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Predicting Sustainability of Agroforestry in a Customary Forest (*Hutan Marga*) in Lampung Province, Indonesia

Christine Wulandari
University of Lampung

SOUTHEAST ASIAN REGIONAL CENTER FOR GRADUATE STUDY AND RESEARCH IN AGRICULTURE
Science and education for agriculture and development

Christine Wulandari
Department of Forestry
Faculty of Agriculture
Lampung University
Bandarlampung, Indonesia
Email: chs.wulandari@gmail.com

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ABSTRACT

Lampung Province has a critical forest encroachment problem that has to be solved immediately. One way to solve this problem is to ensure the sustainability of the *hutan marga* or customary forest as one kind of private forest which can provide farmers their daily needs. It belongs communally to the indigenous people of Buay Belunguh in West Lampung District.

The community manages the hutan marga in West Lampung by agroforestry. To be able to meet the needs of the community, it should be managed in a sustainable manner. Unfortunately, the factors that affect the sustainability of agroforestry in the customary forest and priority ranking on the factors that significantly affect the sustainability have not been recognized until now. This research was conducted in three villages (Bakhu, Bedudu, and Sukarame) where the communities manage the forest communally.

The result of the logit analysis showed that the most influential variables on hutan marga sustainability are the availability of labor and the soil condition. From the analysis results, the level of farming index is moderate with a score of 65.6. This means that on average, there are three types of agricultural activities in the customary forest because the communities practice intercropping vegetables, trees, coffee, and cacao. In addition, they also raise chickens and goats as well as maintain fish ponds. Thus, it is not surprising that 72.33 percent of the respondents have incomes above IDR 3,600,000 per month.

With so many kinds of agricultural activities that are carried out in the hutan marga, such require a sufficient number of laborers. The analysis showed that the number of laborers is an influential variable to the sustainability of the customary forest. The soil condition (i.e., soil nitrogen and soil texture) also have an effect on sustainability. The soil fertility condition is from fair to good. Also based on the analysis results, the level of the communities' social acceptability index in the three research sites is high with a score of 74.92. Thus, SAI is considered an influential variable in the sustainability of the customary forest. The length of residence in the three villages is also a significant variable such that a person's skills, knowledge, and attitude are affected as he or she resides longer in the community.

INTRODUCTION

Rationale and Objectives

Based on the latest data from the Lampung Forestry Provincial Office (2006), 80 percent of protected forests, 71 percent of production forests, and almost 76 percent of conversion-production forests have been damaged. Lampung Province is thus confronted with a great challenge to solve these problems.

The presence of informal settlers is one cause of forest damage in Lampung. According to Sodhi et al. (2010), human population density correlates with the level of informal settlers, deforestation, and species endangerment in Southeast Asia. Similarly, Agrawal and Chhatres (2011) observed that informal settlers would have an impact on deforestation, and indirectly, on biodiversity and the level of economic output.

An intensive management of areas designated or being used as private forests has been considered as one of the best alternatives to solve the forest encroachment problem. This is primarily because 62.68 percent of Lampung's total area is private land used for private forests and housing purposes (Lampung Forestry Provincial Office 2006). In Indonesia, the so-called private forest is a non-state forest or forests located outside the state forests and managed by the community. Thus, the so-called private forest could include community forests or customary forests (i.e., forests managed by indigenous people and located outside the state forests). In addition, a home garden planted predominantly with trees could also be called a private forest.

According to Act No. 41/1999 on Forestry, a forest may be a state forest or a non-state forest or private forest. The law mentions that in general, customary forests are located in the state forest even though there are many customary forests that are located outside the state forest and communally owned by the surrounding communities. Non-state forests or private forests are forests that are located outside of state forests and owned by community members individually or communally by indigenous peoples.

Each area (district or region) has a different name for the customary forest that is located outside the state forest. It is called *dukuh* in South Kalimantan, *lembo* in East Kalimantan, *tembawang* in West Kalimantan, *tombak* in North Tapanuli-North Sumatra, *mamar* in East Nusa Tenggara, and *hutan marga* in Lampung.

Unfortunately, the private forest as a phenomenon has not been fully and consciously taken into account in the formulation of Indonesia's forest management strategies. Thus, socioeconomic problems that have emerged in the formerly forest-rich areas, including the destination sites of the Transmigration Program, have caused forest management problems like those being experienced in the forests of Lampung Province.

In certain circumstances, private forests have proven to be an efficient strategy for capital-poor farmers wishing to intensify land use as land-holding size decreases. As a land-use system, the private forest system has evolved from centuries of trial and error by households that have adapted the practice to the environmental, social, cultural, and economic realities of village life. Aside from filling the household's subsistence needs, the private forest provides a variety of economic, biophysical, and sociocultural functions for the owner while contributing directly and indirectly to the sustainability of other forests such as the state forest.

Recent developments show that now, more than ever, the hutan marga or customary forest needs to be studied more comprehensively due to its potential to provide better management approaches toward more sustainable agricultural and natural resource development especially in West Lampung District, Lampung Province. Moreover, most of the private forest areas are near protected forests or conservation forests, and to meet their daily needs, farmers still rely on the state forest instead of their hutan marga and private forests. The general objective of this study is to determine influential variables to the sustainability of agroforestry in the hutan marga that are practiced by farmers.

The specific objectives of the study are as follows:

1. to identify the factors that could serve as measures of sustainability of agroforestry in the hutan marga in the context of the socioeconomic and biophysical characteristics of the study area, and
2. to determine and rank the priority of variables that affect the sustainability of agroforestry in the hutan marga.

Agroforestry as an Agricultural System

Agroforestry has been defined as a sustainable land-management system that increases the overall yield of the land; combines the production of crops (including tree crops) and forest plants and or animals simultaneously or sequentially, on the same unit of land; and applies management practices that are compatible with the cultural practices of the local population (King 1979).

Agroforestry is a land-use system that involves social and ecological integration of trees with agricultural crops and/or animals, simultaneously or sequentially, to get increased total productivity of plants and animals in a sustainable manner from a unit of farmland, especially under conditions of low levels of technological inputs and marginal lands (Nair 1993).

Generally, the composition of customary forests in Indonesia is a mixture of forest (natural and secondary forest) and agroforest, in which the percentage of the natural forest is only 10 percent and located in the unreachable sites. The hutan marga or customary forests in Lampung Province are generally composed of secondary forests and agroforests. The customary forest in this study is composed of agroforest or a mixture of forest trees with agricultural crops, livestock, and fisheries and managed based on their customary regulation.

Sustainability of the Hutan Marga

In the context of rural development projects, Budiono (2007) refers to sustainability as that which is continuous, self-help, and not only present at a period when support or subsidies were given by the initiator. Erskine (1997) described sustainability based on economic, ecological, and sociological perspectives. In evaluating the success or failure of agroforestry projects such as in this study, Samson (1984) and Wulandari (2005) suggested that projects should be evaluated in terms of their economic, social, and environmental perspectives. Sustainability must simultaneously embrace the economic, ecological, and sociocultural requirements of the system.

In this research, the sustainability of the hutan marga or customary forest means ensuring that the goods and services derived from the forest meet present-day needs. Furthermore, it secures, at the same time, their continued availability and contribution to long-term development. In its broadest sense, forest sustainability encompasses the economic, social, and environmental aspects of the conservation and use of forests. The effort to maintain the sustainability of the customary forest will also mean the conservation of forest resources in the ecological, social, and economic aspects. Steffan-Dewenter et al. (2007) stated that a lot of research in Indonesia have shown that there are integrated conservation efforts between socioeconomic and ecological aspects in the local level and landscape to figure out the ecological-economic trade off.

Contribution to Households' Daily Needs

Contributing to farming practices in private forests, such as the hutan marga or customary forest, home gardens in Indonesia are the source of around 5 percent to 50 percent of the total household income. In West Sumatra Province, 1–2 hectares of agroforests account for 26–30 percent of the total household income. These differences were due to the size of private forest land, choice of plants, degree of commercialization, and farming intensity (Suryana and Simatupang 1992). Another case study in Srihardjo Village, Yogyakarta, stated that total income of a household with an average of 0.5 hectares of land is composed of 49 percent from private forest land, 35 percent from rice farming, and the rest from other sources (Penny and Ginting 1984).

Another important feature of private forest is its ability to produce food throughout the year with relatively low labor inputs (FAO 1992). The activities in the private forest are not only the main job of the household head but also of the wife and other family members.

