Ethnobotanical studies of plants utilization in the gold mining region in Central Kapuas, Indonesia □

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Abstract. *Sunariyati S. 2018. Ethnobotanical studies of plants utilization in the gold mining region in Central Kapuas, Indonesia. Biodiversitas 19: 215-221.* Studying on ethnobotany is intended to expand the knowledge of interaction between human and plants. There are various uses of plants such as in food industry, medicine, and evidently in gold mining activity. Some gold miners believe that specific plants could be used as indicators for the presence of gold metal beneath the area the plants grown. The objective of this research were to (i) learn the ethnobotanical knowledge of Dayak Ngaju people in Central Kapuas, Central Kalimantan, Indonesia gold-mining areas, (ii) identify some species of plants used by local miners as indicators for the presence of gold metal underneath. The research consisted of two phases. The first phase was a qualitative approach, using in-depth interviews and identification of plant species used for gold metal indicators. The second phase was the quantitative approaches analyzing the ethnobotanical knowledge of Dayak Ngaju people in Central Kapuas (Indonesia) gold-mining areas. The results showed that the people of Dayak Ngaju in Central Kapuas had local knowledge about the use of plants for food industry, medicine, and also in gold mining activity. At least 10 (ten) plant species were believed to be indicators for the presence of gold metal. Based on the Fidelity level (FL) and the Relative Used-Value (RUV), katune (*Agrostistachys sessilifolia* (Kurz) Pax & Hoffm) is the most plant served the purpose as indicators for the presence of gold metal.

Keywords: Ethnobotany, gold mining, plants utilization, local ethnic

INTRODUCTION

The traditional knowledge of plants utilization and environmental management is possessed by local communities inherited from their ancestors. Nowadays, the medicinal plants in the local communities are not only served its basic purpose as medicinal plants but also served the wisdom related to the tradition and customs. Waluyo (2014) suggested that the traditional life of tribe or community on understanding the environment provides a view of their local wisdom in utilizations of natural plants resources. Saving biodiversity means taking steps to protect genes, species, habitats or ecosystems. So save biodiversity also means preventing the decline of natural ecosystems are the main and manage and protect them effectively. Realized or not that biodiversity (flora, fauna, remains miniscule/micro-organisms) is the center of all sectors which are essential for human life (bioprospecting). Traditional knowledge is a potency or excellence values from certain regions, which is passed through from generation to generation. Unfortunately, there are still some traditional knowledge and its meaning that have not been explored, yet. Traditional knowledge and conception of local community knowledge toward the local plants within certain environment are defined as activities of collecting local wisdom from local communities. The establishment and protection of collected traditional knowledge must be done by supporting and communicating the knowledge systematically so that it will be understood by the next generation and maintained its existence. Therefore, the ethnobotanical study learning the interactions between human and plants, should be done to explore local knowledge of a community especially related to the tradition in plant utilization (Hansen and Van Fleet 2003; Martin 2004). Ethnobotany is the scientific study of the relationships between people and plants (Catton 1997; Martin 2004). The simplified term of ethnobotany means the interaction of ethnic societies and local environment especially with the plants (botany). Ethnobotany can help the community in recording local wisdom owned over the year. Ethnobotany is going to be valuable instrument for troubleshooting the problems globally (Rahman 2013). The ethnobotanical study assists in collecting the local knowledge record from ethnic society. As an example, the study of medicinal plants can be used as the basis for the conservation and utilization of plants in a sustainable way. Local wisdom can be an important component to carry out saving efforts of forest plant resources. With the local wisdom owned by the local people, it will be able to support the wisdom value in this environment especially for maintaining the sustainability of natural resources and genetic. In addition, local wisdom is a feature of national culture, which should be comprehensively studied and further developed.

Dayak Ngaju is one of ethnic society living in the Central Kapuas District, Central Kalimantan Province, Indonesia. The livelihoods of Dayak Ngaju strongly depend on the natural surroundings. They use plants to predict the environmental conditions. One interesting culture is the use of different types of plants in the gold mining area of

Dayak Ngaju people, in Central Kalimantan for predicting the metal gold deposit in their region. The preliminary study collected from several miners showed that many plants species planted in the gold mining area have many cultural functions. Some people believe that a particular plant can be used to indicate the location of gold metal deposit. Furthermore, they believe that different type of plants can indicate a different gold content. However, the comprehensive data information regarding with the type of plants and its usage is still limited. In many developing countries, ethnobotanical of plants used have not been well studied and exploited, tested, or documented. Therefore, the objective of this study is to identify the plant species, which was believed as indicator for the presence of gold content at Gold mining region in Central Kapuas Indonesia as well as to know the local knowledge of Dayak Ngaju on the use of plant in gold mining areas.

