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Reviewing Biological Consideration in Nepalese Environmental Impact Assessment

Tej Kumar Shrestha[1] [2], Sandhya Manandhar[3], Ganesh Paudel[4], Anish Parajuli[5], Shanta Ram Baral[6], Anju Koirala[7], Sunita Shrestha[8]

Lecturer, Department of Environmental Science, Khwopa College, Bhaktapur, Nepal[1]

Managing Director, Lumbini Environmental Services Pvt. Ltd, Kathmandu, Nepal[2]

Biodiversity Program Officer, Lumbini Environmental Services Pvt. Ltd, Kathmandu, Nepal[3]

Assistant Planning Officer, Department of Forests, Babarmahal, Kathmandu, Nepal[4]

Program Coordinator, Lumbini Environmental Services Pvt. Ltd, Kathmandu, Nepal[5]

Assistant Forest Officer, Department of Forests, Babarmahal, Kathmandu, Nepal[6]

Research Officer, Lumbini Environmental Services Pvt. Ltd, Kathmandu, Nepal[7]

Lecturer, Om Health Campus, Kathmandu, Nepal[8]

ABSTRACT: EIA is an important tool to achieve Sustainable Development that constitutes analysis of development projects impacts on biological, physiochemical, socio-economical and cultural components of the environment. Increasing urbanization and industrialization has been posing adverse impact on biodiversity and thus the review of biological component is getting momentum in developing countries like Nepal and this study also aims to review the quality of EISs in this aspect. Twenty EISs were randomly selected from energy, road, forestry and health sectors representing approved EISs held in MOPE in the period between 2005 and 2015. Evaluation checklist was developed by modifying Lee and Colley Review package and MoFSC, 2002 review guidelines. Energy sector performed better than other sectors with only this sector with high performance EISs, while other sectors performed either medium or low quality. One way ANOVA shows significance difference in the mean performance of EISs in different phases ($F=3.394$, $P=0.007$) at 5% level of significance. Further post hoc test, Least Significance difference shows that performance on baseline information is significantly higher than performance in other phases ($P<0.05$). It also shows that mean performance in other five steps excluding baseline information is not significantly different ($P>0.05$). Performance on baseline information phase has significant positive correlation with the performance on impact identification and mitigation measures. In overall only 5% of EISs performed high quality, while 65% and 30% performed medium and low quality.

KEYWORDS: Environmental Impact Statements, biological, review, baseline, impact identification

I. INTRODUCTION

Sustainable Development (SD) is an appropriate approach that harmonizes development with the environment (Glasson et al., 2012). At the time when population growth of the world is increasing geometrically and development is unavoidable (MEA, 2005), Environmental Impact Assessment (EIA) is being an important tool to achieve SD (Jay et al., 2007).

EIA constitutes analysis of effect of development projects on Biological, Physical, Chemical, Social, Economical and Cultural components and can be more specific according to the nature of the development projects (Glasson et al., 2012). Development activities have direct or indirect impact to the ecosystem or biological component due to the clearing of flora or creating unfavourable atmosphere for terrestrial and aquatic fauna. Thus, biological component

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forms an integral part of EIAs (Morris & Emberton, 2009). The primary aim of EIA is to prevent or minimize the negative impacts and enhance positive impacts to the biodiversity of the proposed development (Morris & Emberton, 2009) assisting in the pursuit of SD goal by ensuring biodiversity conservation (Briggs & Hudson, 2013).

Environment Protection Act (1997) of Nepal has categorized Environmental Assessment (EA) into Environmental Impact Assessment (EIA) and Initial Environmental Examination (IEE) based on the threshold of the project. "Environmental Impact Assessment" means a report on detailed study and evaluation to be prepared to ascertain as to whether, in implementing a proposal, the proposal does have significant adverse impacts on the environment or not, whether such impacts could be avoided or mitigated by any means or not (EPA, 1997). National EIA Guidelines (1993) identifies the Socio-economic, Biological, Physiochemical and Cultural as the major components of environment. Section 3 of the EPA (1997) has made the mandatory provision for conducting EIA of the prescribed projects. Schedule 2 of the EPR, 1997 has a list of projects which requires EIA before the construction.

