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Ethnobiology of the Pesaguan Dayak Tribe as a Science and Biology Learning Resource

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ABSTRACT

A Pesaguan Dayak community is a group of indigenous people living in the upstream area of the Pesaguan river, Ketapang Regency of West Kalimantan, Indonesia. The community utilizes plants and animals for daily life, a highly dependent on nature. The local utilization has not been known widely, including for traditional medicine, ethnic rituals, and food sources. Loss of natural resources and traditional knowledge so rapidly due to high pressure on the resources and intervention of modern culture and development. This research aimed to determine plants and animals' potential as medicine, traditional rituals, and food used for the Dayak Pesaguan community and to see a possible use for biology learning material. This study used a qualitative method, describing potential plants and animals, and a quantitative approach of validation test to analyze the possible use for biology learning material. The research found 22 plant species and ten animal species used as medicine. There were 15 plants and seven animal species promising for traditional rituals; ten plant species and twelve animals were used as traditional food. A customary knowledge of plants and animals has potential as medicine, food, traditional rituals, and science learning resources for junior high school as well as senior high school biology learning sources.

Keywords: biology education, science education, ethnobiology, indigenous people, customary knowledge

INTRODUCTION

Indonesia is a country with diverse tribes and cultures, and still existing till today. The Pesaguan Dayak people are the indigenous community who inhabit in the upstream of the Pesaguan Watershed, Ketapang Regency of West Kalimantan, Indonesia. These communities spread over three sub-districts, namely Tumbang Titi District, Lalang Panjang Village of Pemahan Sub-District, and the western of Sungai Melayu Rayak District (Tio, 2021).

The Pesaguan Dayak community still practices local traditions in utilizing plants and animals, and they interact closely with nature. The community performs the Dayak Pesaguan 'Nganjan', an annual customary ceremony of gratitude to God, where plants and animals are used as additional support for the ceremony. Unfortunately, most customary wisdom has not been known, including information on plants and animals used as traditional medicine, rituals, and food sources.

According to Darong et al. (2021), local culture is generated from humans' interaction with their natural environment. Local cultural values are the foundation and source of community ethics in interacting with nature (Thomas, 2015). The Pasaguan Dayak community carries out daily interaction of the Pasaguan Dayak community with their environment from generation to generation.

However, the availability of wildlife animal and plant species in Tumbang Titi District, Ketapang Regency is decreasing. Many people use plant and animal species for various purposes, and conservation efforts are limited. Modern culture and economic reasons contributed to the loss of natural resources and customary knowledge. Meanwhile, formal education does not support the knowledge, and the information is not well inherited from generation to generation.

Another main cause of species loss is deforestation, including forest fire, which contributes to the loss of genetic resources of endemic plants and animals associated with customary traditions. The opening of oil palm plantations, gold mining, and rubber plantations also disrupted the existence of endemic plant and animal species. Many people switch their jobs to become palm oil workers and mining workers.

The utilization of natural resource biodiversity for medicinal has long been used in Indonesia, especially for

people living in rural areas and communities living around the forests. Due to being very widely used, traditional medicinal need to get more attention and support by using appropriate science and technology in collaboration with universities, including with the community in the villages (Zuhud, 2021).

Indigenous people's knowledge of plants and animals shows biodiversity richness in West Kalimantan and provides information about Indonesia's cultural and natural richness. For education purposes, natural biodiversity can strengthen students' knowledge about nature, one of Indonesia's sub-topics of biology learning materials for students in grade 10 (Yuniastuti et al., 2021). Many learning materials in the surrounding Passaguan community village can support students in understanding school subjects.

A learning process is not only a knowledge transfer but also about how student practices in his daily purposes. Learning resources in science should come from the surrounding where the student lives (Wibowo, 2019). Students may easily get knowledge from their surrounding living areas to support their studies in class. This knowledge is generated from older family generations.

The author interviewed three biology teachers living in the study area. According to the teachers, students had never carried out learning activities using local knowledge, including knowledge of plants and animals used by the local community for medicine, food, or traditional rituals. The school learning material is only taken and entirely relies on textbooks providing examples of plants and animals outside of Kalimantan, especially Java and its surroundings.

This study aims to determine the types of plants and animals used for medicine, traditional rituals, and food by the Pesaguan Dayak community, Ketapang Regency, and explore potential use as biology learning materials.

METHOD

The research was conducted from June 2021 to February 2002. Data was collected with direct observation of the plants and animals used for medicine, traditional rituals, and food by the Pesaguan Dayak community, Ketapang Regency of West Kalimantan Province, Indonesia. Data observation was carried out at Pengatapan Rayak, Seimelayu Rayak, and Usaha Baru villages research sites. This study used 15 respondents from the Dayak customary council, customary leaders, shamans, and traditional community leaders representing the Dayak Tribes (Usaha Baru, Pengatapan, and Sei Melayu), village administrators, Empowerment of Family Prosperity (PKK), and other communities.

This research was developed using data triangulation techniques to enhance validity and in-depth picture of problem with observation, interviews, and documentation. The questionnaire used to conduct surveys, includes specific questions to obtain data on plant or animal species used by community. Interviews were conducted using open-ended questions to explore topics in depth, to understand processes, and to identify potential causes of observed correlations regarding the potential use of plants and animals as medicine, food, and traditional rituals.

The interview result was documented in a table datasheet used for quantitative and qualitative analysis. The quantitative analysis uses statistical validation tests, and the qualitative research uses score tests and additional information from the literature.

