

Potential and pattern of utilization of Renewable Energy sources from vegetation based on local Knowledge of *Ireres* tribe in Tambrauw, West Papua, Indonesia

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This paper deals with local knowledge of *Ireres* tribe in utilizing vegetation for meet fuel needs. Purpose of this study was to reveal traditional knowledge for making fire by means of traditional process that handed down from generation to generation within their tribe. This study was held in the Asses village, Miyah District of Tambrauw on the mid of 2011. Information acquired through direct interviews of 10 persons who are considered to have experience in relation to the process of making such material. In addition, direct survey was also conducted to see and document the whole process. Result showed that scientifically such process quite simple, but the end result of the product was passably. This was evidenced by the calorific value that reaches 4,027 cal/gm. Such value, directly suggests that the product has great potential as a substitution material fuel wood particularly for most traditional communities in Papua.

Keywords: Ethnobotany, *Ireres* tribe, Renewable energy sources, Traditional process, Calorific value.

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Traditional wisdom in utilizing forest resources has been found over time. This can be clearly seen from the shape and pattern of dependence of people living around the forest area. Such dependence could vary depending on their necessity and how to meet it¹. Such subordination are ranging from daily food sources, drinks, shade and shelter up to energy required to meet the requisite of their household. This dependency pattern is indirectly passed down from their ancestors' first^{2,3}.

In the current period, energy is one of the most important issues facing the world. It is important because resources and reserves continuous running low while consumption moving very fast. This has resulted in imbalances that impact on the problem of energy crisis, especially the availability of fossil fuels^{4,5}. Innovation in the field of renewable energy is one of key alternatives that can address such shortages. Wide range of scientific studies is currently has focused on finding alternative renewable energy sources. Based on source, renewable alternative energy is quite varied ranging from air until water power. However, the potential current research trend

is more focusing on plant biomass⁶. Biomass defined as organic matter that can be converted into energy include food crops and crops for energy (e.g., switch grass or prairie perennials), crop residues, wood waste and byproducts, as well as animal manure^{7,8,9}. With the world's total forest area is over 4 billion hectare, it potentially stash biomass about 600,066 million tones or roughly around 148.8 t/h¹⁰. However, in general, the use is still finite to direct process such as woodfuel, while other advanced processes like charcoal, wood bricked and biopellet still limited. Woodfuel is remains a priority as an alternative fuel sources in traditional and semi-traditional household due to it has lots convenience and economically more profitable. Besides it spreads abundance in nature so as simplify in gathering processes¹¹. From the Scientific data shown that in the Southeast Asia region, the total number of woodfuel that has been consumed around 153,496 tones m³, of which Indonesia has become the biggest consumer with the use of reaching 65.033 tones m^{3,12}.

Indonesia with the potential of forests that exist currently is still promising in efforts to develop renewable energy sources from biomass materials. With an area of 1,860,359.67 km square of mainland,

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5.8 million km square of water and 81,000 km square of coastline, provide biomass potency reached 49.81 GW, while installed capacity only for 302.4 MW^{13,14}. Papua is one of the regions which highly contribute to the richness of the tropical rain forest resources in Indonesia. With a total land area of 40,803,132 ha, it is contributes 32.8% of the total land area of Indonesia forest¹⁵. Undoubtedly, with the availability of forest resources is making the Papuan island as one potential region of biomass energy development.

With the availability of forest potency, this study wishes to examine local indigenous knowledge in managing forest resource as a potential alternative for renewable energy. In this investigation, we are focus to acquire information regarding what and how people select and use plant to get a fire of which based on their traditional ways. Through this study, a comprehensive data and optimal information in regard with traditional knowledge in making fire is expected to step up our insight.

Methodology

The study was conducted in May to July 2011 with site location deliberately chosen that is in the Asses village, District of Miyah, Tambrauw Regency. Administratively, the region is adjacent to the Manokwari in the East, Sorong Regency in the West, and Maybrat Regency in the South as well as Pacific Ocean in the North. In that area, there are about 11 Districts and 117 villages. Geographically the area are located between 131059'42,58" – 133028'02,35" East longitude and 00020'27,74" – 01022'30,36" South latitude as well as have broad area of 10,564.46 km square and reaches a population of 9,857 people (Fig. 1).