Only 5.5 percent of the whole family's productive time is devoted to private forest activities. In Indonesia, the labor used is affected by the farming practice and size of the private forest (Suryana 1991). The labor inputs in the private forest on the average are three times higher than those in larger private forests (FAO 1992). Households with little land to use in their customary forest manage such land intensively and carry out crop, livestock, and tree production simultaneously (van der Poel and van der Dijk 1987). The customary forest featured in this study has been managed from generation to generation by the three villages around the forest, and up to now, has remained sustainable. The communities manage the customary forest independently without the financial support of an umbrella policy from the government. This independent management practice, however, puts the customary forest at risk of deforestation. Such risk becomes a threat because of illegal logging by informal settlers who act out of economic necessity.

The hutan marga that is owned by the three villages (Bakhu, Bedudu, and Sukarame) communally is an agroforest stretch. So far, the communities have used agroforestry products from the customary forest to meet their daily needs. It is important, therefore, to keep in mind the level of agroforestry sustainability of the customary forest in order to determine the stage of its sustainability.

Since research on the sustainability of agroforestry in the customary forest, especially for forest-based or forest-using households in Lampung Province, has never been conducted, this study aimed to determine the significant factors that affect the customary forest based on ecology, economy, and sociocultural

dimensions. Determining the indicators of success or failure related to sustainability of such customary and private forests will provide new perspectives and value orientation in pursuing appropriate development planning strategies to prevent forest encroachment.

Description of the Project Area

More than 60 percent of the land area of Lampung Province has been allotted to housing and private forests (Lampung Forestry Provincial Office 2006). The private forests or customary forests, have high plant density and majority are dominated by annual and perennial species such as palms, bananas, coffee, and plantain, intercropped with cassava, herbal medicine, and corn, among other crops.

One of the forests in Lampung Province is a customary forest that belongs communally to the indigenous people of Buay Belunguh, who call it *pelutihan*. Based on Bakhu Village Office (2006) records, Buay Belunguh is located in the villages of Bakhu, Bedudu, and Sukarame, which were established in 1950 and were part of the Sub-District of Balik Bukit, North Lampung District. As a landscape ecosystem, the pelutihan area is 750.95 hectares and located in the three villages. The customary forest is located 800–1,120 meters above sea level and serves as a water resource for downstream villages surrounding the forest. The upstream area of this forest is in Pesagi, West Lampung District, and is part of the Way Semangka Watershed.

The pelutihan was chosen as the study site because of its strategic location in the Semangka Watershed, which is one of the critical watersheds in Lampung Province. Another reason for its choice is that the community which manages this hutan marga was the winner of the Kalpataru Award (given to environmental sentinels) on the district level in 2009 for having voluntarily conserved the forest. The award is well deserved because the customary forest remains to be sustainable even without government intervention at the national, provincial, or district levels. The government, which refers to the Ministry of Forestry, actually does not have the authority to manage the forest because the forest is located outside the state forest.

The Sukarame village area is 327 hectares and has 250 households (1,310 individuals). The villages of Bedudu and Bakhu have areas of 550 hectares and 841 hectares, respectively. They have a population of 963 and 794 persons, respectively (Bakhu Village Office 2006). The communities surrounding the customary forest have rules, such as only residents can harvest forest products. The resident could also be someone who married someone in those three villages and decided to stay; he or she is called *smanda*. If he or she moves to another village, he or she will be called *tudau* and is prohibited from harvesting forest products.

The main occupation of Buay Belunguh is farming, particularly coffee. Besides farming, the residents also work as paid laborers or engage in trading and other jobs. Some of the residents of the communities have activities in the pelutihan. Of these, most of the communities use all harvested products for their daily needs.

The hutan marga or customary forest is a complex system of crops, livestock, and fish, which uses inputs (mainly labor) from the household (family member) and also from outside of the family, to produce a range of goods and services that prove useful to farm families. In this context, the hutan marga is a sub-system of a larger system that incorporates the household and other farmed areas, and which has strong linkages to externalities, such as markets, the extended family, the village, and beyond (Asdi 1996). The use of the customary forest depends largely on the sociocultural, religious, agro-climate, and economic conditions of an individual household.

METHODOLOGY

Research Design

Lampung has 91,881 family heads of forest encroachers (BAPPEDA of Lampung Province 1995). Based on a survey of village people in 2003 (Bakhu Village Office 2006), the customary forest in West Lampung, in particular, has 3,067 residents in three villages: Bakhu, Bedudu, and Sukarame.

The number of samples (minimum) was calculated using equation 1 (Slovin 1960):

$$n = \frac{N}{1 + Ne^2} = \frac{3{,}607}{1 + 3{,}067\ (0.05)^2} = 353.856 \approx 354\ \textit{respondents} \quad (1)$$

where:

n = sample size,
N = population size,
e = desired margin of error (5% margin of error).

The formula distributes proportionally to get the number of samples per village. Sukarame has 1,310 households, Bedudu has 963 households, and Bakhu has 794 households, or a total of 3,067 households. Thus, after calculations, the sample for each village is as follows: Sukarame, 151 households; Bakhu, 111 households; and Bedudu, 92 households.

Data were gathered using an interview schedule, which contained socioeconomic data (11 variables as mentioned in the conceptual framework), farming index (FI), and social acceptability index (SAI). Interviews were conducted by eight enumerators at night in the house of the respondents or during the day on their farms for five months from February to June 2011. These were compiled manually before they were analyzed using the formulas for SAI, FI, logit analysis, and analytic hierarchy process (AHP) as described in the section on SAI.

To complete the data on biophysical factors, soil sampling was conducted at the site. The data collected include nitrogen (N), phosphorous (P), and potassium (K) content; soil pH (pH); organic matter content (OMC); bulk density (BD); soil texture (Tx); and aggregate stability.

The soil samples were taken from each hutan marga with 15 replications in each forest. This soil sampling as a biophysical factor was carried out randomly and

taken from depths of 8–36 inches. The soil samples were then analyzed in the Soil Laboratory at the Soil Research Centre, Bogor, West Java, Indonesia.

Sustainability, meaning sustainable use of land and natural resources in general, can be expressed by combining the operations of production and conservation (Erskine 1997). Sustainability could be achieved if soil fertility is maintained while practicing agroforestry in the customary forest. Thus, there is a guarantee of continuity of production because the soil fertility is maintained (Hairiah, Sardjono, and Sabarnurdin 2003; Sodhi et al. 2010). Fertile soil will support the growing quality of plants that live on it, including the resulting quality and quantity of the products. The sufficient quantity and sustainability of production will provide a sustainable income for the community if the products are always sold. If the quality of the product is high, the prices will also be high (Wulandari 2005). Thus, the sustainability of the customary forest means that it could guarantee supplying the daily need for goods and services, and at the same time, securing their continued availability and contribution to the long-term development of the community.

From a social strategic perspective, sustainability is related to participation because it is increasingly clear that change without participation of those most affected by the change is not likely to be viewed as development, and not likely to be sustainable (Dixon, Varughese, and Sharma 1997). Change should be accompanied by the development of the right attitudes and values associated with the operation of the project at a certain point in time (Asdi 1996).

Social Acceptability Index

Social acceptability index (SAI) refers to some psychological factors such as participation, attitudes, and values as regards some aspects and issues related to sustainability of the customary forest. An objective of analyzing SAI is to identify the understanding level of the community in conserving the customary forest. The formula that will be used in this study for SAI is based on the research methodologies of Agustin (1990), Alicante (1991), Asdi (1996), and Wulandari (1999).

$$SAI = \frac{(TSP + TSA + TSV)}{highest\,(TSP + TSA + TSV)} \times 100 \qquad (2)$$

where:

TSP = total score (participation)
TSA = total score (attitudes)
TSV = total score (values)

Participation, attitudes, and values that have been analyzed are incorporated in the questionnaires. To find out what their participation is, the respondents were asked about their presence in group meetings, and participation in trainings, among others. Community attitudes are known through their statements when they answer questions related to managing and maintaining the sustainability of forest resources. The values of the community are known through their statements related to education, the achievement of a business, and the level of knowledge in maintaining and managing the sustainability of forest resources.

