



Local wisdom in agriculture for environmental sustainability: A case study of the Dusun community

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Local wisdom consists of beliefs, and local knowledge inherited from one to another generation practiced in agricultural activities for the prosperity and harmonious relationship between human beings and other living beings in the surrounding. This study aims to identify the belief elements and local knowledge of the Dusun community in the rural area of Sabah, Malaysia in agricultural activities related to environmental sustainability. The study was conducted using interview and observation methods. All the collected data was analyzed, coded, and interpreted. There are seven main items which can be highlighted through this study. They are as following; no trees should be cut down to open agricultural land, animals should not be treated roughly, crops should be well taken care of, forest burning is done using the right technique, use barriers or dig a hole to withstand black soil from eroding to the bottom section, using natural materials to prepare compost and organic pesticides, and finally to plant crops with strong roots at the slopes. Those in their 50s are still proudly practicing their local knowledge in agriculture; besides helping to sustain the environment. Thus, we find that it is important to highlight this study on local wisdom since it is in line with sustainable development and environmental management in this 21st century.

Key words: *Local Beliefs And Knowledge, Agricultural, Dusun Community, Nature Conservation.*



Introduction

Environmental issues are often discussed at many levels either nationally, regionally or even globally. Unmanaged nature gives implications to the social environment, economics and politics of a country. Giddens (2000) admits that both the development of a country and the physical environment influences the social landscape of a country. As a part of global issue, Malaysia plays a role in contributing ideas gained through the experience of negotiating in Multilateral Environment Agreements (MEAs) to help the efforts of all parties in realizing sustainable development especially in Malaysia, and generally in a global scale (Muhammad et al., 2014). The global initiative in protecting the environment must be strengthened through the involvement of all levels of society especially the rural society. Unique cultural heritage which are inherited from the ancestors are significant factors in helping to sustain the environment in the rural area.

The local wisdom is also known as the traditional knowledge and natural wisdom which is a unique knowledge related to the culture of a community (Flavier, 1995). Anthropologist like Koentjaraningrat (2000) and Geertz (2008), state that there is a close relationship between local wisdom with the traditional culture of a society. Culture is a behavioural pattern which connects the human community with the ecological environment. The lifestyle of a community consists of technology and a form of economic organization, settlement pattern, beliefs, religious practices and more. Zulkarnain and Febriamansyah (Raden et al., 2011), define local wisdom as principles and certain ways which are upheld, understood, and applied by a local community in interacting within their surroundings, in addition transforming them into a value system and customary norms. According to Hornby (Alidri, 2016), local wisdom is built and developed spontaneously in a community or at certain time. Local wisdom owned by a community can determine the dignity of mankind in a community he or she represents due to the wisdom, creativity, and idea becoming a determining factor of the development of human civilization (Evelina, 2016). This is in addition to symbolizing the stage of a race's civilization represented by the community.

Local wisdom is closely related to the positive behaviour of human in adapting to the environment. This statement suits the opinion of Nitty et al. (2016), who states that the local wisdom is a result of knowledge accumulated through observations and environmental experiences by a community group related to the situation. Such perception is associated with values of religion, beliefs, rituals, customs and traditions, taboos, and local culture which organizes human lives with the environment (Imam, 2009). The beliefs and local knowledge act as a medium in dealing with agricultural activities. At the same time, elements of the beliefs and knowledge help in protecting nature from disasters. The traditional society believes that their surroundings are inhabited by both humans and also invisible beings. The invisible beings should be respected to avoid any kind of harm towards humans and crops.



Thus, clearing of lands for agricultural purposes should be done appropriately for the sake of well-being and harmony of the inhabitants of the natural surroundings. Intrusions of a land, as one pleases can fuel the rage of nature. This rage of nature is seen through natural disasters which can only be restored by a society which has local and ecological wisdom of their place (Raden et al., 2011).

