

Ethnobotany of *Canarium* plant species used by Tobelo Dalam (Togutil) ethnic community of Halmahera Island, Indonesia

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Abstract. Tamalene MN, Al-Muhdhar MHI, Suarsini E, Rahman F, Hasan S. 2016. Ethnobotany of *Canarium* plant species used by Tobelo Dalam (Togutil) ethnic community of Halmahera Island, Indonesia. *Biodiversitas* 17: 61-69. Tobelo Dalam (Togutil) ethnic group has been using local plants for years; one of them is *Canarium*. The ethnic are nomads and live in conservation forests. Data on ethnobotanical knowledge was collected through interview technique with “work in the wood” method. There were three types of informant: main informants, key informants, and recommended informants. Main informants were chosen through purposive sampling technique while key informants and recommended informants were chosen through snowball sampling technique. The informants in this study were grouped based on their age: 14 children (5-11 years), 18 teenagers (12-25 years), 13 adults (26-45 years), nine elder (46-65 years) and three old age (> 65 years). The result of fidelity level analysis (FL%) indicated that all age groups had FL value of 100% in utilizing walnut as local food. Regarding the use of skin exocarp the result was as follow: children (FL: 28.57%), teenagers (FL: 77.77%), adults (FL: 69.23%), and elder and old age (FL: 100%). Whereas, the use of Shell endocarp among the age groups was as follow: children (FL: 14.28%), teenagers (FL: 66.66%), adults (FL: 46.15%), elder (FL: 33.33%), and old age (FL: 100%). *Canarium* bark had value of FL% in children (FL: 35.71%), teenagers (FL: 61.11%), adults (FL: 92.3%), elder (FL: 33.33%), and old age (FL: 100%). The use of resin by the groups was children (FL: 50%), teenagers (FL: 83.33%), adults (FL: 92.3%), elder and old age (FL: 100%). The use of *Canarium* root among the groups was children (FL: 14.28%), teenagers (FL: 61.11%), adults (FL: 92.3%), elder (FL: 33.33%), and old age (FL: 100%). The use of plant’s trunk was as follow: children (FL: 50%), teenagers (FL: 77.77%), adults, elder, and old age (FL: 100%). The research indicated that walnut had high utility value. All parts of the plant (root, wood, bark, and resin) were exploited for economic, health and cultural interest.

Keywords: Ethnobotany, Tobelo Dalam, Togutil, *Canarium*, Halmahera

INTRODUCTION

Local communities have knowledge of plants having ecological, economic, medical and cultural benefits. The knowledge is inherited from generation to generation through word of mouth. Local communities have a tradition in managing, utilizing and protecting local plants wisely. Ethnobotany studies the relationship between human’s culture and local plants’ use. Plants can be used as food, fabric, natural dye, medicine, and materials for cultural and religious rituals (Mathias 2004; Kim 2007).

Martin (2001) defined ethnobotany as a study of the utilization and preservation of plants by local society. Hun (2007) stated that ethnobotany studies the use of leaves, flowers, roots, barks, fruits and resin as herbal medicine. Ethnobotany is a study of the relationship between human and plant and the use of plant in society, technological manipulation, nomenclature, and agricultural system (Richard 2008). Ethnobotany helps to clarify the differences between how society utilizes forest products and preserves the nature (Sara et al. 2009). Hurrell and Albuquerque and de Medeiros (2013) stated that ethnobotany study leads to ecological system and plant as a

religious symbol in every culture. Therefore, based on the definition of ethnobotany, study on the utilization of plants by human to fulfill their need such as food, health and culture is an important study in ethnobotany science and it has been going on for long.

Local society uses plants in their surrounding area to fulfill their necessities. Plants used by local society as food is always an important component in providing vitamins and nutrition for their bodies, such as vitamin C, A, calcium, and fiber (Arnason et al. 1981; Kuhnlein and Turner 1991; Marles et al. 2000). Plants also play a crucial role in a cultural society since they are used in traditional healing treatment. The society takes advantage of plants to fix bones’ injury and other general health complaints. Wild plants consumed by local society come from various types of plant, such as trees, bushes, ferns, mosses or fungus. Local society has holistic approaches to healing various diseases, which are physical and emotional approaches. Cultural values, beliefs, and rituals, as well as the roles of family and other society members are the components needed to support the healing process (Andre et al. 2006). Ethnobotany can be used as a tool to document local society knowledge of the use of plants. People in villages

have been benefited from plants to support their living. Various plants are used for food, medicine, building materials, traditional ceremonies, culture, dye, and so on. All society groups in compliance with their area characteristics and custom has a dependency on various plants at least for food. In this modern era, only hundreds kinds of plant are known as food sources; however, there are thousands of plants used by various ethnic groups worldwide (Uryadarma 2008).