In this study, interview method are used to acquire prominent information pertaining how people select and technical working¹⁶. Besides, direct observation in the field is also carried out to get illustrate in regard with selecting process and working stages. Interview process conducted on some people who are considered to have habit of producing the fuel. The people are selected as much as 10 persons as respondents to interview in terms of how and any criteria that have to be considered in selecting process. Focus group discussion is used to dig up information and perception about the process. In addition, observation of the process was also carried out in the field through a demonstration by one of the residents. By means of the stage of this process (Figs 2 & 3), it is hoped that the information obtained will be sufficient associated with the process and able to enrich our

understanding as regards ethnobotanical aspect particularly tribes in West Papua.

Results and discussion

Ethnobotany of *Ileres* tribe

Plant resources in the area of New Guinea are the basis for people whose lives are wandering like hunting and gathering, fishing, gardening or subsisting crops. The advantages of plants that they get are food and other necessities source. Within the scope of this ethnobotanic, New Guinea tribes have given attention to the staple and supplementary crops, currently farming system and wild plants as the resources used¹⁷.

In daily life of Asses village, the utilization of natural resources for energy purposed has lasted long enough. Such custom has been handed down from generation to generation as one pattern of dependence in harnessing of natural resources available. From observation result identified that people in Miyah District have been harnessing some forest vegetation as an alternative fuel source. Those plants come from Arecaceae family that is Nibun (*Gulubia costata*) and Pisang/banana (*Musa* spp.) from liliopsida class. Both of plants utilized as an alternative for fuel in the asses village. However, the components of plants are applicable used only for some certain parts. For Nibun, part of which used only fine hair in the frond part of plant, while for banana, part used is banana peel that has been burned and taken flesh to be eaten.

Plant selection criteria as Fuel component

Nibun (Gulubia costata Becc.)

Based on observation in the field, it appears that the number of plants are quite numerous and abundant. Besides, the plant has dominant growth place and suitable habitat are in the hilly and rocky area. By and large, the criteria of plant growth conditions those are feasible and can be used as a fuel source namely by looking and considering scrupulously the overall tree condition cover height and trunk diameter. The finest and suitable conditions of plant are usually has a high tree reaches 18 m and trunk diameters ranging from 20-40 cm. These criteria are tending to provide optimum result of fine hair in the frond. Normally, the number of fine hair that is attached in the frond can be reach 15. Fine hair is a component that quite soft and inclines to attach in the outer part of frond. The presence of fine hair is closely intertwined by environmental condition. Where the environmental condition is less well then the number of fine hair attendance will be less in the

