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Simple spatially-based model to prevent forest land use conflicts

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ABSTRACT: A simple spatially-based model is proposed that is designed to evaluate the biophysical and socio-economic aspects of the environment in order to determine an equilibrium condition between supply and demand of basic needs, such as defined by developments which meet the needs of the present generation without compromising the options to meet the needs for future generations. The model is designed to generate a development plan for existing forest land use, particularly for buffer forest land, which is appropriate to meet the legal and social requirements identified by indigenous and local people both within and surrounding forest areas in East Kalimantan Province, Indonesia. The effort to improve forest land use planning to prevent forest land use conflict is important to the country, because the degradation of forest resources occurs at a rate of 1.6 million hectares per year in Indonesia, and it requires careful evaluation and planning to ensure sustainable forest management. The proposed model will be spatially-based and will be evaluated with data available in East Kutai Regency, whilst the result will be able to strengthen the forest land gazettal policy as a basis of sustainable forest co-management application.

1 INTRODUCTION

The largest province of Indonesia, East Kalimantan, is covered by state forest of around 14.6 million hectares (2/3 of the province area). According to the Forest Land Use Plan 2001 (FLUP), the forest is allocated as Production Forest (PF) for timber production purposes (5.1 million hectares), Limited Production Forest (LPF) for limited timber production and maintain soil conservation (5.8 million hectares), Protection Forest (PrF) for water conservation purposes (2.8 million hectares), and National Park (NP) for natural conservation (2.1 million hectares).

As part of the forest land gazettal process signed by the Minister of Forestry, boundaries of the *FLUP* are implemented in the field through terrestrial forest land surveys and mapping. The problems of forest land allocation and utilization are only recognized during the survey and mapping process, where part of the forest land is occupied by indigenous and local people. Molnar (2002) mentions that the World Bank uses the terms *indigenous people/indigenous ethnic minorities/tribal groups/scheduled tribes* to describe groups with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process. Indigenous people in the East Kalimantan province are namely *dayak*. Dove

(1988) indicates that *dayak* families mostly live together in one large room of native houses which are called *Rumah Panjang* (long house) and are located near the river or its tributaries.

The forestry policy theoretically is designed to provide economic support to the people, especially for the greatest welfare of people within and around the forest, including both indigenous and local people. In reality, these activities seem to neglect the social and economic development of indigenous and local people, and subject the area to deforestation. Shresta and Zinck (2001) mention that forest degradation is caused by natural processes and human activities through inappropriate land use practices. Ministry of Forestry (2001) states that deforestation averages around 1.6 million hectares annually, however the latest data indicate that deforestation has increased to an amount of 2.0 million hectares annually (Forest Watch Indonesia and Global Forest Watch, 2003), and is normally caused by forest concessions, forest land conversion to estate crop plantations, slash and burn agriculture or shifting cultivation by indigenous and local people, forest fire, natural disaster and illegal logging.

In order to maintain the forest land clear and clean from occupation and disturbance, there needs to be assigned an area inside the forest boundary that is regarded as buffer forest land (*BFL*). This activity seems to revise the existing *FLUP,* however the land status still remains as state forest and merely provides an opportunity for the people to collect non timber forest products, either via agriculture through a social forestry/agroforestry system, and may get part of the benefit in the form of timber extraction activities (*e.g.* employment and/or a certain worth of money to community based development support). The concept adopts a sustainable forest co-management philosophy. Castro and Nielsen (2001) indicate that sustainable forest co-management is a collaborative institutional arrangement among diverse stakeholders for managing forest or natural resources.

2 FOREST LAND USE PLANNING

2.1 *Forest Land Use Planning concepts*

Davis (1976) mentions that forest land allocation in FLUP is broadly based on land characteristics, uses, and combined uses with land characteristics. FLUP in Indonesia was first performed in 1983 and was called Forest Land Use by Consensus (FLU 1983). It was undertaken by the Ministry of Agriculture in the 1980's (Ministry of Agriculture, 1983) due to the absence of a coherent land use plan in each province. The idea of this arrangement is to allocate separate forest areas for utilization and conservation purposes.

The *FLUP* was revised in 2001 (*FLUP 2001*) based on the *Provincial Land Use Plan* (*PLUP 1999*). The *FLUP* is mainly a top-down planning product that takes into account solely land characteristics or biophysical criteria (soil type, slope steepness, and rainfall intensity) for site index classifications. Each site index criterion is divided into five classes where each class is allocated a weight (Table 1). The summation of these criteria for each areas classifies the land as *PF* (site index of < 124), *LPF* (site index of 125–174), and as *PrF* (site index of > 174) (Santoso and Hinrichs, 2000; Ministry of Forestry, 1992; G.o.I, 1983).