Besides being used in traditional healing treatment, plants also serve as food sources, fabric, materials for construction, sources of energy, dye, fragrances, toxic, decorative or ornament, materials for cultural and religion rituals, medicine, rope/wrap, handicrafts, pesticides, and cosmetics. In addition, they can be used as signs of water resources, natural disaster, and season changes (Tamalene 2015). Local society still uses local plants as the sources of food despite the availability of modern food. Local wisdom and local culture are applied wisely, such as plants are utilized as firewood to boil water and to cook. Even some plants can be used as medicine, dye, and contain nutrition which can fulfill human needs for energy.

One of the local plants being used for years by Tobelo Dalam (Togutil) ethnic group in Halmahera is walnut plant (*Canarium*). The ethnic lives as nomads in conservation forests and takes advantages of *Canarium* as source of food, medicine, and construction. Their local knowledge about plants has been applied and well-preserved for years. Walnut plant has been used as the main source of food (walnut grains), resin, logs, and materials for ceremonial and spiritual activities (McClatchey et al. 2011). *Canarium ovatum* (walnut plant) has long been popular on Halmahera Island in North Maluku province. Recently, the plant has been claimed as endemic to the eastern part of Indonesia. Therefore, local knowledge of *Canarium* needs to be recorded to establish the sustainability of local plants information for the sake of conservation.

Canarium is Burseraceae family, and it is a common plant in Indonesia. It exists in other countries as well, such as Africa, South Nigeria, Madagascar, South China, India, Philippine, and Southern part of Asia (Antanionius 2014). The genus *Canarium* contains approximately 77 species. Those species are spread in tropical area of Africa and Indo-Malaysia (Monteiro et al. 2006). *Canarium vulgare* is a native plant of East Malaysia, Papua, Papua New Guinea (Morobe), Alor, Nusa Tenggara Timur (Sunda Kecil Islands) and Moluccas (endemic to Ambon). *Canarium* can also be found in India, Sri Lanka and other tropical places. *C. indicum* is the famous species in Indonesia and grows well in the area of eastern Indonesia, such as Maluku and Southeast Sulawesi (Coronel 1996). Not only in Indonesia but *canarium* is also planted and spread in various Asian countries such as Malaysia, Thailand and Philippine. Philippine is a country that mostly cultivates *Canarium ovatum* Engl (Chaplin and Poa 1988). Walnut is rich in bioactive compound having high contribution in human health. Compounds containing in walnut are able to reduce generative diseases such as, cholesterol, hypertension, Diabetes, and cataract. Bioactive compounds containing in walnut fruits or seeds are phenolic, carotenoid, phytosterol,

and tocopherol. The concentration of the compounds depends primarily on the variety and age of fruits and seeds (Djarkasi et al. 2011). The tree bark of local *Canarium* can be used for construction materials and musical instruments (Tesoro and Aday 1990). Walnut plant is beneficial for health and has high economic use value particularly for its seed that processed to be eaten and sold (Roberto 1996). The plant produces 4.5 ton of seeds per year (Thompson and Evans 2014).

Canarium, which has been utilized by various local ethnic groups for years, is a local knowledge worth knowing. This can give significant contribution to sustainable development in the future. To reach this ideal condition of development, however, support from ethnic groups who live in a particular place, either they are categorized as modern, traditional, or remote, is a necessity. Mostly, local communities who live in the village have maintained genetic resources in their areas. They have cultivated local plants to maintain a sustainable biodiversity for thousands of years. It has been proven that these practices can improve and promote biodiversity locally and can help keep the ecosystem healthy and balanced. Nevertheless, the contribution of local society in preserving and sustaining biodiversity is beyond their roles as the manager of natural resources. Their skills and techniques give invaluable information for a global community. The availability of local food in natural ecosystem has been unable to fulfill the inhabitants' needs. Changes have been brought to the ecosystem by human. Therefore, local biodiversity needs to be preserved to prevent it from extinction. Ethnobotanical study on *Canarium* (walnuts) in Halmahera is one of the efforts to reveal economic, ecological, medical, and cultural benefits of the plants. The results of this study is expected to give a contribution to the development of science and technology as well as to explore the potentials of tropical plants found in Halmahera Island in Indonesia and further to be used as the foundation of sustainable conservation in empowering local community in Halmahera.

