Ethnobotany Database: Exploring diversity medicinal plants of Dayak Tribe Borneo

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Abstract—**This study aimed to collect data and information of the Ethnobotany Dayak Tribe, in particular, development of the database which can be used as a media explorer for exchange information society on Borneo's biodiversity and in an attempt preserving of culture local wisdom in traditional medicine so that not extinction. Ethnobotany database collected from various scientific literature, results of report ethnobotany from Related institutions, field study, journals available in the text form, and local wisdom culture of the Dayak tribe. database system development methodology using to the software engineering framework model, with representation standard data model for taxonomic information refer to International Code of Nomenclature for algae, fungi, and plants (Melbourne Code). To date, data has been collected as many as 233 species records from 45 ethnic Dayak, with datasets; plant species, family name, identification, taxonomy ID from NCBI, geographical occurrence, plant parts used, ethnobotany importance, morphological characteristics, local name, the efficacy of medicinal plants, chemical values, distribution, locations, data sources, references, and descriptions related to the medicinal plants.**

***Keywords*— ethnobotany; database; dayak-tribe; medicinal-plants; tropical-rain-forest.**

I. INTRODUCTION

Biodiversity scattered in Kalimantan forest is very large and has many benefits and has not been explored maximally. Potentials that have not been maximized among them is the potential of plant species that are efficacious as a medicine. Such biological wealth if exploited wisely will certainly provide an invaluable benefit, especially for the health of the nation. Traditional communities in Borneo living in and around forests still depend on the forests around them. Collecting a range of forest products includes utilizing a nutritious plant species to treat various diseases through their traditional medicines [1].

In terms of health care, generally, the traditional community in Kalimantan is now using the existing health center facilities. However, if treatment does not heal or some minor illnesses such as fever, cough, and headache, they use plant herbs through traditional medicine controlled by the elderly or local customary leaders. This knowledge of traditional medicine is difficult to document and less appreciated [2].

Exploration activities concerning forest trees that have potential as raw material for medicines are still very minimal [3]. In certain areas or locations, the number of nutritious tree species of the drug will be very high but not all known, both types and utilization. In addition, changes in the condition of forest areas due to illegal logging and forest encroachment lead to the extinction of some rare plant species that have not been explored the type and usefulness [4]. So that written information about the diversity of plant species that are useful nutritious drugs is still lacking. On the other hand, the existence of degraded forest makes a threat to the preservation of forest plant species that have potential as the raw material of medicine. Similarly, the traditional knowledge of medicinal forest plants that tend to experience degradation. So that the utilization and development of medicinal plant species of medicinal herbs are not widely known by today's society.

The forest medicinal plants that have long been known by the Dayak tribe in Borneo which is used to treat a variety of diseases. Not only that, a wealth of knowledge of traditional medicine using plants that are the heritage from generation to generation in the original ethnic in Kalimantan is also very much, utilization of forest medicinal plants has been carried out by various ethnic groups in Borneo are hereditary. Every ethnicity has its own knowledge regarding the use of various types the forest medicinal plants, this is an invaluable asset, particularly, for the development of health and industrial medicinal.

Unfortunately, this knowledge is undocumented and feared to be eroded as loss of natural habitat and extinction of medicinal plants, especially crops due to tropical forest exploitation and excessive land conversion or even caused by piracy of bio-piracy. [5-6]. Therefore, it is necessary to extract information and documentation of ethnobotany of various medicinal plant species that exist and are owned by The Dayak ethnic groups in Kalimantan, so that the Indonesian germplasm can avoid the threat of extinction.

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Degraded forest, traditional knowledge is also eroded by the lack of interest of young people to learn about medicinal plants and the diversity of medicinal plants used by the Dayak tribe have not been stored in digital databases, mostly, Medicinal plant data are separated on the tables of researchers and other agencies or sometimes not published. In relation to the above, it is necessary to collect ethnobotany data and be integrated into the database management system so that the sustainability of plant biodiversity can be preserved in an ethnobotany management system of biodiversity databases.