Table 1. Weight values of each site index criterion

CLASS	SLOPE STEEPNESS RANGE (%)	SLOPE STEEPNESS WEIGHT VALUE	SOIL TYPE EROSION SUSCEPTIBLE	SOIL TYPE WEIGHT VALUE	RAINFALL INTENSITY INTENSITY (mm)	RAINFALL INTENSITY WEIGHT VALUE
1	0 – 3	20	Not Susceptible	15	Very Low	10
2	3 – 8	40	Moderately	30	Low	20
3	8 – 15	60	Susceptible	45	Moderate	30
4	15 – 25	80	Highly	60	High	40
5	> 25	100	Very High	75	Very High	50

2.2 *Current status: Forest land use conflicts*

The mapping activity and boundary marking implemented in the field through this FLUP definition is designed to control the forest land tenure or indicate a capacity to have or hold land for a certain use. The processes in the field to define the boundaries are sometimes disturbed by the occupation or historical habitation of the area by indigenous and local people. This arises because not all socioeconomic factors are considered in deriving the FLUP. As a result of this disturbance, the forest land that is given to forest concession companies as timber contractors is subject to conflict with other users. The current solution to this conflict is through the provision of a forest area enclave providing relatively small areas of land to the inhabitants. This may be a maximum of five hectares per household or 500 metres distance to the forest land boundary, and this may not be sustainable.

The process results in users feeling undervalued and conflicts still remain. The Indonesia Forest Concession Companies Association (2002) implies that there is evidence of 81 episodes of conflict between 23 forest concession companies and indigenous and local people in East Kalimantan in 1999 – 2001, many arising from these and related issues. The indigenous people, through their resolution, state that 10,000 metres of distances to the forest land boundary is appropriate (Abdurrahman and Wentzel, 1997). The resolution of 10,000 metres of distance will be used as a bottom-up demand in the decision alternatives of the model.

2.3 *Alternative approaches*

Several studies in South East Asia have been undertaken to address the social aspects of forest management. Sandewall and Nilsson (2001) provide an area production model (APM) which takes into account actual FLU, and socioeconomic and environmental consequences that were established in the 1980's in Laos. Community-based forest management was used in the Philippines where local community groups developed their own forest area criteria and indicators (Johnson, 1999), whilst Christ (1999) mentions participatory FLUP in Cambodia which requires a strong bottom-up planning perspective to assist the on-going process of formulating the policy and regulatory framework regarding FLUP and natural resources management. These studies contribute to a better understanding of the diversity of indigenous forest management systems for incorporation of forested landscapes (Wiersum, 1997).

In Indonesia, social forestry programmes and studies began in the 1980s (Chidley, 2002; Lindayati, 2000; Hadikusumah et al. 1993) and show the history and progress of forestry management and policy used to support the welfare of the people. The Ministry of Forestry, Government of Indonesia and *Deutsche Gesellschaft fur Technische Zusammenarbeit/GTZ* conducted a pilot study in 1996 of *FLUP* boundary marking in East Kalimantan Province which provided participative forest mapping or people participatory mapping (PT. Sumalindo Lestari Jaya and Sustainable Forest Management Project, 1996; Santoso and Hinrichs, 2000). The pilot project results do not seem as effective or have even been neglected by local and regional governments, because the indigenous and local people used participative forest mapping as a reason to occupy the forest land beyond their basic requirements. There exists a need to reconsider the specific cultural and environmental factors at work with the objective of improving the *FLUP* outcomes.

In order to eliminate the conflict, *FLUP* should take into account the biophysical and socioeconomic aspects to meet an equilibrium condition between supply and demand to ensure sustainability. Hinrichsen (1989, p.7) defines: "sustainable development as development which meets the needs of the present generation, without reducing the options for future generations to meet their needs". Furthermore, the *FLUP* should not merely conform to the legal requirements, but should be acceptable to indigenous and local people as well as enable co-management between the indigenous and local people, other stakeholders and the government (Sandewall *et al*, 2001; Castro and Nielsen, 2001).

2.4 *Solution: Simple Spatially-based Model*

FLUP as part of forest land gazettal activities, is implemented through *FLUP* mapping and boundary marking in the field, and is sometimes disturbed by the conflicts evident through land occupation by indigenous and local people. The forest land gazettal process for state forests in Indonesia is shown in Figure 1.

The proposed model will provide a scientific basis to strengthen and enrich forestry policy implementation through comprehensive spatial modeling of *FLUP* using *GIS* and improved data gathering. These will be included to identify the needs of the indigenous and local people who occupy forest land. Socioeconomic and biophysical aspects will enable revised *FLUP* arrangements to be developed using a buffer forest land (*BFL*) model. The model is designed to define a certain area of forest land to provide for the welfare of the people with consideration for the legal aspects (utilization status), and biophysical and socioeconomic factors (Fig. 2). The proposed model will be able to strengthen the implementation of forest sector policy in Indonesia, particularly related to forest land gazettal and flowing through to the facilitation of *FLUP* boundary marking in the field. The ultimate goal of sustainable forest management will be achieved if the *FLUP* is clear and clean, which means the boundary of the location is clearly evident on the map as well as in the field, and clean of conflicts between users.