MATERIALS AND METHODS

Study area

Data of this ethnobotanical study were collected in April 2014-April 2015, from Halmahera Island (Tobelo, Akelamo Pumlanga, Tayawi), Indonesia. Figure 1 shows map of the study area. Surveys were done in the areas that chosen based on its accessibility and availability of the remote ethnic group of Tobelo Dalam (Togutil). The surveys were done to gain information about the use of walnut plants. In-depth interviews were conducted to 57 local informants (36 males and 21 females). The informants were grouped based on their age: 14 children (5-11 years), 18 teenagers (12-25 years), 13 adults (26-45 years), 9 elder (46-65 years) and 3 oldage (65 years).

Data were collected from three groups of informants: main informants, key informants, and recommended informants. Main informants were chosen through purposive sampling technique; whereas, the last two groups

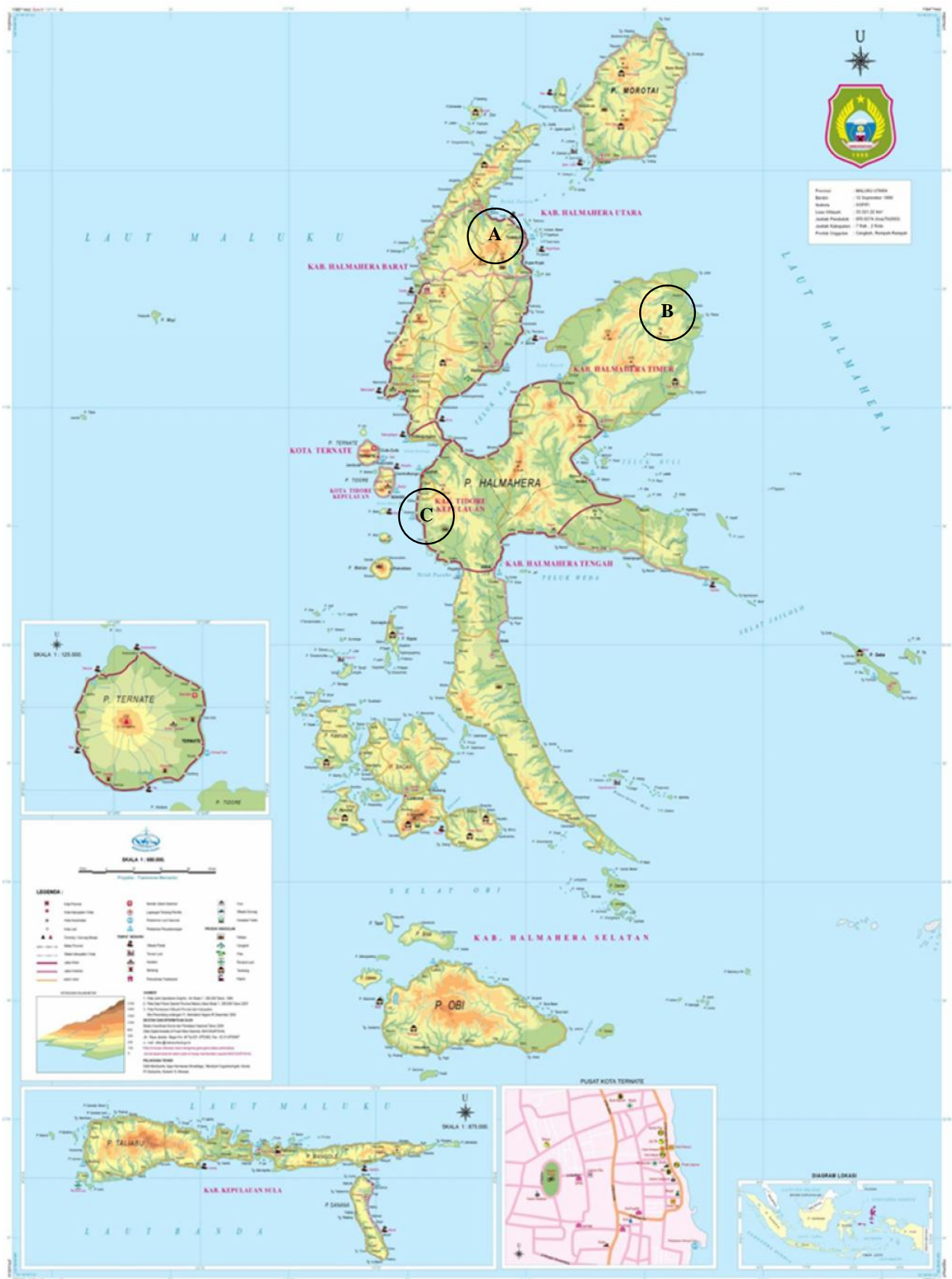


Figure 1. Location of the study conducted in Halmahera, North Maluku Province, Indonesia: A. Tobelo, B. Akelamo Pumlanga, C. Tayawi

of informants were chosen through snowball sampling technique. Information obtained from the main informants determined the presence of other informants and this technique was done continuously until homogenous data was able to answer the research problems. There were three main informants who are the areas' chieftains. However, there was no specific number of key informants and recommended informants since they were determined only to complement the data based on the purpose of this study. Data of this study were collected from interviews with "work in the wood" method to find out types of *Canarium* plants used by the Tobelo Dalam (Togutil) ethnic group.