Identifying how local wisdom of plants and animals is used for customary rituals, medicine, and food may support school subjects by following its basic competencies of learning science for junior high school (SMP) and biology for senior high school biology (SMA). The data was taken with interview processes using provided questionnaires.

Information was documented and analyzed for the potential of their essential competencies as learning resources for junior high and senior high school. Three science teachers at junior high schools in West Kalimantan province were science teachers of SMPN 01 Sei Melayu and SMPN 2 Pemahan, and biology teachers of SMAN 01 Pemahan were used as data validators.

The collected data were analyzed descriptively following three activity paths: data reduction, data presentation, and data conclusion. Data reduction is carried out with a data selection process using an analysis of the feasibility of local materials used for junior and high school learning resources (Arikunto, 2010; Sudjana, 2012), namely:

(1) economic, the distance from the school is very close to learning resources,

(2) practical, the learning process is easy to implement,

(3) flexible, used for various learning purposes, and

(4) conformity with learning objectives, the components of learning resources conform to learning objectives.

This study used a formula to measure the feasibility of traditional knowledge adapted to the criteria for learning resources and converted the scores of the requirements for learning resources into the value of the quality of the feasibility of local materials, where $X = \sum x_n$, X is the average value of the criteria for learning resources, $\sum x$ is the total value of the learning resource criteria, and n is the number of indicators. The score and scale used for assessing the feasibility of local materials that have the potential to be a source of science and biology learning resources are shown in **Table 1**.

The range for assessing the feasibility of local materials that have potential as a resource of science and biology learning can be seen in **Table 2**.

Table 1. The criteria for assessing learning resources using local materials as science and biology learning sources

Rating score	Value	Description
4	Very economical	Very economical-The distance from the school is very close, 0-2.5 km
	Very practical	Very easy to implement
	Very flexible	More than two appropriate basic competencies
	Very fit with the purpose	The components of the learning resources are all following the learning objectives

Table 1 (Continued). The criteria for assessing learning resources using local materials as science and biology learning sources

Rating score	Value	Description
3	Economical	Distance from the nearest school is 2.6-5.0 km
	Practical	Easy to implement
	Flexible	Consists of two appropriate basic competencies
	According to the purpose	Some of components of learning resources have conformity with learning objectives
2	Not economical	Distance from the school is 5.1-7.5 km
	Impractical	Not easy to implement
	Inflexible	Only consists of one appropriate basic competency
	Not according to the purpose	Small number of components of learning resources have conformity with learning objectives
1	Very uneconomical	Distance from the school is very far, 7.6-10 km
	Very impractical	Very difficult to do
	Very inflexible	Not following appropriate basic competencies
	Very inappropriate with purpose	Components of learning resources do not have conformity with learning objectives

Note. Adapted from Arikunto (2010)

Table 2. Range of assessment of the feasibility of local materials as learning resources for science and biology

Rating range	Description
3.1-4	Strongly meets the criteria
2.1-3	Meets the criteria
1.1-2	Does not meet the criteria
0-	Strongly does not meet criteria

Note. Adapted from Arikunto (2010)

RESULTS

Based on the study, the Pesaguan Dayak community uses 22 medicinal plant species from 16 families, consisting of Fabaceae and Poaceae of 14% each, Asteraceae and Lamiaceae of 9% each, and other 12 families of 5% (**Table 3**).

In addition to plants, the Pesaguan Dayak people also use animals as medicine. Based on the observations, ten species

Table 3. Plants used as medicine

No	Species	Part & use	Processing method
1	Yellow bamboo *Bambusa vulgaris* (Poaceace)	Roots used to treat jaundice & appendicitis	Cleaned roots are boiled, & water is drunk
2	*Bako/Mentha arvensis L.* (Lamiaceae)	All parts to treat complications	All plant parts are cleaned & then boiled, & water is drunk
3	Onions/*Bawang jangkut* *Eleutherine americana* (Iridaceae)	Union bulbs are used to treat jaundice & furuncle	Bulbs are cleaned, burned, crushed, & attached to part of furuncle or can be eaten
4	*Belian/Eusideroxylon zwageri* (Lauraceae)	Leaves used to prevent hair loss	Young leaves or shoots eaten
5	Beluntas/*Pluchea indica (L)* (Asteraceae)	All parts of the plant used to treat body odor & fever	All parts are cleaned, cut, & boiled. Steam of boiled water evaporated throughout body
6	*Brotowali* *Tinospora crispa (L)* (Menispermiaceae)	Roots used to treat malaria, rheumatism, and lower blood sugar	Bertangas is an activity where a steam bath made of boiled leaves or spices is used to treat fever and overcome body odor
7	Ganda rusa *Justicia gendarussa* (Acanthaceae)1	The leaves used to treat headache	Roots were cleaned, boiled, & water drunk
8	*Kantong semar*/Nepenthes *Nepenthes mirabilis* (Nepenthaceae)	All parts of the plant are used in pain when giving birth, breast tumors, and headache	Take a few leaves and then heat on coals and stick to the head
9	*Paku sarang burung* *Aspelinum nidus* (Aspleniaceae)2	Leaves treat cancer and tumors	All parts of the plant are cut into pieces, dried, boiled with water, and the water drunk.
10	Patah kemudi/*Gynura segetum* (Compositae)	All parts of the plant to treat blood in the urine (hematuria), vomiting blood	All plant parts are cleaned, dried, boiled, and water drunk
11	*Patah tulang* *Pedilanthus pringlei* (Euphorbiaceae)	The sap of the plant to treat toothache	The sap applied to the aching tooth
12	*Pegagan/Centella asiatica* (Apiaceae)	Leaves overcome senile	Young leaves eaten right away
13	Red bananas *Musa sp* (Musaceae)	The banana trunk used to treat broken bones	The banana trunk burned and wrapped around the wound.
14	*Rumput benua* (Continental grass) *Eleusine indica* (Poaceace)	The root of the grass believes in helping to win a political case	The grass root recited a spell and stored in the person's body
15	*Sapu tunggal/Epipremnum sp.* (Araceae)	Root used to eliminate allergies	Root rubbed all over body while chanting a spell
16	*Secang/Caesalpinia sappan L.* (Fabaceae)	Roots & stems used to treat internal wounds	Roots cleaned, dried, & boiled, & water drunk
17	Sembung/*Blumea balsamifera* (Asteraceae)	Leaves used to treat colds and eye pain	Leaves boiled, hot water vapor inhaled and rapped all over the body

