Mitigating biodiversity destruction through environmental impacts assessment of infrastructural projects

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Abstract.
The geometric rate of biodiversity loss in developing countries like Nigeria has been identified as a problem of major concern. The loss in biodiversity in modern times is evident in the extinction of many plants and animal species. In developing countries like Nigeria, more attention is given to aesthetics, functionality as well as the cost of proposed projects than the environmental impacts of the projects. During construction and rehabilitation of infrastructural projects, biodiversity is destroyed. Thus, this study was aimed at exploring the various ways by which infrastructural projects affect biodiversity, with a view to proffering ways of its restoration. The negative effects of infrastructural projects on biodiversity can be reduced through Environmental impact Assessment (EIA). This will help in averting the detrimental effects on natural resources. In situations, where natural habitat loss is unavoidable, adequate mitigation measures such as provision of strict protection zones along the proposed projects should be adopted. In order to meet sustainable development goal, EIA should be carried out before projects that may have a negative impact on the environment are constructed.

1. Introduction
Biodiversity is seriously declining in developing countries, and infrastructural development constitutes a setback. Biodiversity refers to the various plant and animals in an ecosystem which are usually beneficial to man. [1] pointed out that biodiversity services entail the capability of the various components and ecosystem in producing materials for direct or indirect satisfaction of man. Man depends on biodiversity for food, health, resources, and ecosystem services. Table 1 shows the types of biodiversity.

Table 1: Types of biodiversity [2]
Habitat degradation and unprecedented fragmentation owing to infrastructural project development are mostly encountered. Infrastructural projects provide a foundational structure for conveyance of goods as well as providing basic services in the form of housing, education, energy and healthcare, which are basic amenities for the socio-economic wellbeing of a nation [3]. Infrastructural projects such as building structures, railways, road networks are essential structures for modern economic growth. They can improve citizens’ health [4], and solidifies social cum cultural relations existing between one nation and the other [3, 5]. Despite these advantages to national development, the environment sustains a tremendous impact [6-7], owing to the fact that the interaction existing between the infrastructures and the surrounding environment is unavoidable, and in most cases detrimental. Infrastructural projects can affect biodiversity negatively by causing obstruction to migration and movement as well as extinction of undomesticated animals. This in turn can lead to changes in evolution for wildlife of the same species [8] and biodiversity loss [4]. As human population increases, more infrastructural projects tend to increase so as to improve the wellbeing of man, and thus leading to destruction in biodiversity. Proper understanding of the impact of infrastructural projects on biodiversity destruction, together with developing ways to mitigate their effects has been deemed necessary. Different measures, aimed at curbing the effects of infrastructural projects on biodiversity destruction should be adopted. For instance, in a situation where road construction becomes inevitable, incorporation of measures for mitigating or removal of the negative impact on the environment should be done, so as to ensure that the processes of the ecosystems, continuous flow of landscape and the dynamics of meta population are restored [9]. Moreover, during road construction efforts should be made to reduce animal vehicle collision (AVC) as well as reducing disturbance. This will help in not only curbing the detrimental effects of roads on biodiversity, but also contributing to the safety of man. Various measures have been adopted globally in mitigating biodiversity destruction [10].
However, they are of varying efficiencies. The major method that has been in use over the years for mitigating biodiversity loss is the provision of protected areas. The number of protected areas in existence nowadays are above 100,000, thus they cover about 12% of the entire land mass [11]. The concept of provision of protected area has been recorded, and efforts are made at minimizing biodiversity destruction by reserving areas for parks and natural reserves, by so doing the population is preserved [11-13]. This method focuses on in situ protection of the existing ecosystems, and it is known as fortress preservation [14-15]. Forest preservation approach entails protecting an adequate portion of the ecosystem in a given society, for the benefits of the posterity [16]. However, between 1970-1980, a decline in the rate of its creation was experienced as the rate of global economic growth increased [17]. Reserving conservation areas is a difficult and a disputable issue, owing to the scarcity of resources in the present world [18], thus biodiversity destruction continues in spite of the mitigation measures [19]. Thus, this study was aimed at exploring the various ways by which infrastructural projects affect biodiversity, with a view to proffering ways of its restoration through Environmental Impact Assessment (EIA).

2. Effects of rural infrastructural projects on biodiversity destruction.

In the course of infrastructural developments, the environments sustain some impacts as a result of clearing, cutting and filling of natural materials. Construction work alters the landscape, surface and ground water flows as well as soil density which in turn affect the ecosystem negatively. Biodiversity destruction is always anticipated on the course of infrastructural developments. Despite the usage of land for construction, the effects of barrier and disturbance on the environment are encountered, thus destroying biodiversity [20]. If ecosystem services are ignored during infrastructural development, more detrimental effects will be encountered than expected, thus their advantages may not be up to the standards anticipated [4]. The road construction and maintenance has been identified as one of the major causes of deforestation, thus creating negative effects on biodiversity as well as affecting the tropical forests through carbon removal [21]. Road projects are essential for development of nations, mostly in under-developed regions however, they play a role in biodiversity destruction and fragmentation which go a long way in the reduction or elimination of some species of organisms existing in a particular habitat [4,22]. In addition, development of roads which affect the ecosystems can lead to reduction in tourism and thereby exerting a negative effect on national economy [23]. For instance, the revenue from Yankari Game reserve in Bauchi State, Nigeria adds much income to Nigerian economy. Thus, if the area is degraded, then the income accruing from tourism will reduce, and thereby affecting the economy of the nation, since about 60% of the span of road network length is anticipated by the year 2050[4]. Among all the infrastructures, roads have been found to pose the greatest damage to biodiversity [6]. The damages are numerous, ranging from high death rate arising from animal-vehicle collisions [24, destruction and degradation of biodiversity [25-26], noise and environmental pollution [27], contamination from runoff [8], obstructions in wildlife migration and movement [28], genetic and pollution isolation [7] and strange species of organisms [29] to a high rate of carbon emission [30]. The fragmentation encountered in habitats owing to infrastructural development, coupled with the obstruction of movement is the main challenge militating against the species of organisms, which leads to restrictions and isolation of the species [26]. The impacts sustained tend to linger after the construction of the infrastructures [25]. The destruction in biodiversity caused by road projects can either be direct or indirect. The building projects, on the other hand leads to fragmentation as well as
destruction of coastal habitats owing to clearing of site. Also, excavation, dredging and deforestation arising from building projects bring about the degradation of marine habitats and sedimentation together with siltation of water bodies. The marine environment also, tends to be polluted with toxic wastes arising from inadequate treatment methods.