Data analysis

Descriptive statistical analysis was employed to determine which parts of plants mostly used in relation to their benefits observed from economic, ecological, medical, and cultural aspects.

The frequency of parts of *Canarium* plants used was evaluated through the level of participants' responses based on parts of plant using the following formula:

$$F = (S/N) * 100;$$

S: number of informants who provided positive responses towards the parts of plants used; N: number of informants. Formula explained by Monteiro et al. (2006) was used to recognize the agreement level among the informants on which parts of plants used as well as how to utilize them.

Fidelity level (FL) which was measured to know the specific purpose of using particular parts of plants was calculated using the formula suggested by Friedman et al. (1986):

$$FL (\%) = (n/N) * 100$$

Where n is the number of informants for a specific use, and N is total number of informants.

RESULTS AND DISCUSSION

There were three species of *Canarium* used by community of Tobelo Dalam (Togutil) ethnic i.e.: *Canarium decumanum* (Figure 2), *C. indicum* (Figure 3), and *C. vulgare* (Figure 4). The local name of *Canarium* is *Hiburu*. The fruit flesh (Seed kernel [Cotyledons]) of *C. decumanum* and *C. vulgare* is fairly thick. *C. indicum* is smaller with grayish yellow exocarp and white fruit flesh (mesocarp). The surface of inner skin of *C. decumanum* is uneven; whereas *C. indicum* and *C. vulgare* has smooth and even surface. The three species have 2-3 seeds (endocarp). *Canarium* fruit contained oil used for health such as for massage therapy, aromatherapy therapy, and cosmetic materials. The wood could be used as materials for house construction. Tree trunk of *Canarium* is upright and gray. The tree bark releases resin when it peeled. The resin is white and sticky at first and then it turns into pale yellow. The resin has soft texture, whitish color and

aromatic odor (Figure 5A, B and). The three are fruiting in March to November. The fruit of *C. decumanum*, *C. indicum* and *C. vulgare* has seeds encased in hard shell (endocarp) with flesh that can be eaten raw. The oil contained in the seed could be extracted as a substitute for coconut oil. The hard skin of *Canarium* was used as fuel to substitute firewood. Tree trunk of *C. decumanum*, *C. indicum* and *C. vulgare* species was used for house construction, and the leaves were boiled for traditional medicine to expedite menstruation in women.

Ethnobotanical uses of *Canarium* species

The result of frequency analysis (F) on *Canarium* related to its use showed that Tobelo Dalam (Togutil) ethnic group use *Canarium* for economic, ecological, health and cultural reasons. The values of F observed from the economic use aspects of *Canarium* include; (i) construction materials, (ii) food sources and (iii) medicine. Knowledge of economic values of *Canarium* as construction materials was found in 15.78% of children, 83.33% of teenagers, 100% of adults, elder, and old age. In general, all groups of age use *Canarium* as food sources (100%). *Canarium* was also sold as medicine to the local community. Knowledge of the use of *Canarium* as medicine to support the economy of Tobelo Dalam (Togutil) ethnic group was found in 42.85% of children, 66.66% of teenagers, and 100% of adults, elder, and old age (Figure 6).

Canarium is also functioned to save water, preserve animals habitat, and prevent flood. Tobelo Dalam (Togutil) ethnic group had knowledge of *Canarium* observed from the ecological aspect. The result of frequency (F) analysis on knowledge of how *Canarium* can be used to preserve water is as follows; 35.71% of children, and 100% of teenagers, adults, elder, and old age. Knowledge of how *Canarium* can be used to preserve animal's habitat was found in 78.57% of children and 100% of teenagers, adults, elder, and old age. Whereas, knowledge of how it can prevent flood was found in 35.71% of children, 88.88% of teenagers, and 100% of adults, elder and old age (Figure 7).

