Ethnobotanical study based on the five dimensions of basic life needs in Tidung Tribe of North Kalimantan, Indonesia

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Abstract. Suciyati A, Suryadarma IGP, Paidi Abrori FM. 2021. Ethnobotanical study based on the five dimensions of basic life needs in Tidung Tribe of North Kalimantan, Indonesia. Biodiversitas 22: 3199-3208. The Tidung tribe is one of the original inhabitants of North Kalimantan, Indonesia. Research results related to the Tidung tribe, especially those related to ethnobotany, are still rare. This research aimed to make an inventory of plant species used by Tidung Tribe based on the five dimensions of basic life needs of Tidung Tribe. The five dimensions of basic life needs of Tidung Tribe is that plants are useful as food (ngakan), shelter (baloy), health/medicine (sihat), traditional ceremony (adat), and clothing (memana). Informants were obtained by conducting snowball sampling consisting of 22 family heads and as many as 65 people. There were three instruments in the data collection: questionnaires of list of plant species, quantitative plant assessment instruments, and semi-structured interviews. According to the inventory result, Tidung Tribe utilize 60 plant species in their daily life. Most of these plants are used as food (ngakan) and traditional medicine (sihat). The Availability Index and Frequency Use Index data showed that Arecaceae, Pandanaceae, Solanaceae, Zingiberaceae, and Poaceae families were the most widely available plants in the research location and most often used by the community.

Keywords: biodiversity conservation, Indonesia, local ecological knowledge, quantitative ethnobotany, Tidung Tribe

Abbreviations: AI: Availability Index, FUI: Frequency Use of Index, PUI: Part Used of Index

INTRODUCTION

Indonesia, having many ethnic groups and ecosystem types, is rich in natural and cultural resources (Suryadarma 2019). There are at least 633 ethnic groups consisting of 1331 tribes in Indonesia (Ananta et al. 2014; BPS 2012). Each tribe in Indonesia has a certain perspective on the use of natural resources, especially plants. Several cultures related to the uses of plants have been documented in some ethnobiological studies.

Ethnobiology is expected to have capability to deal with the ecological and humanitarian crises in the 21st century. Biocultural heritage can contribute to a local innovation process that will meet community needs (Davidson-Hunt et al. 2012; Hidayati et al. 2015). The biocultural concept in ethnobiological research has been carried out by many researchers, such as Maffi (2007), Cocks (2010), Sterling et al. (2010), and Rotherham (2015).

Indonesia as a multicultural country has multi-biodiversity characteristics (Simbiak et al. 2019). Every ethnic group in Indonesia has a biocultural heritage that needs to be explored to encourage the creation of a local innovation process. The plant diversity used by Tidung tribe in North Kalimantan is still rarely researched, and is still difficult to find literature on the use of plants by the Tidung Tribe. Several studies related to ethnobiology, especially ethnobotany in the Tidung tribe, have been carried out in several areas, namely: Tarakan, Sembakung, and Bulungan. Ethnobiological studies carried out were the use of herbs and spices and the use of medicinal plants for traditional ceremonies (Lesmana et al. 2018; Listiani and Abrori 2019).

There is a link between the use of natural resources and the social system as a unique cultural feature of the local community (Suryadarma 2011). Tidung Tribe has a lifestyle in which many plant species are used for food (ngakan), shelter/construction (baloy), health/medicine (sihat), traditional ceremony (adat), and clothing (memana). Tidung Tribe implements this lifestyle to optimize the use of natural sources. Therefore, they make each part of the plants as useful as possible for daily needs. People’s reliance on different plant species allows them to sustain their livelihood and meet their different material and non-material needs.

Ethnobotany studies have been done in several areas where the Tidung Tribe lives, but no ethnobotany studies have been conducted in other areas where the largest Tidung Tribe communities live, one of which is Tana Tidung District. Therefore, this research was done in Tana Tidung District with the objectives of documenting: (i) the species of plants used by the Tidung tribe based on the five dimensions of their basic needs, (ii) the availability of these...
plants in nature (based on AI values), (iii) the frequency of these plant used by the Tidung tribe (based on the FUI value), (iv) the plant parts of each species used (based on the PUI value).

