



Case Study

The Need for a Robust Review System to Improve the Quality of Environmental Impact Statements: An Indian Case Study Analysis

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Abstract: Environmental impact assessment (EIA) report, the final output of the EIA process forms the basis for environmental impact statement (EIS) review and decision-making, implying the need for its good quality. This empirical study is based on the literature review, opinions of EIA consultants, and views of experts associated with the EIA system in India. It is inferred that the overall quality of the EIS is below par and there are several inadequacies in the EIA appraisal system. Given the strong correlation between a robust EIS review system and a good quality EIS, a two-tier structured, transparent, and criteria-based review mechanism based on good practices is suggested. Further, it is crucial to adopt a professional approach for appraisal and capacity building of the professionals engaged in conducting the EIA and reviewing the EIS.

Keywords: EIA appraisal, EIA process, EIA report, EIA review, EIA system, EIS evaluation checklist

1. Introduction

The third stage of the four-stage environmental impact assessment (EIA) process [1] is the review of the EIA report, also referred to as environmental impact statement (EIS) in the literature and used interchangeably in this study, by the competent authority to decide on the grant of environmental approval. Given that an EIS is the final output of the EIA process and its quality is one of the main factors influencing the EIA effectiveness, the EIS needs to contain the essential environmental information related to project and decision-making [2,3], abides by the standards of evidence and analysis within relevant disciplines, and demonstrates transparency regarding the methods used and the findings [4]. The basic intention of the EIA review is to determine whether the EIA report: (a) is complete; (b) contains correct and comprehensive details; and (c) could form the basis for taking a well-informed decision on the grant of environmental approval for the proposed project [5,6]. The extent to which the EIA has achieved its objective is evaluated in terms of its effectiveness in achieving its substantive goals and its place within broader decision-making contexts, far beyond procedural issues [7]. The low quality of the EIS is among the most frequently debated issues, particularly in academic literature [8].

The European Commission [9] provided a summary of the main characteristics of a good EIS to meet the objective, *viz.* effective communication of good information to decision-makers and the people likely to be affected by the proposed project. The EIA quality is the fundamental indicator of an effective EIA system, and the improved quality

of the EIS helps to solve the constraints of EIA systems. The quality of the EIS is often used as a major indicator of EIA effectiveness [10,11]. According to Lee et al. [12]: “It is the appropriateness and quality, and not the volume of information provided, which is the relevant consideration”, and Ross et al. [13]: “It is much easier to review a good EIS than a poor one”. Most of the research on EIA quality has been focused on the quality of EIS [14], primarily on the furnishing of important information about different components of EIA. Bond et al. [15] identified nine dimensions of quality to conceptualize and define quality, given that the quality of EIA is a foundation for a good EIS, and concluded that quality and effectiveness are related to an extent. Gunther et al. [16] exhibited certain features of approaches to address the quality of the EIA systems, given the lack of clarity in the concept to precisely define and establish quality control or quality assurance in EIAs. It was concluded that the strength of the EIS review process would vary among countries because of context-dependency of the effectiveness of each approach.

Rocha et al. [17] observed that there was a lack of in-depth empirical research on how the EISs are reviewed by authorities because of scant scholarly attention, even though it is relevant to the effectiveness of the EIA, and that a few studies have gone above the domain of regulatory evaluations to understand the managerial intricacies of the review process. Further, the roles of reviewers remained limited to advising authorities about permitting a project or not. The EIS review is not just a matter of verifying the necessary contents and pertinent information, but also the quality and success of the whole EIA process [18]. Canelas et al. [19] considered the quality of the EIS important to properly inform the public and the decision-makers about the significant environmental effects of the project. The EIS quality needs to ensure that the information provided is sufficient for decision-making and enables classifying [20]: “(i) the level of adequacy of the information provided, (ii) the importance of inadequate information for decision-making, and (iii) the amount of extra effort needed to provide adequate important information for decision-making.” Accordingly, quality assessment of randomly selected EISs was conducted to grade them from A, providing full information with no gaps or weaknesses, to E, providing very poor information with major gaps or weaknesses, and/or missing information that would hamper the decision-making. Kabir and Momtaz [21,22] discussed probable factors that affect the quality of the EISs in Bangladesh. Pöder and Lukki [14] concluded that the evaluation of the EIS quality for the reliability of information and its completeness for the adequacy of relevant information are different, considering different skill sets are required.