Table 3 (Continued). Plants used as medicine

No	Species	Part & use	Processing method
18	*Sirih bumi* (earth *sirih*) *Clerodendrum thomsoniae* (Lamiaceae)	Leaf used to treat urinary stones	Leaves boiled, and the water drunk
19	*Sisik naga* (dragon scales) *Drymoglossum piloselloides (L.)* (Polypodiaceae)	All parts of the plant used to treat jaundice	Plant boiled, boiled with water, & water drunk
20	*Tebu merah* (red sugarcane) *Sacharum sp* (Poaceae)	Stems to treat beriberi disease	Red sugarcane stem ground to smoother, the juice boiled, and water drunk
21	*Tuba/Derris elliptica* (Falbaceae)	Roots used to treat scabies	Roots cleaned, peeled, & rubbed on the skin affected by scabies
22	*Bajaka/Spatholobus littoralis*) (Fabaceae)	Roots used to treat colds & strengthen body	Roots cleaned, cut, & boiled, water drunk

Table 4. Animals used as medicine

No	Species	Use	Processing method
1	Sun bear *Helarctos malayanus* (Mammalia)	Part of animal (fangs bile) used as medicine	Fangs–how to use it is pretty simple: Drinking dripping water of bear fangs with warm water to treat stomach pain. Bile is a part of animal organs used as medicine by people with food poisoning
2	*Ular Sawah* (raticulated phytons) *Hemidactylus platyurus* (Reptilia)	Oil made from the snake used for massage oil, and wound healing	Fat oil is made from snakes
3	*Kura-kura* (turtles)/*Manouria emys* (Reptilia)	Oil made from the snake used for massage oil	Fat in a turtle is separated from meat, then heated in a frying pan, & filtered to get oil
4	*Landak* (Hedgehog) *Hystric brachyura* (Mammalia)	Hedgehog thorns used to treat colds	Hedgehog thorns dried, scraped off, then powder mixed with water, & applied to sick body part
5	*Tokek* (geckos)/*Gekko gecko* (Reptilia)	All parts used to treat asthma	Cooking the gecko meat that has been cleaned and to eat as medicine
6	*Biawak* (monitor lizard) *Varanus salvator* (Reptilia)	Bile of this animal is used to treat asthma, flu, hepatitis, and food poisoning	Bile drained, mixing it in water, and drank
7	*Ikan gabus* (Snakehead fish) *Channa striata* (Actinopterygii)	Cork mucus and its flesh used to treat diabetic wounds	Snakehead fish mucus (on skin) scraped & applied to wound. You can also eat cooked meat
8	*Ikan lele* (Catfish) *Claris batracus* (Actinopterygii)	Mucus from catfish used to treat diabetes wounds	Snakehead fish mucus on the skin scraped, and smeared directly on the wound
9.	*Cicak* (house lizards) *Hemidactylus platyurus* (Reptilia)	All parts of the lizard's body used to treat cancer	The cleaned lizard boiled, and the water drunk
10	*Tikus* (rats)/*Rattus rattus (Mammalia)*	All parts of baby mouse used to maintain healthy	Baby rats soaked in palm wine, & water drunk

used as medicine, including a Pisces class, namely snakehead fish (*Channa striata*) and catfish (*Claris batracus*), reptile class, namely raticulated phyton (*Malayopython reticulatus*), turtles (*Manouria emys*), monitor lizards (*Varanus salvator*), house lizards (*Hemidactylus platyurus*), and geckos (*Gekko gecko*), and mammal class, namely sun bears (*Helarctos malayanus*), hedgehogs (*Hystric brachyuran*), and rats (*Rattus rattus*).

More information about the types of animals used as medicine by the customary community can be seen in **Table 4**.

Plants are also used to support community rituals, including the event of harvesting season of agricultural products, funeral ceremonies, casting out evil spirits, and bathing newborn babies. There are 15 species of nine plant families used for community, as shown in **Table 5**.

Table 5. Plants used as traditional rituals

No	Species name	Traditional rituals	Rituals processions
1	*Bambu kuning* (yellow bamboo) *Bambusa vulgaris* (Poaceace)	Used for *Senggayong* customary dance music	Senggayong customary dance music is played by hitting the bamboo each other while harvesting the durian fruit.
2	*Pulai* (blackboard tree/ devil's tree) *Alstonia scholaris* (Apocynaceae)	Betama'/Death ceremonial	The dead body put into a coffin usually made of board material from the blackboard tree.
3	*Tengkawang* (*light red meranti*) *Shorea stenoptera* (Dipterocarpaceae)	Betama'/Death ceremonial	tengkawang tree trunk is crushed, called *lancing* used for the customary death ceremonial.
4	Tree barks of *tengkawang* *Shorea stenoptera* (Dipterocarpaceae)	Ribis/Death ceremonial	Ribis (cloth made of bark) used for ritual *gelegonding* ritual. There are three pieces of barks used *gelegonding* ritual.
5	*Pulai (blackboard tree/ devil's tree)* *Alstonia scholaris* (Apocynaceae)	*Bebukung*/Death ceremonial	Babukung means to make a bukung. Bukung is a ghost. Bukung dwells in a large tree of Pulai Tree (or the Tempajak Tree), so it is called *Bukung Gana Pulai* or *Bukung Gana Tempajak*.
6	*Kapua* tree (terap nasi or terap) *Artocarpus Elasticus (Moraceae)*	*Bebukung*/Death ceremonial	Bukung must wear a loincloth made from the bark of the Kapua tree.