Environmental Impact Statement (EIS) is a formal document which contains the outcome of an EIA (Wathern, 1988). It serves as a main source of information for both authorities and stakeholders, acting as a means of communication between them (Glasson et. al., 1994). Thus, environmental information and consultation outcomes reported in the EISs are considered by decision-makers before a final verdict is given on a proposed project (Peterson, 2010). The quality of an EIS is crucial in protecting a developer's proposed project (Glasson et. al., 1994; Glasson et al., 1997). However, quality of EISs over time has drawn the attention of academics, instigating a lot of researchers all over the world into evaluating the quality of EISs (Cashmore et. al., 2002; Jalava et. al. 2012).

Review on the quality of biological component documented in EISs has been getting momentum due to the concern on accelerating decline of global biodiversity (Treweek et al., 1993). Similarly increasing urbanization and industrialization in developing countries like Nepal, has been posing adverse impact on biodiversity. In this regard quality review of biological component is useful to identify weaknesses associated with its implementation in order to avoid further biodiversity loss from future development activities (Treweek et al., 1993; Shrestha, 2007). As this type of review is not carried out in Nepal, this study aims to review the quality of EISs in biological aspect. This will address possible deficiencies associated with biological component.

II. RELATED WORK

EIA is an all-encompassing and proactive assessment tool (Christensen et al., 2005) which is characterized by inter-connections between various sciences and their elements (O' Riordan, 2000). Traditionally, planners assessed environmental impacts of development in a totally different way from the systematic, holistic and multi-disciplinary approach as required by EIA (Glasson et al., 2012); hence, the science of EIA is not a completely new concept. EIA practitioners, academics and policy makers have given high attention to the effectiveness of EIA (Sandham & Pretorius, 2008). Examining the quality of EISs has been identified as a vital approach in assessing the effectiveness of the entire EIA process (Treweek, 1996; Fuller, 1999; Cashmore et al., 2002). However the effectiveness of EIA in addressing the negative impacts of developmental projects on the environment have come under scrutiny as several researchers have often identified significant percentages of EISs to be poor quality. Nevertheless, during EIA the assessment has not been carried out in the systematic, holistic and multidisciplinary way as required by EIA studies, questioning the quality of EISs (Glasson, et al., 2005); the published reports have shown some of the main outcomes of the process. Other analysis (CEC, 1993; Lee et al., 1999) has revealed that data presented in EISs is incomplete and does not include the necessary detail (Tromans, 2002). Approved EIA reports in Nepal were ineffective in considering biodiversity aspects, the current focus being on listing of species and proposing compensatory plantation (Uprety, 2005).

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III. METHODS AND MATERIALS

3.1. Sample

The sample selection for this research was based on EISs approved by Ministry of Population and Environment (MOPE). There were altogether 261 approved EISs until 11th September, 2016. The sample EISs were selected from list of EISs which were approved in the period between 2005 and 2015. Twenty EISs were randomly selected from four sectors *viz.* energy, road, forestry and health. Sample selection were restricted to these four sectors because these sectors have significant adverse biological impacts on the environments and availability of EISs copies for each sector in relatively adequate number. Twenty EISs consists of eleven, four, three and two EISs from energy, road, forestry and health sectors respectively. A pilot test was conducted on two randomly selected EISs which were not part of the samples used for the study. This was used to identify areas of weaknesses such as for ambiguity or duplications in the draft evaluation checklist, which was corrected before using it for the final evaluation.

3.2. Evaluation Checklist

An evaluation checklist on impact analysis covering six steps of EIA: baseline information collection, alternative analysis, impact identification, evaluation of significant impacts, mitigation measures and monitoring was reviewed. Review criteria for each step were developed based on the minimum legislative requirements by the EIA legislation of Nepal and best practice of EIA. The Lee and Colley EIS Review package with systematic and hierarchal structured framework was employed due to its robustness, reliability and extensive use, which was further modified for this review through the use of relevant literatures on biological issues, Nepalese EIA legislation, and review guidelines for forestry sector prepared by MoFSC (2002).

Baseline Information had seven evaluation criteria that included type, status and distribution of plants and animals MoFSC (2002), involvement of qualified professionals, ecologists in the survey (Morris & Emberton, 2009) and consultation with the concerned agencies and stakeholders in obtaining baseline information (Thompson et al., 1997). Impact Identification had eight criteria that included clear description of the methods employed in identifying biological issues, cumulative impacts of the project, consideration of impacts, list and description of potential biological impacts, quantification of biological impacts, identification of wild animals that will be effected (Lee et al., 1999), impacts to the terrestrial and aquatic lives and their habitat and impacts caused by relocated families' on the biological conditions MoFSC (2002).