MATERIALS AND METHODS

Study area

Tana Tidung District is located at 30° 12’ 02” - 30° 46’ 41” N, 116° 42’ 50” - 117° 49’ 50” E. Tana Tidung District is one of the regencies in North Kalimantan bordering with Nunukan (on the north), Tarakan (on the east), Bulungan (on the south) and Malinau (on the west). Tana Tidung District has an area of 4,828.58 Km² and consists of five sub-districts: Sesayap, Sesayap Ilir, Betayau, Muruk Rian, and Tana Lia (Tana Tidung District Government 2012).

Tana Tidung District is crossed by three large rivers (Figure 1), namely Kayan River (576 Km), Bandan River (70 Km), and Sesayap River (278 Km) (Tana Tidung District Government 2015). Tana Tidung District is located at altitudes between 250 m and 2000 m. There is a steep plateau overgrown with wilderness, hills, and mountains with altitudes of ± 500 - 2000 m. Tana Tidung District has several islands flowed by dozens of large rivers and small rivers. The islands have hilly terrain, with steep cliffs and sharp slopes.

Data collection

The research was conducted from December 2019 to October 2020. Data about the use of plants in the Tidung tribe consisting of the usefulness in food consumption (ngakan), shelter/construction (baloy), herbal medicine (sihat), traditional ceremonies (adat), and clothing (memana) were gathered from 65 informants from 22 families, selected using snowball sampling technique. The informants have experience in using plants based on the life philosophy of Tidung Tribe. Snowball started with data collection from traditional leaders, traditional medicine practitioners, fishermen, carpenters, farmers and local residents to serve as respondents. The snowball process was considered complete after the data obtained were saturated.

There were three instruments used in the data collection namely questionnaires of list of plant species, quantitative plant assessment instruments, and semi-structured interviews. Quantitative plant assessment was conducted to measure society’s perception related to the plants in the form of numbers. The assessor refers to Pieroni’s instrument (2001). Values measured were Availability Index (AI) (Table 1), Frequency Use Index (FUI) (Table 2), and Part Used Index (PUI) (Table 3). AI describes the availability of plants based on resident’s perceptions. FUI describes the frequency of plant utilization per time. PUI describes various uses of various parts of similar plants.

The last data collection instrument was semi-structured interviews to record how the informants knew plants used in daily life. The main questions being asked were: (i) how do you use the plants? (ii) how often do you use the plants in your daily activities? (iii) which parts of plants are used? Interviews were conducted to: (i) get a list of plant names, and (ii) obtain information about the availability, use frequency, and parts of plants used. From these data, quantitative indexes (AI, FUI, PUI) were calculated.

Figure 1. Location of Tana Tidung District, North Kalimantan, Indonesia
Table 1. AI categorization

| Availability            | Index value |
|-------------------------|-------------|
| Very many               | 4.0         |
| Many                    | 3.0         |
| Average                 | 2.0         |
| Rare / endangered       | 1.0         |

| Localization of usage   | Index value |
|-------------------------|-------------|
| Everywhere              | =           |
| Limited                 | -0.5        |
| Very limited            | -1.0        |

Table 2. FUI categorization

| Usage frequency                  | Index value |
|----------------------------------|-------------|
| > once/week                      | 5.0         |
| Once/week                        | 4.0         |
| Once/month                       | 3.0         |
| > once/year < once/ month        | 2.0         |
| Once/year                        | 1.0         |
| Have never been used over the last 30 years | 0.5 |

Table 3. PUI categorization

| Usage frequency                      | Index value |
|--------------------------------------|-------------|
| Bark                                 | 1.0         |
| Root or rootstock                    | 1.5         |
| Root, young part                     | 1.0         |
| Tuber                                | 1.5         |
| Trunk                                | 1.0         |
| Leaf                                 | 1.5         |
| Leaf Stalk                           | 1.0         |
| Young leaf                           | 1.0         |
| Leaf with a little part of trunk     | 2.0         |
| Sprout                               | 1.25        |
| Sprout, young part                   | 0.75        |
| Bud                                  | 0.75        |
| Flower                               | 0.75        |
| Receptacle                           | 0.75        |
| Fruit                                | 1.5         |
| Seed                                 | 1.0         |
| All parts                            | 3.0         |
| All parts of young plants            | 2.0         |

Data analysis

The data obtained were analyzed qualitatively using tabulations. The species data and plant parts used by the Tidung tribe are presented in the table including the scientific name of the species, local names, and functions. The plant part data used were analyzed descriptively using percentages. AI, FUI and PUI data were obtained based on the results of interviews and were analyzed descriptively using tabulations.

