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Research paper

Biodiversity Information System for Management of Medicinal Plants Data Tropical Rainforest Borneo

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Abstract

This paper is an effort to inform about the potential of medicinal plants in forest areas in the Borneo region. Given the high rate of destruction of rainforests on Borneo, literacy and conservation efforts of medicinal plants that are part of the forest ecosystem are important. This study developed BBIS, namely Borneo Biodiversity Information System. BBIS is the development of computer-based technology for managing information on Borneo's natural resource biodiversity in order to improve the knowledge management of medicinal plants. In particular, development of the Biodiversity Information System which can be used as an exploring media for exchange information society on Borneo's biodiversity. Profile biodiversity complete and well managed will be a reference in the process of monitoring the use of biological diversity, strategies, and plans related to the biodiversity of the medicinal plants on Borneo Island.

Keywords: *Biodiversity; Medicinal Plants; Tropical Rainforest; Borneo.*

1. Introduction

Borneo is the third largest island in the world known as one of the two centers of world plant diversity. Kalimantan is part of the island of Borneo located in the territory of the Unitary State of the Republic of Indonesia [1]. The Kalimantan region includes five provinces, i.e. West Kalimantan, Central Kalimantan, South Kalimantan, East Kalimantan and North Kalimantan. This 73% of the area of the island of Borneo) [2].

Biodiversity data in Borneo is still quite difficult in terms of access, information disclosure does not always encourage this data so that it can be accessed freely and easily by the public. Almost all sites related to biodiversity data are quite difficult to provide complete data, data distribution is still very minimal, others are still in the research desk and not published, each region only collects biodiversity data according to their individual needs and with data formats which do not support interoperability and can only be read by certain software.

One product of Borneo forest plants is medicinal plants. The potential of medicinal plants in the forest area in Borneo is quite diverse, some of which have been utilized by the community around the area as well as untapped. From the study [3] of various studies conducted in the Borneo forest area, it can be seen that this area has the potential for diverse medicinal plants. The potential recorded at this time has not shown the potential of Borneo medicinal plants as a whole, but can describe the potential of medicinal plants in a variety of certain forest areas. The potential of this medicinal plant is spread in various forest areas both conservation areas such as national parks, research forest areas, protected forests and other forest areas.

The types of medicinal plants that have been successfully identified and documented through various studies are types that have traditionally been used by local communities. In fact, several studies have examined the ethnobotany of certain tribes in Kalimantan, including the use of medicinal plants for medicinal purposes. There is a tendency that the types of medicinal plants in the forest area in Borneo are types that are used by tribes that inhabit the area. In terms of utilization, various types of medicinal plants in the Borneo forest have their own efficacy and have a large potential to be developed.

Many researchers at Mulawarman University and Indonesia have conducted research into the potential of Bornean forest medicinal plant biodiversity. But most of the research results are still stored in the form of papers/books/books. There is still a very little amount of data stored in digital systems.

With the large percentage of non-digital documents, data and information about biodiversity are difficult to access. This condition will cause information and knowledge not to be disseminated properly, as a result, it will threaten the sustainability of living natural resources.

Information on medicinal plant biodiversity is very important for scientific studies / research, education and decision-making. In natural resource management, biodiversity information is needed to maintain the continued use of species, explore biological potential and monitor species and ecology, make policies, and develop biotechnology innovations. Given the importance of the role of information on the body, it is necessary to develop a computer-based technology that can manage data, information and knowledge of biodiversity properly and efficiently so that it can be used for exploration, analysis, synthesis, and interpretation of potential biodiversity riches.

Related to the above, require effort for data collection of the ethnomedicine, and integrate into a database management system so that the sustainability of medicinal plant biodiversity in Borneo can be preserved.

This study developed BBIS, namely Borneo Biodiversity Information System. BBIS is the development of computer-based technology for managing information on Borneo's natural resource

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biodiversity in order to improve the knowledge management of medicinal plants. The paper aims to develop a Biodiversity Information System (BIS) of the medicinal plant from tropical rainforest Borneo based on International Code Botany Nomenclature (ICBN), while its specific objectives i.e.: Making software products in the form of medicinal biodiversity information systems in an effort to support a sustainable biodiversity monitoring system. Collecting data on medicinal plants based on information and traditional knowledge of medicinal plants from indigenous tribes in Borneo and as an effort to digitally preservation the culture and local wisdom of indigenous people so as not to erode, and until now, there are still many types of medicinal plants that have not been studied and the benefits are unknown.