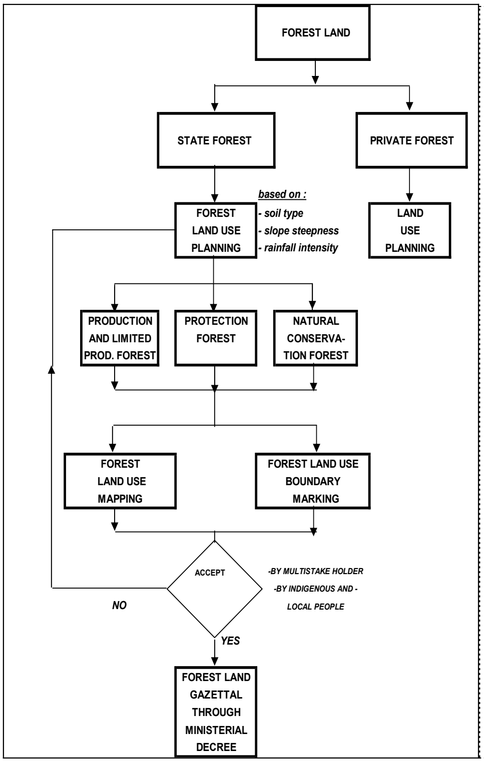

Figure 1. Present forest land gazettal process.

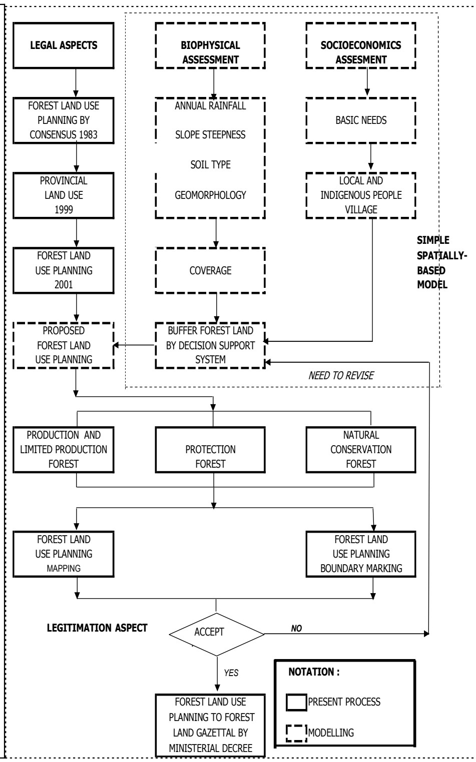

Figure 2. Model flowchart.

Socioeconomic factors include the social and economic factors based on the basic needs of the people. Apthorpe (1970) mentions the basic needs that are categorized as basic consumption, basic services and basic participation. Furthermore Gregg Jr (1994) mentions that to fulfill the basic needs requires a creative balance of: material and energy needs, social needs, spiritual needs and informational needs. During data collection, the basic needs of indigenous and local people were investigated as: accessibility needs, energy needs, wood for housing needs, and land dependency for agriculture activity.

3 DECISION SUPPORT SYSTEM – ANALYTICAL HIERARCHY PROCESS

3.1 *Range of applications*

The disparate nature of these data and the incompatibility of the biophysical and socioeconomic components require an innovative approach to the modelling procedure using a decision support system. According to Saaty (2001), selected criteria on different measurement scales may be transformed to a uni-dimensional scaling problem using an appropriate decision support system, such as the Analytic Hierarchy Process (AHP). Other methods and techniques such as linear programming (LP) and goal programming (GP) are available, however they merely provide assessment based on linear relationships between the goal and constraining variables, without any consideration of preferences provided by decision makers, interest groups and stakeholders (Kangas et al, 2001a; Malczewski, 1999; Mendoza et al, 1999; Saaty, 1989). Since the AHP has demonstrated the value added, therefore it was chosen as a decision support system to incorporate in the model.

3.2 *AHP implementation*

The *AHP* is a comprehensive, logical and structural framework that allows improved understanding of decisions through decomposition of the problem in a hierarchical structure. Fundamentally, the problem is decomposed into a hierarchy, such as: the goal or decision at the top level of hierarchy, the criteria (and sub-criteria) at the next level, and the alternatives at the bottom level.

The data are provided as the criteria or sub-criteria that the relative importance is being compared pairwise with respect to each element, and each value is normalized to reach the relative weight (Fig. 3). The incorporation of all criteria and the pairwise comparison allows the decision maker to determine the objectives. The pairwise comparison is represented as a matrix as:

$$A = [a_{ij}], i,j = 1, \ldots, n; \quad a_{ij} = 1; \; a_{ji} = 1/a_{ij} \tag{1}$$

where A = the matrix of pairwise comparisons, n = number of elements, a_{ij} = the pairwise comparison reciprocal matrix of n criteria that the value is based on a descriptive scale of each criteria/sub-criteria (Table 2), a_{ij} also represents the importance of the i^{th} criterion as compared to the j^{th} criterion.