This paper is based on various research results of ethnobotany of medicinal forest plants and the study of literature conducted by Natural Resource Conservation Technology Research Institute and aims to document the knowledge of the use of medicinal plant species of medicinal plants in traditional Kalimantan ethnic traditional medicine into digital information systems.

II. Related Work

A. A Review of Research Ethnobotany Database

The research of the ethnobotany database has been done by several researchers such as; Sambhaji B Thakar, et al [7], Hong-lin Zhuang, et al [8], Michael B Thomas, et al. [9], Sanjoy S Ningthoujam SS, et al. [10, 11], Vinayak Upadhya, et al. [12], John A Mary, et al. [13]. In developed countries, the use of information technology related to the medicinal plants that they have from the first been used, the need for data access is free and open biodiversity in general as the website; ncbi.nlm.nih.gov, sristi.org, medicinalplants.in, pfaf.org, herbmed.org, nmpb-mpdb.nic.in, globinmed.com, loc.gov, innovipb.com, herbal.web.id, etc.

The research on medicinal plants and development systems of biodiversity, generally, focuses on management of species each country. Furthermore, the availability of complete and specific data is not available, only to the extent of data collection name or any total of species, availability data of species visually and with complete attributes not found. this is caused by the different regions with different endemic species.

The potential of medicinal plants owned has not been able to be managed and developed optimally, inventory of each area has been carried out and only be reported in the form of newsletters, reports, scientific journals nationally and internationally. Unavailability of data inventory of the medicinal plants that can be accessed digitally online.

B. Traditional Knowledge Medicinal Herbs of Dayak Tribe

Based on data recorded in the Plant Conservation Laboratory of the Faculty of Forestry IPB, no less than 2,039 species of medicinal plants originated from Indonesian forests [14]. Some of these species are of course also from Kalimantan forest. In addition to the wealth of biodiversity, indigenous ethnic groups in Kalimantan also have a wealth of traditional knowledge in terms of treatment by using various types of forest plants that exist around them.

Utilization of medicinal forest plants has been done by various ethnic Dayak in Borneo for generations, such as Dayak Paramasan [15], Dayak Tunjung [16], Dayak Iban [17], Dayak Pesaguan [18], Dayak Agabag [19], Dayak Kanayatn, Dayak Karo', Dayak Bukat [20], Dayak Lundayeh and Uma'lung [21], Dayak Seruyan [22], Dayak Paser [23], and other Dayak ethnic in Borneo.

Various studies conducted in Indonesia on ethnobotany indicate, at least there are 78 types of medicinal plants used by 34 ethnic groups to treat malaria, 133 types of medicinal plants to treat febrile diseases used by 30 ethics, and 98 types of medicinal plants used to treat the disease Skin by 27 ethnicities [24].

Dayak tribe always believes that there is a limitation of natural resources, thus requiring conservation, except for certain types of resource availability which exceeds demand. Review of the literature shows that people who intentionally build conservation strategy usually has limited natural resources and easy to decline. The strengthening conservation strategies in the traditional culture is very important to help survive in the limited natural resources, especially when natural resources run out [25].

III. Methodology

A. Data, Sources, and Collection Methods

The main source of medicinal plant data is collected ethnobotanical study from government institutions, agencies or private organizations that handling the problem of plant biodiversity in Borneo, some of the main sources are presented in Table I.