2. Methodology

2.1. Data, Sources, and Collection Methods

The data on medicinal plants are collected from observing agencies, conservation institutions in the Kalimantan region, main book sources from [4], and [5] and several results of ethnobotanical study medicinal plants. The representation of the data model for taxonomic information refers to the International Code Nomenclature for algae, fungi, and plants [6].

2.2. Nomenclature of Medicinal Plants

According to the International Code of Nomenclature [6], there are seven general classification categories defined in plants, such as the example classification for "eleutherine" species [7] shown in **Table 1**.

Table 1: An example of the scientific classification of plants for "eleutherine Palmifolia"

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

2.3. Software Development Models

In principle, software development methods aim to help produce quality software. Software development methods provide techniques for building software related to a broad range of tasks involving requirements analysis, program construction, design, application, testing, and maintenance. The software development model uses a prototype approach [8], the Prototype model implements several parts of the function of the actual software. In this way the user will get an overview of the program that will be produced, so that it can describe in more detail their needs. As for the stages of development of this model is presented in **Fig. 1**.

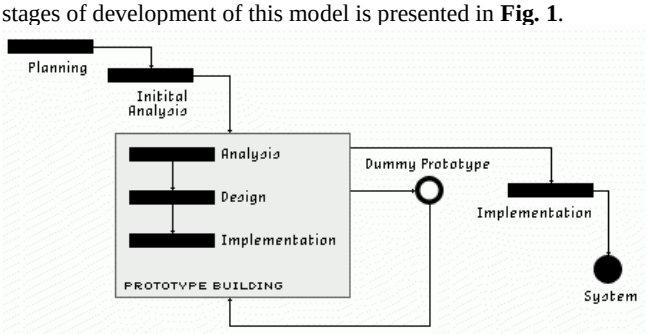


Fig. 1: Throw-away prototyping model [9]

2.4. Software Analysis and Design

The general modeling language used to specify, visualize, construct and document artifacts from the software system uses the Unified Modeling Language (UML). UML is used in modeling an object-based system [10].

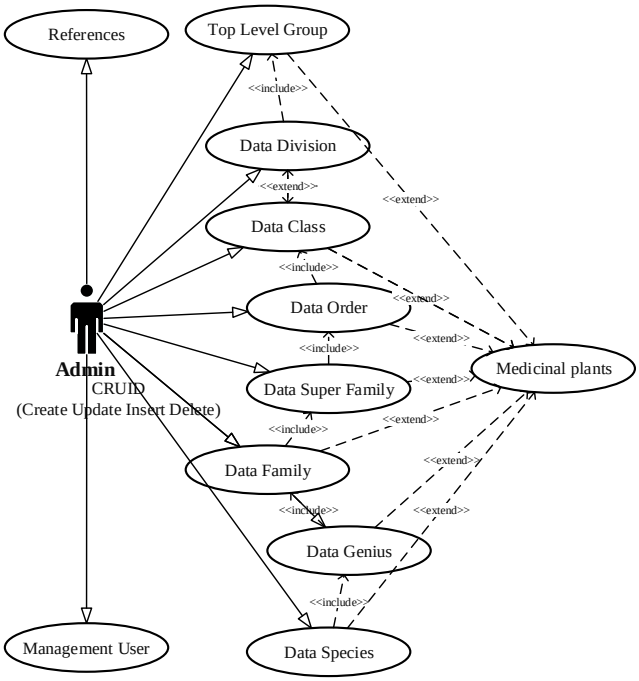


Fig. 2: Use case diagram for administrator

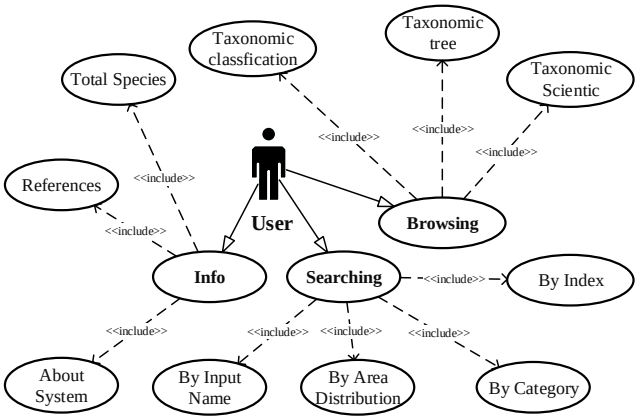


Fig. 3: Use case diagram for user

Fig. 2 and **Fig. 3** Use case diagrams for system user and admin.