Criteria	***Pairwise comparison***			***Relative weight calculation***					
	B_1	B_2	B_3	B_1	B_2	B_3	***Row totals***	***Normalized relative weight***	***Priorities***
B_1	*1*	B_2/B_1	B_3/B_1	$1/X_1$	$B_2/B_1/X_2$	$B_3/B_1/X_3$	Y_1	Y_1/Y	*1st*
B_2	B_1/B_2	*1*	B_3/B_2	$B_1/B_2/X_1$	$1/X_2$	$B_3/B_2/X_3$	Y_2	Y_2/Y	*2nd*
B_3	B_1/B_3	B_2/B_3	*1*	$B_1/B_3/X_1$	$B_2/B_3/X_2$	$1/X_3$	Y_3	Y_3/Y	*3rd*
Totals	X_1	X_2	X_3	*1.000*	*1.000*	*1.000*	Y	*1.000*	-

Figure 3. Pairwise comparison and relative weight visualization in step calculation example

Table 2. Descriptive scale relative important of pairwise comparison

Descriptive scale	Intensity of importance
Equal important, likely or preferred	1
Moderately more important, likely or preferred	3
Strongly more important, likely or preferred	5
Very strongly important, likely or preferred	7
Extremely more important, likely or preferred	9
Intermediate values to reflect compromise	2, 4, 6, 8

Composite priorities of alternatives will result in the ranking of the alternatives according to the criteria and sub-criteria (Fig. 4) and denoted as:

$$W = [w_1, w_2, \ldots\ldots w_n] \tag{2}$$

where W = ranking of all alternatives according to the criteria and sub-criteria, w_i = priority of alternative i where w_i € $[0,1]$ and $\sum_{i=1}^{n} w_i = 1$.

The decision model calculation uses the calculation model mathematically expressed by Korhonen and Wallenius (2001) as:

$$y = y(x) = Ax \tag{3}$$

where y = $_i$vector of consequences or outcome variables, x = $_j$vector of decision variables, and A = matrix of pairwise comparisons.

	Relative weight	***Alternative 1***	***Alternative 2***
Composite priorities	- W -	w_1	w_2
Criteria B	W_B	w_{b1}	w_{b2}
Criteria S	W_S	w_{s1}	w_{s2}
Criteria L	W_L	w_{l1}	w_{l2}

Figure 4. Weighted decision matrix example

3.3 *Data requirements*

The *AHP* originally is a method for converting subjective assessment of relative importance to a set of overall weights, therefore all types of data and information are acceptable including qualitative and quantitative types of data.

3.4 *Analysis model*

In order to analyze the model, there are two assessments that could be implemented such as:

(1) consistency analysis uses a pairwise comparison matrix of criteria and sub-criteria, and is measured by the consistency ratio (*CR*). The *CR* is derived from the consistency index *(CI)* and the random inconsistency index (*RI*). *CR* is a measure of the consistency of pairwise comparison matrix based upon a comparison of the *CI* and the mean of *RI* as the result of averaging the *CI* of a certain order of the pairwise comparison matrices to infinity. Saaty (1990) defines a consistency ratio (*CR*) $\leq$ 0.10 of the pairwise comparison matrix is acceptable or the data are sufficiently consistent. The *CR* determines the data perfectly consistent when $\lambda_{max} = n$ and $CI = 0$, or inconsistent when $\lambda_{max} > n$. The *CR* is calculated as:

$CR = CI/RI;\ \ CI = \lambda_{max} - n/n - 1$ (4)

where λ_{max} = the maximum eigenvalue, n = number of element/criteria/sub-criteria/variables.

(2) sensitivity analysis (*SA*) is performed to determine the robustness of the model. Malczewski (1999) defines the *SA* as a procedure for determining whether the decisions of the model are affected by the changes in the data inputs, or it aims at identifying the effects of changes in the ranking of alternatives and the effect on the outputs.

3.5 *Model hierarchy*

The hierarchy level of the model based on the *AHP* that will be implemented for each village consists of three levels (Fig. 5). The first level is the goal that indicates the optimal distance alternative to assign *BFL* for co-management, whilst the second level consists of biophysical and socioeconomic criteria and legal aspects, and the third level consists of the sub-criteria. The biophysical criteria (B) that affect the *BFL* and *FLUP* arrangements are considered to include: annual precipitation (b_1); soil type (b_2) with sub-criteria of soil depth (b_{21}) and permeability (b_{22}); slope steepness (b_3); land cover (b_4) with sub-criteria of coverage (b_{41}), forest potential (b_{42}) and burn area (b_{43}); and geomorphology (b_5) with sub-criteria of parent material (b_{51}) and terrain (b_{52}).

Land cover criteria, especially coverage sub-criteria (b_{41}) are developed based on a three dimensional graphic representation of the structural vegetation type. The derived bare land coverage is in percentage (van Gils and Wijngaarden, 1984). The three dimensional structural vegetation classification approach is very useful to describe the land cover assessment of each major cover class (tree cover, shrub cover and grass cover). This approach describes vegetation coverage in terms of the proportion of tree, shrub and grass cover, which may be commonly interpreted from satellite images and aerial photographs.