The African indigenous community in Sankana and Tong-Tengzuk of north Ghana (Francis& Issifu, 2015), fishing community in the Tinjil Island of Indonesia (Uyeda et al, 2014), the Baduy community of Bentan Indonesia (Raden et al., 2011), and the society living in the Ban Nong Hua Khon forests of Thailand (Suchart et al., 2010), protect the nature at their settlements through local wisdom inherited from one generation to another. For instance, the Baduy community assesses the types of soil, the content of humus and the inclination of the slope while choosing new agricultural land (Raden et al, 2011). The types of soil and content of humus are closely related to soil fertility to avoid usage of chemical fertilizers; while the inclination of the slope is related to prevention of natural disasters. The Baduy community does not cut down big trees in agricultural land to avoid land erosion. To avoid the humus soil from being washed away by the rain, the terracing of slopes is done using pieces of wood.

The beheading practice by the Dusun community a long time ago is also seen as being significant with the local wisdom on agriculture. Phelan (2001) tells about the beheading ceremony known as *magang* or *manangod* in the Dusun community, believed to have a spirit which could provide prosperity and fortune to the farming community. Phelan also mentions that a part of the decapitated head will be kept or hung in a hut used for rice storage for the purpose of its protection. Minah (2014) claims that the farmers hope that the spirit from the decapitated head will keep away any disease from their crops, as well as prevent wild animal attacks and natural disasters. Farmers who do not own modern technology rely on this belief for the treatment of crops. Theoretically, the tradition of beheading avoids environmental pollution caused by pesticides and chemical fertilizers in addition to avoiding long drought, hurricanes, and continuous rain which brings negative implications especially to the farming community and nature generally.

The Dusun community in Tambunan, Sabah believes that food elements such as eggs, *tapai* (toddy made from rice), rice, betel leaves, fruits and others could protect rice from being eaten by small animals like rats (Zamawi, 2001). These foods are left on the harvested rice. They believe that the elements of the food will hinder the pests (especially rats) from eating the harvest. Besides, the animism belief is taken into consideration during the opening of a new agricultural land, such as chanting of spells (Hanafi, 2005). The spells are recited by a shaman for the purpose of requesting the land spirit to move to another place as the land is



soon to be developed by the owner. The recited spells are believed to free the agricultural land from disturbances of evil spirits and protect the soil from pest attacks.

In this 21st century, studies regarding local wisdom in agriculture and sustainability of environment are still considered relevant. Nakashima et al. (2002) verifies that local wisdom is the foundation in local food production in many developing countries. For instance, the study *Institute Lazare Sehoueto Kilimandjaro* (Benin) proves that local food production in many developing countries are represented by small scale farmers who use local wisdom as the main knowledge resources in the production of 70 to 90 percent of agricultural products. Article 8 (j), *Convention on Biodiversity* (1992) in Rio reaffirms the indigenous society's rights to defend the local wisdom especially in the preservation of biological diversity, continuous usage of its components, and usage of genetical resources to be shared fairly with the community (Neilson & Spencer, 2012).

The Dusun community residing at the foot of Kinabalu Mountain are rural farmers of Sabah, Malaysia who have been practicing the environmental sustainability while practicing agriculture activities. The term 'Dusun' itself describes the society living in that area. Rutter (1985) and Dayu (2008), relate the term 'Dusun' with the villagers living at the foothills, rural areas and practicing agriculture. Generally, the Dusun ethnic uses the environment they reside as agricultural land by traditionally planting various types of rice, fruits and vegetables (Pugh- Kitingan, 2012). The Dusun farming community who are living at the foot of Mount Kinabalu are skilful in the plantation of hillside paddy, various types of potatoes, and highland vegetables.

A small number of farmers belonging to the Dusun community especially the older generation who are living in the same area still hold on strongly to the traditional beliefs such as spirits of the forest, trees, and other natural elements as the factors influencing the growth and fertility of crops, prevention of natural disasters, and liberating humans from any mishaps while doing agricultural activities (Minah, 2013). They have to protect and respect the nature such as forests, rivers, mountains, valleys and others because nature is significant with the continuation of their lives as farmers. For instance, lands are explored for plantation purposes, rivers as sources of drinks and watering plants, and forest products as source of food, as well as equipment for houses and plantations.