MATERIALS AND METHODS

This study was done from June 2011 to July 2012 located in the forest area of gold mining region in Central Kapuas District, Central Kalimantan, Indonesia. The research used mixed methods research by qualitative and quantitative approach. This research consisted of two phases, phase I (one) was the descriptive study of ethnobotany using qualitative and quantitative approach by participatory observation through Participatory Rural Appraisal (PRA), Focus Group Discussion (FGD), field visit (floristic survey) (Figure 4), and the literature study. Phase II (two) was the identification of vegetation types in the gold mining region predicted as the detector of gold deposit area by local people. The location of the research could be seen in Figure 1.

The qualitative approach of ethnobotanical study was used to obtain information and describe local knowledge of Dayak Ngaju tribe about utilization of certain plants (Figure 2.A) participant observation and in-depth interview techniques as the main tools in studying knowledge of the plants (Kraipeerapun and Thongthew 2007) and Focus Group Discussion (FGD) (Figure 2.B). The second phase identified several species of plants that were believed to be presence indicators of gold by Dayak Ngaju people (Figure 2.C-D).
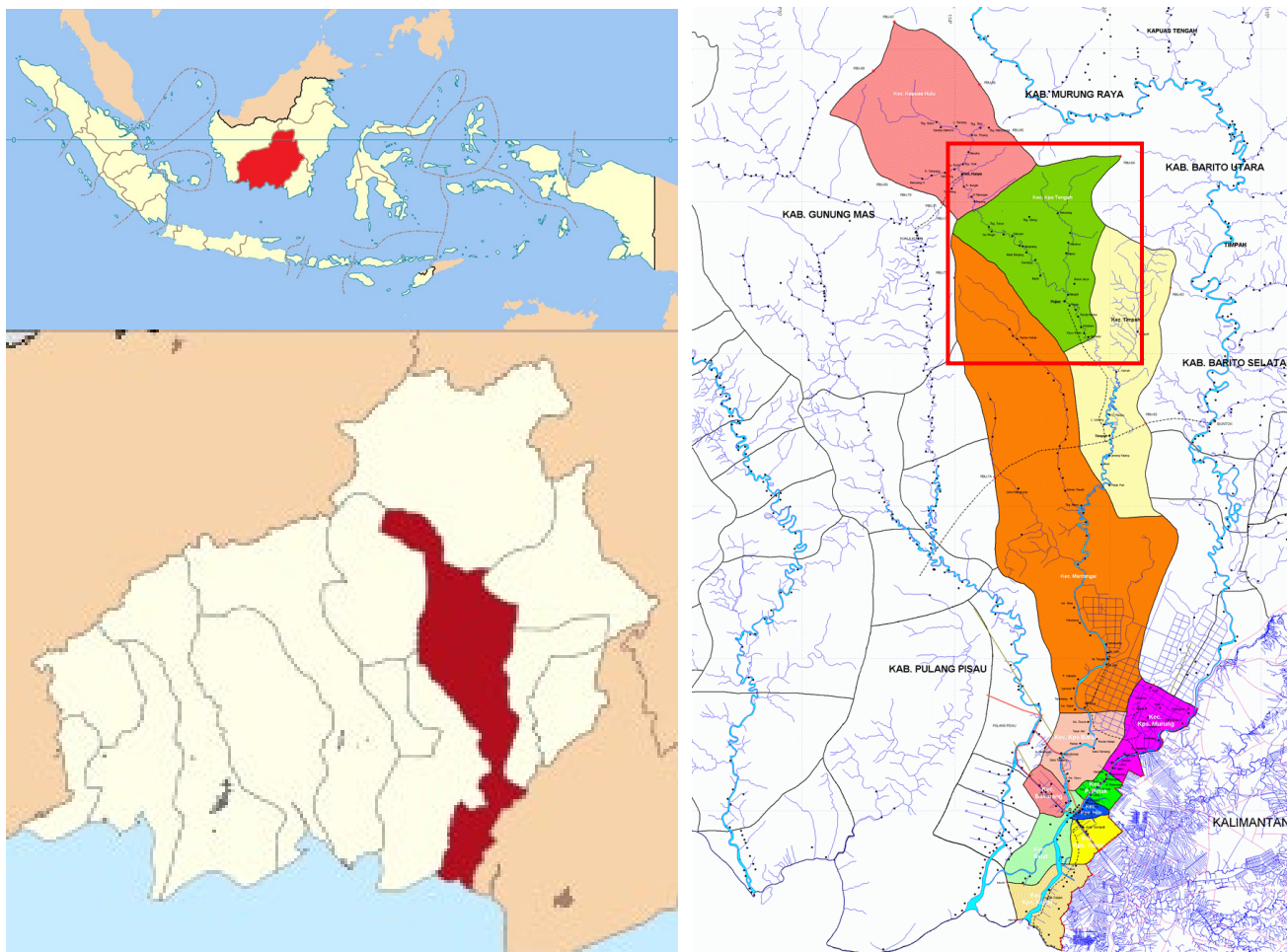