2. EIS review and quality of EIA reports

The review stage of the EIA process is an essential quality control function to ensure that the data collected and the information presented about environmental impacts in the EIS is adequate to form the basis for decision-making [23] and that EIA quality contributes to its effectiveness [24]. Sandham et al. [25] found that over-detailed regulation does not lead to improved quality of the EIA report. Even when general or sectoral guidance is available and experienced reviewers are engaged in the EIS review process, systematic review criteria [26] is essential for a rigorous and transparent review process [23] and to establish its objectivity. Rocha et al. [17] suggested that reviewers should go above the description of the review process to understand its genuine ramifications for EIA effectiveness. Al-Damkhi et al. [27] and Al-Mebayedh et al. [28] discussed guidelines to review and improve the quality of EIA reports.

For a long time, checklists have been a popular tool for appraising EIA reports. Recognizing the need for a systematic review, Simpson [29] developed a review package as an effective tool to review the quality of EIS and also as a checklist to prepare EIA reports. The scope of the EIS quality considered in the environmental appraisal review package [12] includes conformance with the applicable regulations and international best practices in procedures and methods. Given that a large amount of information about the type and impacts of development is contained in the EIS, the objective of the review package is to: “(a) provide the reviewers with a framework within which to interpret this information, (b) enable reviewers to assess the quality and completeness of the information relatively quickly, and (c) enable reviewers to make an overall judgment of the acceptability of the EIS as a planning document”. The review procedure [12] consists of conducting the review and summarizing joint judgment on EIS quality and highlighting the principal strengths and weaknesses of EIS, the omissions which need rectification before impacts can be satisfactorily evaluated, besides compliance with regulatory requirements and best global practices. A checklist of information [9] in different chapters of the EIS is designed to review the quality of the EIS to verify the relevance and adequacy of the information provided for decision-making and consultation. It gives two sets of instructions for using the checklist,

viz. to review an EIS to ascertain the adequacy of the information and further information requirements, if any, and to review EISs to rank them.

Considering weaknesses in the EIA reports submitted to the Asian Development Bank and the importance of the EIS quality for the effectiveness of the EIA system and good decision-making, Kamiyo and Huang [30,31] carried out an extensive review of the quality of the EIA reports from developing countries to identify the key factors using the Lee-Colley review package, considering it to be robust, comprehensive, and widely used for assessing the EIS quality in developing as well as developed countries [22,32–34]. When using the Lee-Colley review package for Egyptian EISs, Badr et al. [35] concluded that descriptive tasks in the EIA reports were performed better than the core elements. The effectiveness of the EIA process can be viewed in terms of both procedural criteria and substantive outcomes [11,36]. Peterson [20] observed a wide variation in the quality assessment of an EIS carried out by several independent reviewers – consultants and individuals from competent authorities, and individuals and groups of reviewers using guidelines [9]. It was concluded that the group was more critical of the details than individual reviewers, and a large number of relevant questions facilitated a proper assessment of the EIS quality for a wide range of projects. Based on the review of modified checklists proposed by several researchers from 1988 to 2008, Pöder and Lukki [14] however, observed that there was a lack of analysis on the validity of these methods in terms of their performance in measuring the quality of EIS and highlighted inadequacies/limitations due to the characteristics of the two most widely used EIS evaluation tools – the Environmental Statement Review Package [12] and the EIS Review Checklist [9]. World Wide Fund for Nature (WWF) [37] proposed an EIS review checklist focusing on the scientific and technical adequacy of the EIS to meet good practice principles for decision-making, not as a grading tool. Laivina et al. [38] proposed a systematic multi-factor method to include quality criteria to assess an EIS and conduct an in-depth assessment of the most important elements of the EIS only to shorten the evaluation time, and Kalnins et al. [39] proposed an indicator-based methodology to evaluate EIA reports.

Paliwal [40] and Mathur [41] identified several constraints in the Indian EIA system, including the poor quality of the EIA reports and limited review. Rathi [42] identified the Indian EIA review mechanism as being weak, posing a major challenge to the robustness of the Indian EIA system and the EIA's effectiveness, and reported that the EIA reports lacked realistic impact assessment and the quality of the EIA reports was far from satisfactory. Based on the online survey on the quality of the EIAs in India, Jha-Thakur [43] reported that 37% of participants agreed that the quality of the EIA reports in India was good, 15% were neutral, and 48% disagreed. Thus, even after 25 years of EIA legislation in India, the verifiability of the EIA, including accuracy of impact predictions and EIS quality, continues to be a weakness in the EIA system. Given that no empirical studies have been undertaken for the EIS review process in India, though there have been some studies concerning the quality of EIA reports, as observed from the above, this study is an attempt to fill this gap.

3. EIS review and quality of EIA: Indian case study

3.1 Methodology

The methodology used for the study consisted of: (a) review of the literature related to the EIA review and EIA quality in India from the leading international journals dwelling on the EIA-related aspects; (b) online open-ended questions asked to 25 randomly selected accredited EIA consultants to seek their opinion on the quality of the EIA reports and the EIS review process in India; and (c) views of experts (experienced with the EIA system in India, directly connected with the EIA review process at the central level, as well as the mandatory accreditation of EIA consultants) [44] to substantiate the findings from the literature and the opinion of the consultants.