The development of the *AHP* as a decision support tool to solve problems in a wide range of disciplines, provides useful decision support for *FLUP* revision based on a combined assessment of biophysical and socioeconomic factors, and legal aspects. The disparate nature of these data and the incompatibility of the data components on different measurement scales may be transformed to a uni-dimensional scaling problem using the *AHP*. The objective of the *AHP* analysis is to define the *BFL* distance that provides an optimum *FLUP* scenario based upon all relevant input criteria and expert advice.

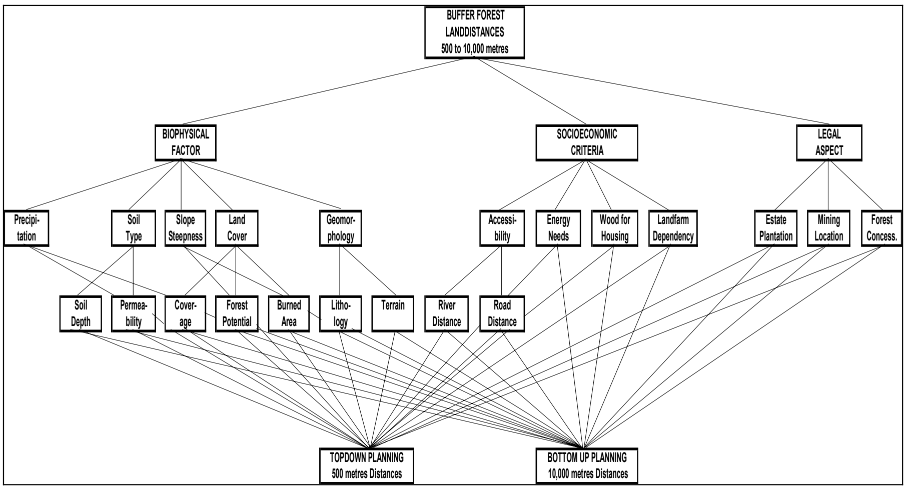

Figure 5. *AHP* hierarchy of the model

4 STUDY AREA

4.1 *Location*

The study area is situated in the eastern part of East Kalimantan Province, Indonesia (Fig. 6). The province consists of 13 regencies whilst the location is administratively located in the East Kutai Regency that is geographically located between 0^{o} 40’ N to 1^{o} 40’ N and 117^{o} 15’ E to 119^{o} 00’ E. East Kutai Regency consists of eleven districts, and the study is undertaken in five districts: Sangatta, Bengalon, Sandaran, Sangkulirang and Kaliorang districts, especially in 13 villages which represents an area of 858,000 hectares. The boundary of the study area is defined in part by the current forest land use in the Regency.

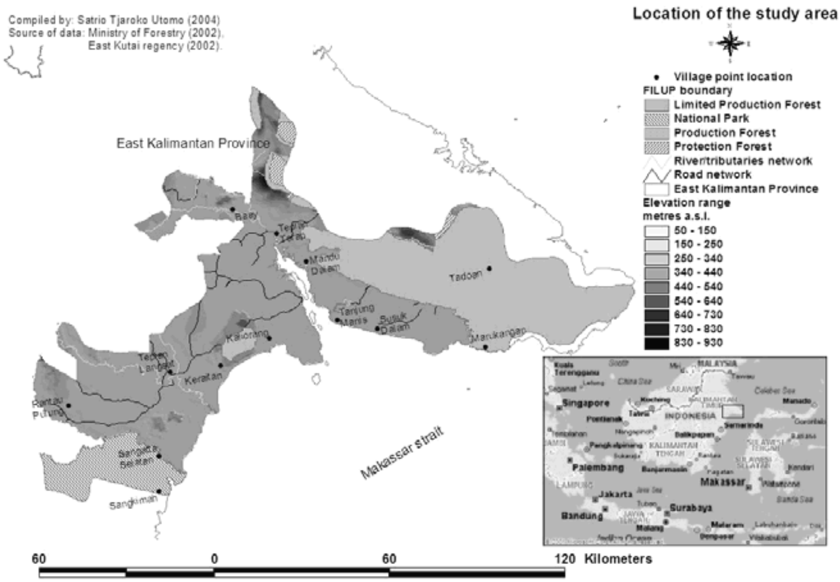

Figure 6. Location of the study area used for model development and evaluation

The villages used in the study were: Baay (v_1), Kaliorang (v_2), Keraitan (v_3), Mandu Dalam (v_4), Marukangan (v_5), Rantau Pulung (v_6), Sangatta Selatan (v_7), Sangkimah (v_8), Susuk Dalam (v_9), Tadoan (v_{10}), Tanjung Manis (v_{11}), Tepian Lembak (v_{12}) and Tepian Terap (v_{13}). In East Kalimantan the major form of village to village transportation is normally using speed boat or traditional boat. During assessment of forest potential data in the field, it is normally difficult to find land transportation, except by logging road. The accessibility of the area, especially the closest village to the regency capital city (Sangatta), is about 250-300 kilometres or three hours by car, and to the furthest village is about three days by traditional boat.