Evaluation of significance impact covered six criteria which recorded the data on method used in determining significance of impacts mentioned and described, whether the criterion used in defining significance of impact well explained, any form of uncertainty associated with the significance of impacts given, documentation of the summary of the potentially significant biological impact (Lee et al., 1999), adequately addressing of the national policies, international conventions and obligations by report MoFSC (2002). Alternative Analysis consists of four criteria based on clear statement of the impacts of respective alternatives, feasibility of the alternatives considered, explanation for rejection of each alternative, consideration of alternatives to the proposed project in terms of different sites, processes, designs, scales, layouts and operating conditions (Lee et al., 1999).

Mitigation Measures covered maximum of twelve criteria. They were based on specification of mitigation measures for potential significant impacts (Lee et al., 1999; IEEM, 2006), description of implementing proposed mitigation measures and time span (Lee et al., 1999; Thompson et al., 1997), description of the residual impacts arising from the project and compensation, statement of the extent of effectiveness of proposed mitigation measures, clear commitment to mitigation by the developer (Lee et al., 1999). It also included appropriateness of the layout of the construction areas, adequate description of the compensatory plantation measures, appropriateness of the measure to restore areas disturbed during construction through plantation and bioengineering, measure for restoration of loss of endangered species, mitigation plan that include provisions for reconnection of fragmented habitat for wildlife and provisions to reduce poaching activities of wildlife in the vicinity of the project area MoFSC (2002).

Monitoring had four different criteria based on monitoring and commitment to monitoring (Lee et al., 1999), adequate monitoring programs for the biological environmental components, relevant indicators for measurement of biological

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aspects during monitoring of both construction and operation and adequate cost for monitoring program presented in the Environment Management Plan (EMP) for the biological component MoFSC (2002).

3.3. Review Quality of EIS

Lee et al. (1999) suggested assigning an assessment symbol and an overall judgment of the EIA as a whole, once the review areas had been assessed. Researchers evaluated criteria for each EIS and assessed the outcomes using Lee et al. (1999) assessment symbols. Each criteria was given with the grades (score) as applicable considering to the corresponding symbol explanation. Grade A was valued score 5 with the criteria generally well performed, no important task left incomplete. Grade B valued score 4 with the criteria generally satisfactory and complete, only minor omissions and inadequacies. Grade C valued score 3 that was considered just satisfactory, despite omissions and/or inadequacies. Grade D valued score 2 which consisted the criteria that parts were well attempted but most, as a whole, be considered just unsatisfactory. Grade E valued score 1 which represented not satisfactory, significant omissions or inadequacies. Similarly, Grade F valued score 0 that represented very unsatisfactory, important task (s) poorly done or not attempted.

3.4. Data Analysis

After all the review criteria were analyzed and the review grade was provided, reviewed EISs were evaluated with the overall appraisal of the report. Qualities of EISs were also evaluated based on the different steps of EIA in Nepal. To evaluate the overall quality of the project characteristics, qualitative values suggested by Lee et al. (1999) was assigned. Thereafter, values such as High (H), Medium (M) and Low (L) based on the symbols given to each variable were obtained where symbol A, B (80%) represented high quality, C, D (50 to <80%) represented medium quality and E, F (<50%) represented low quality.

Each review area consisted of 4 to 12 evaluation criterion. Separate score were given for each evaluation criteria under different review areas with maximum score of 5. Thus, each review area scored maximum ranging from 20 to 60 on the basis of number of evaluation criteria. Score of each review areas were divided by its total score to convert into percentage. Along with descriptive statistics Analysis of Variance (ANOVA) and Least Significance Difference (LSD) were used to compare the mean performance in different phases.

IV. RESULT

4.1. Overall Performance of EIS by Sector

Four key sectors namely energy, road, forestry and health were selected for the review of the quality of EISs. Figure 1 shows that high quality ranking is performed only by energy sector with 9% performing this ranking. None other sector performed high quality. Most of the energy sector performed medium with 82% of the EISs reviewed followed by forestry sector with 66%. 75% of EISs from road sector performed low with rest 25% with medium performance. Half of the EISs from health sector were medium with other half performing low quality.