3.2 Findings

As per the EIA regulation [45,46], the EIA appraisal mechanism consists of: (a) constitution of expert appraisal committees at the central and state levels with a clear demarcation of the projects to be appraised; (b) scrutiny of the EIA report by the concerned regulatory authority for the terms of reference (TOR) prescribed for preparing the EIA report; (c) examination of the EIA report by members of the expert appraisal committee; (d) detailed and transparent appraisal of

the EIA report by the appraisal committee in a proceeding to which the project proponent is also invited for furnishing necessary clarification; (e) categorical recommendations on conclusion of the proceeding to the concerned competent authority for either granting environmental clearance on stipulated terms and conditions or rejecting the application with reasons; and (f) final decision taken by the competent authority. Timelines are prescribed for the scrutiny as well as the appraisal, and the eligibility criteria for expert appraisal committee members are also prescribed in the regulation. However, in practice: (a) regulatory authority does not appear to carry out preliminary scrutiny of the EIA reports uploaded by project proponents to verify that the specified TOR is complied with; (b) the project proponent arranges to deliver a copy of the EIA report to each of the members of the appraisal committee; (c) the EIA consultant, who had prepared the EIA report, makes the presentation to the appraisal committee on behalf of the project proponent and hands over a copy of the presentation to each member; (d) the presentation forms the basis of the EIA appraisal rather than the EIA report, without a system to ensure that the presentation is strictly based on the information contained in the EIA report; and (e) environmental clearance is recommended for almost every project. It is found that while the appraisal procedure is prescribed in the regulations, the appraisal criteria are not prescribed. Also, while eligibility criteria for the members of appraisal committees are notified, and part-time members having different backgrounds and expertise (not necessarily related to the EIA) are appointed to appraisal committees, the process for constituting appraisal committees by the regulatory authority is not transparent. Figure 1 depicts the highlights of the opinions received from 14 EIA consultants on the quality of the EIA reports and EIS appraisal mechanism.