Canarium is beneficial for health especially as aromatherapy oil, massage oil, and cosmetics. Knowledge of this health function was found in 15.78% of children, 100% of adults, elder, and old age. There were 71.42% of children and 100% of teenagers, adults, elder, and old age who had knowledge about *Canarium* functioned as massage oil. Whereas, there were 14.28% of children, 61.11% of teenagers, 46.15% of adults, 33.33% of elder and 66.66% of old age who had knowledge of *Canarium* functioned as cosmetics (Figure 8).

Ethnobotanical use of *Canarium* as materials for religious rituals was found in 14.28% of children, 61.11% of teenagers, 46.15% of adults, 33.33% of elder, and 66.66% of old age. While knowledge of *Canarium* used in cultural rituals was found in 35.71% of children, 100% of teenagers, adults, elder, and old age.

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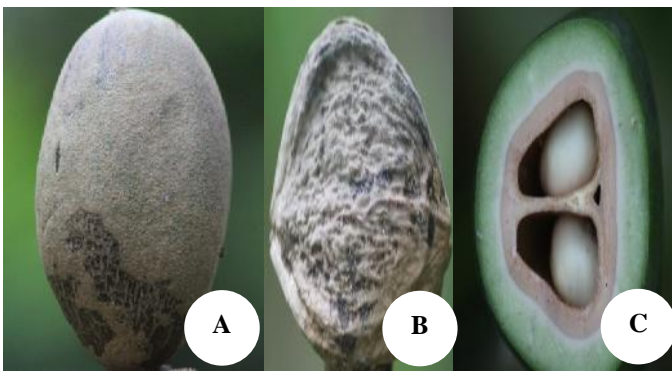


Figure 2. *Canarium decumanum*. A. Fruit, B. Seed, C. Cross section of fruit (with seed kernel or cotyledons)

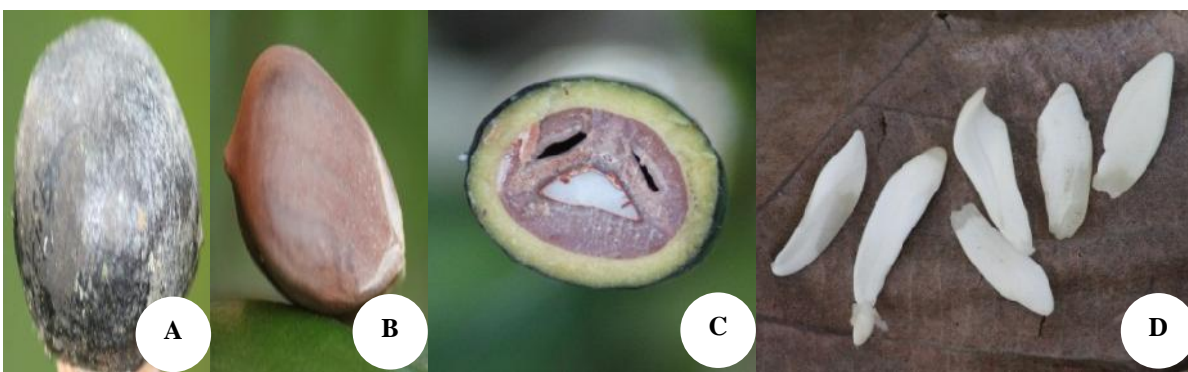


Figure 3. *Canarium indicum*. A. Fruit, B. Seed, C. Cross section of fruit, D. Seed kernel (cotyledons)



Figure 4. *Canarium vulgare*. A. Seed, B. Nuts (seed coat), C. Cross section of fruit, D. Seed kernel (cotyledons)

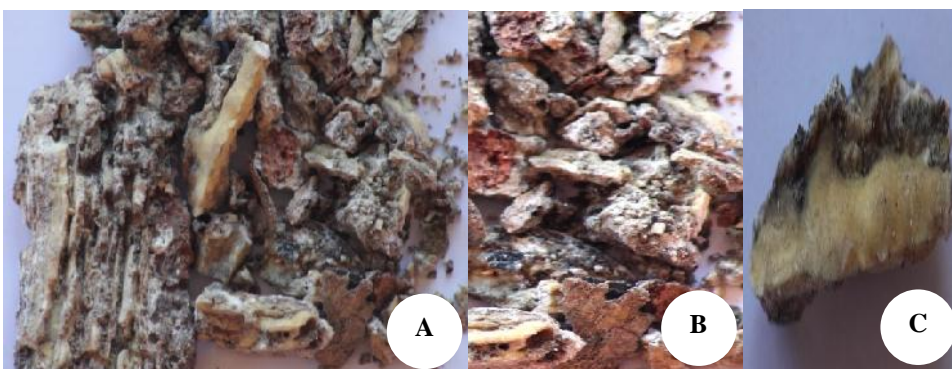


Figure 5. A. Resin of *Canarium indicum*, B. Resin of *C. vulgare*, C. Resin of *C. decumanum*

