APPLICATION OF MULTI CRITERIA DECISION MAKING
(RANKING METHODE ) ANALYSIS FOR SUITABILITY AGROFORESTRY
UP-LAND

Budiaman

Forest Biology Conservation, Faculty of Forestry Hasanuddin University

ABSTRAK


Kata Kunci : Multi criteria pengambilan keputusan, metodel rangking, kesinambungan lahan. agroforestri.

INTRODUCTION

The potencial of Halimun-Salak National Park (HSNP) biology and ecology, can we view as an expensive value and defined to society and their environment in around of HSNP area, so that, this region can be assum as enough big water stock for West Java Province and Banten Province.

All farmers in around of HSNP have been live for tens years before HSNP issued by Forestry Departemen of Indonesia as conservation area. Although most of them have been out of this area, a part of them still live in HSNP area up to the present time (JICA, 2007)
Spatial decision problems typically involve a large set of feasible alternatives and multiple, conflicting and incommensurate evaluation criteria. The alternatives are often evaluated by a number of individuals (decision makers, managers, stakeholders, interest groups). The individuals are typically characterized by unique preferences with respect to the relative importance of criteria on the basis of which the alternatives are evaluated. Accordingly, many spatial decision problems give rise to the GIS-based multicriteria decision analysis (GIS-MCDA). These two distinctive areas of research, GIS and MCDA, can benefit from each other (Malczewski, 2006). Multi-Criteria Decision Making (MCDM) is the study of methods and procedures by which concerns about multiple conflicting criteria can be formally incorporated into the management planning process (Nieminen, 2007). Furthermore Jaya (2006), said that ranking method is each element/criteria given by value based on level importance that perform cardinal rank.

Agroforestry is defined as the planned combination of trees, crops and/or animal, in certain area, at the same time or at the time series. The other words, any ecology interaction and/or real economic, positif and or negative among of woody plant system and non woody plant (Nair, 1993). Huxley, (1999) said that agroforestry is a dynamic resources managemen system ecologically with cultivate in agriculture land or grazing area for obtain many sustainable products so that can increase social, economic and environmental benefit for all land user.

Agroforest sistem were view as more complex ecology and economic than monoculture system. The production of an Agroforestry system always vary and depend on the others. At least, a component is woody plant, so that their cycle always more than one year (Nair, 1993). Agroforestry system also have local characteristics, because of it’s have to favorable toward ecology, social-economic and institutions. It was show that Agroforestry were multydisipliner, for example Agronomy, horticulture, forestry, social, economic, and technology (Huxley, 1999).

Agroforestry is an important in the society of TNGHS as livelihood, the up-land suitability have never observed yet, while their productivity have not yet reach optimum. The other side, water, soil and climate factors seems to support the farm system on that site. Based on that information above, that research would be done as follow, "Application of Multi Criteria Decision Making (Ranking Method) Analysis for Suitability up-Land Agroforestry." The Objectives of this research are To define criteria and indicator to find suitable area for Agroforestry by rangking-weighting method and GIS analysis, to define Suitability and land for Upland Agroforestry.

**METHODOLOGY**

**Materials:**

- Digital Camera
- GPS
- Maps
- Computer
- Software: Arcview 3.2
Method:

Multy Criteria Decition Making --->
Ranking Methode (each elemen/criteria given by value based on level importance that perform cardinal rank. For example):
1 = weakly important
2 = moderately
3 = important
4 = very important
5 = extremely important

Sampling Method:

- Purposive sampling (Sukagali village)
- Number of family Population (population size) = 36
- Number of Sample = 10
- Sampling Intensity = 10/36×100% = 27%

Primary Variable Observation

a. Identity Agroforestry Farmers
b. Ground check : UTM, Slope, Elevation, Distance of (Main river, Small river, Road and Settlement)
c. Semi structure Interview : Scoring to define the Priority of plant chosen in their Agroforestry Component based on farmers opinion.

Secondary Data:

- Maps
- Social & Economic data
- Population
- Community
- Livelihood
- Others related the topics

Data Analysis and Modelling

Ranking weighting method

Definition: Ranking methode is each elemen/criteria given by value based on level importance that perform cardinal rank. For example:

1 = Weakly important
2 = Moderately
3 = Important
4 = Very Important
5 = Extremely important

Ranking weighting formulation as follows:

\[
W_{ij} = \frac{\sum_{k} r_{jki}}{\sum_{i=1} \sum_{k=1} r_{jki}}
\]

Where:

W: weight
r: Indicator ranking
j: Criteria
ki: Indicator

2. GIS Analysis

GIS analysis use were, scoring, overlay, query, calculation and modelling.
Model Analysis (Jaya, 2006) was used as follows:

\[
Y = W_1X_1 + W_2X_2 + W_3X_3 + W_4X_4 + W_5X_5 + W_6X_6
\]

Where:

Y = Land Suitability
W_1: Weight of soil fertility
X_1: Indicator of soil fertility
W_2: Weight of slope
X_2: Indicator of slope
W_3: Weight of elevation
X_3: Indicator of elevation
W_4: Weight of river distance
X_4: Indicator of river distance
W_5: Weight of road distance
X_5: Indicator of road distance
W_6: Weight of settlement distance
X_6: Indicator of settlement
Social-economic data were collected would be analyzed by descriptive analysis.