2.5. Three-tier Architecture

The development of BIS can be implemented with various approaches and technologies. Scale enterprise applications such as BIS was developed with an object-oriented approach using a three-tier-architecture i.e. client environment, network-internet, and database layer [11].

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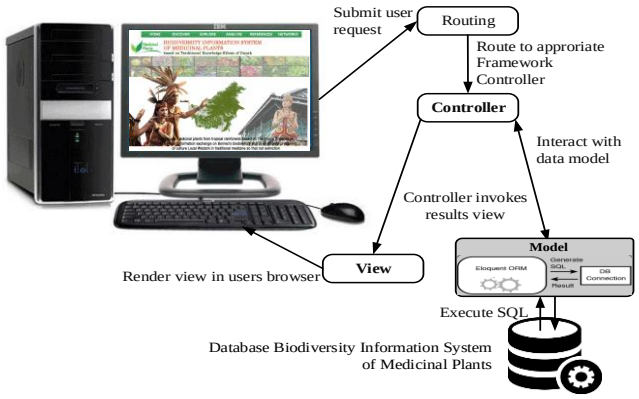


Fig. 4: Three tier architecture for BBIS medicinal plants

In **Fig. 4** as an overview of the Borneo Biodiversity System Information with Model-View-Controller (MVC) and interaction with the database [12-20].

3. Results and Discussion

3.1. System Implementation

The results of BBIS medicinal plants development can be seen at the URL address: https: //borneodiversity.org/index/medicinal, then the main page interface is presented in **Fig. 5**.

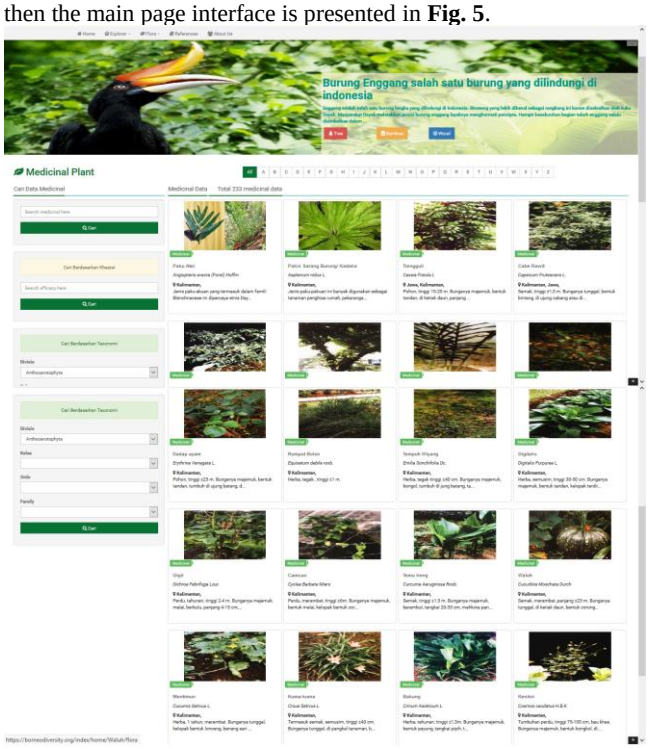


Fig. 5. Homepage BBISystem of Medicinal plants

Based on the results of exploration and initial inventory conducted from various research locations spread in East Kalimantan, Central Kalimantan, East Kalimantan, and South Kalimantan, medicinal plant species used by ethnic groups were recorded in Kalimantan. Found 233 species of medicinal plants used by indigenous tribes of Borneo, Paser Dayak and Buro Mato Dayak in the Tanjung Pinang area, Upper Rantau area and Muara Andeh area in Paser District, East Kalimantan. In the Right Menamang and Menamang Regions, 85 species were used by the Kutai ethnic group in the East Kalimantan Province of Kutai Kartanegara Regency. While in South Kalimantan Province there were 92 types of ethnic Banjar and Dayak Meratus in Mayanau, Awayan, and Japan in Balangan Regency. A total of 56 types of medicinal plants are used by ethnic Manyan Dayaks in the Ampah and surrounding areas in East Barito Regency, Central Kalimantan Province.