Table 5 (Continued). Plants used as traditional rituals

No	Species name	Traditional rituals	Rituals processions
7	*Pakis Merah* (red fern) *Stenochlaena palustris* (Blechnaceae)	*Bebukung* custom Death ceremonial	Bukung must wear a *tekuluk jenjamut* (a headband made of red fern.
8	*Pisang* (bananas) *Musa paradisiaca L* (Musaceae)	Banana trunk Death ceremonial	Families who lose their family members will put banana trunks, complete with complimentary like the dead bodies such as banana trunks, rope mats, and a machete handle.
9	*Enau* (sugar palm) *Arenga pinnata* (Araceae)	*Mamatik tambariring* *Nganjan*	The customary chief will hang an ancak, a modified bamboo (like climbing an areca nut tree complete with prizes), then drip the tuak (fermented drink from palm trees) onto the ground while reciting a spell.
10	*Kelapa Muda* (young coconut fruit) *Cocos nucifera* (Araceae)	*Manumang* head' Nganjan ceremonial	Manumang head means to burn the head on the tumang stove. In ancient times, there were 48 human heads burned. But now, it's not a human head anymore, but changed with young coconut fruits.
11	*Umbut kelapa* (shoot of coconut tree) *Cocos nucifera* (Araceae)	Palalawat submission	Palalawat is an assistance from the community members to the family who organize manumang (manganjan) ceremonial, usually in the form of rice, palm wine, pork, chicken, including umbut of the coconut tree, and other consumption materials. The umbut of the coconut tree is the base of the undeveloped coconut shoot at the top of the coconut tree.
12	*Jarau* (bamboo) *Bambusa vulgaris* (Poaceae)	Cutting jarau	Jarau is a tree made of bamboo with decorations and branches with various gifts.
13.	*Daun Juang* (fighting leaf) *Cordyline fruticose* (Asparagaceae)	*Beturun mandi* (Customary bath ceremonial)	A customary midwife brings newborn babies to bathe in the river with spears, bracelets, shells, and fighting leaves to ward off evil spirits.
14	*Jahe merah* (Red ginger) *Alpinia purpurata* (Zingiberaceae)		A customary midwife brings the newborn baby to bathe in the river, complete with a spear, bracelet, and shell filled with turmeric and red ginger to eliminate the disease.
15	*Kunyit* (turmeric rhizome) *Curcuma longa* (Zingiberaceae)		

Table 6. Animals used in customary rituals

No	Species name	Traditional rituals	Rituals processions
1	Chicken *Gallus gallus domesticus* (Aves)	*Menyimah Tihang Sandung*	*Tihang Sandung* is a tall pillar where the body is buried, covered with chicken blood. While plucking the feathers on the neck of the chicken to be cut, the shaman (*batara*') will pray (*batotau*). The purpose of *batotau* is to ask for the smoothy of the implementation *kanjan serayung* ceremony (death ritual), avoiding diseases, fights, and others avoided in its implementation.
2	Turtles/*Testudines sp.* (Reptilia)	*Menyimah Tihang Sandung*	*Tihang Sandung* will be covered with chicken and turtle blood
3	Pigs/*Sus barbatus* (Mammalia)	Mystical symbol	Symbol of family bonding, a fending off to evil spirits
4	Dogs *Canis lupus* (Mammalia)	Mystical symbol	The sound of a dog barking is a sign of a spirit, and a dog's head is used as an offering in traditional ceremonies
5	Hornbill *Buceros rhinoceros* (Aves)	Mystical symbol	Bird's wing and tail feathers are used to decorate hats used in traditional ceremonies worn by Indigenous Peoples (*Demong*).
6	Rhinoceros hornbill *Aceros sp.* (Aves)	Mystical symbol	The Dayak people believe that the hornbill is a sacred bird. Therefore, the hornbill is not hunted arbitrarily, and this bird is a symbol of exorcising evil spirits.
7	Moluccan scops owl *Otus magicus* (Aves)	Mystical, the incarnation of a Spirit	This owl or Buak is believed to bring misfortune and a sign of someone dying in the village. This bird has different types of sounds, and there is a belief that one of the sounds of this bird brings calamity. The sound of this bird sounds like skin bones which means death.

Customary rituals applied within the community utilize seven species of animals, including the reptile class's turtles (*Testudines* sp.), the aves class's chicken (*Gallus gallus domesticus*), hornbill (*Buceros rhinoceros*), rhinoceros hornbill (*Aceros sp.*), and moluccan scops owl (*Otus magicus*), and the mammalia class's pigs (*Sus barbatus*), and dogs (*Canis lupus*) (**Table 6**).

There are ten species used as food in customary rituals, namely rice (*Oryza sativa*), pekawai (*Durio kuteijeinsis*), forest rambutan (*Castanea argentea*), areca nut (*Areca catechu*), caladium (*Caladium sp.*), cempedak (*Artocarpus integer*), pumpkin (*Cucurbita sp.*), cucumber (*Cucumis sativus*), and durian (*Durio zibethinus*) (**Table 7**).