Farming Index

The farming index (FI) used in this study is based on the research methodology of Asdi (1996) and Wulandari (1999). The objective of FI analysis is to identify the potency level of food and other daily needs and availability of raw material that comes from the customary forest. The analysis is based on both ecological and socioeconomic aspects. In order to conserve the natural resources, such analysis is necessary, for strategies have to be developed at the same time to make the human-dominated area more hospitable to forest biodiversity (Gardner et al. 2009; Gardner 2010). The FI is used to determine the level of availability of food resources.

$$FI = \left(\frac{TEV}{TAA} + \frac{TEC}{HTEC} + \frac{TEG}{HTEG} + \frac{TECt}{HTECt} + \frac{TET}{HTET} + \frac{TEF}{HTEF}\right) \times 100 \qquad (3)$$

where:

TEV = total effective area planted to vegetables
TAA = total area available
TEC = total number of existing chickens
$HTEC$ = highest total number of existing chickens by a respondent
TEG = total number of existing goats
$HTEG$ = highest total number of existing goats by a respondent
$TECt$ = total number of existing cattle
$HTECt$ = highest total number of existing cattle by a respondent
TET = total number of existing beneficial trees
$HTET$ = highest total number of existing beneficial trees by a respondent
TEF = total number of existing fish
$HTEF$ = highest total number of existing fish by a respondent

Animal husbandry calculation was arrived at by manual or conventional calculation. Sampling of livestock data to calculate FI was conducted by counting the number of chickens, goats, and fish ponds owned by each respondent. In addition, data on the types of vegetables and trees planted and size of the planting area were also collected from the respondents.

Related analysis on the number of plants or trees was conducted by constructing various sizes of plots for each tree classification (e.g., seedlings and poles). There is a 20 × 20 meter (m) plot for vegetation at tree level (tree diameter > 20 centimeters [cm]), a 10 × 10 m plot for vegetation at poles level (tree diameter 10–20 cm), a 5 × 5 m plot for the vegetation at stake level (tree diameter < 10 cm, height > 1.5 m), and a 2 × 2 m plot for vegetation of seedlings (plant height < 1.5 m), and ground cover. Stem diameter measurements were performed at an altitude of approximately chest height or diameter at breast height (dbh) or 1.3 m above ground level. Afterwards, FI was calculated for each respondent, these were added up for all respondents (354 households) and the average value was sought to determine the FI value in the customary forest as a whole.

Integrating the various concepts and existing knowledge on the determinants or parameters of sustainability, the study used a conceptual model (Figure 1) to show the interrelationships of the above variables which are expected to have a direct bearing on the sustainability of the customary forest as a management system.

Analytical Procedure

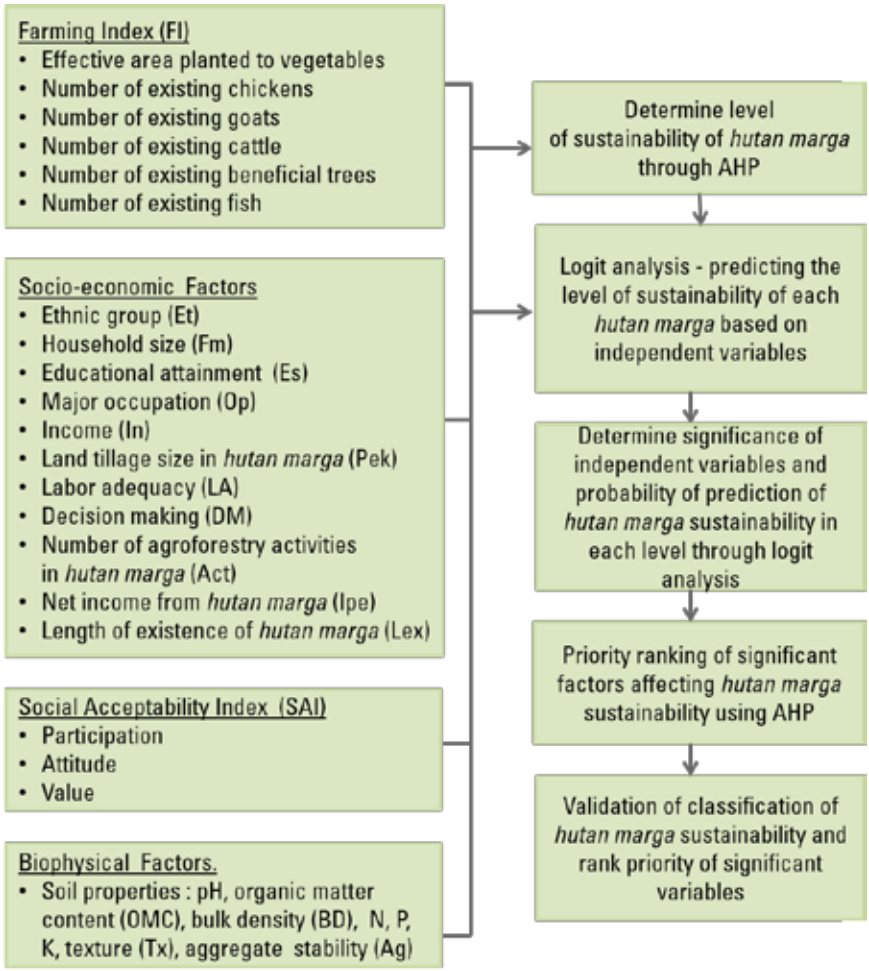
The statistical method used in the analysis of the data was based on the nature of the data and consisted of the following steps:

1. Determination of the sample. This study used a total of 354 respondents.
2. Identification of the relevant variables affecting sustainability of the hutan marga or customary forest based on previous studies. The variables thus used were: SAI, FI, socioeconomic indicators, and biophysical indicators.
3. Reliability test of the instrument (questionnaire) by using the split-half correlation with the Spearman-Brown formula.
4. Gathering of data (354 samples) from the three villages.
5. Determination of the level of SAI and FI based on previous studies.

Descriptive statistics were computed to get SAI and FI. The extent of sustainability of hutan marga was determined using the cumulative scores and categorized into three levels. Based on previous studies (Abd-Ella, Hoiberg, and Warren 1981, Agustin 1990, Alicante 1991, and Asdi 1996), SAI and FI were further determined based on the following scores:

Level	Score	Code
Low	0–33	0
Moderate	34–66	1
High	67–100	2

Figure 1. Conceptual framework showing the relationships of the explanatory variables affecting the sustainability of the hutan marga



6. Derivation of dependent variables (Y) in logit computation through AHP. The inconsistency ratio of AHP process must be less than or equal to 0.1. In AHP, the variables have weight/value (0 to 1.00) based on their rank and inconsistency ratio.

The extent of sustainability of the hutan marga was determined with the use of the cumulative scores and categorized into two levels in the binomial logit model and three levels in multinomial logit models (Abd-Ella, Hoiberg, and Warren 1981; Agustin 1990; Alicante 1991; Asdi 1996).

For the binomial logit model, the value of the dependent variable is either sustainable or not sustainable. This variable was determined based on the following score:

Level	Score	Code
Not sustainable	0.00–0.50	0
Sustainable	0.51–1.00	1

In the multinomial logit model, the dependent variable may be low, moderate, or high (sustainability level). This variable was determined based on the following scoring system:

Level	Score	Code
Low	0.00–0.33	0
Moderate	0.34–0.66	1
High	0.67– 1.00	2

7. Computation of all data by logit models (both binomial and multinomial) to determine the significant variables and to know the probability of prediction of sustainability levels by models. It is a binomial model if the dependent variable (hutan marga sustainability = PS) is coded as 0 or 1. It is a multinomial logit model if the dependent variable (PS) is coded as 0, 1, and 2 (as shown in equation 4 and 5).