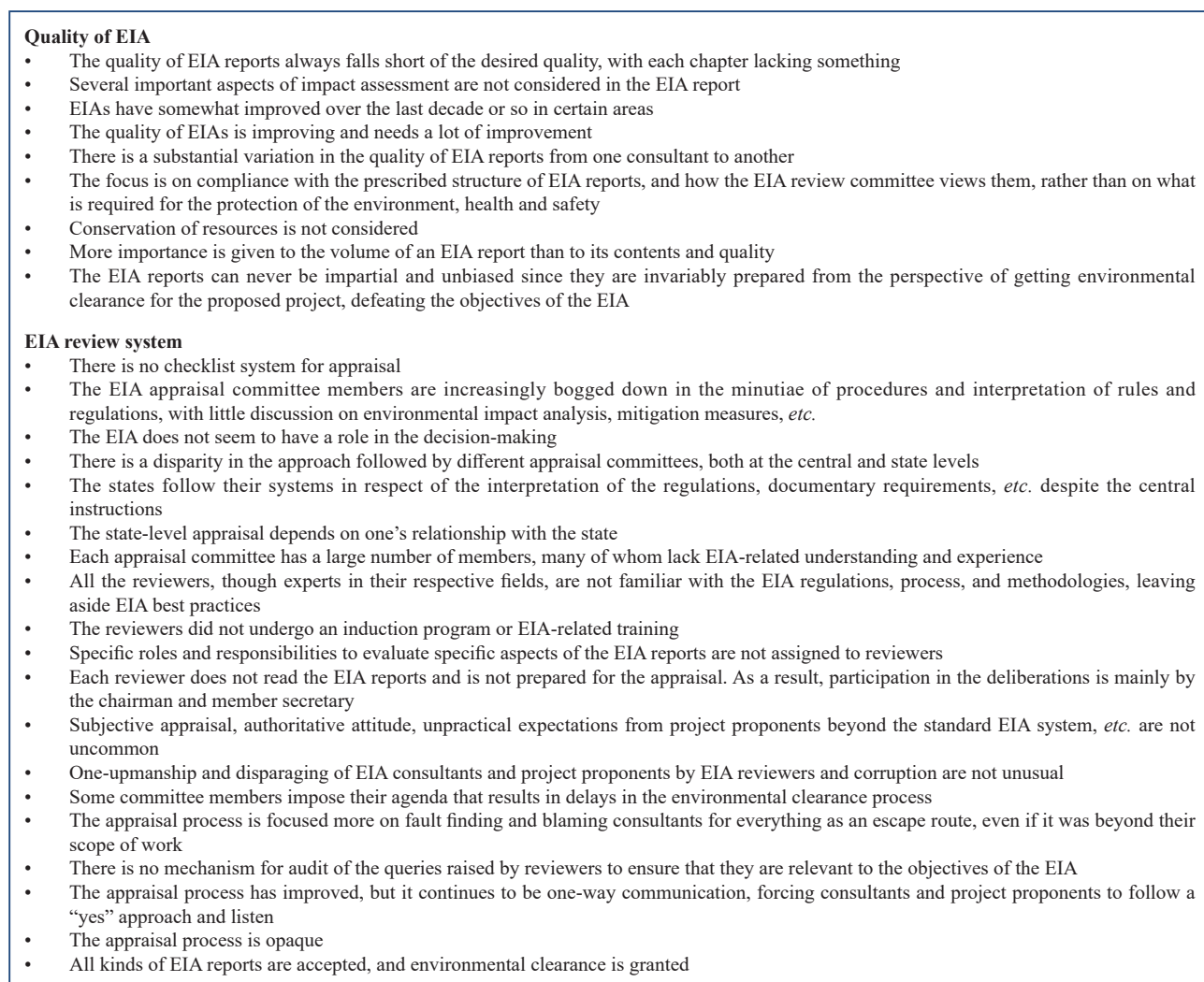


Figure 1. Highlights of opinions of the EIA consultants

4. Discussion

The opinion of the EIA consultants that the EIA reports miss out on several basic and important aspects of environmental impact assessment, and mitigation measures and that the quality of EIA reports leaves much to be desired is corroborated by the views of two experts associated with the accreditation process for EIA consultants and who have examined over 200 EIA reports submitted for environmental clearance in the last ten years or so: “The sad fact is that many EIAs are not up to mark” and “The overall quality of the EIA reports is below par. One can observe the poor quality in almost all the material chapters of the report”. Further, it is not uncommon for the National Green Tribunal to order cancellation of the already granted environmental approvals. The latest case reported by Ramanathan [47] is a reflection on the quality and the review of the EIA reports. The appraisal process giving importance to the volume of EIA reports and procedural compliance is also corroborated by the experts that the reports are bulky and the appraisal is ineffective because the reports cannot be examined within the short time available to the committee members. Further, as long as the consultants prepare the EIAs with the sole objective of seeking environmental clearance for their clients, rather than treating the EIA as “a process having the ultimate objective of providing decision-makers with an indication of the consequences of their actions [48]”, the quality of EIAs is anticipated to remain the same. This is also echoed by an expert: “As long as the EIA reports are prepared by project proponents, there is no way we can expect good quality EIA reports from the consultants”. This is also in agreement with Rathi [42], who reported that EIA consultants do not prepare good quality EIA reports, possibly because consultants are hired and paid by project proponents. However, there is no assurance that the EIA quality would improve merely by letting a third party to select the EIA consultants for the proposed projects. Moreover, the project proponent needs to be accountable for the environmental impact assessment, mitigation measures, and environmental management program [49] for the project proposed.

The inadequacies in the appraisal system opined by the consultants are also reverberated by the experts: “The appraisal committees have a major problem of not having competent and trained professionals to assess EIAs” and “Given that the EIA reports are voluminous documents and eight to ten projects are appraised in one day, it is not possible for members of the appraisal committee to critically examine the reports and understand the projects thoroughly and hence, most of the time, the appraisal is ineffective”. Thus, it is imperative to have competent EIA professionals on the appraisal committees. Further, the prevailing mechanism of *ad hoc* appraisal carried out based on the presentation given by the project proponent in the meeting needs to be replaced with a thorough appraisal of the EIA report. For this, the role of each member of the appraisal committee could be specified to perform a detailed examination of a part or the entire EIA report using the prescribed criteria and a uniform mechanism created by the appraisal committees to arrive at the joint appraisal of the EIS [17,18,20] and EISs could be ranked [9]. Several EIA consultants believe that, at times, they are not treated properly by some members of the appraisal committees. There is merit in the suggestion of a consultant that the appraisal system could be strengthened by building trust between the consultants and the appraisal committee. For this, the appraisal committees need to change their approach by treating the consultants as committee officers, similar to how advocates are treated as court officers.

Among others, the EIS review system is expected to exercise quality control [23] for the EIA reports, whether the EIA is conducted by a project proponent or a third party. The nexus between the robustness of the EIS review process and the quality of EIA reports is very strong as: (a) “The EIA review mechanism is not robust, and it does not motivate consultants to prepare good quality reports [42]”; (b) surmised by experts: “At times, the EIA reports are approved without proper scrutiny due to shortage of time, lack of understanding, or other factors, and EIS quality is the first victim” and “It is not surprising that the lack of professionals with integrity carrying out EIAs, appraisal carried out by the appraisal committees appointed based on political considerations, and inadequate review mechanism result in poor quality of EIA reports”; and (c) opined by a consultant: “Nothing is going to change as long as all kinds of EIA reports are accepted, and environmental clearance is granted. The rejection of poor-quality reports by appraisal committees can only help to improve the quality of the EIA reports”.

