

## **Ecological Evaluation from Road Building Planning Impact in Conservation Forestry Areas**

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### **ABSTRACT**

Road-building in protected forest environment, theoretically do not be enabled, because worried will destroy area ecosystem and extend the happening of illegal logging. But one side, opening of access destined road to increase level live society around protected forest so that don't expand of forest very is needed, so that relation between area in quickening growth between economic growth and region of society around the road will be a mount. And this becomes one of the especial targets of Indonesia in Millennium Developments Gold (MDG'S) 2015. The overall objective of this study is to improve the application of ecological evaluation. In particular, the study focuses on one specific target of ecological evaluations, i.e., biodiversity conservation, and on one specific type of projects, i.e., road developments. The case study is represented by an infrastructure development within an Taman Nasional Kerinci Seblat (TNKS) located in South of Sumatera and Bengkulu Province on Indonesia : The Selangit - Napal Melintang - Lebong, road pass by quickly two province. The approach with three general guidelines that emerged from the analysis of the application of ecological evaluation to EIA (Ecological Impact Assessment). The first, called for the explicit reference to biodiversity. The second, of measurable indicators to assess ecological values, and the consequent separation between prediction and assessment of impacts. The third, evaluation of different project alternatives, and the improvement of methods for their comparison and ranking. All requirement, presentation, and data evaluation, conducted with using multi criteria evaluation in GIS technique. Two different alternative layouts were proposed for the Selangit-Napalmelintang-Lebong road project. The results of the analysis have indicated that Alternative 2 is by far the best-performing one, i.e., the one that causes the least impact on ecosystems. Alternative 2 have shorter traveled distance ( 36,5 Km), with minimum inclination, so that can be cheaper in its step building and manages to spare most of the relevant sites for biodiversity conservation.

**Keywords:** Ecological evaluation, protected forest, road pass.

### **1. INTRODUCTION**

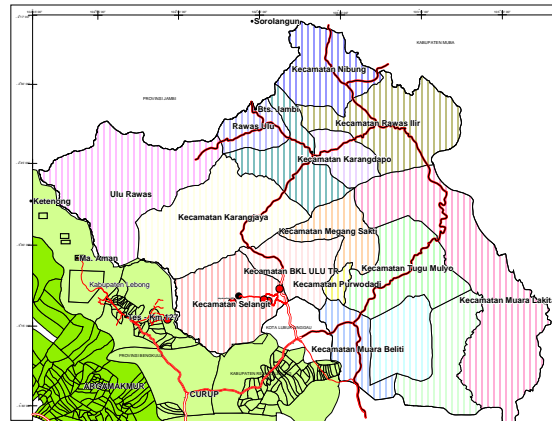
Development of road network in rural region become one of the especial target of Indonesia government in Millennium Development Gold program ( MDG'S) until Year 2015. The program meant as one of the effort to give to access in rural area in improving society economics, is so that expected will lessen poorness number, unemployment and urbanization.

Policy of Sub-Province Musi Rawas to develop road network of two province from Selangit-Batugane-Napalmelintang in Sub-Province of Musi Rawas, South Sumatra Province to Sukanegeri village, in Sub-Province of Lebong, Bengkulu Province, representing one of the effort to interface to three village in borderland between Province of South Sumatra and Bengkulu. Third of the village, located by the side of Natural Forest Conservation boundary of National Park Kerinci Seblat ( TNKS).

Road-building in protected forest environment, theoretically do not be enabled, because worried will destroy area ecosystem and extend the happening of illegal logging. But in existing regulation, area outside of zone is core of from National Park Kerinci Seblat, admit of to be exploited limitedly for the activity of which in character for the prosperity of society. According to existing note in Zone of TNKS map, area plan way in Jungle zone area.

In particular, from Napal Melintang to Sukanegeri Village the most critical intersections are :

- The crossing of the River, that requires to go through the centre of the village of Napal Melintang ;
- The crossing of the some mountains with height above 1000 m mean sea level in the forest area with vegetation type is Secondary and Primary forest.