The logit model for sustainability (PS) would thus take the general form:

$$\Pr\,(PS = j) = \frac{1}{\left[1 + \exp\left(-A_j - X_i B\right)\right]} \tag{4}$$

or

$$\ln \frac{\Pr(PS = j)}{[1 - \Pr(PS = j)]} = A_j + X_i B_{ij} \tag{5}$$

The binomial logit model that was used in this research was calculated by

$$\Pr\,(PS = 0{,}1) = \frac{\Pr(PS = j)}{\left[1 + \exp\left(-A_j - X_i B\right)\right]} \quad \text{or} \quad \ln\frac{\Pr(PS = 0{,}1)}{[1 - \Pr(PS = 0{,}1)]} = A_j + X_i B_{ij}$$

The multinomial logit model used in this research was calculated as follows:

$$\Pr\,(PS = 0{,}1{,}2) = \frac{\Pr(PS = j)}{\left[1 + \exp\left(-A_j - X_i B\right)\right]} \text{ or } \ln\frac{\Pr(PS = 0{,}1{,}2)}{[1 - \Pr(PS = 0{,}1{,}2)]} = A_j + X_i B_{ij}$$

where:

j = 0 or 1 (binomial model); = 0,1,or 2 (multinomial model);
Pr (PS=j) = probability of the jth hutan marga sustainability;
A_j = intercept parameters
X_i = column vector, independent variables (biophysical, socioeconomic factors)
B_{ij} = row vector of coefficients

The dependent variables (PS) were high (2), moderate (1), and low levels (0) of sustainability in the multinomial logit model; and sustainable (1) or not sustainable (0) in the binomial logit model. The independent variables were SAI, FI, socioeconomic indicators, and biophysical indicators.

The priority ranking of significant variables that affected customary forest sustainability through AHP was determined. Inconsistency index on each customary forest sustainability level computation is less than or equal to 0.1.

The analytical process used in this study (Figure 2) followed these steps:

1. Enter and edit all data of SAI, FI, biophysical indicators (eight variables), and socioeconomic indicators (11 variables).
2. Analyze data using descriptive statistics, Statistic, Eviews 6.0 (Winarno 2009), and Expert Choice software (Saaty 1995) for AHP analysis.
3. Print the results of data analysis to check whether the data gathered are complete or not. If data are not yet complete, go back and gather the missing data or edit data. If data are complete, go to the next step.
4. Analyze intensity of dependent variables (Y) using AHP to determine the hutan marga's sustainability level.

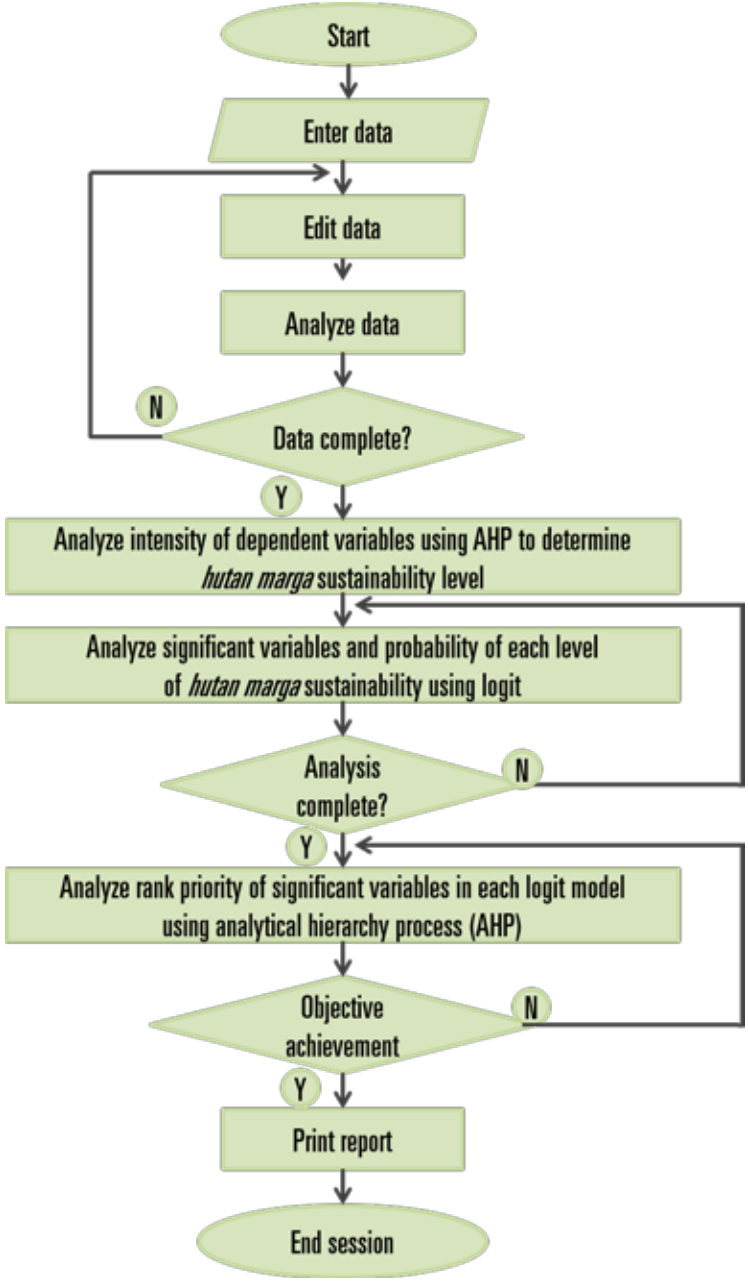
5. Analyze significant variables and the probability of each level of hutan marga sustainability using binomial and multinomial logit model.
6. Print the results again to determine whether or not analysis for each level of hutan marga sustainability in the three villages is complete or not.
7. If the said printed data are complete, continue with rank prioritization of significant variables based on their coefficient and standard error in each logit model using AHP.
8. If the process has already achieved the objectives, but there are cases where the overall inconsistency index of AHP computation to determine the rank priority of significant variables is more than 0.1, the last process must be repeated and the analysis of rank priority of significant variables must be refined.

Limitations of the Study

This study was an evaluation of the management and sustainability of the hutan marga or customary forest in Lampung Province. Being a site-specific case study, the findings could only be generalized to study areas in the Belalau Subdistrict and Batu Ketulis Subdistrict. Findings of the study will, thus, have to speak mainly for the general culture and geography of West Lampung and may not necessarily apply to areas outside the province.

Another limitation was that the study used data gathered from the farmer-beneficiaries of the customary forest in three villages. Based on their attitude, education, and knowledge, it was possible that such respondents might have been unable to answer appropriately and accurately. This situation could have affected the validity and reliability of the data collected as well as the results of the study.

Figure 2. Analytical framework used in this study



RESULTS AND DISCUSSION

Respondents' Profile

Socio-demographic characteristics

The respondents' sociodemographic characteristics are summarized in Table 1. The majority of the respondents in the three villages (97% in Bakhu, 96% in Bedudu, 99% in Sukarame) of the research area are Lampung ethnic.

Since it is known that the three villages of the study sites have indigenous rules to manage the hutan marga it is reasonable to expect that the communities have a high level of SAI, or of participation, attitudes, and values in managing the customary forest. These indigenous rules need to be developed into a village (*peraturan desa*) or regional regulation at the provincial or district level (*peraturan daerah*) in order to guarantee the sustainability of the customary forest in the future.

The ages of the respondents ranged from 20–60 years. The highest percentage of educational attainment is elementary school for sites Bakhu (63.31%) and Sukarame (54.88%), and senior high school for Bedudu (43.86%).

The respondents' household size ranged from one to seven members. Most of the respondents in the three villages (77.55% in Bakhu, 96.99% in Bedudu, 84.15% in Sukarame) have family sizes of one to four members.

The percentage of activities conducted in the customary forest based on husband and wife decisions were 33.71 percent in Bakhu, 35.04 percent in Bedudu, and 41.32 percent in Sukarame.

Table 1. Socio-demographic characteristics of the respondents

Characteristics of the Respondents	Bakhu (%)	Bedudu (%)	Sukarame (%)
Ethnic group			
Lampung	97	96	99
Java	3	3	1
Batak	0	1	0
Age (years)			
20 and below	0	0	0
21–30	14.28	21.95	25.61
31–40	32.65	24.39	48.78
41–50	22.46	26.83	15.84
Above 50	30.61	26.83	9.77
Sex			
Male	53.012	41.96	52.79
Female	46.99	58.04	47.21
Household	26.06 (49 HH)	30.32 (57 HH)	43.62 (82 HH)
Civil status			
Married	25	30.32	43.62
Single/widowed	1.06	0	0
Educational attainment			
No formal education	2.04	1.75	2.44
Elementary school	65.31	31.58	54.88
Junior high school	12.24	21.05	9.76
Senior high school	18.37	43.86	32.93
University/College	2.04	1.75	0.00
Household size			
1–4	77.55	96.49	84.15
5–7	22.45	3.51	15.85
8–10	0	0	0
Above 10	0	0	0

Social acceptability index

The average SAI score of respondents in the three villages was high at 74.92 percent (Figure 3.). This means that the respondents have high participation and positive attitudes, and values toward the operations in the customary forest. Based on the analysis, the SAI indexes in those three villages are almost the same. Bakhu has 76.34, in Bedudu it is 75.89, and in Sukarame it is 72.54.

