

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

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Manuscript received: 27 November 2020. Revision accepted: 16 May 2021.

**Abstract.** Suciya A, Suryadarma IGP, Padi 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 21<sup>st</sup> 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, 1160 42' 50" - 1170 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 Km<sup>2</sup> 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  $\pm$  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.

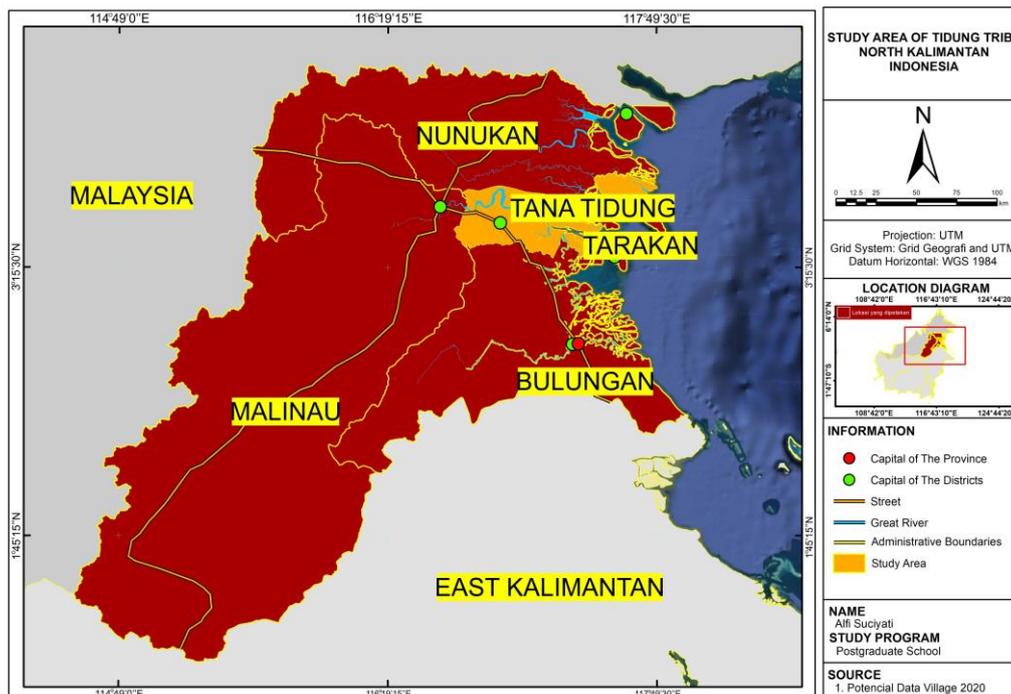
### Data collection

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

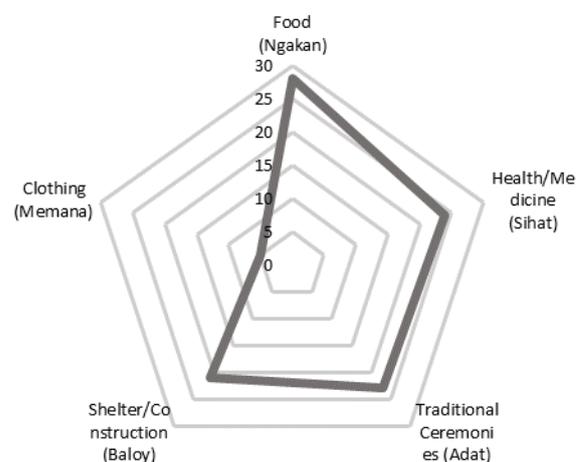
The Tidung Tribe used as many as 60 plant species for food consumption (*ngakan*), shelter/construction (*baloy*),

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 Söukand 2015).