TABLE I. The main Source Data of Plants

Source	Descriptions
DISHUT	Provincial Forestry Office of East Kalimantan site: dishut.kaltimprov.go.id/
B2PD	Research Center of Dipterokarpa forest ecosystem site: http://www.diptero.or.id/
FORDA	Forest Research and Development Agency http://www.forda-mof.org/
BALITEK KSDA	Research Institute for Natural Resource Conservation Technology of Samboja
BALITTRO	Research Institute for Spices and Medicinal Crops balittro.litbang.pertanian.go.id/
BALITBANG DA	Regional Research and Development Agency of East Kalimantan
BPTP	Assessment Institute for Agricultural Technology site: http://kaltim.litbang.pertanian.go.id
B2P2TOOT	Research and Development of Medicinal Plants and Traditional Medicine site: www.b2p2toot.net/
BALITBANG KES	Agency for Health Research and Development
TNK Bontang	Kutai National Park, Bontang-East Kalimantan
UPTD Kebun Raya Balikpapan	Balikpapan Botanical Garden - Sungai Wain Protection Forest, Balikpapan, East Kalimantan site: http://kebunraya.balikpapan.go.id/
Forest Park Bukit Soeharto	Bukit Soeharto Great Forest Park Management, Loa Janan Regency Kutai Kartanegara

B. Nomenclature of Medicinal Plants

International Code of Botanical Nomenclature (ICBN) is the set of rules and recommendations dealing with the formal botanical names that are given to plants. Its intent is that each

taxonomic group ("taxon", plural "taxa") of plants has only one correct name that is accepted worldwide [26]. Seven general classification categories have been defined in plants. These classifications can be arranged in order from the most inclusive group (kingdom) to the least inclusive group (species). Each of these groups constitutes a taxonomic. In addition to these basic groups, subcategories are used in certain cases. These include such as sub-division, sub-class, sub-order, sub-genus, sub-species, and variety (or cultivar). According to the binomial nomenclature, each individual has two-part name; the first part is called the genus (plural: genera) and second part is called a specific epithetor species [26]. An example of species *Eleutherine* classification is presented in TABLE II.

TABLE II. AN EXAMPLE OF SCIENTIFIC CLASSIFICATION OF PLANTS FOR ELEUTHERINE PALMIFOLIA

Taxon	Scientific Name	Common Name
Kingdom	Plantae	Plant
Division	Tracheophyta	Vascular plants
Class	Liliopsida	Monokotiledon
Order	Asparagales	Herbaceous plants
Family	Iridaceae	Flowering Plants
Genus	Eleutherine Herb.	Herb. Flower
Species	*E. Palmifolia (L.) Merr*	Bawang Dayak (local)

C. Database Design Models and Architecture

The term database design can be used to describe many different parts of the design of an overall ethnobotany database system. Principally, and most correctly, it can be thought of as the logical design of the base data structures used to store the medicinal data. In the relational model, these are the tables and views. In an object database, the entities and relationships map directly to object classes and named relationships [27].

1) Class Diagram

In this class diagram, describes the structure and description of classes, packages, and objects and inter-class relationships within the system.

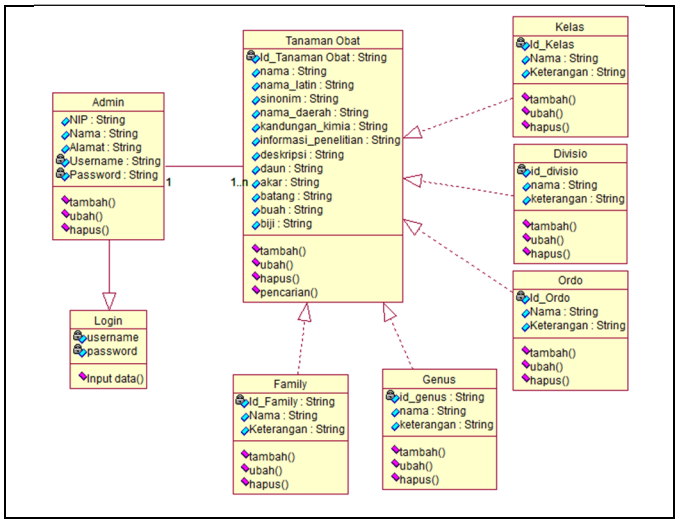


Fig. 1. Class diagram

In software engineering [28], a class diagram in the "Fig. 1" is a type of static structure diagram that describes the structure of an ethnobotany database system by showing the system's classes, their attributes, operations (or methods), and the relationships among objects. The class diagram is the main building block of object-oriented modeling. It is used both for general conceptual modeling of the systematics of the application and for detailed modeling translating the models into programming code. Class diagrams can also be used for data modeling [29].