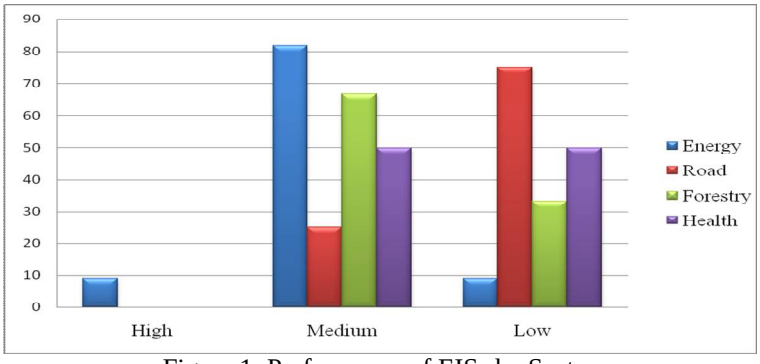

Figure 1: Performance of EISs by Sector

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4.2. Variation in performance by different sectors in different phases

In energy sector, performance in baseline information was found to be highest (73.51%). However, its performance decreased in impact identification (64.09%), evaluation of significant impact (60.91%), alternative analysis (56.36%), mitigation measures (55.61%) and monitoring (57.27%). Road sector performed highest (67.14%) in baseline information. The performance was found to be similar for impact identification (36.25%), evaluation of significant impact (40%), alternative analysis (38.75%), mitigation measures (44.58%) and monitoring (41.25%).

Forestry sector also performed highest (69.52%) in baseline information. The performance of impact identification plunged (48.33%) whereas the performance of evaluation of significant impact (62.22%) and alternative analysis (61.67%) were found to be moderate. However, the mitigation measures showed least performance (42.78%) with improved performance in monitoring (58.33%). Likewise, baseline information for health sector performed highest (72.86%) while impact identification was low (43.75). The performance of evaluation of significant impact, alternative analysis and mitigation measures performed 58.33%, 62.5% and 55% respectively. Monitoring performed least (32.5%).

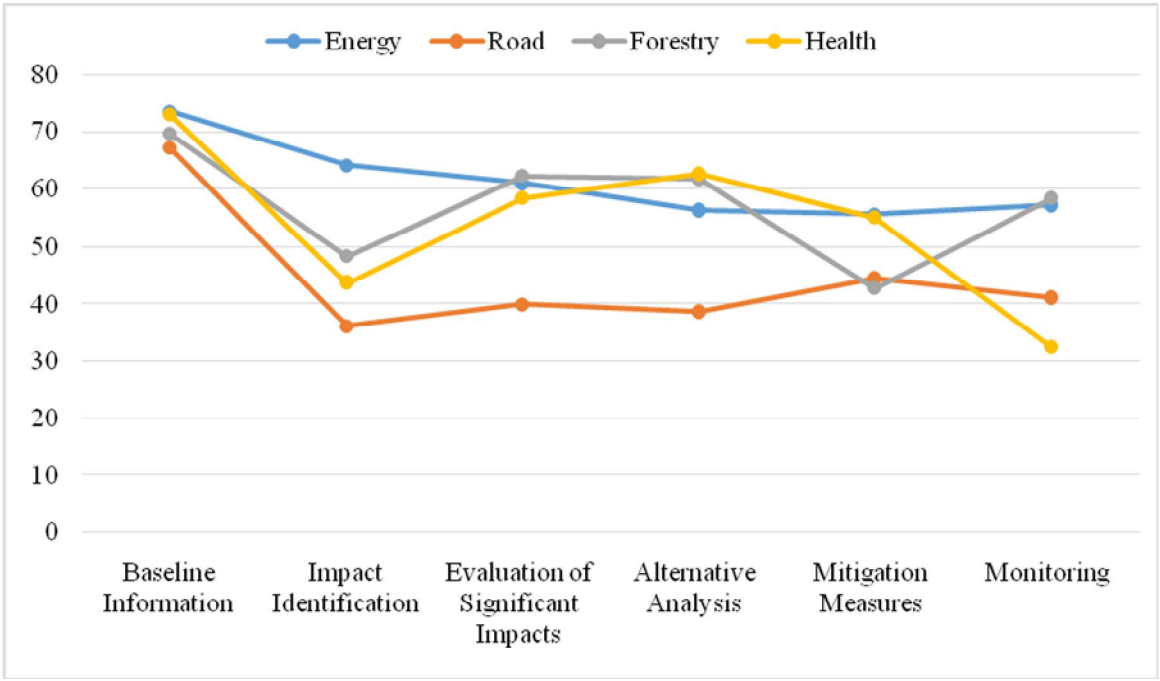

Figure 2: Sector wise variation in performance of review areas

4.3. Comparative performance in Different Phases

Six key phases of the Environmental Impact Assessment were selected for quality review, which were Baseline Information, Impact Identification, Evaluation of Significant Impacts, Alternative Analysis, Mitigation Measures and Monitoring. Each of these phases was individually ranked in terms of their performance.

