Determination of Non-Timber Forest Products' Priority Using an Analytical Hierarchy Process in North Sumatra Indonesia

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Abstract. This study aimed to assess the priority of NTFPs in Aornakan I Village and Kuta Tinggi Village, Pakpak Bharat Regency. This study uses the analytical hierarchy process (AHP) method. The results showed that the expert respondents in Kuta Tinggi Village assessed that the criteria for marketability was the most important priority (0.324). In Aornakan I Village, the criteria for the suitability of the place to grow (0.293) were ranked 1st in the priority order. Based on the order of priority using AHP, it was found that gambier is the leading NTFP product in Aornakan I Village and Kuta Tinggi Village.

Keywords: Gambier, coffee, honey.

1 Introduction

Management and utilization of the forest resource potential in Pakpak Bharat Regency need to be optimized. One way that can be done is to collect information about the potential and opportunities for its use. Forest areas and forest ecosystems in Pakpak Bharat Regency are significant for the Pakpak Bharat Regency area and the surrounding regions that depend on the preservation of forest ecosystem functions. The Pakpak Bharat forest ecosystem maintains water, oxygen, biodiversity, an important microclimate formation, beautiful landscapes, and a carbon sink. Economically, this forest is one of the buffers for economic activities, including a source of income for some people, food, raw materials for medicines, and tourism potential. The community

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has been using non-timber forest products (NTFPs) and wood to meet their living needs and as sources of income.

Some data indicate that forest potential can still be developed in Pakpak Bharat Regency, including non-timber forest products, such as rattan, frankincense, gambier, medicinal plants, ornamental plants, and honey. In addition, there is potential for environmental services in the form of water resources and attractive natural attractions that have not been optimized for use. Likewise, the potential for biodiversity can be explored and harvested as raw material for natural medicines.

Non-Timber Forest Products are widely used by the community in Pakpak Bharat Regency, especially in Kuta Tinggi Village and Aornakan I Village. It is based on the fact that Pakpak Bharat Regency is a district that has high forest wealth. The community has been using NTFPs and wood to meet their living needs as sources of income. Currently, the interview method used in these two villages is to find out the types of NTFPs, and the order of priority levels of NTFPs used by the community has never been done. Therefore, this study used AHP. Knowing the priority level of NTFPs will facilitate mapping the products you want to develop so that they can focus more on priority products in the future. The benefits for the community are making it easier and more focused to create business plans and making it easier to make work plans for the next activity.

The priority level of non-timber forest products in these two villages is significant to maximizing NTFPs that contribute the most to community incomes in these two villages. Knowing the main priority level of NTFPs in each village will provide input to the government and stakeholders (such as the PETAI foundation) regarding the mentoring program currently being carried out to focus more on the main priority NTFPs. This study is essential for the community to assist the community in increasing people's income from NTFPs. This study aims to determine priority NTFPs in two villages, Aornakan I Village and Kuta Tinggi Village Using AHP. The latest information on priority NTFPs is indispensable for communities and decision-makers in natural resource management, especially NTFPs. Therefore, this research is essential. The results of this study are expected to be input for the community and local governments in natural resource management. This study will also provide the benefit of facilitating the process of selecting non-timber forest products, so that process can be developed to focus more on NTFPs products that will be featured in the future.

2 Literature Review

To determine priority NTFPs in Aornakan I Village and Kuta Tinggi Village, Pakpak Bharat Regency, applying the analytical hierarchy process (AHP) method is very appropriate. The AHP method has many advantages in explaining the decision-making process because it can be described graphically for the easy understanding of all parties involved in decision-making [1]. Several studies using AHP have been carried out in areas in various fields and regions for planning forest management strategies [2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22] because AHP is a multi-criteria decision-making process that can assist in decision-making. Moreover, the AHP

method has advantages in solving multi-criteria problems and unstructured problems. AHP can also handle problems whose elements are interdependent in a system and do not impose linear thinking.

3 Methodology

3.1 Research Location

This study was conducted from May 2020 to October 2020 in Pakpak Bharat Regency, a district in North Sumatra Province, Indonesia. The capital city is in the Salak Subdistrict. Pakpak Bharat is located at the foot of the Bukit Barisan mountains. It is a division of Dairi Regency, formed based on Law No. 9 of 2003. Pakpak Bharat Regency was formed on July 28, 2003, resulting from the expansion of the Dairi Regency. The ethnicity that inhabits this district is generally the Pakpak tribe, one of the Batak subtribes. The new district covers eight subdistricts, namely Salak, Kerajaan, Pagindar, Sitellu Tali Urang Julu, Pergetteng-getteng Sengkut (PGGS), Siempat Rube, Tinada and Sitellu Tali Urang Jehe. This study was conducted in two villages in North Sumatra: Aornakan I Village, Pergetteng-getteng Sengkut Subdistrict, located at 2°31'45" south latitude and 98°25" east longitude and the village of Kuta Tinggi, Salak Subdistrict, located at 2°30'14" north latitude and 98°19'49" east longitude. The population in Kuta Tinggi Village is 894 people with 191 family heads. In Aornakan 1 Village, the population is 762 and 175 family heads.