RESULTS AND DISCUSSION

Plant species used by Tidung Tribe

The Tidung Tribe used as many as 60 plant species for food consumption (ngakan), shelter/construction (baloy), herbal medicine (sihat), traditional ceremonies (adat), and clothing (memana) (Table 4).

Most of the plants (33 species) have more than one function in the life of Tidung Tribe. The largest usage of those plants is for food (ngakan), 28 species, and traditional medicine (sihat), 24 species. The data show that Tidung Tribe still implements traditional herbal medication. Meanwhile, there are 23 species of plants for traditional ceremonies (adat), 21 species of plants for construction (baloy), and 5 species of plants for clothing (memana). A shift in the usage of plants for clothing has been happening for quite some time. Tidung Tribe currently uses ready-made materials for clothing. In general, plants used are limited to producing clothing or woven as raw materials for making traditional caps. The number of species and the illustration of plant usage distribution in the life of Tidung Tribe are presented in Figure 2.

Food and medicine

Tidung Tribe has variations in food processing both in terms of selecting basic ingredients, seasoning, spices, and condiments. The basic spices used in most Tidung Tribe dishes are shallots and garlic. Ginger, turmeric, and limes are often used to reduce fishy taste, especially in seafood dishes. *Alpinia galanga*, *Syzygium polyanthum*, *Coriandrum sativum*, and *Kaempferia galanga* are also often added to various types of dishes for flavor enhancement. Plant usage as food and traditional medication is essential for society’s life. Investigation of knowledge about food and medicinal plants in a particular community and area is an important part of ethnobotany research (Haselmair 2014). People always take advantage of biodiversity especially plants as important food ingredients. Pierroni et al. (2016) state that biodiversity and food diversity are naturally connected. Thus, each food in different ethnic groups and areas has its own characteristics (Kuhnlein 2014; Kalle and Sõukand 2015).

Figure 2. Plant usage distribution by Tidung Tribe
Table 4. Plant species used by Tidung Tribe