2) Three-tier Architecture

The development of ethnobotany database management system can be implemented with a variety of approaches and technologies. Scale enterprise applications such as ethnobotany database for medicinal plants in "Fig. 2, was developed with object oriented approach using a three-tier-architecture i.e. presentation layer (client environment), application layer (network-internet), and database layer [30].

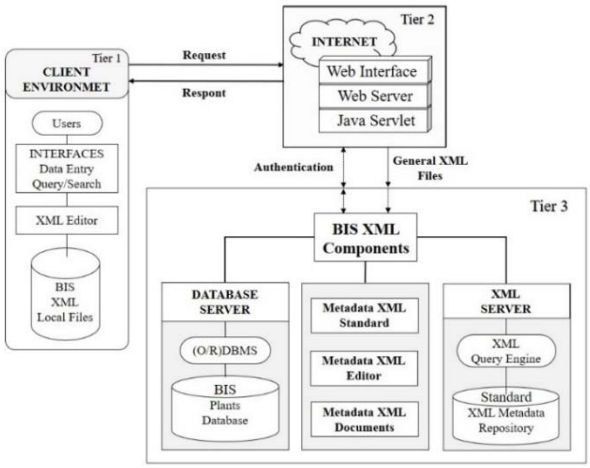


Fig. 2. Figure 3: Three-tier architecture for biodiversity information system

IV. RESULT

A. Results of exploration and data collection

Based on the results of exploration and inventory that has been done scattered in some areas of Borneo Indonesia, recorded the types of medicinal herbs used by 7 ethnic groups in Kalimantan. In TABLE III, and have been documented in the system database online at http://www.borneodiversity.org. To date, data collection has recorded 233 species of medicinal plants. the list of medicinal plants in ethnobotany database system is presented in "Fig. 5".

TABLE III. GROUP AND SUB-GROUP DAYAK TRIBE

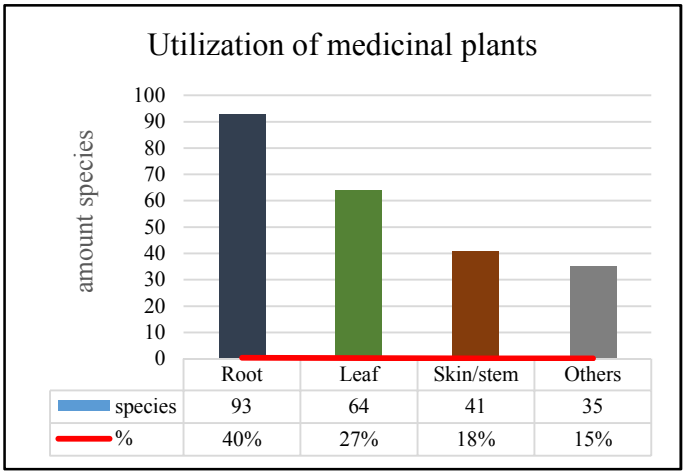
Group	Sub-group ethnic of Dayak
dayak ngaju	ethnic paramasan, meratus, seruyan, katingan, banjar hulu, bakumpai, wehea, jangkang tanjung
dayak apo kayan	ethnic kayan, kenyah, bahau, kelabit, lundayeh, uma'lung
dayak iban	iban, seberuang, randu', kendayan, melanau.
dayak murut	ethnic okolod, agabag, tagol, paluan, tidung
dayak ot-danum	ethnic ma'anyan, tunjung, kapuas, benuaq, lebang, siang, paser, buro mato, pesaguan, suruk, kaburai.
dayak punan	ethnic punan, bukat, aput, hovongan, merapi.
dayak klemantan	kanayatn, salako, daro', bakati', ahe

Ethnic Dayak has been since ancient times use the plants in the treatment of various diseases, Dayak's traditional medicine is very diverse, treatment is done by people who are considered to have intelligence "dukun = healer = shaman" both in terms of knowledge of the use of plants and animals to things that are magical and using mantra in the treatment methods.