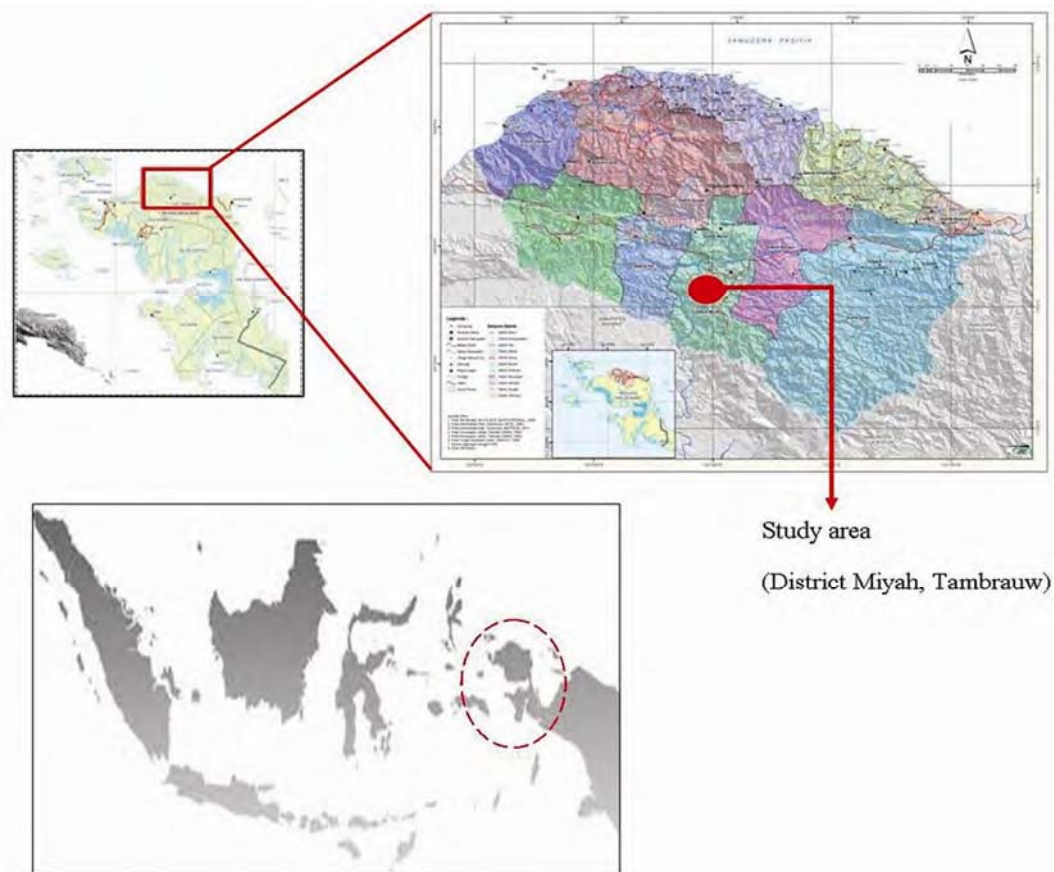


Fig. 1—Research location map that is located in the District Miyah, Tambrau Regency

frond or vice versa. In addition, tree health factor is also affecting the number and presence of fine hair. As an illustration, if there are unhealthy of fine hair and infested at any frond on the tree with a height of about 10 m and diameter around 6 cm then the number of frond will be less than four and the fine hair only less than half. In the separation process of fine hair, traditionally people use machete to erode and usually they only bring the middle part, while both ends are not taken as tends to be less well. In the healthy condition of tree with high and diameter that are suitable then fine hair presence can be found in almost every frond with thicknesses ranging between $\frac{1}{2}$ -1cm. So with this amount, estimated from healthy tree based on aforementioned criteria, it can meet at least 3-5 bamboo which used as a mold.

Banana Peel (*Musa spp.*)

From observations result indicated that the population of banana plant sprouting around Asses village is pretty much with high growth rate. This is due to soil conditions and regular rainfall around

the village. In addition, it is also because silvicultural measures such as continuously environmental cleaning around the plant. Those treatments can be done due to their garden are mostly close to their home. Despite having greater percentage of normal growth, some plants are also prone to pest and disease that attack green banana.

Bananas are one of the favorite staple foods for *Irer*es tribe and even most of the tribes in Papua. Even in some areas, bananas is also be used as a tool of ritual and culture, particularly in the case of marriage which can be used as a form of cultural property in Papua. Apart of those, banana itself has many benefits not only the fruit, but also the peel has important benefit. This is seen in the use pattern of banana peel burnt by Asses villager, Miyah District of Tambrau. People in the village have used banana peel which has been burned into one of the fuel alternative components. Based on observation, people who have been harnessing the banana peel that has been burned is only a certain type of banana such as "*Pisang Dewaka*". The term has been familiar for *Irer*es tribe and Papua in general. The peel is

obtained by peeling and separating it from the fruit and then be heated again. Heating is done by hanging over the furnace in a matter of days before it milled and mixed with fine hair from Nibun. Traditionally, the purpose of drying is to reduce the amount of moisture content of the peel. Thus, the peel expected will be better for fuel in the subsequent processes.

Bamboo (*Schizostachyum caudatum* Backer.)