| Species                     | Local name       | Function                                      | Usage (Ng\(^1\), Si\(^2\), Ba\(^3\), Ad\(^4\), Me\(^5\)) and part being used |
|-----------------------------|------------------|-----------------------------------------------|----------------------------------------------------------------------------------|
| Allium cepa L.              | Bawang Lia       | Herbs for food (seasoning), diabetes medication | Tuber (Ng, Si)                                                                   |
| Allium sativum L.           | Bawang Palak     | Food seasoning, warts medication               | Rhizome (Ng, Si)                                                                 |
| Alpinia galanga (L.) Wild.  | Laua             | Spice for food, asthma medication              |                                                                                   |
| Areca catechu L             | Pinang, Gerat    | Skin fungi medication, offering, building material | Fruit (Si, Ad), Trunk (Ba)                                                      |
| Arctocarpus altilis (Parkinson ex F.A.Zorn) Fosberg | Baka, Sukun   | Food, medication for stomach ache              | Fruit (Ng), Rind Trunk (Si)                                                      |
| Bambusa vulgaris var. striata (Lodd. ex Lindl.) Gamble | Bulah Silaw  | Construction material/furniture, offering container | Trunk (Ba, Ad)                                                                    |
| Blumea balsamifera (L.) DC. | Sembung          | Mosquito larvae eradication, postpartum care   | Rind and all parts (Si)                                                          |
| Boehmeria nivea (L.) Gaudich. | Rami             | Fabric/Sack                                    | Trunk (Me)                                                                        |
| Calamus rotang L.           | Rotan            | Offering, wedding decoration                   | Flower (Ad)                                                                       |
| Cananga odorata (Lam.) Hook.f. & Thomson | Kenanga       | Drink, offering                                | Trunk and root (Ba, Ad)                                                          |
| Capsicum annuum L.          | Sabi, Sesula     | Food seasoning, food ingredient                 | Flower (Ng, Si, Ad)                                                              |
| Citrus hystrix DC.          | Limau            | Herbs for food, cure acne                       | Fruit (Ng)                                                                        |
| Clerodendrum calamitosum L. | Kacibling        | Dysentery medication, snake venom medication    | Fruit, trunk, root (Si)                                                          |
| Cocos nucifera L.           | Piasaw           | Ingredient for drink, construction, cure poisoning, and offerings | Fruit (Ng, Si, Ad), Trunk (Ba)                                                   |
| Coffea arabica L.           | Kupi             | Drinks, medication of shortness of breath (leaves part), traditional ceremonies materials | Seed (Ng, Si, Ad) and leaf (Si)                                                   |
| Coriandrum sativum L.       | Ketumbor         | Spices, stomach ache medication                 | Fruit (Ng, Si)                                                                    |
| Davallia sp.                | Pakis Hias       | Wedding decoration                              | Leaf (Ad)                                                                         |
| Diplazium esculentum (Retz.) Sw. | Pakis Sayur   | Vegetable                                       | Young sprout (Ng)                                                                |
| Dipteroecarpus sp.          | Upun Keruung    | Construction material/furniture, offering container | Trunk (Ba, Ad)                                                                    |
| Dryobalanops aromatica C.F.Gaertn. | Upun Kapur    | Construction material/furniture, offering container | Trunk (Ba, Ad)                                                                    |
| Durio katejensis Becc.      | Durian Lia, Duyan Lia | Food ingredient, construction material, fever medication | Fruit (Ng), Wood (Ba), Root (Si)                                                 |
| Dyera costulata (Miq.) Hook.f. | Jelutung        | Building raw material, Furniture                | Trunk (Ba)                                                                        |
| Eusideroxylon zwageri Teijm. & Binn. | Ulin       | Building raw material                           | Trunk (Ba)                                                                        |
| Gigantochloa apus Kurz      | Bulah Betung     | Construction material/furniture, offering container, caping frame | Trunk (Ba, Ad)                                                                    |
| Gigantochloa levis (Blanco) Merr. | Bulah Suluk    | Construction material, offering container       | Trunk (Ba, Ad)                                                                    |
| Helminthostachys zeylanica (L.) Hook. | Tunjak langit | Inflammatory medication                         | Root (Si)                                                                         |
| Jasminum sambac (L.) Aiton   | Busak Melati    | Medicine, bee stings, offering in traditional ceremony | Flower (Si, Ad)                                                                  |
| Kaempferia galanga L.       | Kusar, Kucur    | Herbs, repel mosquitoes, kill mosquito larvae   | Rhizome (Ng, Si)                                                                 |
| Magnolia Champaca (L.) Baill. ex Pierre | Busak Cempaka  | Traditional ceremony                            | Flower (Ad)                                                                       |
| Manihot esculenta Crantz.   | Sabai           | Staple food                                     | Tuber (Ng)                                                                        |
| Metroxylon sagu Rottb.      | Sagu, Rumbia    | Food ingredients, medication of flatulence       | Trunk (Ng, Si)                                                                    |
| Michelia alba D.C.          | Busak Susul Kantil | Offering                                   | Fruit (Ng, Ad)                                                                    |
| Musa × paradisica L.        | Punti Sanggar   | Food ingredient, offering                      | Fruit (Ng, Ad)                                                                    |
| Musa textilis Née           | Punti Ijou      | Food, offering, fabric                         | Fruit (Ng, Ad), Trunk (Me)                                                       |
| Plant Name                     | Use                          | Part Used              |
|-------------------------------|------------------------------|------------------------|
| *Nicotiana tabacum* L.        | Tembakau Offering            | Leaf (Ad)              |
| *Nypa fruticans* Wurmb        | Nipah Food ingredient        | Fruit (Ng), Leaf (Me)  |
| *Oryza sativa* L.             | Padai, Bagas Food ingredient | Pulp (Ng, Si, Ad)      |
| *Oryza sativa* var. *glutinosa* Blanco | Ketan Food ingredient, offering | Pulp (Ng, Ad)          |
| *Pandanus amaryllifolius* Roxb. | Pandan Herbs, medication for dizziness | Leaf (Ng, Si)          |
| *Pandanus tectorius* Parkinson ex Du Roi | Pandan Besar, Pandan Material for wall and hut, material for caping | Leaf (Ba, Me)          |
| *Piper betle* L.              | Buyu Eliminate bad breath    | Leaf (Si)              |
| *Piper crocatum* Ruiz & Pav.  | Kelikit, Buyu Lia Gout medication | Leaf (Si)              |
| *Piper nigrum* L.             | Sahang Herbs                 | Fruit (Ng)             |
| *Rhodomyrtus tomentosa* (Aiton) Hassk. | Perijok, Pelijok Syrup or food mixture | Fruit (Ng)             |
| *Rosa* sp.                    | Busak Mawar Brighten skin, offering | Flower (Si, Ad)        |
| *Shorea almon* Foxw.          | Meranti Buaya Bukit Building raw material, Furniture | Trunk (Ba)             |
| *Shorea balangeran* (Korth.) Burck | Balangeran, Kahoi, Meranti Merah Building raw material, Furniture | Trunk (Ba)             |
| *Shorea coriacea* Burck       | Meranti Jurai, Samar Benua Building raw material, Furniture | Trunk (Ba)             |
| *Shorea fallax* Meijer        | Engkabang Layar, Kontoi Building raw material, Furniture | Trunk (Ba)             |
| *Shorea joheorensis* Foxw     | Merkayung Building raw material, Furniture | Trunk (Ba)             |
| *Shorea laevis* Ridl.         | Bengkirai Building raw material, Furniture | Trunk (Ba)             |
| *Solanum lycopersicum* L.     | Tomat Food                   | Fruit (Ng)             |
| *Swietenia macrophylla*       | Mahoni Furniture materials, a dye for clothes | Trunk (Ba), Bark (Me)  |
| *Syzygium polyanthum* (Wight) Walp. | Salam Herbs for food | Leaves (Ng)            |
| *Tectona grandis* L.f.        | Upun Jati Construction material/furniture, offering container | Trunk (Ba, Ad)         |
| *Uncaria gambir* (Hunter) Roxb. | Gambir Wound medication, offering | Leaf (Si), Flower (Ad) |
| *Vatica oblongifolia* Hook.f. | Resak Gunung Building raw material, Furniture | Trunk (Ba)             |
| *Zingiber montanum* (J.Koenig) Link ex A.Dietr. | Banglai Stamina improvement, kitchen spices | Rhizome (Ng, Si)       |
| *Zingiber officinale* Roscoe  | Layo Spices, warm bodies, cure fever | Rhizome (Ng), Young Rhizome (Si) |