Economic characteristics

The respondents' main source of income is farming with 93–100 percent of the respondents citing it as their occupation (Table 2). Besides farming, less than 10 percent are also employed in government services (as school teachers, officers, and field workers), paid labor, trading, and other jobs.

Figure 3. FI and SAI of research sites

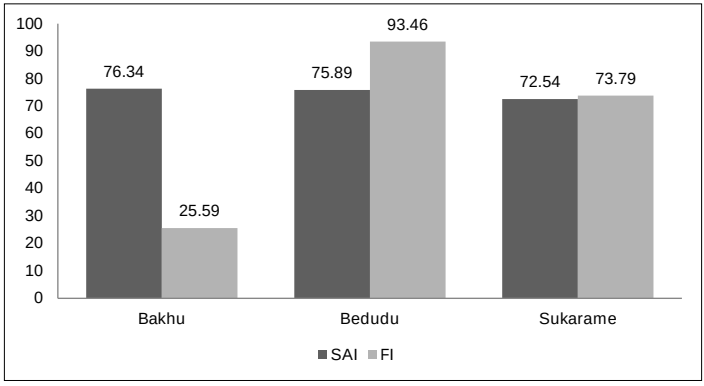


Table 2. Distribution of respondents according to their economic characteristics

Characteristics	Bakhu		Bedudu		Sukarame	
	Total	%	Total	%	Total	%
Occupation						
Farming	92	100.0	103	92.8	141	93.4
Others	0	0.0	8	7.2	10	6.6
Annual family income (IDR)						
1,200,000 and below	0	0.0	9	8.8	4	2.4
1,201,000–2,400,000	2	2.2	12	10.5	24	15.9
2,401,000–3,600,000	6	6.5	14	12.3	37	24.4
3,601,000 and above	84	91.3	76	68.4	86	57.3
Annual net income from forest (IDR)						
600,000 and below	0	0.0	8	7.0	0	0.0
601,000 and above	92	100.0	103	93.0	51	100.0
Size of land tillage (m^2)						
100 and below	2	2.0	6	5.3	11	7.3
101–300	0	0.0	6	5.3	7	4.9
301–500	9	10.2	37	33.3	11	7.3
501 and above	81	87.8	62	56.1	122	80.5
Ownership of land tillage						
Owner	88	95.9	101	91.2	136	90.2
Share tenant	4	4.1	0	0.0	15	9.8
Renting	0	0.0	10	1.8	0	0.0

Around 41 percent of the respondents have an annual income level above IDR 3,601,000 per year (Figure 4). Income and net income from the forest products are not significant variables to the customary forest management in the three villages, either under the binomial or multinomial logit analysis, because generally the community members fulfill their daily needs by harvesting their own land, either the private forest, customary forest, or their own fields. Based on customary regulations, the members of the community are allowed to take wood/trees from the hutan marga, especially for the timber supplies to be used to build their houses. Every household has a one-time right to harvest the timber for a maximum of 5 cubic meters (m^3).

The respondents' average length (duration) of stay in the hutan marga was 10.08 years. Most of respondents have three activities in the customary forest*:* tree planting, fishery or husbandry, and vegetable planting. As shown in Figure 5, majority or more than 50 percent of the respondents had more than 500 square meters of land tillage. There were less than 7.3 percent that had small land tillage (100 square meters and below). Most of the respondents were land tillage owners on a communal basis. The owner also had management rights in the hutan marga on the basis of customary rules.

Farming index

As a whole, the average FI score of the respondents was 65.61 (Figure 3). This means that the FI of respondents was moderate. That condition is understandable because majority of the respondents have nothing to harvest except trees, which farmers harvest seasonally depending on the species. FI in Bedudu (93.46) and in Sukarame (73.79) are in the high category, whereas FI in Bakhu is in the low category (29.59). The condition in the field did show that there are fewer types of plants in the customary forest in Bakhu. This may be because part of the Bakhu region is close to the highway and so it is susceptible to illegal logging by non-residents of Bakhu.

The moderate levels of FI show that the communities around the hutan marga could maintain sustainable production in the forest. One cause of the moderate FI is a high level of SAI, supported by the existence of indigenous rules that always bind the community to conserve the forest. Based on the moderate level of FI, a high level of income was obtained by 72.33 percent of the respondents (i.e., more than IDR 3,600,000 per year per household). Fourteen percent had an income of IDR 2,400,001–3,600,000, 9.67 percent had an income of IDR 1,200,001–2,400,000, and 4 percent had a low level income at less than IDR 1,200,000.

Figure 4. Family annual income (IDR)

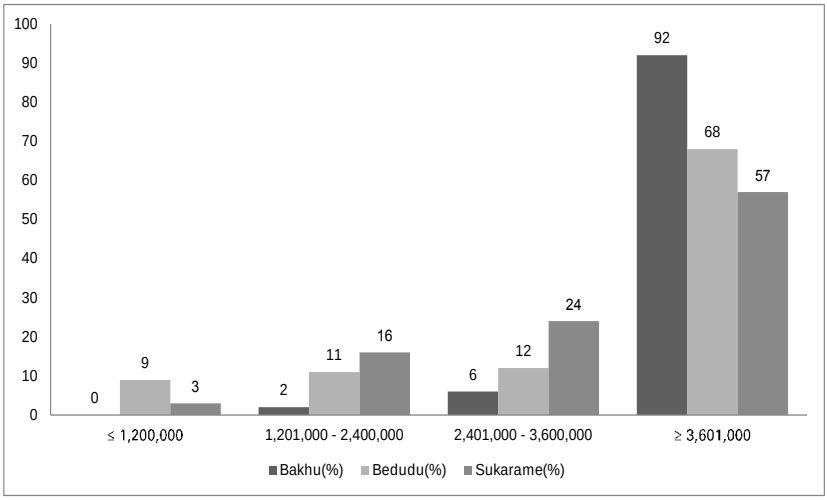
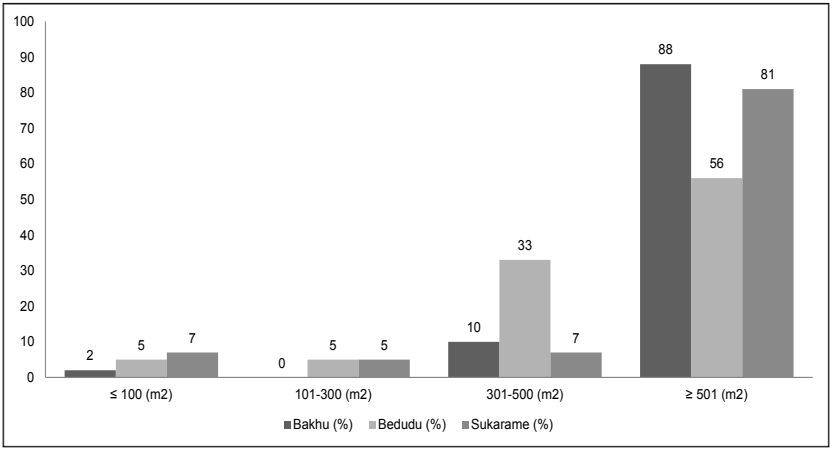


Figure 5. Size of land tillage (in sq.m)



The respondents in the villages of Bakhu (21.23%), Bedudu (22.34%), and Sukarame (20.82%) prioritized selling products for the market.

Family labor is the main source of labor in the conservation of the hutan marga. Majority (80.19 percent) indicated labor is sufficient for all activities. Most of the respondents (76.71 percent) also stated that the wives were mostly involved in all activities. The husbands and children gave support only when needed.

Biophysical characteristics

Fertilizer and pesticide

A greater number of the respondents did not use fertilizers (73.54%) or pesticides (76.19%). According to Clough et al. (2011), fertilizers and pesticides will increase production and have only a little effect on biodiversity if used correctly.

Soil properties

The average conditions of some soil properties in the study area are shown in Table 3. Bakhu and Sukarame villages are known to have silt loam with fair texture, and Bedudu has silt clay loam texture. Based on Table 3 as a whole, and according to Rachman (1997), the soil fertility in Bakhu and Sukarame is fair, and in Bedudu it is good. Thus, it is reasonable to state that the FI levels in the three villages were moderate (65.61) because the level of soil fertility ranges from fair to good.