The communities also use 13 animal species as food, and serve them in customary rituals, namely chicken (*Gallus gallus domesticus*), pig (*Sus barbatus*), dog (*Canis lupus*), deer (*Muntiacus muntjak*), monitor lizard (*Varanus salvator*), rice field snake (*Phyton reticulatus*), softshell turtle (*Dogania*

Table 7. Plants are used as food in traditional rituals

No	Species name	Customary ritual	Customary processions
1	Beras (Rice) *Oryza sativa* (Poaceae)	Offerings in the Kanjan Serayong Customary Ritual	There are three kinds of rice, namely tiny rice, big rice, brown rice, and black rice, used and processed into traditional food, namely *lemang*, and *emping*.
2	*Pekawai* *Durio kuteijeinsis* (Bombaceae)	Offerings in the Kanjan Serayong Customary Ritual	Offerings in the Kanjan Serayong Customary Ritual, namely fruits of pekawai (yellow durian), *linang* (forest rambutan), and *pinang* (areca nut).
3	Rambutan hutan *Castanea argentea* (Fagaceae)	Offerings in the Kanjan Serayong Customary Ritual	Offerings in the Kanjan Serayong Customary Ritual, namely fruits of pekawai (yellow durian), linang (forest rambutan), and pinang (areca nut).
4	Pinang *Areca catechu* (Arecaceae)	Offerings in the Kanjan Serayong Customary Ritual	Offerings in the Kanjan Serayong Customary Ritual, namely fruits of pekawai (yellow durian), linang (forest rambutan), and pinang (areca nut).
5	Keladi *Caladium sp* (Araceae)	Offerings in the Kanjan Serayong Customary Ritual	Vegetables from garden.
6	Langsat *Lansium domesticum* (Meliaceae)	Offerings in the Kanjan Serayong Customary Ritual	Offerings in the Kanjan Serayong Customary Ritual, namely fruits of pekawai (yellow durian), linang (forest rambutan), and pinang (areca nut).
7	Cempedak *Artocarpus integer* (Moraceae)	Mystical, the incarnation of a Spirit	This owl or Buak is believed to bring misfortune and a sign of someone dying in the village. This bird has different types of sounds, and there is a belief that one of the sounds of this bird brings calamity. The sound of this bird sounds like skin bones, which means death.
8	Labu (pumpkin) *Cucurbita* (Curcubitaceae)	"*Nyabit tahun*"	Pumpkins and cucumbers are scraped and eaten with other fruits harvested from the forest.
9	Mentimun (cucumber) *Cucumis sativus* (Curcubitaceae)		
10	Durian *Durio zibethinus* (Bombaceae)	*Tempoyak* and *lempok*	Flesh of durian fruit is separated from seeds & then sprinkled with salt and fermented in a tightly closed jar or made "*lempok*" by means of durian flesh being stirred & cooked.

Table 8. Animals as food in traditional rituals

No	Species	Used part	Customary processions
1	Chicken/*Gallus gallus domesticus* (Aves)	Meat	Animals are used as traditional food at large parties such as traditional wedding ceremonies and priests/shamans.
2	Pigs/*Sus barbatus* (Mammalia)	Meat	Animals are used as traditional food at large parties such as traditional wedding ceremonies and priests/shamans.
3	Dogs/*Canis lupus* (Mammalia)	Meat	Animals are used as traditional food at large parties such as traditional wedding ceremonies and priests/shamans.
4	Deer/*Muntiacus muntjac* (Mammalia)	Meat	Some Dayak people like to hunt, & deer are often used as a food.
5	*Biawak* (monitor lizard)/*Varanus salvator* (Reptilia)	Meat	Some Dayak people like to hunt, & monitor lizar is often used as a food.
6	*Ular Sawah* (rice field snake)/*Phyton reticulatus* (Reptilia)	Meat	Some Dayak people like to hunt, & rice filed snake is often used as food.
7	*Labi-labi* (softshell turtle)/*Dogania subplana* (Reptilia)	Meat	The meat cooked for food.
8	*Tupai ramping* (slender squirrel)/*Tupaia gracilis* (Mammalia)	Meat	The meat cooked for food.
9	*Kodok sawah* (rice field frog)/*Fejervarya cancrivora* (Amphibia)	Meat	The meat cooked for food.
10	*Monyet* (proboscis monkey)/*Nasalis larvatus* (Mammalia)	Meat	The meat can be processed into food or usually smoked to make it last longer.
11	*Udang kecil* (small shrimp)/*Acetes indicus* (Malacostraca)	All parts	Shrimp were cleaned, then sprinkled with salt & covered with a jar (fermented)
12	*Bekicot* (snail)/*Achatina fulica* (Gastropoda)	Meat	The meat cooked for food.
13	*Landak raya* (Great hedgehog)/*(Hystrix brachyura)* (Mammalia)	Meat	The meat cooked for food.

subplana), slender squirrel (*Tupaia gracilis*), rice field frog (*Fejervarya cancrivora*), monkey (*Nasalis larvatus*), small shrimp (*Acetes indicus*), snail (*Achatina fulica*), and great hedgehog (*Hystrix brachyura*) (**Table 8**).

All plants and animals used for rituals, medicine, and food by customary communities are also potentially developed as a source of learning biology materials under-recognized essential education level competencies (**Table 9**).

The assessment learning resources of materials used by the customary community were tested to see the acceptable value of these learning materials used in schools (**Table 1**).

