to Apply its Environmental Impact Assessment Guidelines to Sakhalin II.
Wylie, D.K., Bhattacharjee, S., Rampedi, I., 2018. Evaluating the quality of environmental impact reporting for proposed tourism-related infrastructure in the protected areas of South Africa: a case study on selected EIA reports. Afr. J. Hospit., Tour. Leisure 7 (3).
Yuan, F., 2008. Land-cover change and environmental impact analysis in the Greater Mankato area of Minnesota using remote sensing and GIS modelling. Int. J. Rem. Sens. 29 (4), 1169–1184.
Zhang, J., Kornov, L., Christensen, P., 2013. Critical factors for EIA implementation: literature review and research options. J. Environ. Manag. 114, 148–157.