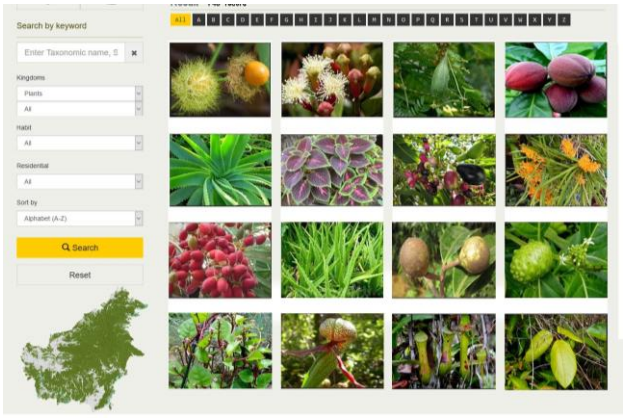


Fig. 6: Menu browse taxonomic classification

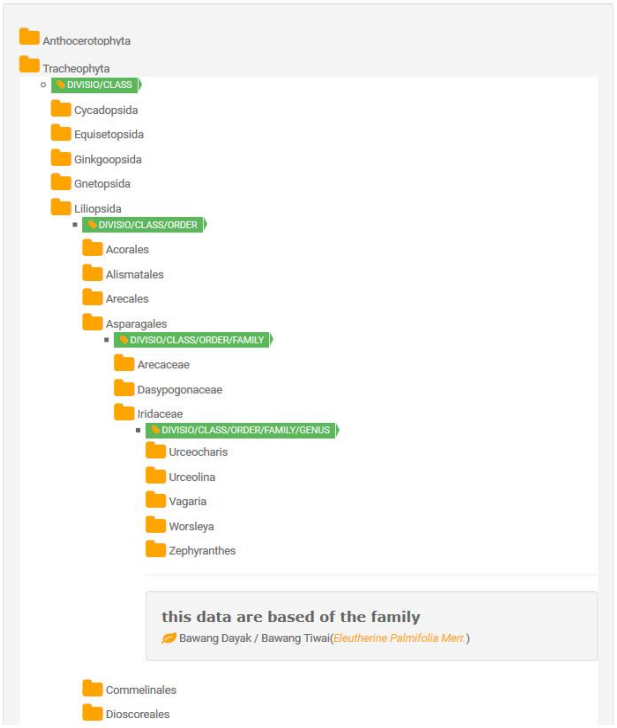


Fig. 7: Menu browse Tree diagram

Fig. 6 Classification of medicinal plant plants is arranged based on taxon-taxon regularly following a hierarchy. Taxes found in lower taxon (category) levels have more in common than taxon contained in taxon levels (categories) in them. Tree diagrams provide an overview of the phylogenetic relationships among subgroups. For example, the tree diagram of the type species "*Eleutherine*" presented in **Fig. 7**.



Fig. 8. Menu searching a species "*eleutherine*"

For document searching of medicinal plant, we provide several models of the search interface menu i.e. in the **Fig. 8**, user input keyword and press search button by all names, searching by category, by area distributions or habit, by indexing, etc. The result of searching for "*eleutherine*", which a displays general information on the species, taxonomic data and photo galleries.

3.2. Utilization of Efficacious Medicinal Forest Plants

The results of research from medicinal plant data show that the use of medicinal plants, especially forest plants, still uses simple processing methods, such as boiling, soaking, chewing, squeezing and pounding or pounding. There are plants that are used in traditional medicine that go through the process before being used, some of which are directly used without going through the processing process. Ways to preserve raw materials from Efficacious Medicinal Plants Medicines still use conventional methods by drying or aerating. The most widely used parts of the drug vary depending on the extraction system and the amount taken. Taking these medicinal ingredients can cause growth and regeneration of plants to be disrupted. From the results of data collection, parts of plants used as medicinal ingredients can be grouped into 4 (four) groups, i.e.: roots, leaves, skins/stems, etc. (Fruit, sap, flowers, seeds, and fruit peels, water stems, tubers) The part of the plant used is shown in **Fig. 9**.