For example, kind of similar plants that are different flower color considered a pair, as well as the size, or shape of the leaves are different it will be categorized as a couple of plants and considered to have better efficacy in treatment. the Dayaks method's in taking medicine plant from nature using its own way and requested permission to guard the plants, in their beliefs

B. *Utilization of medicinal plants*

The results of research on the use of plants by ethnic Dayak in Kalimantan indicate that the utilization of medicinal plants especially forest plants still use simple processing methods, such as boiled, soaked, chewed, crushed and crushed or crushed. Plants used in traditional medicine there are through the processing before use, there is also a direct use without going through the processing. How to preserve raw materials derived from medicinal plants are still using a conventional way that is dried or dried.



	Root	Leaf	Skin/stem	Others
species	93	64	41	35
%	40%	27%	18%	15%

Fig. 3. Part of the plant used in the treatment

Based on the results of this study, parts of plants used as medicinal ingredients can be grouped into 4 groups i.e. root, leaf, stem and others (fruit, gums, flowers, seeds and fruit skin, water stem). Part of the utilized plant is presented in "Fig. 4".

In “Fig. 4”, the roots are part of the most widely used plant in traditional medicine. In terms of conservation, the use of roots as raw materials of drugs will interfere with the survival of plants and the possibility of causing plant death. The use of root in the treatment tends to undermine the preservation of this type of medicinal plant. In contrast to the utilization of leaves and bark. Therefore, the use of medicinal plants should be coupled with conservation and cultivation efforts for the sustainability of medicinal plants in Borneo.

C. *User Interface for Ethnobotany Database Management*

A user interface, also sometimes called human-computer interface, it handles interaction between the user and the system, as for the front-end display the main menu admin interface for ethnobotany database management system that has been develop is shown in the following “**Error! Reference source not found.**”.

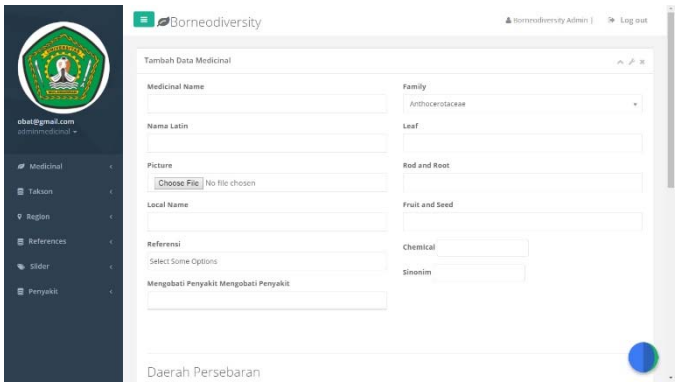


Fig. 4. Screenshot of the main interface of ethnomedicinal database

We have been developed the ethnobotany database based medicinal plants of Dayak, the application runs on web-based system with the PHP framework Laravel. The application is divided into two main functionalities, i.e. medicinal plant management and document searching of medicinal plants. Also, we developed medicinal plant database.

For medicinal plant management, the standard data model representation for taxonomic information plants, implementation user interface for data management of the ethnobotany database system we present in the form interface of browse taxonomic classification and taxonomic hierarchy tree. In “Fig. 5” showing interface ethnobotany database system can perform to browsing taxonomic classification. Taxanomic classification divides species in a hierarchical system beginning with a domain and ending with a single species.