4.2 *Data collection*

Data were collected from the Ministry of Forestry, Statistical Office, East Kutai Government, and The Forest Land Gazettal Centre Region-IV. Primary data were collected through sample household interviews which were randomly taken of about five percent or a maximum of ten households in each village. Forest land cover was interpreted and classified from *Landsat ETM* images (116/59 and 116/60, 2002 and 2003) using the three dimensional structural vegetation classification.

The forest potential of merchantable tree species data were provided by Hanurata Coy Ltd (Forest Concession Company) through 100 % cruising in the *FP* area (100 % potentials measurement of the line sample plot), and other forest cover classes were collected through forest inventory by the *Systematic Sampling with Random Start* method (*SSR*). The *SSR* was chosen because there is no obvious structure or pattern in the population of mixed broad-leaf canopy trees (Brack, 1999; Hinrichs *et al*, 1998).

4.3 *Data analysis*

Considering the factors affecting the *FLUP* and *BFL* of each village, the indicator value was assigned through the expert optimization with respect to the distance for co-management (Table 3). The indicator value in the pairwise comparison matrices were calculated based on the expression (2) and (3), and the result presented in Table 4.

Table 3. Indicator judgment in pairwise comparison matrix

Criteria	***Sub-criteria***	***Subsub-criteria***	***Optimization Indicator***	***Unit***
Biophysical	Annl. precipitation	-	Max. annual prec.	mm/year
	Soil type	Soil depth	Max. depth	cm
		Permeability	High saturation	%
	Slope steepness	-	Low slope	% steepness
	Landcover	Coverage	Min. bare cover	% bare cover
		Forest potential	Max. tree potential	m^3/hectares
		Burn area	Min. burn land	% area
	Geomorphology	Lithology	Max. plough parent mtrls.	% weathered
		Terrain	Max. flat area	% ploughed
Socioeconomic	Accessibility	River	Min. distance	km
		Road	Min. distance	km
	Energy needs	-	Max. firewood depend.	% household
	Wood for housing	-	Max. wood dependency	% household
	Land farm	-	Max. land farm depend.	% household
Legal aspects	Estate plantation	-	Min. distance	km
	Mining location	-	Min. distance	km
	Forest concession	-	Min. distance	km

Table 4. Distance (*D*) of each village (v_i) in kilometres

	v_1	v_2	v_3	v_4	v_5	v_6	v_7	v_8	v_9	v_{10}	v_{11}	v_{12}	v_{13}
D	3,507	2,991	3,537	3,810	5,377	2,827	4,969	4,468	5,010	4,241	4,864	4,019	4,809

4.4 *Output*

In order to graphically represent the result of the *AHP*, *ArcView 3.3 GIS* software is used to show the buffer distance for cartography. The main objective is to provide a clear stepwise process and enable local planners to implement the model, therefore a combined approach is used with the *AHP*-based computation undertaken using *Microsoft Office Excel* and the output presented using *ArcView 3.3*. The simple spatially-based model is intended to develop and generate a model of *FLUP* in which the criteria properly meet the legal requirements of Indonesia as well as the social and economic needs identified by the indigenous and local people of the area. Although particularly applying to the central part of East Kalimantan Province, Indonesia, the model will be designed to have broad application to forestry sector policy in Indonesia, particularly forest land gazettal.

The model aims are directed towards:

(1) to identify and explore the factors influencing *FLUP* by indigenous and local people. These factors may be generally described as biophysical and socioeconomic factors. It is important to be able to indicate an appropriate balance in order to reach a sustainable condition between biophysical factors, such as supply, and socioeconomic factors such as demand;
(2) to formulate biophysical criteria and
(3) socioeconomic criteria, respectively. The criteria are mainly developed as site indexes due to observed and potential *FLUP* arrangements, and will be suitable for convenient assessment to simplify the procedure for local and regional planning implementation;
(4) to generate a spatial database largely derived from remote sensing and using *GIS* techniques to incorporate a *DSS* to model *BFL* occupied by indigenous and local people;
(5) to develop a model that integrates biophysical and socioeconomic criteria based on the data available in the location;
(6) to evaluate the effectiveness of the model and future research.

4.5 *Possible Future Problems*

The *BFL* model indicated that not all of the village samples are influenced by the existing *FLUP* because the villages are not all located close to forest areas, however the basic needs may still depend on the productivity of forest land. Those villages are in the proximity of activities, such as: estate plantations either mining locations. This problem will arise when not all villages are provided with *BFL* for co-management, except when the government revises the contract or contract addendum to estate plantation and mining companies to provide co-management areas of forest that are located within estate plantation and mining areas. This may lead to future land use conflicts to estate plantation and mining expands.

Further study is needed in measuring the village area, because there are not any exact boundaries or areas of the villages. The area could be measured in the field, otherwise derived from aerial photographs or *Landsat ETM* images interpretation.