The quality of an EIA report is governed by the project proponent, EIA consultant, and the EIA review mechanism. It is indirectly influenced by the agency that accords mandatory accreditation to the EIA consultants and the public. Both the project proponent and the EIA consultant have vested interests. The former wants to obtain environmental approval for the proposed project yesterday, and the latter requires EIA assignments for its business and is willing to follow shortcuts and compromise its professionalism, more so, in the intensely competitive environment. The public

has an extremely limited role in the Indian context [45] because the public consultation is held very late in the EIA lifecycle. While the accreditation agency needs to have sturdy systems to ascertain that only competent EIA consultants get accredited, it also has a vested interest to some extent since its revenue is linked to the number of accredited EIA consultants. Given the above, a robust EIA review mechanism imbibed in the well-formulated EIA regulation and its earnest and effective implementation can only serve as a quality control tool for the EIA reports and give impetus to developing high-quality EIA reports in the long run. Thus, comprehensive [50] and high-quality information is more important [23] than the voluminous information for the objective EIS review. A strong EIS review system could only induce the EIA consultants to improve the quality of the EIA reports even when the project proponents are the ones hiring the EIA consultants.

5. Conclusions and way forward

The study is based on the literature of the EIS review. It is complemented by the opinions of the EIA consultants obtained via online inquiry and substantiated by the views of experts directly associated with the EIA system in India. Every shade of opinion of the consultants and experts reveals that the overall quality of the EIA reports is sub-standard and the EIS review system is weak. The view of one expert sums up these and the ramifications thereof: “Knowing this state of affairs, *i.e.* any document having the title “EIA report” sails through the appraisal process, EIA consultants do not strive for good quality EIA reports”. It is learned from private communications that the accomplishment of the mandatory accreditation scheme for EIA consultants [44] to enhance the quality of EIAs is not evident even after a decade or so of its existence and that the scheme has not been reviewed for its efficacy.

Given the aspirations of the people, the elected representatives in democracies are under pressure to get environmental clearance for the proposed projects speedily. Added to this, many developmental projects seeking environmental clearances put the EIS appraisal system under severe pressure of time [42]. Even though the appraisal committee members meet regularly, they have little time to thoroughly review the EIA reports. Hence, decisions are taken based on the 15 to 20-minute presentation made by project proponents. The final decision is in the form of “go” or “no go,” and it is invariably “go” based on the overall subjective and *ad hoc* considerations. It is not surprising that EIAs are influenced by political and socio-economic conditions and constraints [51] because of the priorities given by the developing countries for economic growth, poverty alleviation, employment generation, and development and improvement of infrastructure. As a result, the EIA review process boils down to the minutiae of interpretation of the applicable rules and regulations, and procedural compliance with little discussion on environmental impact analysis, putting good practices on the back seat in the regulation as well as its implementation [42].

Ad hoc EIS reviews carried out by appraisal committees, constituted in a non-transparent manner, without following structured evaluation criteria, have limitations in assessing the quality of EIA reports and hence the effectiveness of the EIA process as a whole [10,24,42]. It is evident that the EIS review mechanism fails to exercise quality control on EIA reports, considering that the robustness of the EIS review process has a positive correlation with the quality of the EIA reports. Given the need for having a more structured, transparent, participative, interdisciplinary, objective, uniform, detailed, and grounded EIS review meeting practices [17], and for ensuring that the EIA plays its intended role in decision-making, the way forward is to follow a two-tier simplified, practical, and robust EIS review mechanism as depicted in Figure 2 [6] using the criteria checklists presented in Figure 3 and 4 [6].

While a consistent and rigorous accreditation system for EIA consultants operated by accredited EIA professionals could help improve the quality and integrity of EIAs, a robust EIS review mechanism imbibed in the well-formulated EIA regulations and its earnest and effective implementation can only make a significant difference in ensuring that the spirit of the law is followed rather than only the letter of the law and making the EIA reports useful to stakeholders. After all, the EIA reviewers are expected to look at the big picture, the overall context of the proposed project. Extending the mandatory accreditation system for the EIA professionals preparing the EIA reports for the EIA reviewers [26] and appointing competent members on the EIA appraisal committees in a transparent manner would further strengthen the EIS review system. In developing countries, only a few institutions are offering EIA courses in their curricula, and many professionals engaged in preparing and reviewing EIA reports may have not taken these courses [6]. Hence, there is a need for capacity building and rigorous appraisal of the EIA professionals involved in the accreditation

process of the EIA consultants and reviewing the EIA reports engaged in preparing the EIA reports. The case study method in academic is considered an effective tool for learning. Thus, this country-specific study should be useful for developing countries, more so where political and socio-economic scenarios are similar.