**Figure 2.** Plant usage distribution by Tidung Tribe

**Table 4.** Plant species used by Tidung Tribe

Species	Local name	Function	Usage (Ng <sup>1</sup> , Si <sup>2</sup> , Ba <sup>3</sup> , Ad <sup>4</sup> , Me <sup>5</sup> ) and part being used
<i>Allium cepa</i> L.	<i>Bawang Lia</i>	Herbs for food (seasoning), diabetes medication	Tuber (Ng, Si)
<i>Allium sativum</i> L.	<i>Bawang Pulak</i>	Food seasoning, warts medication	Tuber (Ng, Si)
<i>Alpinia galanga</i> (L.) Willd.	<i>Laus</i>	Spice for food, asthma medication	Rhizome (Ng, Si)
<i>Areca catechu</i> L.	<i>Pinang, Gerat</i>	Skin fungi medication, offering, building material	Fruit (Si, Ad), Trunk (Ba)
<i>Artocarpus altilis</i> (Parkinson ex F.A.Zorn) Fosberg	<i>Baka, Sukun</i>	Food, medication for stomach ache	Fruit (Ng), Rind Trunk (Si)
<i>Bambusa vulgaris</i> var. <i>striata</i> (Lodd. ex Lindl.) Gamble	<i>Buluh Silaw</i>	Construction material/furniture, offering container	Trunk (Ba, Ad)
<i>Blumea balsamifera</i> (L.) DC.	<i>Sembung</i>	Mosquito larvae eradication, postpartum care	Rind and all parts (Si)
<i>Boehmeria nivea</i> (L.) Gaudich.	<i>Rami</i>	Fabric/ Sack	Trunk (Me)
<i>Bougainvillea spectabilis</i> Willd.	<i>Busak Keratos</i>	Offering, wedding decoration	Flower (Ad)
<i>Calamus rotang</i> L.	<i>Rotan</i>	Binding tool, furniture material, offering container	Trunk and root (Ba, Ad)
<i>Cananga odorata</i> (Lam.) Hook.f. & Thomson	<i>Kenanga</i>	Drink, offering	Flower (Ng, Si, Ad)
<i>Capsicum annum</i> L.	<i>Sabi, Sesula</i>	Food seasoning, food ingredient	Fruit (Ng)
<i>Citrus hystrix</i> DC.	<i>Limaw</i>	Herbs for food, cure acne	Leaf, fruit (Ng), Fruit (Si)
<i>Clerodendrum calamitosum</i> L.	<i>Kacibling</i>	Dysentery medication, snake venom medication	Fruit, trunk, root (Si)
<i>Cocos nucifera</i> L.	<i>Piasaw</i>	Ingredient for drink, construction, cure poisoning, and offerings	Fruit (Ng, Si, Ad), Trunk (Ba)
<i>Coffea arabica</i> L.	<i>Kupi</i>	Drinks, medication of shortness of breath (leaves part), traditional ceremonies materials	Seed (Ng, Si, Ad) and leaf (Si)
<i>Coriandrum sativum</i> L.	<i>Ketumbor</i>	Spices, stomach ache medication	Fruit (Ng, Si)
<i>Davallia</i> sp.	<i>Pakis Hias</i>	Wedding decoration	Leaf (Ad)
<i>Diplazium esculentum</i> (Retz.) Sw.	<i>Pakis Sayur</i>	Vegetable	Young sprout (Ng)
<i>Dipterocarpus</i> sp.	<i>Upun Keruing</i>	Construction material/furniture, offering container	Trunk (Ba, Ad)
<i>Dryobalanops aromatica</i> C.F.Gaertn.	<i>Upun Kapur</i>	Construction material/furniture, offering container	Trunk (Ba, Ad)
<i>Durio kutejensis</i> Becc.	<i>Durian Lia, Duyan Lia</i>	Food ingredient, construction material, fever medication	Fruit (Ng), Wood (Ba), Root (Si)
<i>Dyera costulata</i> (Miq.) Hook.f.	<i>Jelutung</i>	Building raw material, Furniture	Trunk (Ba)
<i>Eusideroxylon zwageri</i> Teijsm. & Binn.	<i>Ulin</i>	Building raw material	Trunk (Ba)
<i>Gigantochloa apus</i> Kurz	<i>Buluh Betung</i>	Construction material/furniture, offering container, <i>caping</i> frame	Trunk (Ba, Ad)
<i>Gigantochloa levis</i> (Blanco) Merr.	<i>Buluh Suluk</i>	Construction material, offering container	Trunk (Ba, Ad)
<i>Helminthostachys zeylanica</i> (L.) Hook.	<i>Tunjuk langit</i>	Inflammatory medication	Root (Si)
<i>Jasminum sambac</i> (L.) Aiton	<i>Busak Melati</i>	Medicine, bee stings, offering in traditional ceremony	Flower (Si, Ad)
<i>Kaempferia galanga</i> L.	<i>Kusur, Kucur</i>	Herbs, repel mosquitos, kill mosquito larvae	Rhizome (Ng, Si)
<i>Magnolia Champaca</i> (L.) Baill. ex Pierre	<i>Busak Cempaka</i>	Traditional ceremony	Flower (Ad)
<i>Manihot esculenta</i> Crantz.	<i>Sabai</i>	Staple food	Tuber (Ng)
<i>Metroxylon sagu</i> Rottb.	<i>Sagu, Rumbia</i>	Food ingredients, medication of flatulence	Trunk (Ng, Si)
<i>Michelia alba</i> D.C.	<i>Busak Susul Kantil</i>	Offering	Flower (Ad)
<i>Musa × paradisiaca</i> L.	<i>Punti Sanggar</i>	Food ingredient, offering	Fruit (Ng, Ad)
<i>Musa textilis</i> Néé	<i>Punti Ijou</i>	Food, offering, fabric	Fruit (Ng, Ad), Trunk (Me)