Data analysis was conducted at the Forestry Study Program, Faculty of Forestry, Universitas Sumatera Utara (USU), Medan, North Sumatra, Indonesia. The map of the research location can be seen in Figure 1.

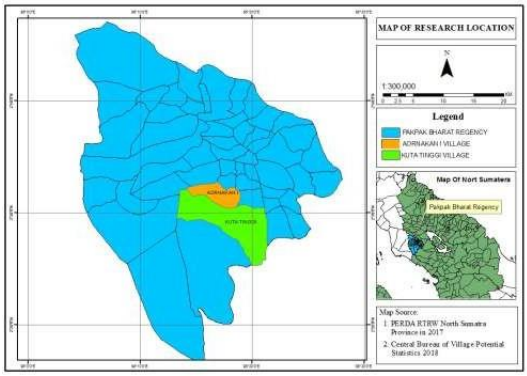

Fig. 1. Map of research location

3.2 Data Collection

The stages in collecting the data needed in this study were determining expert respondents in the two villages, compiling a hierarchical structure, making AHP questionnaires based on the hierarchical structure, having questionnaires filled out by

expert respondents in each village, processing the data with expert choice software, and determining weighting. The expert respondents selected in this study consisted of eight people in each village. Expert respondents are key respondents from the two villages who use NTFPs as their source of income. The method of selecting respondents is the purposive method. Respondents are individuals or actors interested in a problem to be solved and assessed in the expert category, either because of their position, knowledge, or experience. In this study, the respondents were selected based on their experience processing and using NTFPs. The hierarchical structure of the problems compiled must reflect the relationship between goals, criteria, and alternatives.

In the AHP method, expert respondents must fill out questionnaires and interview several expert respondents. The expert respondent's assessment includes an assessment of the criteria and alternatives based on a predetermined rating scale [2, 3, 23]. The AHP method can absorb decision-makers' perceptions, preferences, and experiences and does not require high expertise.

3.3 Data Analysis

To determine Priority NTFPs in the two chosen villages in the Pakpak Bharat Regency, the AHP method was used. The basic principles of AHP, according to reference [3], include preparation of the problem hierarchy (problem decomposition), pairwise comparison assessment (comparative judgment), priority determination (synthesis of priority), and logical consistency. In preparing the hierarchy, it is necessary to detail or reduce the whole problem into several elements/components, forming a hierarchy from these components.

4 Findings

4.1 The Respondents' Characteristics in Kuta Tinggi Village and Aornakan Village I

Based on the study results, all of the expert respondents were natives of Aornakan I Village and Kuta Tinggi Village. The gender of the expert respondents was male, and their main occupation was farmer. The age range of respondents in Aornakan I Village was 39–70, and in Kuta Tinggi it was 37–53 and up to 58 years (Figure 2). Based on Figure 2, the age range of respondents in the Kuta Tinggi Village was dominated by the age group of 41–45 years (37%), followed by the age range of 35–40 (25%) and 46–50 years (25%), while the age range of 51–55 represented only 13% of the respondents. In Aornakan I Village, the age range of 46–50 years dominated (37%), followed by the age range of 41–45 years (25%), with the rest in the age ranges of 35–40 years, 51–55 years and more than 55 years, with 12.67% each. The education level of the expert respondents in Kuta Tinggi Village and Aornakan I Village spanned elementary school, junior high school, and high school (Figure 3). Based on Figure 3, it can be seen that the respondents in the two villages were dominated by the level of education of senior high school, with 62% each.

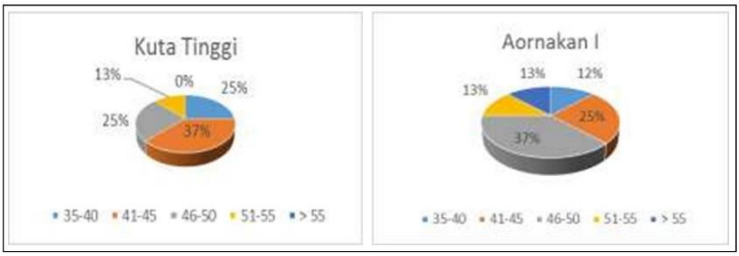

Fig. 2. The age range of expert respondents: Kuta Tinggi Village and Aornakan Village I.