Note: 1Ngakan (food), 2Sihat (herbal medicine), 3Baloy (shelter/construction), 4Adat (traditional ceremonies), 5Memana (clothing)
Different plant parts are used as raw materials for preparation of herbal medicine. The parts can be leaves, roots, flowers, seeds, rhizomes, and tubers. Most of the plants used for food are also used for preparation of medicine. Plants for food and health are interconnected because, basically, healthy plants are traditionally consumed as staple foods, spices, and condiments (Awuchi and Godswill 2019). The Zingiberaceae family (e.g Zingiber officinale, Kaempferia galanga) is most often used, both in cooking and in medicinal properties in the Tidung Tribe. The study of antioxidant activity (Danciu et al. 2015) showed increased polyphenols amount and antioxidant activity in the Zingiberaceae family tested. Not only in the Tidung Tribe, during the Covid 19 pandemic, but Zingiber officinale as an immune-enhancing drink is also increasingly being used in Indonesian society.

The Tidung Tribe has various traditional medicines. Information on the species of plants for traditional medicine of the Tidung Tribe in this study can be the initial information for modern medicine based on indigenous knowledge. Each tribe has a certain knowledge of the use of medicinal plants from the forest. This knowledge is very useful for the development of traditional medicines and the herbal medicine industry. Research on the properties of various species of medicinal plants used by the Tidung Tribe can be interesting as a continuation of the results of this study. The documentation of all useful plants with ethnomedicinal potential is also helpful in conserving plant biodiversity (Kumar et al. 2018).

Traditional ceremonies

The Tidung Tribe also has various traditional ceremonies, one of which is Iraw Tengkayu. This ceremony presents offerings in the form of special food and objects from Tidung Tribe placed and brought to the sea using decorated boats. In Iraw Tengkayu ceremony, plants used as food ingredients are used as offerings in the form of daily diets such as Cocos nucifera, Metroxylon sagu, Musa acuminata × balbisiana, and Oryza sativa var. glutinosa. For decorations purposes, flowers of Jasminum sambac, Michelia alba, Camanga odorata, and Bougainvillea spectabilis are used. In general, plants for decoration have special distinctive colors such as yellow (C. odorata) and purple (B. spectabilis). Meanwhile, plants for offering containers are quite complex. For example, in Iraw Tengkayu ceremony, society makes a boat as the container to place offerings. The plants for boat frames are usually woody plants such as Dipterocarpus sp. and Tectona grandis. In addition, there are also plants for boat masts such as Bambusa vulgaris var. striata, and Gigantochloa apus.