Bamboo is one of the potential crops to grow and spread in almost all of tropical until sub tropical region, including Papua Island. Particularly in Papua, the plant is spread in almost all areas ranging from lowland to highland areas. Its utilization is also quite diverse, starting from root, stems, leaves and young

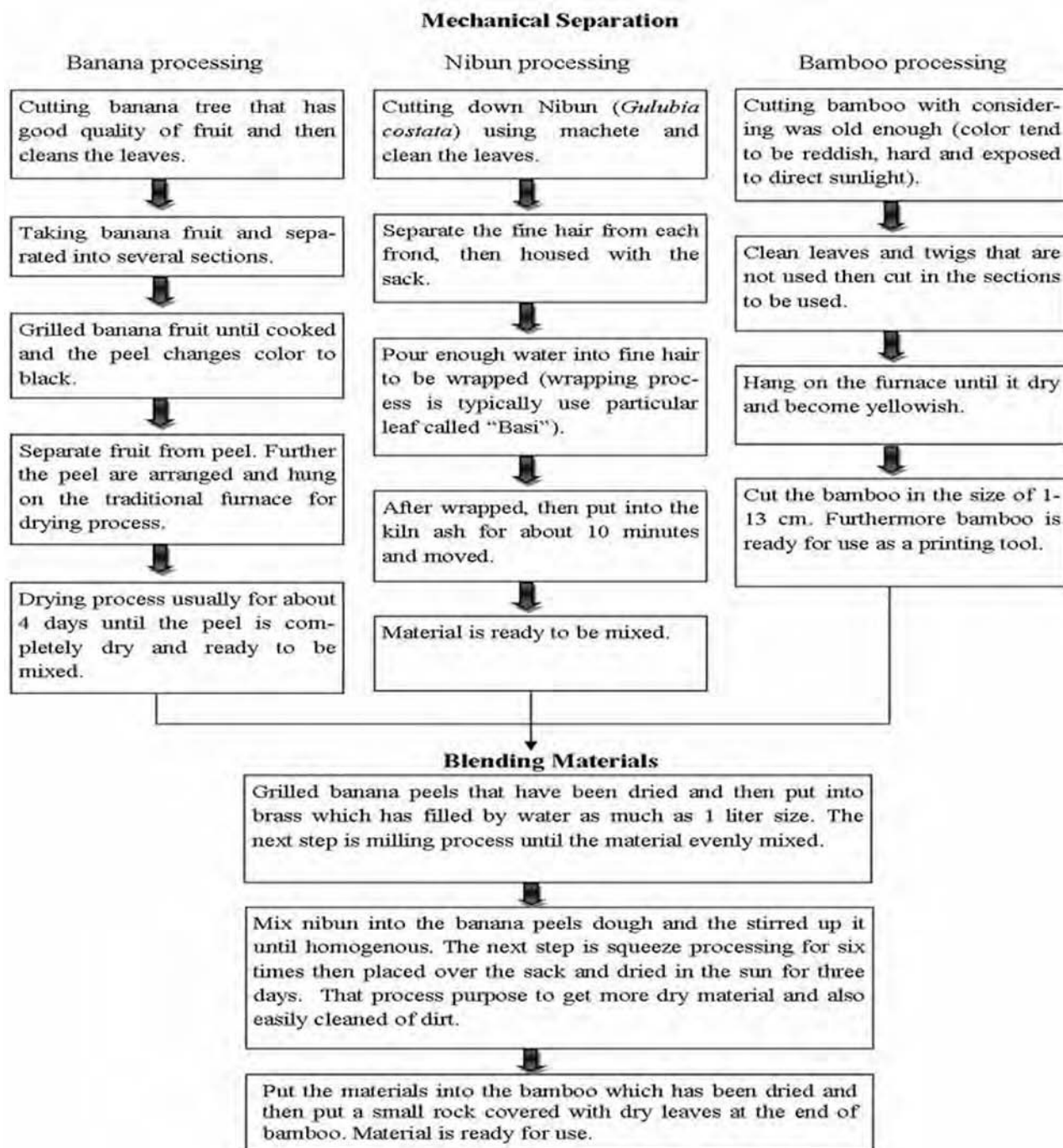


Fig. 2—Stages of material processing (Banana peel, Nibun and Bamboo) until ready for use



3a. Banana processing: Bananas were burned until cooked and peeled. The next step was arranged in parallel along the rope and hanged on the furnace.