5 CONCLUDING REMARKS

A model of *FLUP* derived using the *AHP* is indicated to be a valuable decision support tool in forestry in terms of its application to *FLUP* and to prevent forest land use conflicts. This research attempts to revise the existing *FLUP* by integrating socioeconomic factors/criteria with respect to the basic needs sub-criteria of indigenous and local people, as well as the established process of using biophysical criteria and legal aspects.

The model is designed to consider:

(1) the distance and *BFL* area of each village and not a generalized value, because each village varies in the value of basic needs. The basic needs considered are the accessibility, energy needs, wood for housing needs, and land farm dependency;
(2) the basic needs criteria of each village should be investigated carefully to maintain the users are not feeling under valued, especially the outer villages located adjacent to the forest land.

The central government should not discriminate and encourage the private companies (estate plantation and mining company) to implement co-management concepts within a certain distance of the village location, because historically the land is provided to the company free of charge.

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REFERENCES

Abdurrahman, H., and Wentzel, S. 1997. *Konsep untuk Menyelesaikan Masalah Status Tanah Masyarakat di Kawasan Hutan pada Areal HPH dan HPHTI di Propinsi Kalimantan Timur*. Samarinda, East Kalimantan, Indonesia: Ministry of Forestry in Corporation with Deutsche Gesellschaft fur Technische Zusammenarbeit GTZ.

Apthorpe, R. 1970. *People Planning and Development Studies, Some Reflections on Social Planning,* London, UK: Frank Cass.

Brack, C.L. 1999. *Technical Note: A Simple Procedure for Measuring Single Tree Volume Using The Centroid Sampling Technique*. Canberra, Australia: Department of Forestry, Australian National University, http://sres.anu.edu.au/associated/mensuration/centroid.htm.

Chidley, L. 2002. Forests, People and Rights, in: *Down to Earth, International Campaign for Ecological Justice in Indonesia,* Marr, C. eds.., Jakarta, Indonesia: Forest Peoples Programme and Rainforest Foundation, pp. 1-33.

Christ, H. 1999. Participatory Land Use Planning in Cambodia, in: *Introductory Workshop,* Sustainable Management of Resources Project and GTZ ed.., Phnom Penh, Cambodia: GTZ/MRC-ADB-Cambodia Community Forestry. pp. 1-14.

Castro, A.P., and Nielsen, E. 2001. Indigenous people and co-management: Implications for conflict management, *Environmental Science & Policy*. 4: 229-239.

Dove, M.R. 1988. *Sistem Perladangan di Indonesia, Suatu Studi-Kasus dari Kalimantan Barat,* Yogyakarta, Indonesia: Gadjah Mada University Press.

Forest Watch Indonesia and Global Forest Watch 2003. *Potret Keadaan Hutan Indonesia,* Bogor, Indonesia: FWI & GFW 2001.

G.o.I. 1983. Keputusan Menteri Pertanian tentang Penunjukan Areal Hutan Kalimantan Timur Seluas 21.144.000 Hektar sebagai Kawasan Hutan Ministry of Agriculture Decree on Appointed Forest Land Area in East Kalimantan as Amount of 21,144,000 Hectares., in: *Decree No. 24/1983*, Vol. 24/Kpts/Um/I/1983, pp. 1-3.

Gregg Jr, W.P. 1994. Developing landscape-scale information to meet ecological, economic, and social needs, American Forests. in: *Remote Sensing and GIS in Ecosystem Management*, Sample, V.A. ed.., Washington, D.C., USA: American Forests, Island Press, pp. 13–17.

Hadikusumah, H., Iskandar, J., and Sukmananto, B. 1993. Communities and forest management in East Kalimantan: Pathway to environmental stability, in: *Southeast Asia Sustainable Forest Management Network,* Poffenberger, M. and McGean, B eds, Berkeley, USA: Center for Southeast Asia Studies, University of California, pp. 1-5.

Hinrichs, A., Ulbricht, R., Soedirman, S., and Solichin. 1998. *Panduan Survey Orientasi di Areal HPH untuk Pengelolaan Hutan Lestari, Digabung dengan Metode Survey Hutan Bekas Tebangan*, Jakarta, Indonesia: Promotion of Sustainable Forest Management System SFMP. in East Kalimantan, Ministry of Forestry and Estate Crops in Cooperation with Deutsche Gesellschaft fur Technische Zusammenarbeit GTZ.

Hinrichsen, D. 1989. *Our Common Future, A Reader's Guide, The Brundtland Report Explained*, London, England: IIED/Earthscan, Earthscan Publication Ltd.

Indonesia Forest Concession Companies Association 2002. *Menuju Pengelolaan Hutan Lestar*i. Samarinda, Indonesia:Komda APHI KALTIM.

Johnson, T. R. 1999. Community-based forest management in the Philippines. *Journal of Forestry* 97: 26-30.