The aim of this study is to discuss the local wisdom in agriculture for the Dusun community in rural areas in sustaining the environment based on the following questions:

- (1) What are the elements of beliefs in agricultural activities which could help in sustaining the environment?;
- (2) What is the local knowledge in agricultural activities which could help in sustaining the environment? and

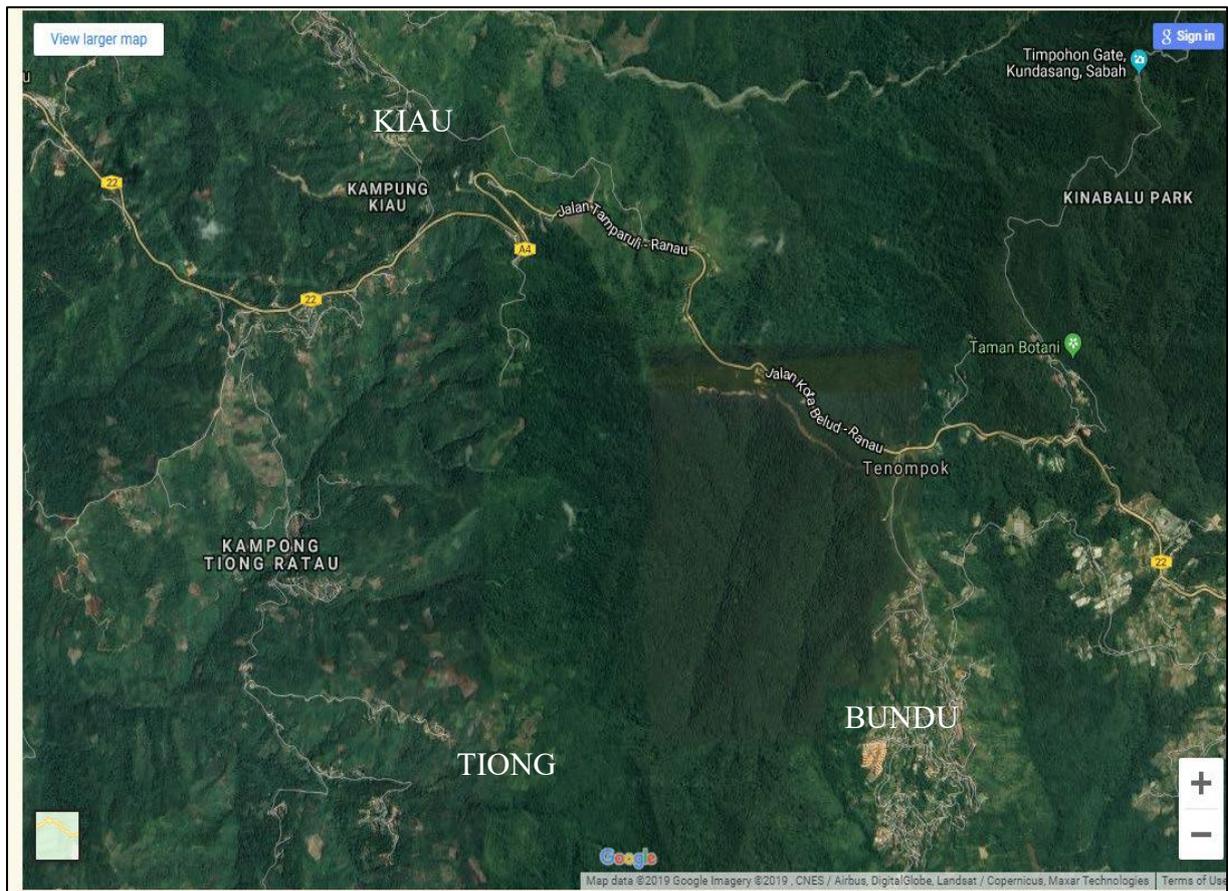
(3) How are beliefs and local knowledge practiced by generations of farmers in agriculture?

Methods

Study area

This study was conducted in three villages at three districts located at the foot of Mount Kinabalu which are Bundu Tuhan (Ranau district), Kiah Nuluh (Kota Belud district) and Tiong Gondohon (Tuaran district).

Fig. 1. Location of all three research areas at the foot of Mount Kinabalu.