Fig. 3. Education level of expert respondents: Kuta Tinggi Village and Aornakan Village I.

In terms of age and education level, the respondents in the two villages included respondents of productive age with the general education level being senior high school, so they had a good level of understanding in choosing criteria and alternatives of priority NTFPs. Pakpak Bharat Regency has a small population in the province of North Sumatra. Economic activities are focused on agriculture and plantations. The community's use of non-timber forest products has continued for a long time. The people in these two villages have very close interactions with the surrounding nature, especially the forest. For the people of this village, life is heavily dependent on the forest which provides all their primary needs. This dependence of the people in these two villages results in them continuously using forest resources. One of the potential forest resources often used by the community in these two villages are non-timber forest products (NTFPs). Non-timber forest products are one of the forest resources that have advantages and the people living around the forest are in direct contact with them on a daily basis. One of the benefits of NTFPs is that they can increase community income in these two villages.

4.2 Hierarchical Structure Determination of Priority NTFPs

The selection of goal, criteria and alternatives is based on discussion and agreement from expert respondents. The hierarchical structure that the expert respondents in this study have agreed upon is presented in Figure 4.

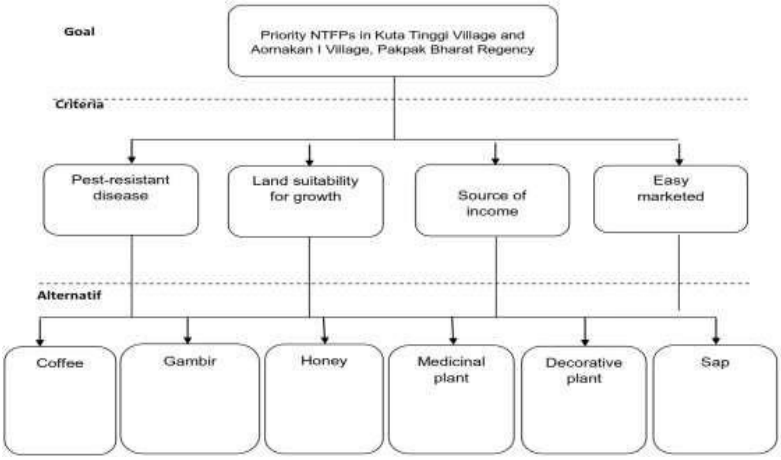

Fig. 4. Hierarchy chart determination of priority NTFPs in Aornakan 1 Village and Kuta Tinggi Village, Pakpak Bharat Regency

Fig. 5. Types of priority NTFPs in Aornakan I Village and Kuta Tinggi Village, Pakpak Bharat Regency: A. Coffee harvest, B. Gambier that have been processed, C. Gambier being dried, D. Honey harvest

4.3 Priority Level of Criteria and Alternatives in Determining the Type of NTFP

The selection of respondents in determining the type of NTFPs based on the criteria in Kuta Tinggi Village and Aornakan 1 Village can be seen in Table 1.

Table 1. Ranking of the respondents' selection results based on criteria in Kuta Tinggi and Aornakan 1 Villages

Criteria	Kuta Tinggi		Aornakan 1	
	Value	Rank	Value	Rank
Pest resistant	0.262	3	0.225	3
Location suitability	0.142	4	0.293	1
Income source	0.272	2	0.266	2
Easy to market	0.324	1	0.216	4

Furthermore, based on the results of the expert choice calculations in the same way as the criteria calculations, the final results of the measure of the level of alternative importance concerning the criteria in the hierarchical structure (Figure 4) according to the expert respondents are described in Table 1 and 2. Results of respondent selection based on alternatives in determining the types of Priority NTFPs in Kuta Tinggi Village and Aornakan I Village, Pakpak Bharat Regency, can be seen in Table 2.

Table 2. Ranking of respondents' selection results based on alternative in Kuta Tinggi and Aornakan 1 Villages.

Alternative	Kuta Tinggi		Aornakan 1	
	Value	Rank	Value	Rank
Coffee	0.266	2	0.159	3
Gambier	0.282	1	0.351	1
Honey	0.180	3	0.229	2
Medicinal plants	0.075	5	0.075	5
Decorative plants	0.039	6	0.056	6
Sap	0.157	4	0.129	4