Iraw Tengkayu ceremony symbolizes gratitude by Tidung society to God for the blessing they get from the sea (Sofyan 2017). Traditional ceremonies such as Iraw Tengkayu are also found in other tribes in Indonesia. For example, Sedekah Laut ceremony for the community in Pekalongan, Central Java (Wahyu 2012), and the Mappadensasi ceremony for the Mangal group, North Sulawesi (Alkiasar 2011). The purpose of these traditional ceremonies is almost the same, namely as a form of gratitude and hope for safety and abundant marine products. The plant species used in traditional ceremonies are different, but there is the same species namely rice (Oryza sativa). The use of various species of plants at the Iraw Tengkayu and other traditional ceremonies is in accordance with the statement that plants for traditional ceremonies are divided into three parts: for offerings in the form of food, for decoration in the form of flowers, and for containers of offering (Suswita et al. 2013).

Constructions

Plants species used for construction by Tidung Tribe are quite a lot, at least 21 species. Plants for construction have important roles: as basic building materials, foundation, windows, building walls, and boat making. The characteristics of plants are having hard and durable wood (Ijaz et al. 2017). Trunk is the most used part of plants for construction and other things (Figure 3).

Dipterocarpaceae family is widely used as a house construction material. Most of the Tidung Tribe’s houses in Tana Tidung District are wooden houses (Figure 4a). Eusideroxylon zwageri, which is very strong, has been used as the main wood house frame or wood pillar. However, the species is currently endangered and expensive, Tidung society uses other species for timber, such as Shorea laevis (bengkirai). Areca catechu, which has softer wood, is also used by the Tidung Tribe as a construction material.

Clothing

The last usage is for clothing (memana), which is not limited only to apparel but also accessories. Only a small part of plants is used for this memana group and the plants are only used for craft of traditional caps. Tidung's traditional cap is made from woven nipah leaves (Nypa fruticans) and bamboo sticks (Gigantochloa apus) (Figure 4b). Several plant species were made into fabrics, such as Bohmeria nivea and Musa textilis.

The Tidung tribe has several types of traditional clothing, but in this study, it was not found that the clothes were directly made using the plants around them. In Indonesia, there are many tribes who make traditional clothes using materials from plants that grow in their area. A study conducted by Rahayu & Sihotang (2013) reported 9 species of plants used as clothing by tribes in Indonesia, namely Antiaris toxicaria Lesch., Artocarpus elasticus Reinw. ex Blume, A. integer (Thunb.) Merr., Boehmeria nivea (L.) Gaudich, Broussonetia papyrifera (L.) L’Her. ex Vent., Ficus minahassae (Teijsm. & de Vriese) Miq., F. pungens Reinw. ex Blume, F. variegata Reinw. ex Blume, and Streblus elongatus (Miq.) Corner. Apart from using plant materials for making clothes, the tribes in Indonesia also use various plants for dying fabrics. Rahayu et al (2020) reported 22 species used as fabric dyes and color binders in Traditional Pringgasela Woven Fabric, East Lombok, West Nusa Tenggara, Indonesia. These plants include Anacardium occidentale L., Areca catechu L., Curcuma longa L., Pterocarpus indicus Wild., and others.

The part of plants mostly used by Tidung Tribe is the trunk (32%), followed by fruit/pulp (21%). There are 9 species of plants in Dipterocarpaceae family used by
Tidung Tribe. Meanwhile, fruit/pulp is widely used in daily life, such as foods, medicines, and traditional ceremonies.

**Figure 3.** Percentage of plant parts used by Tidung Tribe

Al, FUI, and PUI

AI, FUI, and PUI assessment of each plant species are described in Table 5. There are 32 plant families. The most widely used families by Tidung Tribe are Dipterocarpaceae (9 species), followed by Poaceae (5 species), Zingiberaceae (4 species), Piperaceae (3 species), Solanaceae (3 species) and other families. Figure 5 shows five families that are mostly used. Several families such as Arecaceae, Pandanaceae, Solanaceae, Zingiberaceae, and Poaceae groups had the highest index values for AI and FUI. This is inversely proportional to Dipterocarpaceae family. Index value of AI and FUI of this family are low. The number of plants with high AI and FUI values indicates that these species in the Tana Tidung District area are quite abundant and often used to fulfill their daily lives. The highest PUI of plant is 3. There is only one plant with the highest PUI value which is Cocos nucifera L. All parts of this plant are used by society. This PUI value illustrates that more species of plants are used only in certain parts.