The results of the assessment of learning resources on local materials as a source of science learning for junior high schools are shown in **Table 10**.

Table 9. Local wisdom and its potential as a source of learning biology

No	Local wisdom	Basic competencies
1	*Bertangas* or steam bath activities used derived from boiled beluntas vegetation species (Pluchea indica L.) help treat fever and overcome body odor	Class VII, KD 3.4; analyzing the concepts of temperature, expansion, heat, heat transfer, and their application in everyday life, including the mechanism for maintaining a stable body temperature in humans and animals
2	A "begondang" dance accompanies the rice harvest to welcome the fruit harvest season from the forest or the rice harvest season	Class VIII, KD 3.1; analyzing motion in living things, motion systems in humans, and efforts to maintain a healthy movement system
3	Red banana (Musa sp) stems are burned and then bandaged on the wounded body caused of a broken bone	Class VIII, KD 3.1; analyzing motion in living things, motion systems in humans, and efforts to maintain a healthy movement system
4	Yellow Bamboo Root (*Bambusa vulgaris*) is used to treat jaundice and appendicitis	Class VIII, KD 3.5; analyzing the digestive system in humans, understanding disorders related to the digestive system, and efforts to maintain a healthy digestive system
5	The fat of rice field snakes is made into oil to treat external wounds	Class VIII, KD 3.7; analyze a circulatory system in humans, understand disorders related to the circulatory system, and efforts to maintain a healthy circulatory system
6	Bile of the monitor lizard (*Varanus salvator*) has been used in treating diseases such as asthma and flu	Class VIII, KD 3.9; analyzing the respiratory system in humans and understanding disorders related to the respiratory system and efforts to maintain a healthy respiratory system
7	Earth betel leaves (*Clerodendrum thomsonae*) to treat urinary stones	Class VIII, KD 3.10; analyze the excretory system in humans and understand disorders related to the excretory system and efforts to maintain the health of the excretory system.
8	Snakehead fish mucus and meat are used to treat diabetes wounds	Class VIII, KD 3.10; analyze the excretory system in humans and understand disorders related to the excretory system and efforts to maintain the health of the excretory system.
9	Owls (*Otus magicus*) have different types of sounds, where there is a belief that one of the sounds of this bird brings misfortune. The sound of this bird is like skin bones which means death	Class VIII, KD 3.11; analyzing the concepts of vibration, waves, and sound in everyday life, including the human hearing system and the sonar system in animals
10	Semar bags (Nepenthes mirabilis) treat birth and breast tumors in all parts of the species	Class IX, KD 3.2; analyzing the reproductive system of plants and animals as well as the application of technology to the reproductive system of plants and animal
11	Small prawns are cleaned, then sprinkled with salt, and fermented in a jar	Class IX, KD 3.7; applying the concept of biotechnology and its role in human life
12	Durian flesh is processed into food by a fermentation process called "tempoyak" and "curry durian"	Class IX, KD 3.7; applying the concept of biotechnology and its role in human life

Table 10. The results of the validation of junior high school science learning resources

Aspect	Validator			Average
	1	2	3	
Economical	4	4	4	4.00
Practical	3	4	4	3.67
Flexible	4	4	4	4.00
According to the purpose	4	4	4	4.00
Total average				3.92

Based on the results presented in **Table 10**, it shows that school can use local materials as science learning resources with a value of 3.92 for the following reasons:

1. Very economical with a value of 4.00, where learning resources from schools are very close or less than 2.5 km.
2. Practical with a score of 3.67, where using these learning resources is easy to implement.
3. Very flexible with a value of 4.00, where learning resources derived from plants and animals have more than two appropriate basic competencies of learning materials.
4. Very suitable with the purpose, with a value of 4.00, where the components of the learning resources all conform to the objectives of learning science in junior high school.

According to Wahyuni (2015), local wisdom-based science learning can improve students' critical thinking skills. Local community wisdom has scientific value, and it can be used as a source of learning science (Jufrida et al., 2018). The use of learning resources derived from plants and animals commonly used by the Pesaguan Dayak community can help junior high school students living around Dayak community settlements develop critical thinking skills and scientific knowledge. According to Utari et al. (2021), plants and animals used in traditional ceremonies are also relevant as science material for junior high school students. The senior high school's study about classification of living things, plant structure and its function, interaction of living things with the environment, the motion of objects and living things in the surrounding environment, and reproduction of plants and animals. The assessment of learning resources on local materials as a source of high school biology learning is shown in **Table 11**.

Table 11. The results of the validation of high school biology learning resources

Aspect	Validator			Average
	1	2	3	
Economical	3	3	4	3.33
Practical	4	4	3	3.67
Flexible	4	4	4	4.00
According to the purpose	4	4	4	4.00
Total average				3.75

Based on the results of the potential assessment learning materials as a senior high school biology learning resource presented in **Table 11**. Based on the assessment, a school can use local wisdom as a learning resource with a value of 3.75, with the following details:

1. Economical with a value of 3.00, where learning resources from schools are pretty close, between 2.6-5.0 km.
2. Practical with a score of 3.67, where using these learning resources is easy to implement.
3. Very flexible with a value of 4.00, where learning resources derived from plants and animals have more than two appropriate basic competencies of learning resources.
4. Very suitable with the purpose with a value of 4.00, where the components of the learning resources follow the high school biology learning purposes.