<i>Nicotiana tabacum</i> L.	<i>Tembakau</i>	Offering	Leaf (Ad)
<i>Nypa fruticans</i> Wurm	<i>Nipah</i>	Food ingredient (nira), traditional cap raw material	Fruit (Ng), Leaf (Me)
<i>Oryza sativa</i> L.	<i>Padai, Bagas</i>	Food ingredient, anti-acne powder, offering	Pulp (Ng, Si, Ad)
<i>Oryza sativa</i> var. <i>glutinosa</i> Blanco	<i>Ketan</i>	Food ingredient, offering	Pulp (Ng, Ad)
<i>Pandanus amaryllifolius</i> Roxb.	<i>Pandon</i>	Herbs, medication for dizziness	Leaf (Ng, Si)
<i>Pandanus tectorius</i> Parkinson ex Du Roi	<i>Pandan Besar, Pandan Tikar</i>	Material for wall and hut, material for <i>caping</i>	Leaf (Ba, Me)
<i>Piper betle</i> L.	<i>Buyu</i>	Eliminate bad breath	Leaf (Si)
<i>Piper crocatum</i> Ruiz & Pav.	<i>Kelikit, Buyu Lia</i>	Gout medication	Leaf (Si)
<i>Piper nigrum</i> L.	<i>Sahang</i>	Herbs	Fruit (Ng)
<i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	<i>Perijok, Pelijok</i>	Syrup or food mixture	Fruit (Ng)
<i>Rosa</i> sp.	<i>Busak Mawar</i>	Brighten skin, offering	Flower (Si, Ad)
<i>Shorea almon</i> Foxw.	<i>Meranti Buaya Bukit</i>	Building raw material, Furniture	Trunk (Ba)
<i>Shorea balangeran</i> (Korth.) Burck	<i>Balangeran, Kahoi, Meranti Merah</i>	Building raw material, Furniture	Trunk (Ba)
<i>Shorea coriacea</i> Burck	<i>Meranti Jurai, Samar Benua</i>	Building raw material, Furniture	Trunk (Ba)
<i>Shorea fallax</i> Meijer	<i>Engkabang Layar, Kontoi</i>	Building raw material, Furniture	Trunk (Ba)
<i>Shorea johorensis</i> Foxw	<i>Merkuyung</i>	Building raw material, Furniture	Trunk (Ba)
<i>Shorea laevis</i> Ridl.	<i>Bengkirai</i>	Building raw material, Furniture	Trunk (Ba)
<i>Solanum lycopersicum</i> L.	<i>Tomat</i>	Food	Fruit (Ng)
<i>Swietenia macrophylla</i>	<i>Mahoni</i>	Furniture materials, a dye for clothes	Trunk (Ba), Bark (Me)
<i>Syzygium polyanthum</i> (Wight) Walp.	<i>Salam</i>	Herbs for food	Leaves (Ng)
<i>Tectona grandis</i> L.f.	<i>Upun Jati</i>	Construction material/furniture, offering container	Trunk (Ba, Ad)
<i>Uncaria gambir</i> (Hunter) Roxb.	<i>Gambir</i>	Wound medication, offering	Leaf (Si), Flower (Ad)
<i>Vatica oblongifolia</i> Hook.f	<i>Resak Gunung</i>	Building raw material, Furniture	Trunk (Ba)
<i>Zingiber montanum</i> (J.Koenig) Link ex A.Dietr.	<i>Banglai</i>	Stamina improvement, kitchen spices	Rhizome (Ng, Si)
<i>Zingiber officinale</i> Roscoe.	<i>Layo</i>	Spices, warm bodies, cure fever	Rhizome (Ng), Young Rhizome (Si)