Figure 1. Location of research in Central Kapuas Sub-district, Central Kapuas District, Central Kalimantan, Indonesia geographically located at coordinates between 114º-114 º 2 ′0′S and 0 º 48 ′0" -1 º 27 ′ 62″W

Figure 2. A. Interview with the key informant. B. Focus Group Discussion with miners. C. Floristic survey at the gold mining in Central Kapuas, Central Kalimantan, Indonesia

Data from ethnobotanical surveys were collected using the observation and in-depth interviews with 40 local gold miners in Central Kapuas District. This study used purposive sampling technique (Tongco 2007) to obtain information about the object of the study, then analyzed descriptively. The recorded data informant include: name of informant, age, long worked as a miner, the last education, and knowledge about plants indicator of gold. To find out the utilization of each species of plants and calculate an index of interest types of plants (Fidelity level) and comparing the relative knowledge of the informant used the formula as follows:

$$FL = \frac{Ip}{Iu} \times 100\%$$

Where:
FL   = Fidelity level
Ip   = Number of informants who gave the same answer to a particular species
Iu   = The total number of informants stated the usefulness of these species

The Use Value of each plant species relative to the informant was calculated as follows:

$$UVis = \frac{\Sigma Uis}{nis}$$

Where:

ΣUis = The number of uses mentioned by informant i for species s in each interview
nis = The number of interviews with informant i for species s

The overall Use Value for each species (UVs) was calculated as follows:

$$UVs = \frac{\Sigma UVis}{ns}$$

Where:
UVs   = Number of overall use value for each species
UVis   = Number of use value of each species for each informant
ns   = The number of informants interviewed for each species

To compare the relative knowledge of different informant for each informant using formula as follows:

$$RUV = \frac{\Sigma UVis}{nis} / UVs$$

Where:
nis   = The number of folk species with data from three or more informants

(Source: Hoffman and Gallaher 2007)

RESULTS AND DISCUSSION

Local knowledge of Dayak Ngaju tribe on utilization of plant in gold mining areas

Dayak Ngaju people have a role in knowledge plants utilization because they were very close to the natural resources and environment. Human interaction with plants is an experience of traditional hereditary knowledge inherited from its ancestors to the next generation. To determine the appropriate places for mining activities, the use of simple techniques, such as using certain plant species, certain types of land or trying with specific techniques was conducted. The results of the in-depth interviews showed that among miners generally believes that the existence of plant indicators in certain area, it is likely that the land contains a gold metal. This could be seen from results of interviews with miners which showed that most of them used the characteristic of specific plants (52%) to determine the presence of gold places while another one used the characteristics of soil (36%), and trial and error (12%) (Figure 2). To those who used the characteristics of soil believed that the indicator of gold presence was on the top of soil layer (top soil) in terms of white or yellow sand, while underneath of top soil layer was a gravel/coral and granite. According to the miners, this was correlated with land factors. For example, Katune as plant indicator generally has comprised the top layer soil as peat soil layer, below ground layer is white or yellow sand, and the layer under the sand is gravel/coral and granites. ☐