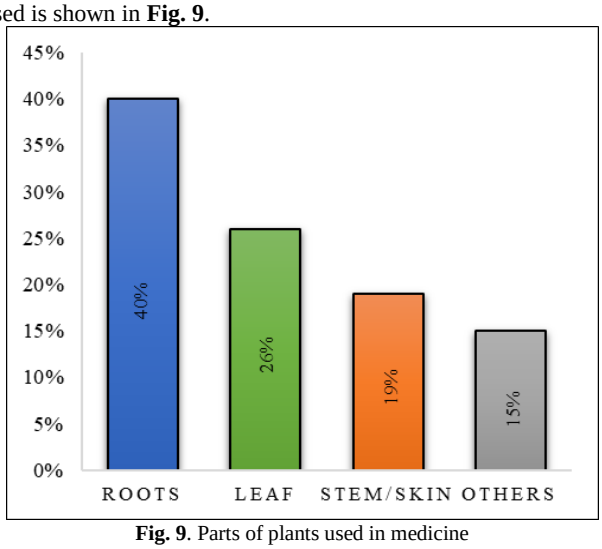


Fig. 9. Parts of plants used in medicine

In **Fig. 9**, roots are part of the most widely used plant in traditional medicine. In terms of conservation, the use of roots as medicinal raw materials will disrupt the survival of plants and possibly cause death. The use of roots in medicine tends to damage the preservation of the efficacious species of forest plants. In contrast to the use of medicinal leaves of medicinal plants, it must be accompanied by conservation and cultivation efforts for the preservation of the nutritious medicinal plants of Borneo.

3.3. Web Performance Testing

The more technology develops, the faster the use of websites as a medium of communication, through media sites, information is easily presented and accessed. However, errors in website development, both in terms of programming and content, will affect the performance of web and network servers. Therefore, application developers need to use tools to assess the performance of web applications, so as to reduce errors or lacks. The analysis and calculation of efficiency testing of website:borneodiversity.org using GT-Metrix tool [21-23], then the Grade and score as shown in **Fig. 10** for recommendation of Pagespeed and recommendation of YSlow. The results of the performance tests for YSlow are presented in **Fig. 11**.

PageSpeed

RECOMMENDATION	GRADE	TYPE	PRIORITY
Serve scaled images	F (0)	IMAGES	HIGH
Optimize images	F (0)	IMAGES	HIGH
Leverage browser caching	F (0)	SERVER	HIGH
Enable gzip compression	C (77)	SERVER	HIGH
Defer parsing of JavaScript	A (97)	JS	HIGH
Minify CSS	A (98)	CSS	HIGH
Minify HTML	A (98)	CONTENT	LOW
Specify a character set early	A (99)	CONTENT	MEDIUM
Minify JavaScript	A (99)	JS	HIGH
Specify image dimensions	A (99)	IMAGES	MEDIUM
Avoid bad requests	A (100)	CONTENT	HIGH
Avoid landing page redirects	A (100)	SERVER	HIGH
Enable Keep-Alive	A (100)	SERVER	HIGH
Inline small CSS	A (100)	CSS	HIGH
Inline small JavaScript	A (100)	JS	HIGH
Minimize redirects	A (100)	CONTENT	HIGH
Minimize request size	A (100)	CONTENT	HIGH
Optimize the order of styles and scripts	A (100)	CSS/JS	HIGH
Put CSS in the document head	A (100)	CSS	HIGH
Serve resources from a consistent URL	A (100)	CONTENT	HIGH
Specify a cache validator	A (100)	SERVER	HIGH
Specify a Vary: Accept-Encoding header	A (98)	SERVER	LOW
Combine images using CSS sprites	A (100)	IMAGES	HIGH
Avoid CSS @import	A (100)	CSS	MEDIUM
Prefer asynchronous resources	A (100)	JS	MEDIUM
Avoid a character set in the meta tag	A (100)	CONTENT	LOW
Remove query strings from static resources	A (100)	CONTENT	LOW

Fig. 10: Recommendation of PageSpeed

In principle, the page loading speed of a website will improve the user experience in accessing information.
Fig. 10 is the result of website analysis based on recommendations from PageSpeed using the GTMetrix web performance tool. The results of the analysis indicate that there are Recommendations that obtain a Grade worth 0, i.e: Serve scaled images F (0), Optimize images F (0), and Leverage browser caching F (0), and Enable GZIP compression with Grade score C (77).