3. Mitigating biodiversity destruction of rural infrastructural projects

Biodiversity destruction of rural infrastructure projects can be mitigated through Environmental Impacts Assessment (EIA). Environmental Impacts Assessment is used globally, and it should form a regulatory structure to be used internationally [31-37]. EIA is aimed at evaluating the environmental impacts of proposed projects. The general aim of EIA is to promote the inclusion of issues pertaining to the environment in decision making, in order to achieve environmentally friendly actions [38]. This implies that EIA comprises not only the investigation of the proposed impacts which a project exerts on a given environment (analytical aspect), but also on the influence which the outcome of the assessment will have on the process of decision making, with a view to approving the project (procedural aspect).

The phases in EIA involve the following; screening, scoping, baseline study, impact prediction, impact assessment, mitigation, Environmental Impact Statement, review and monitoring [39]. The approach in EIA for decision making is shown in fig.1.

![Fig. 1: Approach in EIA for decision process [40]](image)

Screening entails determining the likelihood for a project to have detrimental effects on the environment while scoping is aimed at identifying the issues of major concerns during the process of EIA [39]. The typical mode of operation of scoping is by using specified questionnaires and guidelines [41]. But, practically majority of EIA processes use a combination of different methods, involving the usage of scale limits, records, together with ingenuity [39]. An example of the adoption of such method of screening was shown by European Commission, [42]. It often involves some form of consultations. The baseline study entails describing the background of the environment that may be affected by the proposed infrastructural projects. Such description shall not be ambiguous, but rather explicit and necessary to explain the environmental impacts of the proposed project. Impact prediction is aimed at analyzing changes that are likely to occur consequent upon the construction of projects. First and foremost, the impacts are identified followed by a detailed study of the impacts.

Impact identification is usually carried out using matrices, checklists or networks. A set of diagrams showing the cause and effect of a process, which aim at showing secondary or
advanced impacts is known as networks [43]. While a compendium of the key factors in an environment that may experience impact in the future is known as checklist. Impact assessment stage involves the analysis of the impacts which have been predicted and its significance. It requires the expression of people’s priorities as well as notion. Thus, public opinions, scientific judgment, stakeholders’ views are taken into consideration. In addition, quality standards are taken note of (for example, the noise level or the concentration of contaminants in air etc). The presence of pre-set legal framework, the duration, frequency, change recoverability, geographical extent, the socio-political acceptability and the likelihood for mitigation, for the assessment of the outcome from environmental impact has been considered [44]. Mitigation stage entails taking actions so as to find out the one that can reduce or eliminate the predicted impacts. There are five basic methods of mitigation: avoiding, replacing, reducing, restoring and compensating [45]. Avoiding refers to changing of route for a road, in order to avoid crossing the nature reserve. Replacing entails regeneration of habitat in another location, which has the same similarity with the previous area destroyed on the course of construction of infrastructural projects. Reducing on the other hand refers to the act of erecting a wildlife corridor, in order to ensure that the effect of fragmentation caused by the projects is minimized. Restoring refers to the act of regaining back the site after mineral extraction. While compensating entails financial compensation together with resettling of the communities displaced as a result of the construction of infrastructures.

Environmental Impact Statement (EIS) refers to the documents which are usually submitted to the authorities for the approval of the project. The EIS stage encompasses a detailed report containing investigations relating to baseline study together with the assessment, mitigation and impact prediction [45]. The review stage involves the checking of the adequacy of the EIS. It is usually carried out by team of experts or a government agency [46]. In a situation where any of the analyses done in EIS is found to be incorrect, further investigation will be required from the proponent after which he should revise the EIS for re-submission. At the review stage, the EIS is made open for criticisms and inputs, after which a revised version together with other important documents for the project are submitted to the decision makers for approval.

Monitoring stage is an important aspect of EIA. It entails checking whether the actual impact caused by the project is in conformity with the impact forecasted in the EIS. Monitoring takes place during the construction process and it is therefore compulsory to set up monitoring plan.

4. Conclusion
It is worthy to note that infrastructural projects are important in national development. However, the negative impacts of infrastructures on biodiversity are far more than the benefits. In developing countries like Nigeria, more attention is given to aesthetics, functionality as well as the cost of proposed projects than the environmental impacts of the projects. Efforts have been made in this paper to enumerate the various impacts of rural infrastructural projects on biodiversity, and to discuss ways of mitigating their impacts. In order to balance human and biodiversity needs during construction of infrastructural projects, a proactive measure should be taken as soon as possible.
5. Recommendations
The EIA is an important tool which can be adopted in salvaging the nation from the problem of environmental degradation. This will go a long way in ensuring a proper ecosystem, devoid of fragmentation. By so doing, sustainability of infrastructural projects will be achieved. In situations, where by natural habitat loss is unavoidable, adequate mitigation measures such as provision of strict protection zones along the proposed projects should be adopted. This may be in form of corridors so as to connect fragmented habitats.

6. References

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