**Figure 4.** A. One of wooden houses of Tidung tribe with walls made of Shorea laevis. B. A Tidung Tribe wears a traditional cap and brings offerings for traditional ceremonies

**Figure 5.** Five families (out of 32 families) that Tidung Tribe mostly uses

**Figure 6.** Eleven species with the highest AI and FUI values, completed with PUI values
### Table 5. Value Index of AI, FUI, and PUI

| Species                     | Family                  | AI  | FUI | PUI |
|-----------------------------|-------------------------|-----|-----|-----|
| *Allium cepa* L.            | Amaryllidaceae          | 4.0 | 5.0 | 1.5 |
| *Allium sativum* L.         | Amaryllidaceae          | 4.0 | 5.0 | 1.5 |
| *Cananga odorata* (Lam.)    | Annonaceae              | 3.0 | 3.0 | 0.75|
| *Dyera costulata* (Miq.)   | Apocynaceae             | 0.5 | 1.0 | 1.0 |
| *Areca catechu* L.          | Areceae                 | 4.0 | 4.0 | 1.5 |
| *Calamus rotang* L.         |                        | 1.5 | 2.0 | 1.0 |
| *Cocos nucifera* L.         |                        | 4.0 | 5.0 | 3.0 |
| *Metroxylon sagu* Rottb.    |                        | 3.0 | 4.0 | 1.5 |
| *Nypa fruticans* Wurmb      |                        | 3.5 | 2.0 | 3.0 |
| *Diplazium esculentum* (Retz.) | Davalliaceae         | 3.0 | 4.0 | 0.75|
| *Dipterocarpus sp.*         | Dipoterocarpaceae       | 0.5 | 1.0 | 1.0 |
| *Dryobalanops aromatica* C.F.Gaertn. |                | 1.0 | 1.0 | 1.0 |
| *Shorea alomon* Foxw.       |                        | 0.5 | 1.0 | 1.0 |
| *Shorea balangeran* (Korth.) | Burck                  | 0.5 | 1.0 | 1.0 |
| *Shorea coriacea* Burck     |                        | 0.5 | 0.5 | 1.0 |
| *Shorea fallax* Meijer      |                        | 0.5 | 0.5 | 1.0 |
| *Shorea johorensis* Foxw    |                        | 0.5 | 1.0 | 1.0 |
| *Shorea laevis* Ridl.       |                        | 1.0 | 1.0 | 1.0 |
| *Vatica oblongifolia* Hook.f | Euphorbiaceae          | 0.5 | 1.0 | 1.0 |
| *Manihot esculenta* Crantz. | Lamieae                 | 4.0 | 5.0 | 1.5 |
| *Clerodendrum calamitous* L.| Lamiaceae               | 3.0 | 1.0 | 1.5 |
| *Easideroxylon zwageri* Teijsm. & Binn. | Lauraceae    | 0.5 | 1.0 | 1.0 |
| *Magnolia Champaca* (L.) Baill. ex Pierre | Magnoliaceae | 4.0 | 3.0 | 0.75|
| *Michelia alba* D.C.        | Magnoliaceae            | 3.0 | 1.0 | 0.75|
| *Dario kutejensis* Becc.    | Malvaceae               | 1.5 | 2.0 | 1.5 |
| *Swietenia macrophylla*     | Meliaceae               | 1.0 | 2.0 | 1.0 |
| *Artocarpus alt lis* (Parkinson ex F.A.Zorn) Fosberg | Moraceae | 2.0 | 3.0 | 1.5 |
| *Musa x paradisiaca* L.     | Musaceae                | 3.0 | 2.0 | 1.5 |
| *Musa textilis* Née         | Musaceae                | 2.0 | 2.0 | 1.5 |
| *Rhodomyrtus tomentosa* (Aiton) | Myrtaceae            | 1.5 | 2.0 | 1.5 |
| *Syzygium polyanthum* (Wight) | Myrtaceae         | 3.0 | 5.0 | 1.5 |
| *Bougainvillea spectabilis* Willd. | Nyctaginaceae   | 3.0 | 1.0 | 0.75|
| *Jasminum sambac* (L.) Aiton | Oleaceae               | 4.0 | 3.0 | 0.75|
| *Helminthostachys zeylanica* (L.) Hook. | Ophioglossaceae | 2.0 | 2.0 | 1.5 |
| *Pandanus amaryllifolius* Roxb. | Pandanaceae        | 4.0 | 5.0 | 1.5 |
| *Pandanus tectorius* Parkinson ex Du Roi | Pandanaceae | 4.0 | 4.0 | 1.5 |
| *Piper betle* L.            | Piperaceae              | 4.0 | 5.0 | 1.5 |
| *Piper crocatum* Ruiz & Pav. | Poaceae                | 3.0 | 5.0 | 1.5 |
| *Piper nigrum* L.           | Poaceae                | 1.5 | 2.0 | 1.5 |
| *Bambusa vulgaris* var. striata* (Lodd. ex Lindl.) | Poaceae | 3.0 | 2.0 | 1.0 |