PageSpeed YSlow

RECOMMENDATION	GRADE	TYPE	PRIORITY
Add Expires headers	F (0)	SERVER	HIGH
Use a Content Delivery Network (CDN)	F (0)	SERVER	MEDIUM
Make fewer HTTP requests	D (60)	CONTENT	HIGH
Use cookie-free domains	F (0)	COOKIE	LOW
Compress components with gzip	B (89)	SERVER	HIGH
Minify JavaScript and CSS	A (90)	CSS/JS	MEDIUM
Reduce DNS lookups	A (95)	CONTENT	LOW
Avoid URL redirects	A (100)	CONTENT	MEDIUM
Make AJAX cacheable	A (100)	JS	MEDIUM
Remove duplicate JavaScript and CSS	A (100)	CSS/JS	MEDIUM
Avoid AlphaImageLoader filter	A (100)	CSS	MEDIUM
Avoid HTTP 404 (Not Found) error	A (100)	CONTENT	MEDIUM
Reduce the number of DOM elements	A (100)	CONTENT	LOW
Use GET for AJAX requests	A (100)	JS	LOW
Avoid CSS expressions	A (100)	CSS	LOW
Reduce cookie size	A (100)	COOKIE	LOW
Make favicon small and cacheable	A (100)	IMAGES	LOW
Configure entity tags (ETags)	A (100)	SERVER	LOW
Make JavaScript and CSS external	(n/a)	CSS/JS	MEDIUM

Fig. 11: Recommendation of YSlow

For the results of performance analysis according to recommendations from YSlow, In **Fig. 11** shows that Recommendations: Add Expires headers Grade F (0), Use a Content Delivery Network (CDN) is F (0), Make fewer HTTP requests is D (60), and Use cookie-free domains is F (0).

Evaluation:

- Generally the problem with the results of a web performance analysis is the lack of assessment achieved in the ADD Expired Header recommendation section. One thing that must be understood is that if Leverage browser Expires Headers are closely related to a web page such as images, CSS, Java Script, and so on. So, when reopening the same web page, the webpage will open faster. Because files that were originally downloaded must now be stored in the storage media. The main function of Leverage browser caching itself is to set expires in static HTTPS headers. besides also giving commands to the browser to load the Source Code that was previously downloaded in the storage media, and the function of the Caching is to set the length of file storage that was downloaded when opening.
- Basically, Serve scaled images is to call or display images according to their dimensions, meaning that each image source is adjusted to the size of the image displayed. For Optimize images problems means optimizing image size so that large image file sizes can be smaller. Smaller images will certainly be faster than large images. It is recommended to optimize the image as much as possible.
- Content Delivery Network (CDN) is one of the technologies to fulfill these two factors. By placing multiple servers in different locations, CDN will be able to reduce access times much faster than normal access times. When a user or user sends a web page request to a web server, the web page will be sent to the main server, even though the main server is located throughout the country from the user's position. But by using CDN technology, when a user or user sends a web page request to a web server, the web page will be sent to the server closest to the user's location. But because CDN is digital technology, it means that CDN is vulnerable to cyber-ware problems that have spread in various countries.

4. Conclusion

The level of biodiversity of medicinal plants high in the forests of Borneo is currently experiencing a lot of pressure due to excessive use and use of forest products beyond its carrying capacity. The potential value of future beings disappears. Regarding this matter, it is necessary to follow up on data handling and monitoring activities so that the sustainability of medicinal plant biodiversity is maintained and sustainable.

Development of the Biodiversity Information System of the tropical rain forest Borneo as a media for management data and information on medicinal plants is the first step in efforts to disseminate public literacy, the potential use of Kalimantan medicinal plants by inventorying and documenting knowledge. Concerned about the increasing number of Bornean medicinal plants that are extinct due to our ignorance of the benefits and roles in life, especially the potential that has a contribution in public health.

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