**Figure 1** Location of Road Plan two province in frontier of South Sumatra and Bengkulu Province in Indonesia which passing Forest Conservation TNKS area.

## 2. MATERIALS AND METHODS

Transportation infrastructures, and above all road networks, are blamed for highly contributing to the decrease in both the quantity and the quality of natural habitat. Therefore, a comprehensive Biodiversity Impact Assessment (BIA) in road planning and development needs to become a routine activity, as do other commonly considered elements. Biodiversity Impact Assessment of roads focused on three EIA stages (baseline study, impact prediction and assessment) and two impact types (habitat loss and fragmentation).

Besides the land-use map, an extensive geographical database was available from the material offices. This database is constantly updated and includes data layers such as the forest plan (i.e., the description of the tree cover of each forest parcel) and a Digital Terrain Model with a spatial resolution of 25 m. For each of these classes, a set of ground-truth data referred to 1:50.000 topographic sheets was collected. The survey was performed in July 2007 and the ground data cover almost the 3% of the total area to be classified. The study area was sampled as homogeneously as possible, approximating a “stratified random” criterion (ERDAS 1991). This means that, ideally, the total area surveyed for each class is proportional to the total cover of that class within the image.

Most environmental impacts are characterised by a spatial component (e.g., spread of pollutants in the air, fragmentation of natural habitats, etc.). Consequently, their prediction and assessment involve the gathering and processing of spatial data. In this research, a GIS will represent the supporting platform to apply the methodology proposed for BIA. In particular, a GIS will be required to integrate spatial data from different sources (e.g., remotely sensed images) and to perform basic spatial operations (e.g., map overlaying, map aggregation, distance computation).

### 3. RESULTS AND DISCUSSION

### 3.1 Base line study

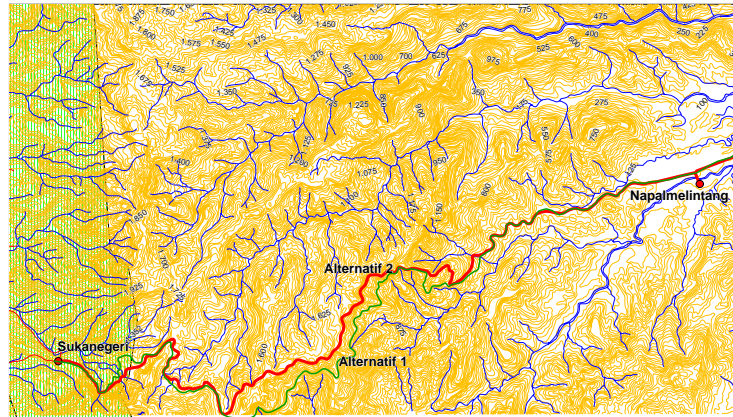
First of all, the forests were masked out of the TM+7 image to classify the remaining areas. In particular, the following seven classes were identified in the study area : (1) Seagrass; (2) Primary Forest; (3) Bush; (4) Secondary Forest; (5) mixture Plantation; (6) Agriculture; and (7) Non Irrigated Dry field. The land-cover map of the study area represents the basic data layer for the prediction and assessment of the impacts caused by the road alternatives. In particular, the impact analysis will focus on the natural ecosystems that occur within the study area.

The natural ecosystems are characterised by the presence of an essentially intact, at least in its main features, native vegetation cover. According to the potential-vegetation map of the study area, this means that all the woodlands (except from the plantations, such as the *meranti payau* stands), as well as the riverside vegetation associations, can be considered as natural ones.

The two alternative layouts are shown in Figure 2 : Each alternative is designed to be partly 2-laned with 12,5 m-wide, and 120 m buffer zone.

(1) Alternative 1 runs along the western side of the Napalmelintang Village, then crosses the Nike river and fringing along river and growing up with relief until 5 % at Km 20+00 and until Km 36+00 gradual up with 11,4 % relief .

(2) Alternative 2 runs along the northern side of the Nike river and then go up along relief with inclination until 11 % at Km 22+00 with height 1100 m msl. This alternate for cutting short distance and avoiding some inclination of very steep bevel. Travelled distance from second alternate shorter (36 Km) from Napal Melintang to Sukanegeri Village on Bengkulu.