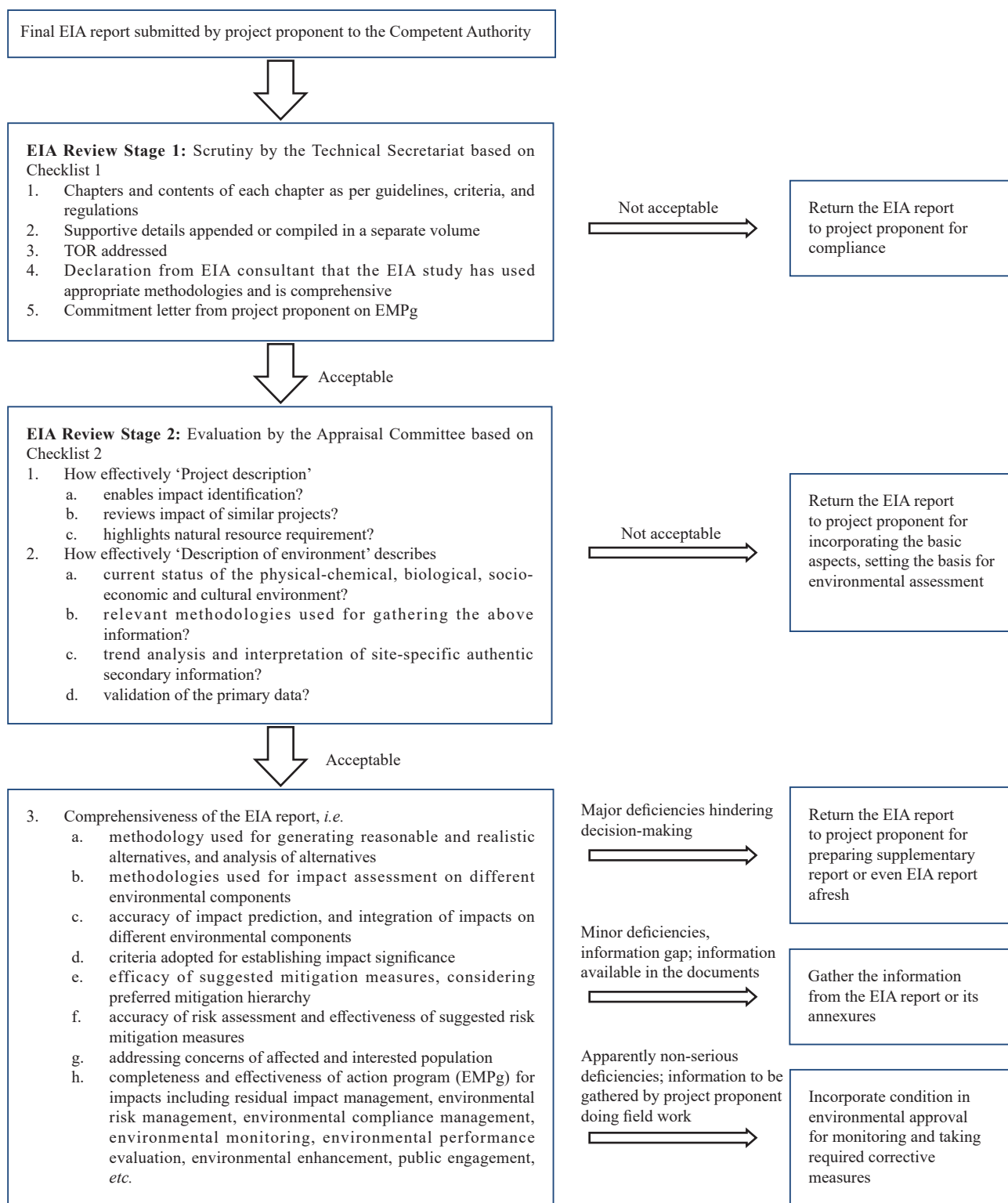


Figure 2. EIA appraisal methodology [6]