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Local knowledge of *Canarium* parts' functions

Tobelo Dalam (Togutil) ethnic group use *Canarium* parts: fruit, skin exocarp, shell endocarp, bark, sop, root, and stem, to fulfill their daily needs. Parts of *Canarium* plants give direct benefit to the people because they have high use-value observed from the economic, ecological (such as for water reserve, animal habitat and to prevent flood), medical, and cultural aspects. The result of fidelity level (FL) analysis (Figure 10) proves that all age groups had 100% of FL in utilizing *Canarium* as local food source.

The FL of skin exocarp use can be described as follows: 28.57% among children, 77.77% among teenagers, 69.23% among adults, 100% among elder and old age. The FL of

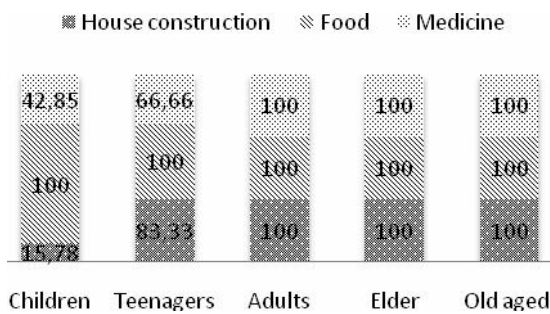


Figure 6. Ethnobotanical use of *Canarium* in economy based on age groups

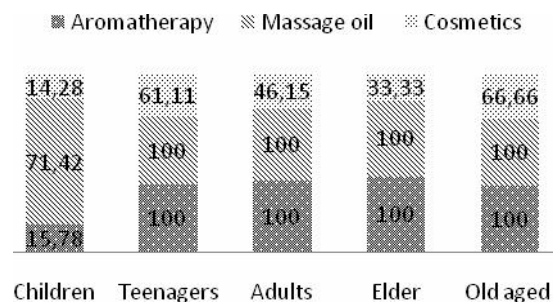


Figure 8. Ethnobotanical use of *Canarium* in medicine based on age groups

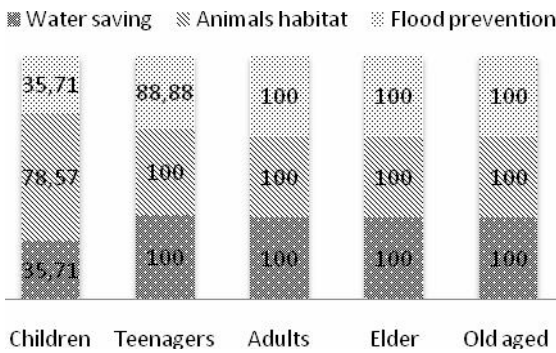


Figure 7. Ethnobotanical use of *Canarium* in ecology based on age groups

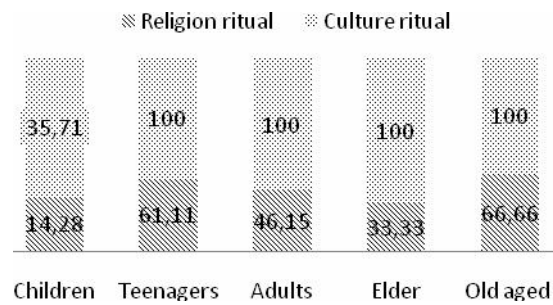


Figure 9. Ethnobotanical use of *Canarium* in rituals based on age groups

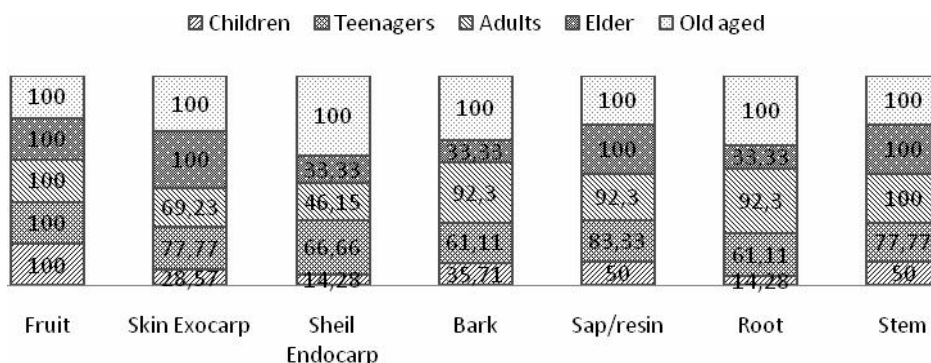


Figure 10. Fidelity Level (FL) of ethnobotanical use of *Canarium*

shell endocarp used can be described as follows: 14.28% among children, 66.66% among teenagers, 46.15% among adults, 33.33% among elder and 100% old age. The FL of *Canarium* bark used is described as follows: 35.71% among children, 61.11% among teenagers, 92.3% among adults, 33.33% among elder and 100% among old age. The FL values of sap/resin and roots part among group age were as follows: children (resin: 50%, roots: 14.28%), teenager (resin: 83.33%, roots: 61.11%), adults (resin and roots: 92.3%), elder (resin: 100%, roots: 33.33%), old age (resin and roots: 100%). The last is that FL of *Canarium* trunk can be described as follows: 50% of children, 77.77% of teenagers, and 100% of adults, elder, and old age. This study had depicted that walnut plants were beneficial and they had high use-value. Each part of the plants served many advantages to local people. All parts of the plants (root, wood, bark, sap) were exploited to fulfill the economic, health, and culture needs.

The results of the study revealed that children, teenagers, adults, elder, and old age had local knowledge of *Canarium* use-value and the knowledge had been preserved up to now. In every generation, the knowledge was obtained through direct experiences without having to attend any formal education. Local knowledge had been perceived as a system built on some subsystems that need one another. One of the subsystems' important components was humans. They, therefore, play role in protecting local resources especially plants that gave direct benefit to them. The overview of local knowledge of *Canarium* is illustrated by Figure 11.

Discussion