| *Gigantochloa apus* Kurz     | Poaceae                | 3.0 | 2.0 | 1.0 |
| *Gigantochloa levis* (Blanco) Merr. | Poaceae            | 4.0 | 3.0 | 1.0 |
| *Oryza sativa* L.           | Poaceae                | 4.0 | 5.0 | 1.5 |
| *Oryza sativa* var. glutinosa Blanco | Poaceae            | 4.0 | 4.0 | 1.5 |
| *Rosa sp.*                  | Rosaceae               | 4.0 | 3.0 | 0.75|
| *Coffea arabica* L.         | Rubiaceae              | 3.0 | 5.0 | 1.0 |
| *Uncaria gambir* (Hunter) Roxb. | Rutaceae            | 3.0 | 2.0 | 1.5 |
| *Citrus hystrix* DC.        | Rutaceae               | 3.0 | 5.0 | 1.5 |
| *Capsicum annuum* L.        | Solanaceae             | 4.0 | 5.0 | 1.5 |
| *Nicotiana tabacum* L.      | Solanaceae             | 2.0 | 2.0 | 1.5 |
| *Solanum lycopersicum* L.   | Solanaceae             | 4.0 | 5.0 | 1.5 |
| *Boehmeria nivea* (L.) Gaudich. | Urticaceae        | 2.0 | 3.0 | 1.0 |
| *Tectona grandis* L.f.      | Verbenaceae            | 2.0 | 1.0 | 1.0 |
| *Alpinia galanga* (L.) Wildl. | Zingiberaceae       | 4.0 | 5.0 | 1.5 |
| *Kaempferia galanga* L.     | Zingiberaceae          | 3.0 | 5.0 | 1.5 |
| *Zingiber montanum* (J.Koenig) Link ex A.Dietr. | Zingiberaceae | 3.0 | 5.0 | 1.5 |
| *Zingiber officinale* Roscoe.| Zingiberaceae          | 4.0 | 5.0 | 1.5 |
Arecaaceae, Pandanaceae, Solanaceae, Zingiberaceae, and Poaceae groups have the highest index value for AI and FUI because these families are the staple food of the community which are generally used in daily activities. Figure 6 shows plot graphic of 11 species with the highest AI and FUI values, completed with FUI values. Families that have low values of AI and FUI are those plants rarely found in nature. This study indicates species in the Dipterocarpaceae family are widely used by the Tidung tribe, especially for building construction, but these species are increasingly rare. For example, *Shorea johorensis* is categorized as Critically Endangered plants (IUCN 2.3) (Ashton, 1998). Other species that have low value of AI are *Eusideroxylon zwageri* (ironwood) and *Dyera costulata* (jelutong wood). *Eusideroxylon zwageri* is categorized Vulnerable Plant (VU) (IUCN 2.3) (Asian Regional Workshop, 1998). It has long been known as a high-quality wood, one of the hardest timber species in Southeast Asia, but its growth rate is very slow and becomes endangered in some parts of Southeast Asia (Komara et al. 2016; Gibson and Rebicca 2016). Based on the AI index that has been compiled in this study, we also need to be aware of species whose existence in nature is increasingly rare. Utilization of biological biodiversity is deep-rooted in every tribe in Indonesian society (von Rintelen 2017), but the conservation of this biodiversity is often very lacking.

Ngakan (eat), baloy (construction), sihat (health/medication), adat (worship and traditional ceremonies), and memana (clothing) in Tidung Tribe represents five aspects that are necessary for human life. Tidung Tribe uses all species of plants in this research to fulfill their basic needs. Various plant species have long played an important role in humanity (Faruque et al. 2018). The various species used by the Tidung Tribe are also local potentials of the Tana Tidung area, constituting the region’s wealth or resources (Suciyati and Yulinda, 2019). North Kalimantan has a variety of natural resources both at sea and on land (Suciyati et al. 2019). Ethnobotanical knowledge has a vital role in managing natural resources (Navia et al. 2020).

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