**Figure 2** The two road layouts (Alternative 1 represented in green and 2 in red)

### 3.2 Impact prediction

The first step in predicting the impacts caused by the space occupation of the project alternatives consists in estimating the extent of such an occupation. For similar types of roads, the occupation buffer proposed in the literature is of about 120 m. The buffer maps of the different project alternatives were overlaid to the map showing the distribution of the natural ecosystems (see Figure 3). The comparison between the original ecosystem map and the different landscape scenarios allowed to compute the expected loss for each ecosystem type. The losses are presented in Table 1 and in Figure 3. This is mainly due to the fact that all the two alternatives heavily interfere with the fluvial system of the Bai Metat River, by running along it and crossing it. The design of the road alignments reveals the willingness of sparing the highly valuable forestry land, at the fluvial corridor's expenses.

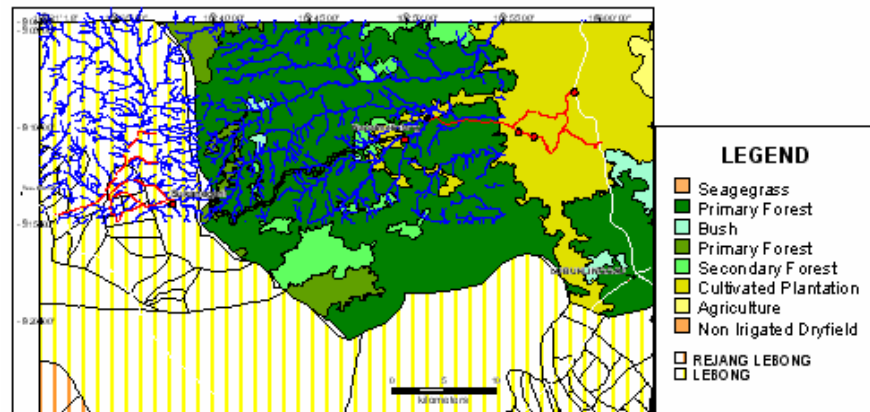
**Table 1**

Estimate of land area losses (area losses= $A_j$ ) at difference ecosystem types

Primary Forestry (core) [ha]	Primary Forestry [ha]	Secondary Forestry [ha]	Mix Forestry [ha]	Open Forestry [ha]
501,40	78,26	60,09	53,76	311,04

### 3.3. Impact Assessment

From Tables 1 above can be estimated, that forest of core on TNKS to pass by the road plan for the primary forest equal to 501,40 Ha, what in this time around in zone of prop area or jungle zone. For obtain value ecosystem impact to lose effect awaking up of this road two province, conducted with calculation like shown in Tables 2.



**Figure 3** Buffer zones at the road plan alternate two

From Tables 2., total of plant ecosystem or tree will lose at area along the road plan is equal to 436,90 Ha. The area fair within measure and can be supported with government regulation of Minister Forestry No. 14 Year 2006, enabling to open farm for the sake of public, as long as pertinent local government provide the same as substitution farm broadly or more to be converted to become protected forest.

**Table 2**

Value of Ecosystem-Loss Impact (ELI) for each ecosystem type which estimated to lose in hectare (left side column) and assigned value (right side column)

Ecosystem Losses											ELI
Plan	Core Forestry		Primare Forestry			Second Forestry			(weighted, Ha)		
Alt.2	501,4	0,11	78,26	0,14	60,0	0,35	53,76	0,72	311,04	1,0	436,90

#### 4. CONCLUSION

(1) Alternative 2 is by far the best-performing one, i.e., the one that causes the least impact on ecosystems. Such an alternative is shorter with inclination of bevel under 11% and a little cut of hill and facilitating to chosening of the sites relevant for biodiversity conservation.

(2) The use of measurable indicators to assess the evaluation criteria. In the context of EIA, this means also that the impact prediction (i.e., the description of changes in the indicator values) can be kept separated from the impact assessment (i.e., the evaluation of the relevance of such changes);

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