Based on the study result, it can be concluded that Tobelo Dalam (Togutil) ethnic group knew that *Canarium* plants are multifunctional in the aspect of economy, ecology, health, and culture. Therefore, they protect the plants through *ex situ* conservation. In addition, it is recommended for pregnant women to consume the *Canarium* fruit. It is believed that the fruit can keep the babies healthy when they are still in their mother's wombs. Roposi (1994) reported that *Canarium indicum* contains protein 14.2 g/100g, carbohydrate 5.5g/100g, calcium 119 mg/100g, and oil 74.9g/100mg. *Canarium* fruit or root can be used as sources of energy since they contain nutrition and vitamins (Terashima and Ichikawa 2003). *Canarium* fruit has become traditional food for local people for thousand years (Wissink 1994). The fruit is eaten raw to boost their energy (Smith 1991).

Henderson (1994) recorded that the economic use-value of *Canarium* could improve the consistent prosperity of local community through conservation. *Canarium* has the potential to increase income of local people by selling *Canarium* fruit products and producing oil for cosmetic industries (Varghese and Ticktin 2008; Pauku 2010). *Canarium* wood can be used as materials for home framing and musical instrumentals (Tesoro and Aday 1990; Menna et al. 2012). The wood can also be used to make key holders that very attractive and popular among local and international tourists in Indonesia (Gonzalez and Bunoan 1947; Coronel 1966). Resin powder is given orally

to treat rheumatism, fever, cough, asthma, epilepsy, chronic skin disorders, syphilis, and hernia and also helps to improve skin (Meena et al. 2012). *Canarium* species are used extensively in the application of traditional medicine to treat bronchitis, catarrh, extreme coughing, aged, damaged or Injured skin and generalized stress (Schwab 2007). Walnut contains phenolic compounds from different chemical properties, including flavonoids, phenolic acids and tannins (Djarkasi et al. 2011). *Canarium indicum* has brought very useful value to society. *Canarium* can be used as food products that can be consumed, *Canarium* fruits contain fiber, and they can be used as fuel, or a pole house, and drugs. Resin powder is beneficial to cure rheumatic, fever, cough, asthma, epilepsy, skin chronic disturbance, syphilis, hernia and help to improve skin (Augustine and Krishnan 2006). In addition, *Canarium* species is also functioned for soil stabilization (Evans 1999; Elevitch 2006).

Remote tribe living in the forest area in Halmahera island-Indonesia had deep knowledge of source of native plants. Most of native fruits were collected from the forest. Fruits of wild plants such as *Canarium* were their everyday food; its fruit is an exotic fruit in Halmahera Island. *Canarium* is the most preferred fruit by children, teenagers, adults, the elderly, and seniors. Commercialization of walnut was carried out by certain groups to supplement their family income. *Canarium* is a local plant, which has an important role in the regeneration of forest vegetation on the Halmahera Island. Local ecological knowledge of Tobelo Dalam (Togutil) related to *Canarium* conservation could positively affect local biodiversity. Furusawa et al. (2014) reported that behaviors, such as giving respect to forest reserves and semi-domestication of some species can contribute to the effort of preserving local biodiversity especially local endemic species. *Canarium* plant also serves ecologically to withstand high winds (Tesoro and Aday 1990).