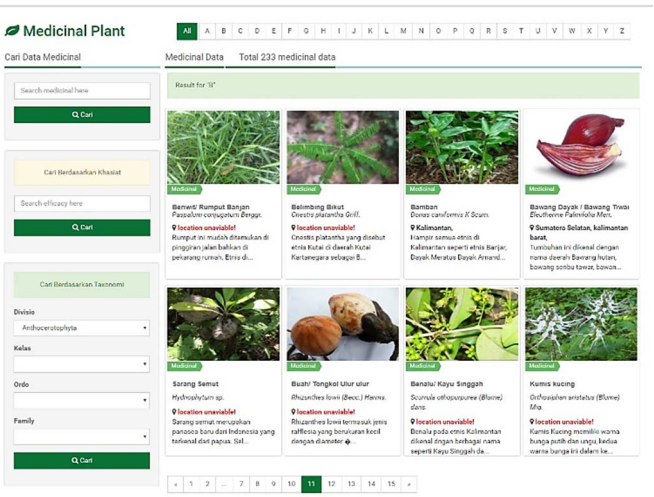


Fig. 5. Screenshot of the medicinal plants in ethnobotany database system

In 0", is the result of searching for "*Eleutherine Palmifolia Merr.*", which a displays general information on the species. The results of the data information species provide a detailed explanation relating to the species, dataset showing the data scientific name, local name, efficacy of medicinal plants (including; leaves, flowers, fruits, roots, stems/rod, and etc.), chemical values, distribution locations, research information, data sources, references, researcher or author, and descriptions related to the medicinal plants.

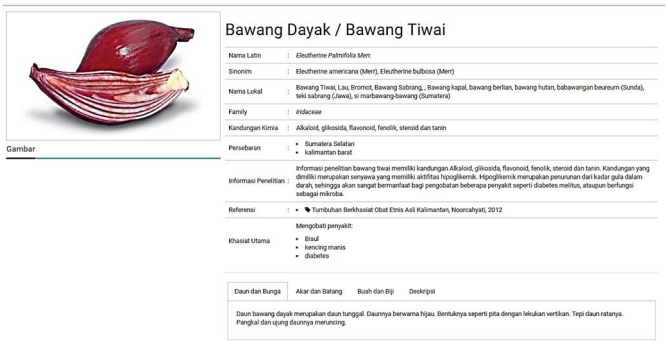


Fig. 6. Screenshot of the species to print documents in form a poster

D. Ethnobotany Condition of the Dayak Tribe Borneo

Ethnobotany database of medicinal plants medicinal Dayak tribes is a medicinal plant data management system that reveals the traditional of Dayak tribe knowledge system in Borneo Indonesia. Data obtained in ethnobotanical studies are expected to bridge the development of various plant species in the future, as well as studies of medicinal plants used by ethnic Dayak groups Borneo Indonesia in traditional medicine.

Based on research conducted, although on a national scale there is an increase in the use of natural medicinal ingredients or known to the public as herbal medicine, nowadays there is a decline in the use of medicinal plants in some ethnic groups in Kalimantan. Unpopular use of medicinal plants in forest communities is caused by several factors i.e.:

1) The entry of various types of chemical drugs that are easily obtained and sold freely such as dizziness, abdominal pain, and other minor ailments.
2) Damage to natural habitat Medicinal plants due to the conversion of forest land to plantation and mining land, logging, and forest fires. This has resulted in forest communities becoming increasingly difficult to obtain the usual medicinal plants they use that ultimately make the people around the forest prefer chemical drugs because it is easy to obtain and the price is relatively cheap.
3) Knowledge of traditional medicine is considered impractical and is generally controlled by the elderly, whereas young people are not interested in learning it.