Kangas, J., Pukkala, T., and Kangas, A. S. 2001. A HERO: Heuristic Optimisation for Multi-Criteria Forestry Decision Analysis, in: *The Analytic Hierarchy Process in Natural Resource and Environmental Decision Making,* Schmoldt, D.L., Kangas, J., Mendoza, G.A., and Pesonen, M., eds.., Dordrecht, The Netherlands: Kluwer Academic Publisher, pp. 51–65.

Kangas, J., Hytönen, L.A., and Loikkanen, T. 2001b. Integrating the AHP and HERO into the Process of Participatory Natural Resources Planning, in: *The Analytic Hierarchy Process in Natural Resource and Environmental Decision Making,* Schmoldt, D.L., Kangas, J., Mendoza, G.A., and Pesonen, M., ed.., Dordrecht, The Netherlands: Kluwer Academic Publisher, pp. 131–147.
Korhonen, P., and Wallenius, J. 2001. On using the AHP in multiple objective linear programming, in: *The Analytic Hierachy Process in Natural Resource and Environmental Decision Making,* Schmoldt, D.L., Kangas, J., Mendoza, G.A., and Pesonen, M., eds, Dordrecht, The Netherlands: Kluwer Academic Publisher, pp. 37–50.
Lindayati, R. 2000. *Community Forestry Policies in Selected Southeast Asian Countries*. CBNRM Ottawa, Canada: Program Initiative International Development Research Centre.
Malczewski, J. 1999. *GIS and Multicriteria Decision Analysis*. New York, USA: John Wiley & Sons.
Mendoza, G.A., Macoun, P., Prabhu, R., Sukadri, D., Purnomo, H., and Hartanto, H. 1999. *Guidelines for Applying Multi-Criteria Analysis to the Assessment of Criteria and Indicators*. Jakarta, Indonesia: Center for International Forestry Research.
Ministry of Forestry, G. o. I. 2001. Key Issues Identified by The Ministry of Forestry's NFP Working Group to Develop National Forestry Statement through Multi-stakeholders Participation, Government of Indonesia, http://www.dephut.go.id/informasi/intag/NFP/Is_NFP_ e. htm
Ministry of Forestry, G. o. I. 1992. Forest Land Use Plan in Indonesia, *DGFILUP Report*, Jakarta, Indonesia: Ministry of Forestry.
Molnar, A. 2002. [MCNRM] Week 1: World Bank Definitions of Indigenous People, http://www.icimod.org/iym2002/culture/mcnrm/msg00027.html.
PT. Sumalindo Lestari Jaya and Sustainable Forest Management Project 1996. *Pemahaman dan Pemetaan Penggunaan Lahan Partisipatif dalam rangka Persiapan Kegiatan HTI Tanjung Limau, Promotion of Sustainable Forest Management System SFMP. in East Kalimantan*, Jakarta, Indonesia: Ministry of Forestry and Estate Crops in Cooperation with Deutsche Gesellschaft fur Technische Zusammenarbeit GTZ.
Saaty, T.L. 2001. Fundamentals of the Analytic Hierarchy Process, in: *The Analytic Hierarchy Process in Natural Resource and Environmental Decision Making,* Schmoldt, D.L., Kangas, J., Mendoza, G.A., and Pesonen, M., eds, Dordrecht, The Netherlands,: Kluwer Academic Publisher, pp. 15–35.
Saaty, T.L. 1990. *Multicriteria Decision Making: The Analytic Hierarchy Process*, Pittsburgh, USA: RWS Publisher.
Saaty, T.L. 1989. Group decision making and the AHP, in: *The Analytic Hierarchy Process, Application and Studies*, Golden, B.L., Wasil, E.A., and Harker, P.T., eds, Berlin, Germany: Springer-Verlag, pp. 59 – 67.
Sandewall, M. Ohlsson, B., and Sawathvong, S. 2001. Assessment of historical land-use changes for purposes of strategic planning, A case study in Laos. *Journal of Ambio* 30(1) 55–61.
Sandewall, M., and Nilsson, N.E. 2001. The area production model: A tool and concept for sustainable land use and forest resource management. *Environmental Management* 2001: 415-427.
Santoso, I., and Hinrichs, A. 2000. *Forest Mapping for Land Use Mapping and Sustainable Forest Management in Indonesia*, Promotion of Sustainable Forest Management System SFMP. in East Kalimantan. Jakarta, Indonesia: Ministry of Forestry and Estate Crops in Cooperation with Deutsche Gesellschaft fur Technische Zusammenarbeit GTZ.
Shresta, D.P., and Zinck, J.A. 2001. Land use classification in mountainous areas: Integration of image processing, digital elevation data and field knowledge application to Nepal. *ITC Journal* 31: 78-85.
Saunders, J. 1994. A comparison of decision accuracy in the analytical hierarchy process and point allocation, http://users.erols.com/jsaunders/papers/ahpvpa/ahpvpa.htm.
van Gils, H.A.M., and van Wijngaarden, W. 1984. Vegetation structure in reconnaissance and semi-detailed vegetation surveys. *ITC Journal* 3: 213-218.