Table 3. Interpretation of some soil properties in the study area

Location	pH	OMC	BD	N	P	K	Tx (%)			Ag
							Sandy	Dust	Clay	
Bakhu	4.00	13	0.82	0.22	63	186	17	49	34	95.8
Bedudu	4.48	8	1.03	0.39	71	202	33	55	12	81.8
Sukarame	4.45	5	1.07	0.28	44	164	21	70	9	59.8

Notes: Soil analysis was done by the Soil Laboratory, Soil Research Centre, Bogor, Indonesia (2011) and interpretation of soil condition was according to Rachman (1997).
pH = soil pH, OMC = organic matter content, BD = bulk density, N = nitrogen, P = phosphorous, K = potassium, Tx = soil texture, Ag = soil aggregate

The Hutan Marga Sustainability Models

As stated earlier, the sustainability of the hutan marga is a function of the social acceptability index, farming index, socioeconomic factors, and biophysical factors.

The SAI used in this study consisted of participation, attitudes, and values. The level of SAI of the respondents was computed using equation 2. Level of FI on each site was computed using equation 3.

Hutan marga sustainability level (Y or dependent variable) was derived through AHP. The SAI, FI, land tillage size in the customary forest, household size, income, and soil texture were used to determine the dependent variables. The overall inconsistency index was 0.054, the result was calculated through AHP.

The independent variables used in this research were discrete and class variables. Both binomial and multinomial logit were used. The binomial logit used as dependent variables was sustainable or not sustainable (coded as 0=not sustainable and 1=sustainable). On the other hand, the multinomial logit had as its dependent variable low, moderate, and high levels (coded as 0=low, 1=moderate, and 2 = high) of customary forest sustainability.

Not sustainable versus sustainable

Bakhu village

Based on the binomial logit analysis (Table 4), from a total of 92 samples, 48 samples were predicted as not sustainable but actual data collected showed 45 samples are not sustainable. It means that there is a difference of three samples or 1.06 percent between the prediction and actual data. Because the value is less than 15 percent, this analysis can be said to be effective. There are five variables which are significant (at 5%), that is, household size (Fm), labor adequacy (LA), length of existence of the hutan marga managed by the villagers (Lex), soil nitrogen (N), and soil phosphorous (P). All coefficients have marks as expected; especially for soil nitrogen, which had negative marks because of the possibility that the community uses fertilizer with high N levels (Jones et al. 2013) that would have a negative impact because of its excessive use (Clough et al. 2011).

Bedudu village

Out of a total of 111 samples analyzed by binomial logic, 48 samples were predicted as not sustainable. Actual analysis results showed that 47 samples were not sustainable. Thus, this analysis process is effective because there was only one sample difference between the prediction and actual. Similarly for the data which were classified as sustainable, there was only one sample difference between the actual data and the prediction at 54 samples and 53 samples, respectively (Table 5). Land size is the only variable that is significant with a positive sign which means that the more extensive the customary forest, the more assured its sustainability.

Sukarame village

Of 151 units analyzed by binomial logic, 68 samples were predicted as not sustainable. Actual analysis results showed that 71 samples were not sustainable. Based on analysis, there was a 95.77 percent probability for non sustainable class and a 96.38 percent probability for the sustainable class. Of the samples, 83 were predicted to be sustainable but actual data showed only 80. Six significant variables affected hutan marga sustainability, namely: educational attainment (Es), labor adequacy (LA), length of existence of the hutan marga managed by the

villagers (Lex), soil pH (pH), bulk density (BD), and soil nitrogen (N). The signs of the coefficients of the significant variables were all logical. Labor adequacy has a negative sign because so far, respondents use family members as laborers in managing the customary forest. The more laborers, the more family members needed, so in turn this requires more forest products for the fulfillment of their daily needs, whereas the customary forest is governed by traditional rules which limits the volume that can be harvested.

Table 4. Binomial logit results for the three villages

Significant Variable (at 5%)	Coefficient	Std. Error	z-Statistic	Prob.
Bakhu Village				
Household size	1.847936	0.674454	2.739898	0.0061
Labor adequacy	3.868709	1.793476	2.157102	0.0310
Length existence	0.199979	0.100097	1.997855	0.0457
Soil nitrogen	-203.0597	97.85765	-2.075052	0.0380
Soil phosphorous	18.90926	7.637880	2.475721	0.0133
Bedudu village				
Land size	10.83184	5.081716	2.131532	0.0330
Sukarame village				
Education attainment	0.671898	0.329598	2.038534	0.0415
Labor adequacy	-176.2196	62.92494	-2.800473	0.0051
Length existence	0.081888	0.030664	2.670465	0.0076
Soil pH	2.319121	0.994852	2.331121	0.0197
Soil bulk density	2.203718	1.088747	2.024087	0.0430

Note: alpha = 5%

Table 5. Classification of samples based on binomial dependent variables

Bakhu Village				
		Predicted		TOTAL
		0	1	
Actual	0	43	2	45
	1	5	42	47
Total		48	44	92
Bedudu Village				
		Predicted		TOTAL
		0	1	
Actual	0	42	5	47
	1	6	48	54
Total		48	53	111
Sukarame Village				
		Predicted		TOTAL
		0	1	
Actual	0	62	9	71
	1	6	74	80
Total		68	83	151

Low, moderate, and high levels of sustainability

Based on the overachieved and underachieved sustainability level, almost all multinomial logit equations in the three villages are effective (Table 6).

Bakhu village

There are 28 samples that are actually not sustainable but analysis showed there are 30 samples not sustainable. This accounts for 7.14 percent overachieved rate. The analysis process using multinomial logit is effective since classification as moderate level is underachieved at 1.72 percent and underachieved in high classification at 16.67 percent. From correctly classified sustainable hutan marga, it was found during field validation and interview that most of the customary forest samples are sustainable. Based on the analysis, 30 samples have low sustainability, 57 samples are moderately sustainable, and 5 samples are highly sustainable (Table 7). One significant variable is labor adequacy.

Bedudu village

There were three significant variables affecting the moderate level of hutan marga sustainability, namely: SAI, bulk density (BD), and soil texture (Tx). The signs of significant variables are logical. The multinomial analysis was effective because there are 29 samples that are in fact classified to have low level sustainability while the analysis predicted 30 samples. This accounts for 3.44 percent overachieved rate in the low level. For the moderate level, there is 1.38 percent underachieved. Based on the analysis results, there are 30 samples of agroforestry in hutan marga in Bedudu village categorized as having low sustainability, 71 samples are moderately sustainable, and 10 samples are categorized as highly sustainable. Field validation and interview showed that most of the samples are sustainable.

Sukarame village

Out of 152 samples, 20 classified at low level of sustainability were predicted correctly. Under the moderate level, 125 samples were predicted correctly, while seven samples at high level were predicted correctly. There were four significant variables, which affected the customary forest sustainability, namely: labor adequacy (LA), decision making between husband and wife on agro-forestry management in hutan marga (DM), length of existence of hutan marga managed by the villagers (Lex), and soil pH (pH). Field validation and interview showed that majority of the samples are sustainable.

Table 6. Multinomial logit result for the three villages

Significant Variable (at 5%)	Coefficient	Std. Error	z-Statistic	Prob.
Bakhu village				
Labor adequacy	-11.91421	5.249838	-2.269443	0.0232
Bedudu village				
SAI	114.2533	58.51154	1.952663	0.0409
Soil bulk density	-220.2704	119.6246	-1.841346	0.0456
Soil texture	27.58409	15.19354	1.815514	0.0494
Sukarame village				
Labor adequacy	-239.5661	114.4940	-2.092391	0.0364
Decision making	1.354816	0.513107	2.640415	0.0083
Length existence	0.111214	0.057893	1.921017	0.0447
Soil pH	3.404752	1.372598	2.480516	0.0131

Table 7. Classification of samples based on multinomial dependent variables

Bakhu					
	Predicted				TOTAL
		0	1	2	
Actual	0	26	2	0	28
	1	3	54	1	58
	2	1	1	4	6
TOTAL		30	57	5	92
Bedudu					
	Predicted				TOTAL
		0	1	2	
Actual	0	26	3	0	29
	1	4	67	1	72
	2	0	1	9	10
TOTAL		30	71	10	111
Sukarame					
	Predicted				TOTAL
		0	1	2	
Actual	0	0	19	0	19
	1	1	124	0	125
	2	0	1	7	8
TOTAL		20	125	7	152

Ranking of Significant Variables

Binomial logit

Based on binomial logit calculations using eviews 6.0, there are five significant variables that affect sustainability of the customary forest in Bedudu, namely: household size (Fm), labor adequacy (LA), length of residence or management of the forest (Lex), soil nitrogen (N), and soil phosphorous (P). An analysis using

AHP found that the ranking of significant variables is household size (Fm) first, followed by soil phosphorous (P), labor adequacy (LA), soil nitrogen (N), and length of existence (Lex).