Note: <sup>1</sup>Ngakan (food), <sup>2</sup>Sihat (herbal medicine), <sup>3</sup>Baloy (shelter/construction), <sup>4</sup>Adat (traditional ceremonies), <sup>5</sup>Memana (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 Tengkeyu*. 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 Tengkeyu* 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*, *Cananga 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 Tengkeyu* 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 Tengkeyu* ceremony symbolizes gratitude by Tidung society to God for the blessing they get from the sea (Sofyan 2017). Traditional ceremonies such as *Iraw Tengkeyu* are also found in other tribes in Indonesia. For example, *Sedekah Laut* ceremony for the community in Pekalongan, Central Java (Wahyudi 2012), and the *Mappadensasi* ceremony for the Manggal ethnic group, North Sulawesi (Alkausar 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 Tengkeyu* 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 *Boehmeria nivea* and *Musa textilia*.

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 dyeing 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* Willd., 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.

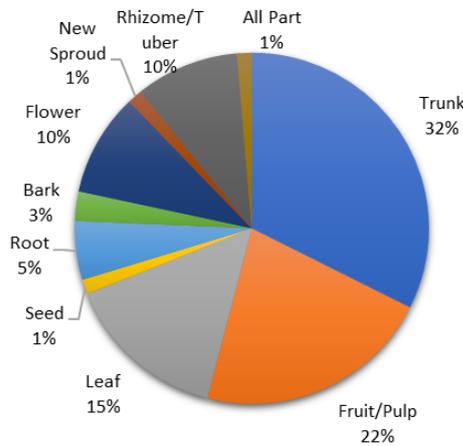


Figure 3. Percentage of plant parts used by Tidung Tribe

**AI, 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 Arcaceae, 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