Canarium fruits were used by Tobelo Dalam (Togutil) as skin protection. This fruit has long been exploited for aromatherapy, cosmetics and massage products. The resin is used for dry skin (Athar and Nasir 2005). The resin is used differently to coat the ship, make a torch and tonic (Bradshaw 2013). *Canarium* species are functioned as panacea (panacea of witchcraft, cough) (Jiofack et al. 2009). *Canarium* resin is used as incense in religion and cultural ceremony (Augustine 2006). *Canarium* species is used by local people as food source (the seed), resin, and wood which can be used in healing ceremony, religion ceremony, rituals and wars (McClatchy et al. 2006). Local people use *Canarium* resin for prayer rituals (Varghese and Ticktin 2008).

This study has provided crucial information about ethnobotanical knowledge of Tobelo Dalam (Togutil) ethnic group found in Halmahera, Indonesia. *Canarium decumanum*, *C. indicum* and *C. vulgare* had been used economically, ecologically, medically, and culturally. It means that the plants are multifunctional. Local knowledge of *Canarium* by the age group showed that the elder and

the old aged had the highest level of knowledge in the use of *Canarium*. Children, teenagers, and adults knew the

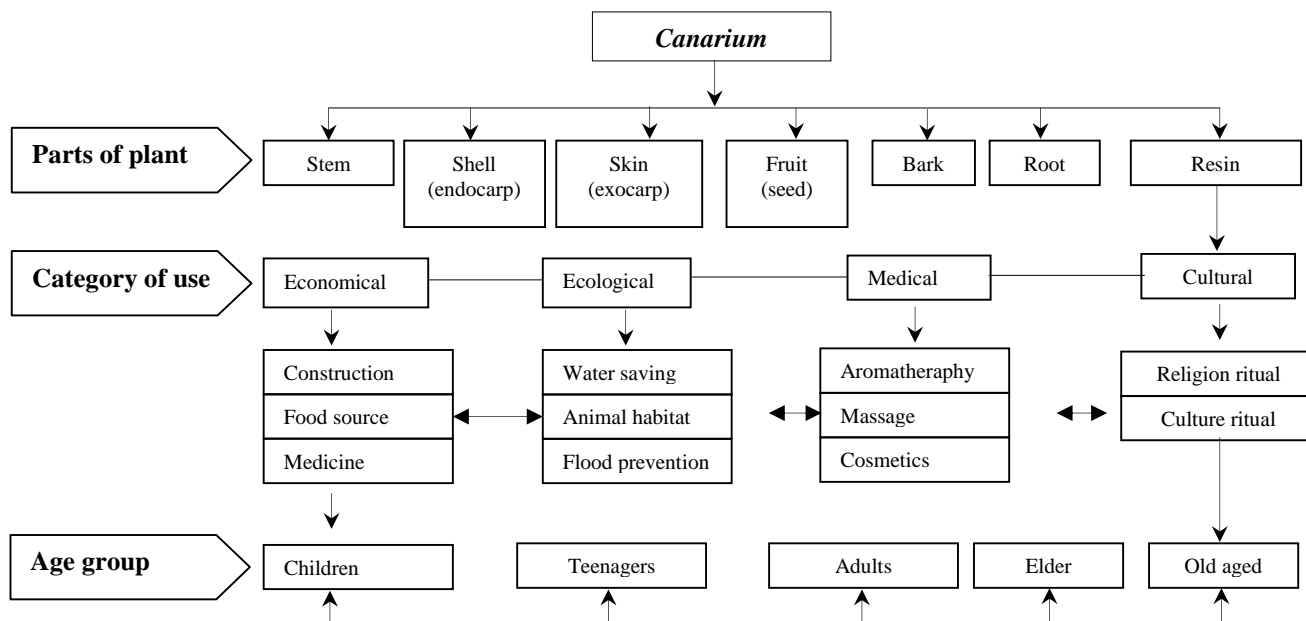


Figure 11. Local knowledge of *Canarium* use in Tobelo Dalam (Togutil) ethnic group

benefits of *Canarium* from everyday life experience gained from the elder and the old age. Socio-cultural study helped to promote *Canarium* species as one of the plants that has high use value for local communities. This study contributes to the development of science and technology as well as explores the potential of tropical plants on the Halmahera Island, Indonesia that will serve as the basis for sustainable conservation to empower local communities.

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