In Bakhu, the significant variable is land tillage (Pek). In Sukarame the significant variables are educational attainment (Es), labor adequacy (LA), length of existence (Lex), soil pH (pH), bulk density (BD), and soil nitrogen (N). Based on the results of the AHP analysis shown in Table 8, the ranking of significant variables in Sukarame is as follows: labor adequacy (LA), length of existence (Lex), soil pH (pH), soil nitrogen (N), educational attainment (Es), and bulk density (BD).

Table 8. Overall inconsistency index and ranking of significant variables in binomial logit

Village	Overall Inconsistency Index	Ranking of Significant Factors				
		1	2	3	4	5
Bakhu	0.02	Pek				
Bedudu	0.02	Fm	P	LA	N	Lex
Sukarame	0.03	LA	Lex	pH	N, Es	BD
In general	0.02	LA	Lex	N		

Notes: Pek = land tillage size in hutan marga, Fm = household size, P = soil phosphorous, LA = labor adequacy, N = soil nitrogen, Lex = length of existence of hutan marga managed by community, pH = soil pH, Es = educational attainment, BD = bulk density.

In Bedudu, household size (Fm), which also means labor availability, was the highest ranking variable. All this time, it is the whole family that works together to make productive use of the hutan marga. This variable is highly associated with labor adequacy in the third rank. The second-ranked variable which is significant to the sustainability in Bedudu is the availability of soil phosphorous. This applies also to the availability of the soil nitrogen in the fourth rank. According to Butar-butar (2003), if a person stays longer in one place, the sustainability of natural resources in that area will be affected, and this is also found to be true in Bedudu. The duration of stay in the Bedudu village is the fifth ranked significant variable. Different village sites between Bedudu and Bakhu also have different significant variables. Analysis using binomial logit showed that the significant variable in Bakhu is land tillage size *(Pek)*.

Overall, based on the binomial logit analysis, labor adequacy (LA), length of existence (Lex), and soil nitrogen (N) are the three variables that significantly affect the sustainability of the customary forest in the three villages. After analysis by AHP, it was found that length of existence (Lex) is the most significant variable, followed by labor adequacy (LA) and soil nitrogen (N). It was expected for labor

adequacy (LA) to become the most significant variable, because according to Clough et al. (2011), yield is positively correlated with labor.

The customary rules in the three village areas include how to manage forest resources and the regulations on logging, which include:

1. Issuance of logging license is held by the *peratin* (village head) and the chairman of customs of each indigenous group. The logging license includes various provisions that must be followed by every person involved for every community in every logging activity;
2. Logging of timber in the hutan marga is only for the development in the subdistricts of Belalau, and Batu Ketulis, and is not for sale; and
3. The right to take timber applies to both the members of indigenous groups and the migrants who stay and live in those two subdistricts.

In Bakhu, the community manages and maintains the forest, including growing seedlings, land management, planting, fertilizing, watering, pruning, and marketing. Products that can be harvested from the customary forest are timber used as building material such as *kandis* (*Garcinia cowa*), *Afrika* (*Maesopsis eminii*), *medang* (*Litsea* sp.), and *meranti* (*Shorea* sp.); and non-timber forest products such as rattan (*Calamus rotang*) and bamboo (*Bambusa* sp.) used for handicrafts. The various types of utilization by villagers can be classified into three general forms: timber (building materials, firewood), non-timber (medicinal plants, rattan, bamboo, and fodder), and environmental services (water supply and irrigation).

Most of the timber in Bakhu is used for home building materials but it is also used for firewood and irrigation. Outside of Bakhu village, however, the use of timber for construction is not allowed. In addition, there is the wisdom of the indigenous peoples and the villagers in observing the regulations that maintain forest boundaries, zoning, planting, and selection of timber harvested.

Ravines and streams serve as forest borders. The buffer zone (ecozone) between forests and paddy fields helps prevent damage to the ecosystems and the fields from animals and, thus, helps conserve the forests.

Multinomial logit

Based on multinomial logit results, significant variables at moderate and high levels were determined.

In each of the three villages and in all sites as a whole, some soil properties were found to be significant variables. Soil properties that were found to affect forest sustainability are different in each area particularly soil texture, soil pH, and bulk density. Soil texture is a soil property related to nutrient accessibility for root development and soil erodibility (Glaesner et al. 2011). Soil texture was found to be one of the significant variables in Bedudu. In relation to soil condition and function, soil texture is used as a preferred measure to know the retention and transport of water and chemicals. In addition, bulk density is also a significant variable in Bedudu. According to Rachman (1997), bulk density is a soil property used for assessment of capacity to exchange gaseous materials with the above-ground atmosphere for plant growth and development.

All significant variables would be superfluous if the SAI of farmers is not high. According to Gregersen (1988), two components are common in successful social forestry programs such as home gardens and/or customary forests. These components are widespread local participation backed by high level of political support and sustainable productivity that increase technology adoption and acceptance. Therefore, local participation is the first element to consider in programs related to increasing agricultural productivity. This involves recognizing local knowledge (value), understanding, and commitment (attitude) in local resources to organize production and to distribute fairly any increase in production.

In Bedudu, SAI is the most important variable in sustaining agroforestry in the hutan marga because the people have already benefitted from it.

In Bakhu, the one and only significant variable when analyzed by multinomial logit is labor adequacy.

In Sukarame, the significant variables are labor adequacy (LA), decision making between husband and wife (DM), length of existence (Lex), and soil pH (pH). Decision making is a significant variable because most of the respondents make their decisions based on discussions between husband and wife, like those in North Lampung (Wulandari 1999) and in the same region in West Sumatra (Asdi 1996). This variable means that husband and wife should discuss all things and make a precise decision in choosing among alternatives before they carry out the activities in the forest that will result in getting the best harvest.

Settling duration in a region strengthens forest resources' sustainability. If the community has high SAI levels as in Bakhu, Bedudu, and Sukarame villages, the length of existence in managing the forest and duration of residency of community members will have positive effects on the forest resources especially in agroforestry. As Clough et al. (2011), also had observed, mature agroforestry will reduce the risk of deforestation.

The data in Table 9 verified the rank of significant variables in Bedudu, Bakhu, and Sukarame by multinomial logit analysis. The significant variables for all of these three villages are labor adequacy (LA), soil nitrogen (N), soil texture (Tx), and SAI ranked according to priority.

The availability of sufficient labor to manage the forest is absolutely necessary. The availability of labor here is not only in terms of numbers but also skills because the condition of the forest is very specific and also preserved by the customary rules. According to Asdi (1996) and Wulandari (2005), these are the major problems identified by the respondents in the Food and Nutrition Diversification Project.

Table 9. Overall inconsistency index and ranking of significant variables using multinomial logit

Village	Overall Inconsistency Index	Ranking of Significant Factors				
		1	2	3	4	5
Bakhu	0.03	LA				
Bedudu	0.03	SAI	BD	Tx		
Sukarame	0.04	DM	pH	LA	Lex	
In general	0.03	LA	N	SAI	Tx	

Notes: LA = labor adequacy, SAI = Social Acceptability Index, Tx = soil texture, DM = decision making between husband and wife on agroforestry management in hutan marga, N = soil nitrogen, Lex = length of existence of hutan marga managed by community, pH = soil pH, BD = bulk density.

The SAI is developing to be one of the significant variables as a whole in Bakhu, Bedudu, and Sukarame villages that might be an important social capital in conserving their forest resources. Another capital that is seen to contribute to the sustainability of agroforestry in the customary forest is indigenous rule. However, indigenous or customary rules are still not recognized as formal policy in Act No. 10 of 2004 (Hierarchy of Laws). These customary or indigenous rules should be developed into a village regulation (*Peraturan Desa*) or district regulation (*Peraturan Daerah*). With such a regulation, the next important

step is to communicate and demonstrate the functional role of agroforestry in the hutan marga as written in the rules so that the community will comply with these regulations. There is tangible evidence in the field of the benefits of agroforestry in the customary forest. Such evidence should be followed by trainings relevant to the needs of the community in responding to the challenges of agroforestry management in the three villages. The community, specifically 76 percent of the respondents, said there is the need for a well-organized training program in agroforestry and other skills so that the villagers will be updated on the development of agroforestry technology and production, including the market information for the products.