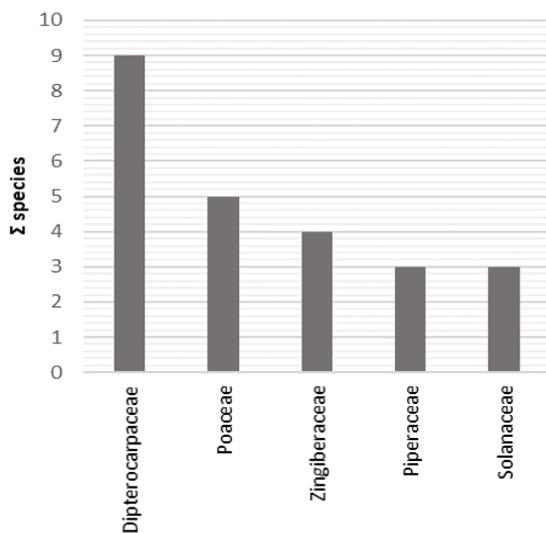


Figure 5. Five families (out of 32 families) that Tidung Tribe mostly uses

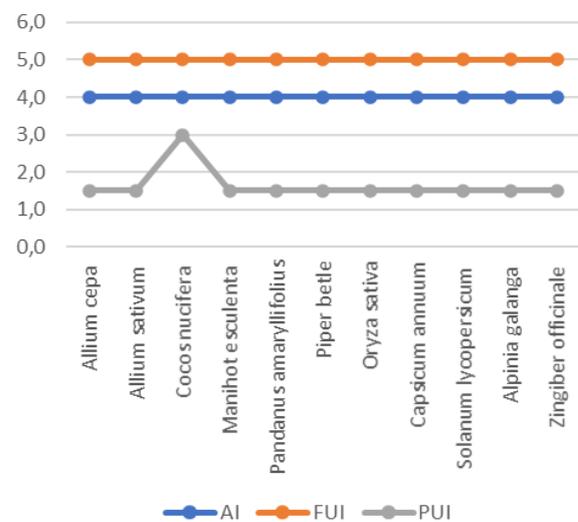


Figure 6. Eleven species with the highest AI and FUI values, completed with PUI values