Examining conformity to basic requirements

1. Chapters and contents of each chapter of the EIA report meeting requirements prescribed in the applicable EIA regulations
2. Supporting details appended or compiled in a separate volume
3. Use of standard terminologies
4. Certificate from the EIA consulting organization where
 - i. EIA study is conducted, and the EIA report is prepared in accordance with the robust quality management system adopted by the EIA consulting organization for the EIA process. The TOR are addressed
 - ii. Relevant methodologies are adopted to ensure relevance, authenticity and consistency of the data used and predictions done
 - iii. EIA report is complete, meeting regulatory requirements
5. Commitment letter from the project proponent on the implementation, operationalization and maintenance of the proposed environmental management program, including environmental monitoring simultaneously with the project and making provision for the required funds
6. Presentation of data, information, observations, findings, *etc.* made in graphical, pictorial and tabular representations (in this order), and maps and flow charts, avoiding long texts as far as possible
7. Point-wise compliance with TOR in a tabular form giving references to the concerned sections, paragraphs, or pages of the EIA report where each is addressed for compliance

Figure 3. Checklist 1 [6]

Evaluation of the adequacy of the information for each phase of the project lifecycle

Green-field projects

1. General
 - i. Consistency in the language and data used
 - ii. Brief and crisp EIA report, while being comprehensive with supportive details appended or compiled in a separate volume
 - iii. Proportionate extent and depth of coverage in each chapter
 - iv. Comprehensiveness of the standalone non-technical executive summary
 - v. Due diligence is carried out on the data and information provided by the project proponent
2. Introduction
 - i. The purpose of the EIA study, background information on the project proponents and the project, and the need and importance of the proposed project for the region as well as the country
 - ii. The overall synoptic view of the site, consisting of historical background, geological, biophysical and social features
 - iii. Definition and delineation of the study area on the authentic and updated base map, with latitudes and longitudes
 - iv. Status of the available infrastructure-physical as well as social with photographs
 - v. Time period of conducting the EIA study
3. Project description
 - i. Technology proposed to be used, whether commercially proven or not
 - ii. Major project-related and allied activities are included separately in each lifecycle phase of the project and represented in flow diagrams or flow charts
 - iii. Construction schedule of the project
 - iv. Resource requirements, including construction materials, water, energy, other utilities and manpower, and the sourcing
 - v. The material balance for the processes, whether continuous or in batch, showing all the inputs, intermediates and products, and wastes generated at every stage, and proposed inventories and sourcing/evacuation of these substances
 - vi. Material handling, storage, and transportation practices
 - vii. Quantities and characteristics of wastewater and wastes (hazardous, e-waste and others), treatment systems and modes of disposal
 - viii. Pollutants load (tonnage) of each of the pollutants emitted and discharged as air emissions, wastewater, solid and semi-solid waste, *etc.*
 - ix. Review of the environmental impacts of similar projects, *etc.*
4. Description of the existing environment
 - i. Existing activities, major resources and sources of pollution in the study area
 - ii. Period of generation of primary data for each environmental component
 - iii. Justification for the selection of the monitoring or field investigation locations for different parameters
 - iv. Methodologies adopted for the collection and generation of relevant data, including project-specific parameters, trend analysis and interpretation of the data relevant to the project site for physico-chemical, biological, socio-economic, cultural and visual environmental components
 - v. The methodology used for the verification and validation of the data collected as well as generated
 - vi. Representation of the monitored baseline values of each of the parameters for the physico-chemical parameters, along with the corresponding permissible values as per the respective applicable regulations, and mapping on the base maps
 - vii. Representation of the relevant ecological and social data, duly validated for the study area, and mapping on the base maps

Figure 4. Checklist 2 [6]