Several customary rules in the research areas are:

1. Decision P/004/KPTS/IX/2002 to preserve forest products and fisheries owned by the Sukarami;
2. Regulation No. 3/2005 on forestry, plantations, and fruits in Bedudu;
3. Regulation No. 141/003/KPTS/BKH/H/2006 on *hutan rakyat* (community forests) and hutan marga management in Bakhu.

The research results showed that the customary forest of Bedudu had the highest number of tree species composition (19 species), followed by Bakhu (15 species), and Sukarame (6 species). Species belonging to the family Verbenaceae are dominant in Sukarame village, *Shorea* sp. in Bedudu village, and *Payena* sp. in Bakhu village.

The tree composition in the customary forest is relatively low compared to virgin forests, as evidenced in the research areas, because the villagers rarely planted new tree species. According to customary rules, people from the three villages around the forest (Sukarame, Bakhu, Bedudu) are allowed to harvest timber but are obliged to plant new trees. Generally, the species of tree seedlings is obtained from the customary forest itself, hence, there are no additional species planted.

In the research areas, agroforestry system is not only practiced in the hutan marga but also in hutan rakyat or community forests which belong to villagers individually, not communally, as in hutan marga. To prevent excessive exploitation of the hutan marga, customary rules in each village oblige community forest owners to plant trees as forest boundaries in order to meet the needs of the people and minimize the practice of always harvesting wood from the customary forest. Tree species that are commonly planted in the community forest include chrysolite (*Michelia alba*), bambang (*Nicolaia speciosa*), and gamal (*Gliricidia sepium*). Besides serving as forest boundary, these trees are also sold by the villagers as wood products from the community forest for household income and as wood in the form of standing trees.

Community forests keep villagers from going into the hutan marga to extract timber. Most of the villagers take advantage of non-timber forest products from the customary forest such as rattan and bamboo, which are used as raw materials to make handicraft for their own use or to be sold.

The customary forest is also ecologically regarded by the community as a means to prevent flood and soil erosion, to protect wildlife, and as a source of water and clean air.

Communities highly appreciate the customary rules that have been agreed upon and assume that the hutan marga is a source of daily needs and, for this reason, they maintain its sustainability.

Importance of the Hutan Marga Sustainability Levels and their Applications

Three findings based on the results of the hutan marga sustainability modeling levels in this study are: identification of the significant variables that affect each level of customary forest sustainability in the three villages; generation of specific prediction of customary forest sustainability level based on SAI, FI, socioeconomic factors, and biophysical factors; and ranking of significant factors that affect customary forest sustainability at each level.

Considering that data on customary forest sustainability in Lampung Province is not all available yet, application of the logit models in combination with the AHP process was an efficient methodology because it is simple, effective, practical, not time-consuming, and highly objective. The ranking of significant variables in each process was highly objective because it was not only based on the references and experts but also on logit computation results. The ranking was based on coefficient values and standard errors in each significant variable.

SUMMARY AND CONCLUSIONS

This study predicted and analyzed the sustainability of the hutan marga or customary forest in West Lampung with the use of the following variables: SAI, FI, eight biophysical indicators (i.e., pH, organic matter content, bulk density, N, P, K, texture, and aggregate stability), and 11 socioeconomic indicators (i.e., ethnic group, household size, educational attainment, major occupation, income, land tillage size, labor adequacy, decision making, number of agro-forestry activities, net income from the forest, and length of existence of the hutan marga).

The results of the analysis indicate that the soil conditions in the three villages are fair to good. The SAI level of the community is 74.92 categorized as high, which means that the community in the three villages has the willingness and ability to manage the sustainability of agroforestry in the hutan marga. The ability of communities to manage agroforestry in the customary forest is supported by the high level of FI (65.61, categorized as moderate). For most respondents, their income level is more than IDR 3,600,000 per year per household (72.33%).

Overall, binomial and multinomial logit equations used in the analysis are effective for analyzing the sustainability of agroforestry in the hutan marga. This is proven by the small deviation in the number of sample units factually compared with the unit sample by analysis.

In the research sites there are customary rules on managing the products from the hutan marga through sustainable agriculture methods. These customary rules, however, have not been included yet in the hierarchy of law in Indonesia. It is important to develop village, district, or provincial policies on managing customary forests that would be binding to both the indigenous and non-indigenous people in West Lampung.

Using AHP, the significant variables which had been analyzed by the binomial and multinomial logit models were ranked. Binomial logit showed that in Bakhu, land tillage size is the only significant variable. In Bedudu, the significant variables are household size, soil phosphorous, labor adequacy, soil nitrogen, and length of existence. In Sukarame, the significant variables are labor adequacy, length of existence, soil pH, educational attainment, soil nitrogen, and bulk density.

The ranking of the variables analyzed by multinomial logit found that labor adequacy is ranked first in Bakhu. In Bedudu SAI is ranked first, followed by bulk density, and soil texture. In Sukarame, decision making between husband and wife on agroforestry management in hutan marga comes first, followed by soil pH, labor adequacy, and length of hutan marga existence.

POLICY IMPLICATIONS/ RECOMMENDATIONS

Based on the conditions in the field, the hutan marga is a forest area located outside the state forests, which could be classified as private forest. Based on the information of the community, these forests are collectively or communally owned by indigenous peoples. There are some people, however, who live around the forest but are not from the original or indigenous community. They pose a threat to the sustainability of these forests which they might exploit to meet their needs, since they may not feel bound to observe the customary rules followed by the indigenous community.

As described earlier, the level of SAI in the three villages is high, so it is not surprising that they have the willingness and ability to have customary rules that govern the management of the hutan marga and their crops in a sustainable manner. Because customary rules have not been mentioned in Act No. 10 of 2004 (Hierarchy of Laws), then these customary rules do not serve as binding rules for non-indigenous people. If the outsiders perform illegal activities because there is no legal punishment that binds them, the result may have a negative impact on the sustainability of agroforestry in the hutan marga. Thus, a policy should be developed for customary rules to become recognized as binding for everyone. This study presents three possible recommendations related to hutan marga sustainability as follows:

1. Immediately arrange for a local regulation to become a village, district, or provincial regulation as a step forward, so that the forest could be processed to be recognized by the state as an indigenous people's forest (*masyarakat hutan adat* or *hutan adat*). This is in accordance with Act No. 41 of 1999 on Forestry. Although it is possible that this move could be rejected by the state, at least there are existing local regulation or peraturan daerah (*perda*) that underlie the management of the hutan marga. The existence of perda is very important because conservation and preservation of the region surrounding the hutan marga will be assured. There would be a local government budget that could be used to manage the hutan marga on sustainable terms.
2. Because the development of district- and provincial-level regulations takes a long time, a second recommendation could be followed, which is to prepare a proposal on the hutan marga in a region. This proposal could

be submitted to the Ministry of Forestry to be immediately processed. For instance, another scheme as village forest (*hutan desa*) community forest program (*hutan kemasyarakatan*) could be endorsed. Alternative status is taken as HKm or forest village because on the national level, there is no legal scheme for customary forests or *hutan adat* yet.

3. Village regulation on the hutan marga in that region could also be arranged. These regulations have the same strength as the provincial regulation according to Act No. 10 of 2004 (Hierarchy of Laws). These could be prepared based on the existing customary order or customary policies in every village.
4. The results of the analysis show that the significant variables that are dominant in the three villages are associated with the capacity of human resources, social capital, and soil conditions. What is needed is a local level policy, fundamental to which is to conduct training, increase social capital and human resource capacity, and program the training in a structured, sustained, and organized manner in accordance with the needs at the local level. This policy could be included in the village or provincial regulations as mentioned in the first recommendation and followed by the development of technical and operational guidelines as basis for implementing rules and regulations.

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ANNEX

Picture 1. Agroforestry in hutan marga

Picture 2. Wood harvesting from hutan marga

ANNEX

Picture 3. Hutan marga landscape

Picture 4. Tree measurement during research

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