Students can use plants and animals as learning materials for junior high and senior high schools regarding economy, practicality, flexibility, and learning objectives to the expectations of junior and senior high school biology. Based on the validation test presented in **Table 10** and **Table 11**, the availability indicator of junior high school biology learning resources with a score of 3.92 or higher than the availability indicator of high school biology learning resources with a score of 3.75. Both junior and senior high school's locations are very economically where science learning material for junior high school is closer than high school to the presence of plants and animals as a source of learning biology.

DISCUSSION

The use of medicinal plants has been carried out since ancient times. It can even be considered the origin of modern medicine, where compounds of plant origin are an essential source of compounds for therapy (Manzano et al., 2020). Dayak Pasaguan community uses plants as medicine by utilizing all plant parts, from the roots to the leaves, and each part of the plant is believed to have its benefits.

The leaf is part of the plant that produces energy from photosynthesis and is mainly used as medicine (Purwanti, 2019). Having many plant leaves, people can take leaves without damaging other parts of the plant to grow and develop. One example of leaves as medicine is *Clerodendrum thomsoniae*, a species of flowering plant in the genus *Clerodendrum* of the family lamiaceae. People use the leaf to treat urinary stones and prefer to make boiled leaves water rather than eat the leaves directly. According to Supriyanto et al. (2021), solutes will accelerate the body's metabolic processes.

The World Health Organization (WHO) estimates that 80% of the world's population depends mainly on animal and plant-based medicines. The Pasaguan Dayak community used several types of animals for their generations as medicine to heal human diseases. The animals used as medicine, such as reptiles, bears (*Helarctos malayanus*), hedgehogs (*Hystric brachyuran*), and monitor lizards (*Varanus salvator*). Some animals are now difficult to find in the Dayak community living area because their habitat is damaged due to forest fires used for clearing fields. People also cut trees, practice gold mines, and converted forests for oil palm plantations. Types of rodents such as rats (*Rattus rattus*) are also used as medicine by drinking water soaked in red rats in "tuak" (a traditional drink from fermented palm trees). The general public does not commonly use this method, but it has become familiar and has proven effective in increasing the endurance of the Dayak community.

The Pasaguan Dayak community has several traditional ritual events, and one of the most frequently performed traditional rituals is the death customs, called "Nganjan". This tradition is a sign of last respect to the dead family. The coconut species (*Cocos nucifera*) is commonly used in traditional Nganjan rituals known as "*menumang* heads" or burning the head on a *tumang* stove. In ancient times people burned the human head but now changed with a young coconut fruit. It shows that local wisdom is a positive value that prioritizes elements of harmony and balance between the needs of society and nature (Kusuma, 2018). Young coconut fruit is also commonly used in many places in Indonesia for certain religious ceremonies, including as one of the means of carrying out religious traditions for Hindus in Bali (Pratiwi & Sutara, 2013). The coconut tree is also a versatile tree used for various purposes. According to Kpode et al. (2021), the coconut tree in which its parts are used for multiple purposes, including for food, construction, traditional medicine, and traditional ceremonies.

The bond between humans and nature is demonstrated in the tradition of the Pesaguan Dayak community, known as the annual "*Nyapat* Year" or Great Harvest events. This ritual is a year-end thanksgiving marked by a procession of fruit and vegetable harvests from the forest accompanied by *seggayong* music. This musical instrument is made of bamboo (*Bambusa vulgaris*). Other indigenous peoples in Indonesia also use bamboo for different purposes. The Dayak Kanayatn indigenous peoples in Saham Village of Landak District use bamboo species of *Gigantochloa atter*, *Bambusa eutuldoide*, and *Schizostachyum brachycladum* for traditional ceremonies (Munziri et al., 2013). People around Puri Ubud and Payangan of Bali Province-Indonesia also conserve species of bamboo

that are useful for traditional ceremonies and usada (treatment) (Arinasa, 2014).

The Pesaguan Dayak people still believe in mysticism, and 71.43% of them use animals as mystical symbols in certain traditional rituals. Several animals are used as mystical symbols, including the hornbill (*Aceros sp.*), which is believed to be a sacred bird that is a symbol of exorcising evil spirits. The owl (*Otus magicus*) is believed to symbolize a harbinger of impending death. The belief can help to protect the species from hunting activities, and this prohibition maintains the availability of animals that function as mystical symbols. The availability of turtles (*Testudines sp.*) and hornbills (*Buceros rhinoceros*) is limited because people still hunt them for food. Based on the research of Rukeh et al. (2013), Nigerian culture contributes to conserving natural resources by representing natural spirit such as rocks, trees, and forests, also respecting God. These traditional beliefs help preserve the environment and biodiversity conservation through sacred forests. The conditions in the Pasaguan Dayak tribe in West Kalimantan-Indonesia, are not much different from those in Nigeria.

Indonesia has a lot of forest resources richness. People have used plants for their daily needs, including as food sources (Andesmora et al., 2017). In the study area, people can take pekawai (*Durio kuteijeinsis*) and durian (*Durio zibethinus*) from the forest and consume them as fruits. The harvesting of the fruit is through a traditional procession known as "panen rayak or mass harvesting" during the harvest season. The Pesaguan Dayak community carries out a customary ceremonial at the main Durio tree in the forest to respect for ancestors. After the procession, people are only allowed to pick fruit such as forest rambutan (*Castanea argentea*), cempedak (*Artocarpus integra*), and other fruit trees grow in the forest. Harvested fruit is then paraded to the community with the accompaniment of senggayong music and consumed by the community with other foods. Other foods derived from plants, including bamboo shoots/saplings (*Bambussa vulgaris*) used as vegetables and served during a communal meal. Some food is also prepared with the fermentation process, such as durian (*Durio zibethinus*) processed into "tempoyak" and "lempok", durian fruit which is processed through a fermentation process and can be stored for a longer time.