Based on the interviews, it also showed that most of informant used specific plants as gold indicators were obtained from their ancestor with the percentage of 50% while another 27% of informants got the information by their own experiences and followed by 23% informants who gained knowledge from other miners. This shows that the actual ancestors of Dayak Ngaju tribe owned the concept of knowledge of the local ecology or ecological sensitivity in mining. The ethnobotanical study by Setyowati et al. (2005) in the Dayak community Ngaju in the area Timpah, Central Kapuas District, Central Kalimantan reported that Dayak Ngaju tribe in the study area is relying on forests in the surrounding areas, which could be reflected from using plants to meet their daily needs. The local knowledge was acquired from generations derived from ancestors. Hunt and Berkes (2007) suggested that traditional ecological knowledge is an accumulation of ecological adaptation pattern of local communities that have been practiced and developed through a process of adaptation hereditary. The Dayak Ngaju tribe lived close to the natural resources and the environment. It played a role in knowledge of plant utilization. Human interaction and plants is an experience of traditional knowledge passed down from generations of ancestors to the next generation. Unwittingly, the local knowledge possessed by primitive society is the knowledge source of ethnobotany. ☐
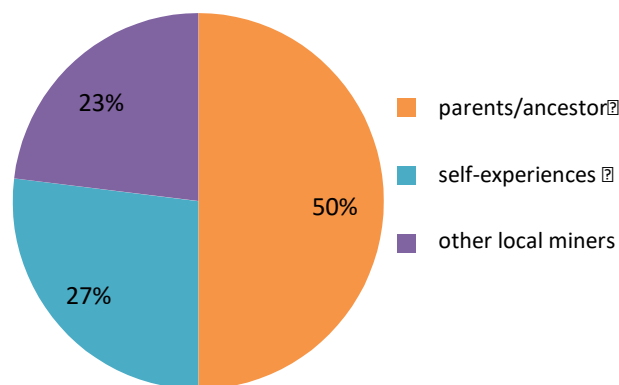

Figure 2. Percentages of informants who obtained local knowledge of the use of certain plant species as gold indicator

Inventory and identification of plant

The results of interviews with informants who used the plants to indicate the gold presence in Central Kapuas showed that 11 species of plants living in specific habitat were believed by Dayak Ngaju tribe as gold indicators. The types and characteristics of plants used as gold indicators are presented in Table 1.

The highest percentage of plant species mentioned by informants was *katune (Agrostistachys sessilifolia* (Kurz) Pax & Hoffm). This means that the initial selection of gold mine places was based on the katune plants. According to the informants, the presence of katune plants generally show the characteristics of the soil composed of sand and coral-containing grains of gold. A quantitative approach is used to prove the local knowledge about the identified plant utilization (Purwanto and Munawaroh 2002; Tongco 2007; Rahman 2013). The result of the calculation through a quantitative approach is Fidelity level, Use Value, and Relative Use Value. The highest fidelity level is from *A. sessilifolia*. It showed the total utilization of Katune has economical, pharmacological and ecological high value. These values demonstrated local knowledge about plants indicators had been used by some miners to determine the presence of gold places. The traditional system used by the Dayak Ngaju tribe in determining the particular environment is obtained from the ancestors orally. Therefore, the next generation may not get the same knowledge and information. Of this reason, a quantitative approach is used to complement the qualitative data collection, so that the system analysis of local knowledge about the use of plants can be examined deeply. Ethnobotany is the logical study which plays an important role in understanding the vigorous relationship between human beings and plants (Rahman 2013)

The results of interviews with informants stated that *A. sessilifolia* was not only used to determine the presence of gold deposit but also for traditional medicine especially for treating rheumatism, toothache and high blood pressure medications. In addition, its wood can be used for building materials and firewood (Table 1).

Table 1. The Fidelity Level (FL) of each plant used for economical, pharmacological and ecological purposes

Local names	Scientific name	Utilization	*FL*(%)
Kapurnaga	*Calophyllum hosei* Ridl.	Indicator of Au, furniture, firewood, building materials	12.12
Katumbu	*Dillenia excelsa* Gilg	Indicator of Au, building, firewood	24.24
Karuingbukit	*Dipterocarpus crinitus* Dyer	Indicator of Au, building, firewood, furniture	6.6
Katune	*Agrostistachys sessilifolia* (Kurz) Pax & Hoffm	Indicator of Au, traditional medicine, building, firewoods	48.48
Belawan/Pelawan	*Tristania obovata* R.Br.	Indicator of Au, traditional medicine, building, furniture	18.18
Galamtikus	*Tristaniopsis merguiensis* (Griff)	Indicator of Au, building materials, firewood	15.15
Katiau	*Ganua motleyana* (de Vriese)	Indicator of Au, building materials, firewood	27.27
Rangas	*Swintonia glauca* Engl.	Indicator of Au, building, furniture, traditional medicine	24.24
Kayulalas	*Syzygium zeylanicum* (L) DC	Indicator of Au, building, firewood, traditional medicine	24.24
Tumih	*Combretocarpus rotundatus* Miq	Indicator of Au, firewood, medicine, building, furniture	21.21
Kayuemas	*Memecylon myrsinoides* Blume	Indicator of Au, building, firewood, traditional medicine	18.18