- viii. Description of resources which are susceptible to change or have potential getting affected
- 5. Consideration of alternatives
 - i. Methodologies used for generating reasonable alternatives for project design, site, technology, implementation, operation, and/or no-project alternatives
 - ii. Methodologies used for comparative assessment of alternatives
 - iii. Justification for the selected alternative
- 6. Impact assessment and mitigation measures
 - i. Methodologies adopted for impact identification, prediction or estimation, and assessment or evaluation
 - ii. Estimation of the loss of flora and dependent fauna, other fauna, and their habitats
 - iii. Estimation of impacts of extraction, storage, and transportation of resources from the identified sources to the project site
 - iv. Interpretation of the water balance diagram showing all the inlet and outlet streams to/from all the users and equipment
 - v. Use of treated wastewater and its disposal mechanism in monsoons
 - vi. Identification of different types of solid waste from different sources, estimation of the quantities, identification of suitable storage places within project premises, and treatment and disposal mechanism
 - vii. Prediction of changes in land use/land cover in the core and buffer zones considering the development of physical infrastructure, and induced and associated growth
 - viii. Prediction of changes in the landscape
 - ix. Estimation of impacts due to changes in the drainage pattern
 - x. Prediction/estimation of impacts arising from the transportation, handling, and storage of feedstock, products, utilities, and waste.
 - xi. Identification of fugitive sources of emissions, including handling, transportation or conveyance, storage, leakages, and impact assessment
 - xii. Impact assessment on physico-chemical components of the environment, including air, water, and land at the locations where the environmental baseline monitoring was carried out
 - xiii. The impact assessment on ecology and biodiversity, including flora, fauna and avifauna, social and abiotic components of the environment from project-related activities, and the changes predicted in physico-chemical parameters at the locations where field investigations were carried out
 - xiv. Methodologies used for establishing significant impacts on each environmental component
 - xv. Mapping of the predicted concentration levels of air pollutants on the respective base maps of adequate size along with baseline concentration values of the corresponding parameters and the receptors
 - xvi. Prediction of vulnerable zones and mapping, baseline and predicted information, and receptors on the base map
 - xvii. Social and cultural impact assessment, consisting of evaluation of all the impacts on human beings and the forms in which people and communities interact with their biophysical, cultural, and socio-economic surroundings
 - xviii. Specific mitigation measures suggested, corresponding to each significant impact in the hierarchy of impact avoidance, minimization, control and compensation
 - xix. Estimation of employment potential, direct as well as indirect, taking into consideration skills mapping of the local population, *i.e.* available local skills, level of proficiency, and skills required for different project-related activities
 - xx. Social need assessment
 - xxi. Integration of environmental impacts on different components of the environment, considering strong linkages between different impacts
 - xxii. Justification(s) for concluding that there will be 'no impacts' or the impacts will be 'insignificant'
- 7. Environmental monitoring program, either as a separate chapter or part of the environmental management program chapter
 - i. Details on monitoring for environmental compliance with the applicable regulations, consisting of
 - a. locations (preferably the same where baseline monitoring was carried out), physico-chemical, biological and social parameters, and frequency
 - b. methodologies for sampling, sample preservation and transportation, and analysis
 - ii. Administrative structure of the monitoring cell responsible for implementing and operationalizing the environmental monitoring program, and estimation of the funds' requirement for capital and recurring expenditures
 - iii. Mechanism of data representation and reporting
 - iv. Details on monitoring for performance evaluation and representation as indices, *etc.*
- 8. Environmental management program
 - i. Administrative structure of the cell responsible for implementing, operationalizing and maintaining the environmental management program (EMPg), consisting of programs for environmental impact management, residual impact management, reduction of environmental impact prediction uncertainty, environmental monitoring, environmental compliance management, and environmental and social enhancement, along with the project and estimated funds required for capital and recurring expenditure for each of these programs
 - ii. Integration of the actions arising from additional/special studies, including risk assessment and marine environmental assessment
 - iii. R&R program for the project affected persons
 - iv. Specific environmental management programs, like
 - a. topsoil management
 - b. soil erosion and soil degradation management
 - c. transportation and traffic management
 - d. construction waste management

Figure 4. (Continued) [6]

- e. management of large volumes of non-hazardous industrial waste, ash, *etc.*
- f. occupational health and safety management
- g. oil spill management
- h. green belt development, showing width along the inner periphery of the project boundary
- v. Social upliftment programs, including action program on social needs assessment report, like enhancing employment opportunities through skill development and improvement through vocational training and entrepreneurship development programs, and contributions to achieving the UN's sustainable development goals for the local population
- vi. Resource conservation measures, including cleaner production, utilization of waste in some other facilities, water harvesting, *etc.*
- vii. Measures for reduction of carbon footprint, creation of artificial habitats, greening and landscaping, *etc.*
- viii. Mechanism for measuring, analyzing, and assessing environmental performance against a set of criteria like benchmarking
- ix. Mechanism of periodic audit of EMPg, management review and revision
- x. Periodic training programs for the personnel at different levels
- xi. Mechanism of engagement with the public and external authorities; *etc.*

Brown-field projects

1. Comprehensive environmental management program for the project complex as a whole, incorporating the features described above for green-field projects
2. Information on the operating facility, *viz.:*
 - i. Environmental impact assessed and mitigation measures implemented:
 - a. Due diligence of the environmental impacts assessed, and the models or software used for prediction/estimation
 - b. Credibility of the assumptions made in predictions
 - c. Accuracy and completeness of the environmental impact assessment conducted (based on the currently measured values of parameters and those predicted earlier)
 - d. Performance evaluation of the control and other mitigation measures employed
 - ii. Prevailing environmental management program:
 - a. Compliance with the applicable environmental regulations
 - b. Efficacy and performance of the environmental monitoring program
 - c. Efficacy and performance of the EMPg
 - d. Status of the fulfilment of the commitments made by the project proponent, and environmental and social environmental enhancement programs
 - e. Observations on the audit reports for EMPg, environmental, safety, energy, water, *etc.*, and management review; *etc.*

Figure 4. (Continued) [6]

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