The Pesaguan Dayak communities use animals for medicine. Besides medical purposes community also use animal as a source of food, such as bears (*Helarctos malayanus*), hedgehogs (*Hystric brachyuran*), and monitor lizards (*Varanus salvator*). The Pesaguan Dayak community also processed some animal species into food, such as rice field snakes (*Phyton reticulatus*), rice field frogs (*Fejervarya cancrivora*), proboscis monkeys (*Nasalis larvatus*), and snails (*Achatina fulica*). A proboscis monkeys (*Nasalis larvatus*), its meat can be processed into smoked meat. This species is currently prohibited from hunting by the local government, protected by law. Because the community often hunts deer (*Muntiacus muntjak*), it is not easy to find and needs protection. Wildlife depletion through overhunting is closely linked to food security and community livelihoods as many forest-dwelling or forest-dependent people have few sources of protein and few alternative incomes (Vliet et al., 2012).

Human activities have pushed plant species toward extinction a hundred to a thousand times faster than average. One way to prevent extinction is to promote a better knowledge of plant species to contribute to the success of conservation efforts, such as protecting more land for wildlife and tree species conservation. Actual actions are needed, and they can start from what is already known to prevent the extinction of plants, including animals (Pimm, 2019).

A student should know about endemic plants and animals, and the knowledge has to be transferred from the older generation to the younger generation. Knowledge of exotic species significantly affects local biodiversity in Argentina; 9-17-year-old students in San Juan learn about native and exotic species, the diversity of native wild species, and their importance to ecosystems (Nates, 2010).

The experience of Argentina may be relevant to Indonesia, where plants and animals used for medicine, traditional rituals, and food also have potential as learning resources for science and biology. For Indonesia, the Pasaguan wisdom in using local plants and animals is relevant to the 8th-grade science material with the typical Pesaguan Dayak dance, including a Senggayong Bedansai, traditional Nganjan dance. According to one of the basic competence indicators (KD) 3.1 class VIII and KD 3.5 Class XI, a human movement system. The typical dance movements of the Sungkai tribe (in Lampung Province of Indonesia) are functioning human limbs such as the feet, hands, and fingers. According to Wibowo (2022), the ability to perform body movements in humans is supported by a movement system resulting from harmonious cooperation between organs of the motion system, such as the skeleton (bones), joints, and muscles.

High school biology learning is a continuation of the material learned in junior high school. Local wisdom for class X can be used as a source for high school biology learning as referred to KD 3.2-analyzing data from observations of various levels of biodiversity (genes, species, and ecosystem) in Indonesia.

Some of the potentials of local wisdom include the root of bajaka (Spatholobus littoralis) to treat flu and boost immunity. Kapua (*Artocarpus elasticus*) is a tree species belonging to the moraceae family. The trunk can be used as a building material, while the tree's bark can be used as clothing (loincloth). It is also relevant to high school biology teaching materials regarding the role of biodiversity in everyday life (Krismanto & Yusniastuti, 2021).

The validation analysis results of this study also showed that endemic plants and animals living in the wild have potential as medicine, food, and rituals and can be used as a source for learning science in junior and biology in senior high schools.

CONCLUSION

Plants used as medicine consist of 22 species of medicinal plants from 16 families, most of which belong to fabaceae and poaceae family, followed by asteraceae and lamiace and then 12 other families. Animals used as medicine include the pisces class, namely snakehead fish (*Channa striata*) and catfish (*Claris batracus*). The reptile class consists of snake (*Phyton reticulatus*), turtles (*Manouria emys*), monitor lizards (*Varanus*

salvator), house lizards (*Hemidactylus platyurus*), and geckos (*Gekko gecko*). Class mammals, namely bears (*Helarctos malayanus*), hedgehogs (*Hystric brachyuran*), and rats (*Rattus rattus*).

The plants used in traditional rituals consist of 15 species that have the potential for customary rituals. These rituals use six species of animals. They are reptile class, namely turtles (*Testudines sp.*), aves class, namely chickens (*Gallus gallus domesticus*), hornbills (*Buceros rhinoceros*), hornbills (*Aceros sp.*), and mammals class consist of pigs (*Sus barbatus*) and dogs (*Canis lupus*).

Customary communities as indigenous peoples also use plants as food served at traditional ritual events, namely rice (*Oryza sativa*), pekawai (*Durio kuteijeinsis*), forest *rambutan* (*Castanea argentea*), *pinang* (*Areca catechu*), *keladi* (*Caladium sp.*), *cempedak* (*Artocarpus integer*), pumpkin (*Cucurbita sp.*), cucumber (*Cucumis sativus*), and durian (*Durio zibethinus*).

There is some potential for indigenous food found in 13 animal species of 13 families. Theye are chickens (*Gallus gallus domesticus*), pigs (*Sus barbatus*), dogs (*Canis lupus*), deer (*Muntiacus muntjak*), monitor lizards (*Varanus salvator*), rice field snake (*Python reticulatus*), softshell turtle (*Dogania subplana*), slender squirrel (*Tupaia gracilis*), rice field frog (*Fejervarya cancrivora*), monkey (*Nasalis larvatus*), small shrimp (*Acetes indicus*), snail (*Achatina fulica*), great hedgehog (Hystrix brachyura).

Ethnobiology research results on plants and animals that have the potential as medicine, food, and rituals can be used as a source of learning material for junior high school and senior high school. There is a need for further research on ethnobiological studies on other Dayak tribes in West Kalimantan to protect natural resources.

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