5 Discussion

From Table 1, it can be seen that the expert respondents in Kuta Tinggi Village rated the marketability criterion to be the most important priority (0.324) and ranked it first concerning the goals in the hierarchical structure (Figure 4). This is then followed by the income source criterion (0.272) that ranks second, the pest and disease resistance criterion (0.262) ranks third, and the suitability criterion for growing places (0.142)

ranks 4. Based on Table 1, it can be seen that the expert respondents in Aornakan I Village assessed the suitability of the place to grow (0.293) as ranked first, the source of income criterion (0.266) as rated second, the pest resistance criterion (0.225) as ranked third, and the marketability criterion as the fourth priority (0.216) concerning the target or goals in the hierarchical structure (Figure 4). The difference in opinion of respondents at the priority level in the two villages is understandable considering the two villages have different respondent backgrounds, different regional characteristics, and are located in different subdistricts. Aornakan I Village is one of the largest producers of gambier in Pakpak Bharat; therefore, the community generally focuses their livelihood on marketing gambier. However, every year the sale and marketing of gambier decreases, hampering the residents' livelihoods. Therefore, a strategy is needed to market gambier plants.

Aornakan Village and Kuta Tinggi Village are approximately 179 km and 190 km from Medan City, respectively. A trip to Medan, the capital of Sumatra, takes about six hours. The two research sites are adjacent, where PGGS Subdistrict is in the northern part and Salak Subdistrict in the southern region. Salak Subdistrict is at an altitude of 922 meters above sea level, and PGGS Subdistrict is 1032 above sea level. Aornakan and Kuta Tinggi villages are directly adjacent to protected forest areas. The contours of the settlements are flat, sloping to steep hilly.

The selection of the criteria for easy marketability in Kuta Tinggi Village has the highest priority because all respondents are experts with experience in managing and selling gambier. This village is located in the district capital, namely in the subdistrict. The selection criteria for the suitability of the place to grow in Aornakan I Village has been given the highest priority because all expert respondents know that this area is very suitable for gambier growth. Besides, gambier leaf is one of the attributes of the Pakpak Bharat district symbol. Seven gambir leaves on the logo illustrate that the gambir plant is a superior specific product from Pakpak Bharat Regency that other regions do not possess. The significance of there being seven leaves refers to Pakpak Bharat Regency being inaugurated in the seventh month (July). Based on Table 2, the results of the priority order using AHP for the NTFP products in Aornakan I Village are gambier, honey, coffee, sap, forest medicinal plants, and decorative plants. Meanwhile, in Kuta Tinggi Village are gambier, coffee, honey, sap, medicinal plants, and decorative plants. Table 2 indicate that the expert respondents in Kuta Tinggi Village decided that the alternative gambier was the highest priority factor (0.282) in their village. Likewise, gambier was also the most critical priority (0.351) in Aornakan I Village, ranking one concerning the objectives in the economic structure. Based on the results of the AHP analysis used in this study (Tabel 1 and Table 2), it is seen that at the criteria level, Kuta Tinggi Village's main priority is market access. In contrast, Aornakan 1 Village' s main priority is a suitable location. The two villages chose gambier as the main NTFP priority at the alternative level. The most important thing is to prioritize its implementation in these two villages in Pakpak Bharat Regency because respondents think the gambier plant is the most suitable and sustainable product of the forest. Besides, gambier can increase income, is accessible to the market, and these villages are ideal for the natural habitat of gambier. In addition, the main livelihood

practiced in both villages is agriculture, especially polyculture, which dominates such as corn, rice, or gambier.

After the issuance of Community Forest Utilization Business Permits (IUPHKm) to Forest Farmers Groups (Kelompok Tani Hitan [KTH]) in these two villages, farmer groups received assistance from the Pesona Tropical Nature Indonesia (PETAI) Foundation starting in March 2017 to be able to access the potential of NTFPs legally. The forest farmer groups are KTH Pemuda Tani in Aornakan1 Village and KTH Dos Ukur Mersada in Kuta Tinggi Village. The use of NTFPs must be at the core of using forest products. Besides preserving forests in general, the use of NTFPs is defined as the sustainable use of forests without damaging the stands. NTFPs can be the main activity of utilizing forest products in forest management mechanisms, especially in community forests. Therefore, this study related to how superior NTFP products can help in future business planning to increase people's income, especially in Pakpak Bharat Regency. Further, the selection of NTFPs with the AHP method can help make decisions more powerful and flexible because they can assist in making choices consisting of several aspects in the assessment. According to reference [24], AHP can help make choices about priorities and make decisions where qualitative and quantitative aspects are involved, and both must be considered.

6 Conclusion & Recommendations

This research concludes that, based on the criteria, NTFP products in Kuta Tinggi Village, which are assessed as essential priorities, are accessible to market (0.324). For NTFP products in Aornakan I Village, the most critical priority criterion is the suitability of the place for growing products (0.293). Based on the alternative priority order results using AHP, the highest priority NTFP product to be developed in Kuta Tinggi Village and Aornakan I Village is gambier.

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