Traditional knowledge of medicines using different types of plants is inherited down from generation to generation. The knowledge transfer process is done verbally and has not been well documented. Distribution of medicinal plant knowledge sources can be seen in Figure 8 Traditional knowledge of medicines using different types of plants is inherited down from generation to generation. The knowledge transfer process is done verbally and has not been well documented. Distribution of medicinal plant knowledge sources can be seen in "Fig. 7".

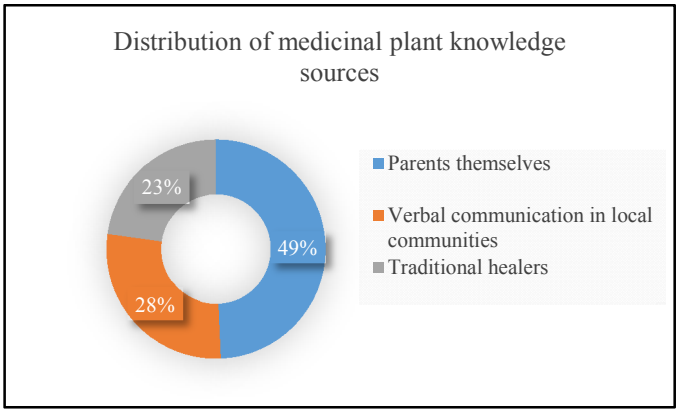


Fig. 7. Distribution of medicinal plant knowledge sources the dayak tribe

"Fig. 7", it can be seen that the process of transfer of knowledge of traditional medicine is more widely distributed through parents to their children (49.3%), then obtained through verbal communication in the local community (27.9%) and last sourced from traditional healers (22, 8%). There are several things that cause why this transfer process tends to be slow and down, namely the existence of some requirements in the transfer of knowledge. These requirements, such as knowledge not inherited to each child, are not forced to be studied, there are age restrictions, and in the beliefs that exist in traditional forest communities the knowledge of traditional medicine may not be shared by the knowledge owner, and some other requirements.

Currently the knowledge of traditional medicine using plants shows symptoms of degradation. Utilization Medicinal plants through traditional medicine have been replaced with modern medicine. In addition, young people in forest communities are not motivated to learn the traditional remedies that their ancestors possessed. This is exacerbated by the condition of damage to natural habitat Medicinal plants. If not done the documentation of traditional knowledge and make efforts to save medicinal plants then it is feared more and more Kalimantan germplasm extinct due to our ignorance of the benefits and role in life, especially the potential of medicinal plants that have a contribution in public health

V. Discussion and Conclusions

A. Conclusions

The knowledge of traditional medicine of Dayak tribe who using forest plants as raw material in the treatment have been documented and inventoried digitally. This research has developed an ethnobotany database software of medicinal plants from tropical rainforest Borneo based on traditional knowledge Dayak tribe, which can be used as a media for information society exchange on Borneo's biodiversity and in an attempt preserving of culture local wisdom in traditional medicine so that not extinction. Furthermore, the availability of medicinal

plant database can be to support ongoing research on medicinal plant by building a modern knowledge base.

The main source of medicinal plant data is collected from ethnobotanical study of traditional knowledge on medicinal plant use by 45 sub-ethnic of Dayak tribe in Kalimantan. To date, data has been collected as many as 233 medicinal plants species records, with various local names and have been identified the scientific name refers to International Code of Botanical Nomenclature of plants.

B. Discussion

The development of traditional medicine and the trend of "going back to nature", causes increasing research on traditional medicinal plants as alternative medicine. Activities scientific forum, included workshops, talk shows, seminars, and discussion about research, utilization, and development of the increase the use of medicinal plants indicated that medicinal plants and their derived products from nature are known and needed by the public.

Currently, the knowledge of traditional medicine using the forest plants tend to be degraded. Similarly, the traditional knowledge about medicinal plants, so that utilization and knowledge of the types of medicinal forest plants not yet widely known by the public. On the other hand, utilization of the rainforest medicinal plant through traditional medicine has been replaced with modern medicines.

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