RESULTS AND DISCUSSION

Criteria and Indicator:

Criteria and Indicator were used based on Semi Structure Interview from the Agroforestry farmer as follow:

distance
<table>
<thead>
<tr>
<th>No.</th>
<th>Criteria</th>
<th>Indicator</th>
<th>Verifier</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Soil</td>
<td>Soil fertility</td>
<td>Fertile soil</td>
<td>5</td>
</tr>
<tr>
<td>2.</td>
<td>Slope</td>
<td>0 - &gt;45 %</td>
<td>0-8 %</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8-15 %</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15-25 %</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25-45 %</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>45-&gt;45 %</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Elevation</td>
<td>500 – 1250 m</td>
<td>500 – 750</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; 750 – 900</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; 900 – 1000</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; 1000 – 1150</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>&gt; 1150 – 1250</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>River / Water distance</td>
<td>0 – 500 m</td>
<td>0-100</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100 – 200</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200 – 300</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>300 – 400</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>400 – 500</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>Road distance</td>
<td>0 – 1000 m</td>
<td>0 – 200</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200 – 400</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>400 – 600</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>600 – 800</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>800 – 1000</td>
<td>1</td>
</tr>
<tr>
<td>6.</td>
<td>Settlement distance</td>
<td>0 – 1000 m</td>
<td>0 – 200</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>200 – 400</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>400 – 600</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>600 – 800</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>800 - 1000</td>
<td>1</td>
</tr>
</tbody>
</table>

**Rangking Weighting Method**  Weighting of criteria and indicator
<table>
<thead>
<tr>
<th>Criteria and Indicator</th>
<th>Value</th>
<th>Total</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil (X1)</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Slope (X2)</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Elevation (X3)</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>River distance (X4)</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Road distance (X5)</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Settlement distance (X6)</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>69</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Based on the criteria and indicator have observed by Semi Structure Interview and Groundcheck, modelling can be model as follow:

Model: \( Y = 0.362 \times X1 + 0.126 \times X2 + 0.068 \times X3 + 0.362 \times X4 + 0.232 \times X5 + 0.17 \times X6 \)
Up-Land Suitability Agroforestry

Land suitability of up-land Agroforestry in were showed in Figure1. The picture showed that distribution of land suitability in around the corridor of Halimun-Salak Nasional Park. Most of them very suitable for agroforestry 65371.1 ha. The land remained were suitable is 2461.4 ha, and less suitable is 512.2 ha (Table 1). It’s suggested that there were water resources abundant, and large origin forest in around the Agroforestry was always support it’s agroforestry system. The farmers have a soil vertility as priority to define their land, which water source distance were main cosideration

Table 1. Suitability Class and the Large of up-Land Agroforestry

<table>
<thead>
<tr>
<th>No.</th>
<th>Suitability Class</th>
<th>Area(Ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Less Suitable</td>
<td>514.2</td>
</tr>
<tr>
<td>2.</td>
<td>Suitable</td>
<td>2461.4</td>
</tr>
<tr>
<td>3.</td>
<td>Very Suitable</td>
<td>6537.1</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>9512.7</td>
</tr>
</tbody>
</table>

LAND SUITABILITY OF AGROFORESTRY IN UPLAND
Social-Economic Aspect

Based on Semi structure Interview had been done for Agroforestry farmer, we can perform the results as below

1. Composition of Existing Agroforestry

a. TREES (Wood, Multi Purpose Trees, Shrubs, Podder trees)
   1. Durian
   2. coconut
   3. Avocado
   4. orange
   5. jackfruit
   6. clove
   7. Banana
   8. Albizia
   9. Jackfruit
   10. Uruhiris
   11. Mahoni
   12. Bamboo
   13. Tea
   14. Rubber
   15. Coffea
   16. Pete

b. CROPS
   banana; chilli, tomato, long bean, lettuce, paddy rice, corn, brocolly, papaya

c. Fisheries :
   Nila and gold fish

d. Animal :
   Chicken, and Goat

2. Land productivity
   Average of Income per ha per year is 11 million rupiahs

3. The farmers needed based on economic value as below:
   a. Trees will cultivate : coconut, Avocado, orange, jackfruit, clove,
   b. Crops: chilli, tomato, long bean, lettuce,
   c. Skill : training of cultivation,
   d. Capital work: financial institution
   e. Wood need for : House construction material, fuel wood, and not for sale.

CONCLUSION

1. The criteria and indicators had obtained for weighting suitable up-land Agroforestry as below: Soil, Slope, Elevation, River distance, Road distance, Settlement distance

2. The suitability class of up-land agroforestry in Coridor area consist of three classes namely; less suitability with large 514,2 ha, suitable 2461,4 ha, and very suitable 6537,1 ha

3. Most of the area very suitable for up-land agroforestry 6537,1 ha.

4. The composition of Agroforestry consist of trees 16 kinds, crops 10 kinds, fisheries 2 kinds, animal 2 kinds.

5. Land productivity of Agroforestry per ha, per year is 11 million rupiahs

6. The agroforestry farmer supposed to use the area very suitable class for optimize their agroforestry productivity.

7. It' supposed to use the criteria and indicators for GIS- weighting suitable up-land Agroforestry as below: Soil, Slope, Elevation, River distance, Road distance, Settlement distance

REFERENCES

JICA, 2007. Taman Nasional Gunung Halimun-Salak. Gunung Halimun-
Salak Nasional Park Management Project.