3b. Nibun processing: Cutting down the tree and taken the fine hair using sack as a base. The next was mixing with a little water and wrapped with leaves. After that, it was buried in the ash for some minutes.



3c. Bamboo processing: Cut bamboo, clean the leaves and twigs that are not used then cut in the sections to be used. Hang on the furnace until it dry and become yellowish. After that, Cut the bamboo with the size desired.



3d. Mixing process: Milling process until the material evenly mixed. The next step was squeeze processing for six times then placed over the sack and dried in the sun for three days. Put the materials into the bamboo which has been dried and then put a small rock covered with dry leaves at the end of bamboo. Material is ready for use.

Fig. 3—Documentation processing of each material until mixing process

green shoots which used as a source of vegetable¹⁸. From these, the utilization of stem is tending to be higher than others. One of which is appears from the pattern of use by *Ireres* tribe in Asses village, Tambrau Regency. Traditionally, not all of bamboo can be used by the tribe, but it selected only from certain types that is *Schizostachyum caudatum*. The type was chosen with several reasoning, i.e. the stem have a large cavity so it will give more load capacity; distance between segment is quite long where ranges around 40-50 cm; light in weight and can be easily carried and moved.

Mechanical separation and blending materials

In this process, techniques and methods used are quite simple. Mixing process is done by combining two materials that have undergone initial treatment and subsequently incorporated into bamboo that has been provided (Fig. 2).

How to use and Calorific value produced

In the daily life of *Ireres* tribe in Asses village, traditional use of fire is quite attractive. The processes and ways of use are also quite unique by taking a tiny fraction of the material and then stick to the surface of bamboo, after that swiped in the while stone. Through the process, the fire will appear in the material and will burn until the material is exhausted. Besides, the material is also considerable potential as an alternative fuel. In general, the shape and size of the fuel product is adjusted the mold tool. In everyday, Most of *Ireres* tribe uses the product either as a trigger or fuel in cooking. Thus, the utilization rate of the product in the district of Meiyah is still high up to now.

By looking at the quality of the fire and heat produced from such product then further laboratory testing was conducted in order to obtain scientific information in regard to calorific value contained of the fuel product. Analysis result indicated that the fuel has a high calorific value. Note that with the fuel moisture content of 10%, can produce the calorific value of 4,027 cal/gm. Calorific value is an important factor from characteristic of energy and usually associated with object as a heat-generating¹⁹. It is defined as a unit of heat produced per unit weight of combustion process enough oxygen from a combustible material^{20,21}. If compared with other calorific value from woody plant species particularly in Papua Island, the content is also almost equivalent. As illustrates, *Arwob* species (*Dodonaea viscosa* JACQ) 10 years old from analysis showed an average calorific value contained is of 4015.74 cal/gm. in addition,

testing was also carried out on *Agathis* (*Agathis philippinensis* Warb) with a specific gravity of 0,39 show the content of calorific value reach 4045 cal/gm.

Through these comparisons, indirectly show that the quality of fuel produced by means of traditional process by *Ireres* tribe is almost proportional to the woody plants that often used by several tribes in Papua for cooking. In general, there are several factors that greatly affect the quality and amount of calorific value from such material. Those are moisture content, lignin content, resins, terpene and wax. In addition to those components, the lignocelluloses material is also an important factor in increasing the calorific value of material²². So proportionality, those presences affect greatly the ability of fire as fuel produced. However, scientifically it is necessary to study closely related to chemical compounds that affect the fire of the fuel (Fig. 3).

Conclusion

Ethnobotany is one pattern of community understanding of forest resources, notably the potency to be used as a complement in their daily lives. This is also clearly seen in the life of *Ireres* tribe in Asses village, District Miyah, Tambrau. From generation to generation, fuel fabrication techniques as complementary component in their culture showing that indigenous communities are adequately contribute in development and sustainability of their community. Scientifically, the process quite simple, but the end result of aforementioned product is passably. This is evidenced by the calorific value that reaches 4,027cal/g. Such value, directly suggests that the product has great potential as a substitution material fuel wood particularly for most traditional communities in Papua.

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