Table 2. The usage value of each plant species

Local name	Use Values (UV)					
	Indicator of *Au*	Traditional medicine	Building materials	Furniture	Firewoods	Total
Kapur naga	1	0	0.83	0.16	0.5	2.5
Katumbu	0.88	0	0.83	0	0.83	2.13
Katune	1	0.21	0.5	0	0.5	2.21
Belawan	0.75	0.25	0.75	0.25	0	2.25
Galam tikus	1	0	0.5	0	0.5	2
Katiau	0.87	0	0.63	0	0.37	1.87
Rangas	0.75	0.12	0.75	0.63	0	2.25
Kayu lalas	1	0.25	0.25	0	0.5	2
Tumih	0.7	0.4	0.7	0.2	0.3	2.2
Kayu emas	1	0.33	0.67	0	0.5	2.16

Based on data analysis, it shows that 5 out of 11 species i.e., *kapur naga, katune, galam tikus, kayu lalas*, and *kayu emas* gathered from informants as a potential plant gold indicators had the same value as a marker or indicator of gold (Au). Furthermore, the calculation of use values of five species of plants approved by 10 key informants who had been interviewed twice revealed that the relative use value was 0.68. This means that the comparative relative use value from different informants about the use of plants as a gold presence indicator can be believed upon benefits as 68%.

These use values demonstrated that local knowledge of the informants about the use of plant as gold indicator is still applied by majority of miners to determine the presence of gold places. Most of the traditional system used by the Dayak Ngaju tribe in determining the particular environment is information obtained from the ancestors orally. The next generation may not necessarily get the same knowledge and information. Therefore, a quantitative approach is used as the supplement of qualitative-collected data, so that the system analysis of local knowledge about the use of plants can be examined deeply. Since the future of ethnobotany lies in the conservation, the use and documentation of herbs is a great way to manage the local knowledge of culture for the benefit of others. Through quantitative approaches can be used to analyze the use of plants that are associated with the complex issues that exist in a society that is interdisciplinary. Therefore, the results

of this research could be used as a strategy for promoting conservation in plant utilization. Conservation effort or action was important to keep the existence of plant used as gold indicators continuously in good quality and quantity. This was in accordance to Alzina (2017) who stated that Approaches concerned with people and environment relations have contributed to traditional ecological knowledge, this is an important driver for management and conservation of biological resources. It should also be viewed in terms of socio-cultural, political and economic.

Therefore, it could be concluded that (i) Dayak Ngaju tribe in Central Kapuas had local knowledge about plants (Ethnobotany) used for mining area selection, (ii) Nine species habitat-specific of plants was believed by the Dayak Ngaju tribe as the indicators of gold presence, (iii) The highest value of the plant species utilization (Use Value), and relative utilization (Relative Use Value), was katune (*Agrostistachys sessilifolia* (Kurz) Pax & Hoffm), (iv) Conservation efforts could be carried out through the ethnobotanical study by applying the principle of sustainable use of natural resources. Although the further exploration of local knowledge documentation from the public society regarding the potential usage of herbs (ethnobotany, should be done in an effort to explore biodiversity in the local area comprehensively. Moreover, the exploratory research needs to be done to provide the wider and established information of plant benefits in Central Kalimantan.

Relevance of ethnobotanical study for the conservation of plants

The research was conducted to discuss the utilization of plants by the local people for the mining, but in fact, the indicator plants were used by the local community because they had benefits for medicine, tooling, furniture, firewood and other necessities. All of the 11 species mentioned by the informants can be utilized for various economic purposes (Table 1) Therefore, to maintain the sustainability of its utilization, the local community should also maintain and manage it wisely. Dharmono (2007) stated that Ethnobotany is a study of interactions between humans and plants. It not only examines the taxonomic botanical data, but also concerns traditional botanical knowledge in the various of reviews, interpretations, and associations that examine mutual relations between humans and plants. Local knowledge about plants that have not been explored, whereas many potentials can be developed in the diversity of the use of plant resources (ethnobotany). Local knowledge in utilizing natural resources is not an acquired knowledge. It passed through a long process by trial and error. This suggests that local knowledge has a very important role in developing ethnobotany in the future. Conservation efforts therefore are conducted through ethnobotany learning by applying the principle of sustainable use of natural resources. Conservation is one of the efforts to maintain environmental conditions so that natural resources are used wisely and not beyond the carrying capacity. Furthermore, there is needed to devise the utilization of a sustainable for several plants species in gold mining areas. Indeed, giving stewardship of natural resources to local people and encouraging uses of many plants species may provide a powerful contribution for conservation (Amusa et al. 2010).