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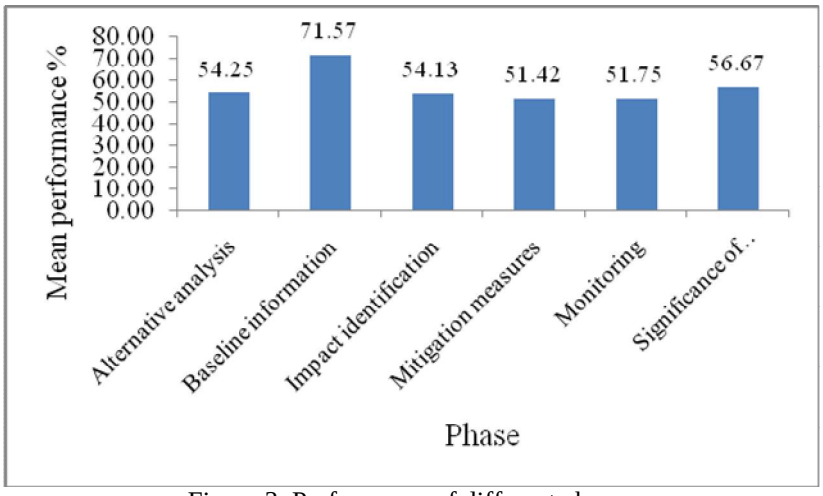

Figure 3: Performance of different phases

In reviewed EISs, performance of the EIS is found best (71.59%) in the baseline information (Figure 3). EIA performance in mitigation measures is the lowest (51.42%). One way ANOVA shows that there is significance difference in the mean performance of EISs in different phases (F=3.394, P=0.007) at 5% level of significance (Table 1). Further post hoc test, Least Significance difference (LSD) shows that performance on baseline information is significantly higher than performance in other phases (P<0.05). It also shows that mean performance in other five steps excluding baseline information is not significantly different (P>0.05).

Table 1: ANOVA table

Sources of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	5724	5	1144.7	3.394	0.007
Within Groups	38455	114	337.3		
Total	44178	119			

Baseline information collection was the only step with more than one third (35%) EISs performed high quality and 95% performing high to medium quality, only 5% EISs performed low quality. Second better performing step was evaluation of significant impact with 75% performing high to medium quality, followed by alternative analysis with 70% performing high to medium quality. Monitoring and impact identification performed 65% and 60% respectively in terms of high to medium quality. Least performing step was mitigation with 55% performing high to medium while 45% performing low quality (Figure 4).

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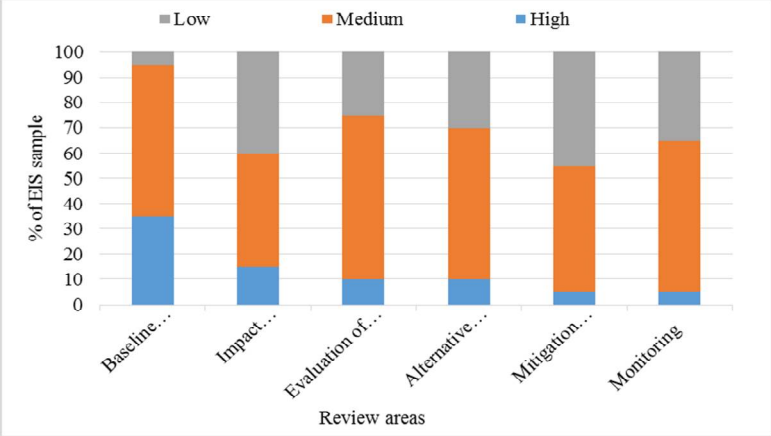

Figure 4: Overall Performance of Review Areas in EISs

Most of the steps of EISs performed medium followed by low and high quality respectively. Review showed that number of EISs with high performance decreases from 35% in baseline information towards monitoring with only 5% EISs performing high quality. This illustrates that the baseline information was effectively conducted during the EIA process, however as the step precedes the quality declines due to ineffective methods.