**Table 5.** Value Index of AI, FUI, and PUI

Species	Family	AI	FUI	PUI
<i>Allium cepa</i> L.	Amaryllidaceae	4,0	5,0	1,5
<i>Allium sativum</i> L.		4,0	5,0	1,5
<i>Cananga odorata</i> (Lam.) Hook.f. & Thomson	Annonaceae	3,0	3,0	0,75
<i>Coriandrum sativum</i> L.	Apiaceae	3,0	5,0	1,5
<i>Dyera costulata</i> (Miq.) Hook.f.	Apocynaceae	0,5	1,0	1,0
<i>Areca catechu</i> L.	Arecaceae	4,0	4,0	1,5
<i>Calamus rotang</i> L.		1,5	2,0	1,0
<i>Cocos nucifera</i> L.		4,0	5,0	3,0
<i>Metroxylon sagu</i> Rottb.		1,5	3,0	1,0
<i>Nypa fruticans</i> Wurm		3,0	4,0	1,5
<i>Blumea balsamifera</i> (L.) DC.	Asteraceae	3,5	2,0	3,0
<i>Diplazium esculentum</i> (Retz.) Sw.	Athyriaceae	3,0	4,0	0,75
<i>Davallia</i> sp.	Davalliaceae	3,0	1,0	1,5
<i>Dipterocarpus</i> sp.	Dipterocarpaceae	0,5	1,0	1,0
<i>Dryobalanops aromatica</i> C.F.Gaertn.		1,0	1,0	1,0
<i>Shorea almon</i> Foxw.		0,5	1,0	1,0
<i>Shorea balangeran</i> (Korth.) Burck		0,5	1,0	1,0
<i>Shorea coriacea</i> Burck		0,5	0,5	1,0
<i>Shorea fallax</i> Meijer		0,5	0,5	1,0
<i>Shorea johorensis</i> Foxw		0,5	1,0	1,0
<i>Shorea laevis</i> Ridl.		1,0	1,0	1,0
<i>Vatica oblongifolia</i> Hook.f		0,5	1,0	1,0
<i>Manihot esculenta</i> Crantz.	Euphorbiaceae	4,0	5,0	1,5
<i>Clerodendrum calamitosum</i> L.	Lamiaceae	3,0	1,0	1,5
<i>Eusideroxylon zwageri</i> Teijsm. & Binn.	Lauraceae	0,5	1,0	1,0
<i>Magnolia Champaca</i> (L.) Baill. ex Pierre	Magnoliaceae	4,0	3,0	0,75
<i>Michelia alba</i> D.C.		3,0	1,0	0,75
<i>Durio kutejensis</i> Becc.	Malvaceae	1,5	2,0	1,5
<i>Swietenia macrophylla</i>	Meliaceae	1,0	2,0	1,0
<i>Artocarpus altilis</i> (Parkinson ex F.A.Zorn) Fosberg	Moraceae	2,0	3,0	1,5
<i>Musa × paradisiaca</i> L.	Musaceae	3,0	2,0	1,5
<i>Musa textilis</i> Née		2,0	2,0	1,5
<i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	Myrtaceae	1,5	2,0	1,5
<i>Syzygium polyanthum</i> (Wight) Walp.		3,0	5,0	1,5
<i>Bougainvillea spectabilis</i> Willd.	Nyctaginaceae	3,0	1,0	0,75
<i>Jasminum sambac</i> (L.) Aiton	Oleaceae	4,0	3,0	0,75
<i>Helminthostachys zeylanica</i> (L.) Hook.	Ophioglossaceae	2,0	2,0	1,5
<i>Pandanus amaryllifolius</i> Roxb.	Pandanaceae	4,0	5,0	1,5
<i>Pandanus tectorius</i> Parkinson ex Du Roi		4,0	4,0	1,5
<i>Piper betle</i> L.	Piperaceae	4,0	5,0	1,5
<i>Piper crocatum</i> Ruiz & Pav.		3,0	5,0	1,5
<i>Piper nigrum</i> L.		1,5	2,0	1,5
<i>Bambusa vulgaris</i> var. <i>striata</i> (Lodd. ex Lindl.) Gamble	Poaceae	3,0	2,0	1,0
<i>Gigantochloa apus</i> Kurz		3,0	2,0	1,0
<i>Gigantochloa levis</i> (Blanco) Merr.		4,0	3,0	1,0
<i>Oryza sativa</i> L.		4,0	5,0	1,5
<i>Oryza sativa</i> var. <i>glutinosa</i> Blanco		4,0	4,0	1,5
<i>Rosa</i> sp.	Rosaceae	4,0	3,0	0,75
<i>Coffea arabica</i> L.	Rubiaceae	3,0	5,0	1,0
<i>Uncaria gambir</i> (Hunter) Roxb.		3,0	2,0	1,5
<i>Citrus hystrix</i> DC.	Rutaceae	3,0	5,0	1,5
<i>Capsicum annuum</i> L.	Solanaceae	4,0	5,0	1,5
<i>Nicotiana tabacum</i> L.		2,0	2,0	1,5
<i>Solanum lycopersicum</i> L.		4,0	5,0	1,5
<i>Boehmeria nivea</i> (L.) Gaudich.	Urticaceae	2,0	3,0	1,0
<i>Tectona grandis</i> L.f.	Verbenaceae	2,0	1,0	1,0
<i>Alpinia galanga</i> (L.) Willd.	Zingiberaceae	4,0	5,0	1,5
<i>Kaempferia galanga</i> L.		3,0	5,0	1,5
<i>Zingiber montanum</i> (J.Koenig) Link ex A.Dietr.		3,0	5,0	1,5
<i>Zingiber officinale</i> Roscoe.		4,0	5,0	1,5

Arecaceae, 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 PUI 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 (Suciwati and Yulinda, 2019). North Kalimantan has a variety of natural resources both at sea and on land (Suciwati et al. 2019). Ethnobotanical knowledge has a vital role in managing natural resources (Navia et al. 2020).

## ACKNOWLEDGEMENTS

We would like to thank the Directorate of Research and Community Service, Ministry of Research and Technology, Republic of Indonesia which funded this research with contract number T/2.1.20/UN34.21/PT.01.03/2020. Many thanks to Yogyakarta State University for the support of this study. Lastly, we would like to thank the anonymous reviewers and journal editors for their valuable comments, which greatly improved our manuscript.

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