Based on the ethnobotanical study there were many benefits of plants, not only for wood, but also can be used for other uses such as for herbal treatment. It showed some types of plants that have more useful value than just used as fuel. Potency of plants that can be utilized as medicine needs attention in the management and conservation, because of the high dependence of society on herbal medicine due to limited medical physician in rural areas, even in Masaran village (the research area). If anyone is sick, the population tends to use herbal remedies. Parvaiz (2014) The research in Mangowal, District Gujrat, Punjab, Pakistan. indicate that area is in rich vegetation but remained botanically virgin and not explored extensively and intensively. Many studies have been conducted on the ethnobotany of medicinal and other useful plants throughout the world (Khan et al. 2013). Similarly stated Abdulrahman (2006) that the use of plants as medicine is not only limited to traditional aboriginal people but more than 25% of the world's pharmaceutical products are derived from tropical plants. Cheikhyoussef et al. (2011) traditional knowledge on the indigenous uses of the medicinal plants could boost new innovations in the pharmaceutical industry and have many beneficial applications. The loss of species will have a major impact on the Earth. □

The Dayak Ngaju tribe basically has a good knowledge about the diversity of plant resources and the condition of its environment from generation to generation. This was shown by the way they recognize the diversity of plant species and their utilization. For example, Kaleka, a heritage area of ancient Dayak tribe. Kaleka is usually marked by the presence of betang poles ("rumah panggung"), the big old trees like durian, lanzones and so on. The location is generally maintained and protected by the family from generation to generation as an heir to the designation and utilization (eg cropping fruits) for the common property.The perspective of Kaleka can be called as a genetic pools ecologically. Another example, since ancient times, the ancestors of the Ngaju Dayak tribe in each village maintained a limited area of natural asylum forest called "pahewan". Local convention forbids anyone to cut down trees in the pahewan area. Pahewan is one example of a local wisdom culture that shows the relationship between humans and plants and the environment using conservation principles. □

According to the Dayak tribe in Central Kalimantan had efforts that have also been practiced for generations to conserve natural resources and the protection of biodiversity resources in the life. The effort was born along with the presence of Dayak tribe civilization itself. The Dayak human image, characterized by socio-religious-magic, in turn gives rise to wise and responsible attitudes and behaviors in forest resource management practices. The activities of collecting local wisdom from and with local communities are expected to contribute greatly in the process of recognition of natural resources in a particular region. Examples of local wisdom in utilization of plants as gold indicator are an ethnobotanical study which can be used as a basic of conservation and sustainability of plants. □

Local wisdom can be an important component for carrying out efforts to conserve plant resources. Local people will be able to create environmental wisdom by using their own local wisdom.In this case, the natural and genetic resources will be preserved. In addition, local wisdom is one of the characteristics of national culture so it should be explored and developed further in the future. As stated by Rahman (2013) mention that ethnobotany is the study of relationship between plant and people. Ethnobotany studies the complex relationships between uses of plants have been used, managed and perceived in human societies and includes plants used in various purposes of life. Ethnobotany will be valuable tool if it can help to solve the latest problems globally. In relation to local wisdom, it impacts on dealing with natural resource management and the utilization of biodiversity. Ethnobotany can assist the community in recording the local wisdom.

Human being used natural resources, both biotic and abiotic to support their survival on the earth. The demand for natural resources tends to increase steadily due to two factors; those are (i) rapid population growth and (ii) technological developments in the utilization of natural resources. The use of natural resources without caring the carrying capacity of the environment will bring disadvantages

to human life, such as erosion, flood, pollution, plant pests and diseases, and the extinction of biodiversity.

The future of ethnobotany lies in conservation, through documenting the use of plants and managing local knowledge of culture for other purposes. Quantitative approaches can be used to analyze the use of plants related to issues existed in an interdisciplinary society. The implications of this research as a strategy to promote conservation in the utilization of plants. Conservation is an effort or action to maintain the existence both quality and quantity of something continuously. One step of conservation can be done by maintaining certain types of plants that have important value in the mining area. According to Neelo et al. (2015) the local communities have to be educated on conservation of woody plants, especially those mostly used for various important activities. Environmental conservation is not only limited to ecological values, but also in terms of socio-cultural, political and economic. There has been international recognition that traditional and local ecological knowledge can be useful sources of information (Junior and Santos 2017).

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