Table 2: Correlation coefficient of performance between baseline information and other phases

Phases		Correlation coefficient (r)	P-value
Baseline information	Impact identification	.622*	0.003
	Significance of evaluation	0.371	0.107
	Alternative analysis	0.099	0.678
	Mitigation measures	.599*	0.005
	Monitoring	0.341	0.141

*Correlation is significant at 0.05 level

The correlation coefficient between the performance of baseline information phase and impact identification is positive (0.622) which is significant at 5% level of significance (P=0.003) (Table 2). Likewise significant positive correlation coefficient (r=0.599, P=0.005) is found between performance of baseline information and mitigation measure phases. The correlation coefficient between performance of baseline information and other phases is insignificant.

4.4. Overall Performance of EISs

Overall assessment on consideration of biological component shows that only 5% of EISs performed high quality, while 65 % performed medium quality. Almost one third (30 %) EISs reviewed performed low quality.

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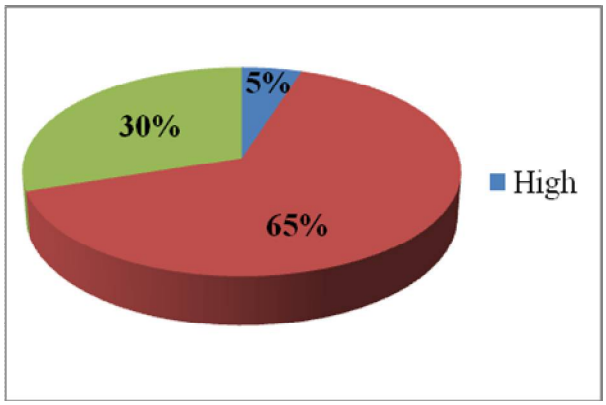

Figure 5: Overall Performance of EISs in terms of consideration of Biological issues

V. DISCUSSION

5.1. Overall Performance of EIS by Sector

On sectoral basis, the percentage of quality of EISs reviewed for biological issues for each of the sectors were below average. Nonetheless, in identifying the best and worst performing sector, it is important to interpret the data with care due to the small sample for road, forestry and health sector. Energy sector was the only sector having high quality EISs while road sector had low quality EISs. Energy sector has been practicing EIA from the early development in Nepalese context. Sectoral guidelines with various improvements in EIA report has been frequently conducted in this sector. The poor quality of the road sector might be attributable to the large land take required for development activities. Thompson et al. (1997) and Samarokoon and Rowan (2008) stated that size of a development is proportional to the magnitude of ecological impacts it will have on the environment. Thus, as a result of the larger size of road developments, it may be difficult to adequately address the broad range and complexity of their associated ecological impact. As such, alternatives such as different locations are usually exempted from consideration.

5.2. Variation in performance by different sectors in different phases

More baseline information was found to be collected than focus on other steps of EISs in all sectors. Baseline information can be collected through primary (field observation) as well as secondary sources, thus adequate information can be obtained. However, impact identification can be conducted mainly through field observation. Thus, the performance of impact identification was found to be decreased than baseline information in all sectors. Evaluation of significant impact was found to be decreased than impact identification in energy sector while it was found to be increased in other sectors which indicate that impact identification is not well performed in energy sector. Alternative analysis depends on evaluation of significant impacts. The better performance by the evaluation of significant impacts, better performance is achieved by the mitigation measures. Similarly, mitigation measures also depend on impact identification. Monitoring enables to test the success of the mitigation measures and provide enhancement in progress of the project thus it is eventually dependent on mitigation measures.

5.3. Comparative performance in Different Phases

In terms of the performance in individual phases of EISs, it was observed that baseline information was the best performed stage while the worst performed stage was the mitigation. A significant percentage of unsatisfactory EISs for mitigation were equally observed by Cashmore et al. (2002). Further discussion on each phase is discussed in following sub headings.

Baseline Information

A good percentage of the EISs reviewed for this study for biological issues performed high quality for baseline information. The four sectors considered in this study also had percentages of EISs above average that performed high

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quality. However number of deficiencies was identified within the baseline information. While existing biological status was adequately provided by the reviewed EISs, there were lacks of detail information about the expertise involved in the baseline collection which can effect in this phase. Treweek (1996) and Byron et al. (2000) noted that short time allocated to collection of ecological baseline information may influence the accuracy of the information provided. Even though the EISs adequately described the current ecological baseline condition, their accuracy remains questionable due to the short period of time within which ecological surveys were conducted as documented in reviewed reports. Also, the main sources of baseline data as observed in the review include desk study, consultation and field survey, showing that biological issues were obtained from reliable and robust sources. It is interesting that the review of EISs show that public consultation was effectively complied with the EPA 1997 and EPR 1997. The performance of baseline information being satisfactory reflects that the legal compliance, rules and guidelines for this stage is clear and convenient to follow.

Impact Identification

Eight criteria were used for the review of EISs in terms of Impact Identification. Impact Identification showed moderate performance in overall. Thompson et al. (1997) observed that most linear development projects (e.g. road) only provide the length of the proposed project rather than the area covered. Deficiency was observed in this study in entire sector about identification of wild animals which suffer most and impacts caused by relocated families on biological conditions. Listing and impacts of biological were however described satisfactorily.

Significant Evaluation

From this study, it was observed that evaluation of significant impact performed second worst. It was also observed that this step showed similarities and linkage with the impact identification. EISs with high or medium performance in impact identification either performed similar or less insignificant evaluation. Evaluation of significant impact follows impact identification and prediction (Glasson et al., 2012). Thus the evaluation is always possible for impacts of their good impact identification.

Alternative Analysis

Steinemann (2001) describes alternatives as the heart of the EIA and the quality of decisions depend on the robustness of selection of alternatives to choose from. Glasson et al. (2012) also emphasize the importance of alternatives in ensuring that all feasible approaches to a project are adequately taken into account and thus, contribute to preventing harm to the environment.

Mitigation Measures

As observed from the result, mitigation measure was the worst performed stage of the EIA. This was because most of the very important review criteria under mitigation were poorly addressed in all the reviewed reports. There were highest (12) criteria for review of this stage. Criteria such as means of implementation and time span, mitigation measures for residual impacts and compensation for them, extent of effectiveness of proposed mitigation measures, commitment to mitigation measures and appropriate layout for avoiding damages on biological issues were either incomplete or poorly performed. This was also reflected by the poor performance by significant evaluation of impacts.

Monitoring

This stage in the EISs reviewed showed medium performance. Although most of the EISs discussed on the monitoring types and mechanism, there were lack of monitoring commitment and inadequacies in proposed monitoring activities.

5.4. Overall Performance of EISs

This study observed only one EIS i.e. 5% EISs performed high quality. In addition majority i.e. 65% performed medium quality while 30% performed low quality. Thus, with slight improvement on some crucial areas of EIA this is expected to result into higher percentage of quality EISs in the country.

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VI. CONCLUSION

On the basis of sectoral performance, the percentage of reports deemed medium for the EISs reviewed under each sector. Several inadequacies comparable to findings from past international studies were equally observed in this study. For EIA to effectively contribute to sustainable development, the identified inadequacies in this study need to be addressed with full commitment of stakeholders involved in the process.

It was found that performance of EIS on mitigation measure was the worst. Criteria such as means of implementation and time span, mitigation measures for residual impacts and compensation for them, extent of effectiveness of proposed mitigation measures, commitment to mitigation measures and appropriate layout for avoiding damages on biological issues were either incomplete or poorly performed. Deficiencies observed include uncertainty associated with significance of impacts given and documentation of summary of potentially significant biological impact. Similarly the performance on evaluation of significant impact is also worst next to mitigation measures. Baseline information collection was satisfactory in overall. Alternative analysis was also satisfactory below baseline information. There were significant correlation between the performance in baseline information, impact identification and mitigation measures. It revealed that the performance in mitigation measures was related to the performance of impact identification which in turn was related with the performance baseline information.

Key to a successful EIA is the level of ecological input that goes into it (Gontier et al., 2006). Based on the findings of this study, it can be seen that the overall performance of the EISs considering biological issues are poor, showing that best practice in the EISs is yet to evolve in the country as well as poor compliance with the legislative requirements of the EIA. With the bulk of the report assessed as medium quality, a bit of effort in addressing the observed inadequacies are expected to improve the quality of the EISs.

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