Source: Adapted from “Map of Mount Kinabalu in Bundu Tuhan area” by maplandia.com,
<http://www.maplandia.com/malaysia/sabah/bundu-tuhan/parks/mount-kinabalu/>

All three villages are inhabited by the Dusun community who have been conducting traditional agricultural activities for a long time. Burrough (1978) explains that the Dusun community in Bundu Tuhan has been practicing traditional activities such as the plantation of hillside paddy, corns, cassava, sweet potatoes, sugar canes, coffee, and tobacco in the cleared forest area. According to Burrough, the community in the village began planting highland



vegetables such as tomatoes, lettuce, *pi-tsui*, beans, potatoes, capsicums, leeks, cauliflowers, carrots and rhubarb around the year 1955. The cultivation of highland vegetables in Bundu Tuhan have become commercial agricultural plants (Vincent et al, 2017), in addition to pineapple plantations (Suraidah, 2018) at Kiau Nuluh. Based on our observations, Tiong Gondohon farmers also plant rubber trees for commercial purposes.

All three villages had experienced a mild vibration as the effect of an earthquake measuring 6.0 on the Richter scale, which took place at Mount Kinabalu on 5th June 2015 (Bernama, 2015). The Dusun community living around the foot of Mount Kinabalu believe that the supernatural protector of the mountain protected the people who lived around the area from a natural disaster (Pak Roshan, 2015). There was no loss of human or animal life, and no destruction of property, damage of crops, or agricultural soil erosion. Local wisdom is based on the traditional beliefs known as *monolob om monogit Akinabalu* (rituals to recover the effect of hidden danger and to restore the hot climate back to cold) which has been practiced to communicate with the supernatural elements in order to forgive the misbehaviour of human beings and to protect people who live in the community (Dewina, 2015).

Study participants

Participants were identified from locations which experienced the vibration of the earthquake at Mount Kinabalu in 2015. This was done through online newspapers (Berita Harian and Sayang Kinabalu). We collected the telephone numbers of all three presidents of the Village Security and the Development Committee (JKKK) through a commonly known friend. All three presidents were contacted and informed about the purpose of the research. Appointments to interview the informants were fixed by the president of JKKK at the house of one of the informants in every research location. The criteria to choose informants include:

- (1) Farmers of Dusun ethnicity;
- (2) Has been working as a full time farmer, in the research locations, for not less than 30 years; and
- (3) Has experiences in traditional agriculture.

The number of informants is thirteen, 4 females from Bundu Tuhan, 2 females and a male from Kiau Nuluh, as well as 2 females and 4 males from Tiong Gondohon village. Ages of informants are within 50 to 84 years old. Informants' identities were kept secret and only labelled as informant B1, B2 and so on in addition to abiding to the ethical principles in research (Table 1).

Table 1: Informant Demography

Informant	Sex	Location	Occupation	Age
B 1	Female	Bundu Tuhan, Ranau	Farmer	77
B 2	Female	Bundu Tuhan, Ranau	Farmer	77
B 3	Female	Bundu Tuhan, Ranau	Farmer	84
B 4	Female	Bundu Tuhan, Ranau	Farmer	50
K 5	Female	Kiau Nuluh, Kota Belud	Farmer	69
K 6	Female	Kiau Nuluh, Kota Belud	Farmer	74
K 7	Male	Kiau Nuluh, Kota Belud	Farmer	50
T 8	Male	Tiong Gondohon, Tuaran	Farmer	65
T 9	Male	Tiong Gondohon, Tuaran	Farmer	78
T 10	Female	Tiong Gondohon, Tuaran	Farmer	58
T11	Male	Tiong Gondohon, Tuaran	Farmer	57
T 12	Male	Tiong Gondohon, Tuaran	Farmer	54
T 13	Female	Tiong Gondohon, Tuaran	Farmer	53

Data collection and analysis

Field research is a suitable method for an ethnography research. Further, we will obtain information from the answers and the ways informants react, besides being able to observe the surrounding of the location (Spradley, 1997). Field research helps in judging the trustworthiness and validity of information when doing repeated observations on the researched phenomenon, besides encouraging active participation in judging whether the interpretation explained is as what they have meant (Othman, 2009). Data is collected using partially structured interview method and observations (Othman, 2009). Some of the questions were prepared earlier are forwarded during interviews. However, we are free to further explore the answers informants provide through further but minimum prompting questions.

The language used in interviews is simplified based on the understanding of informants who are aged farmers and lacking in formal education. Interviews were held in groups according to the villages. The purpose of having a group interview was to allow the informants to remind and correct each other's information regarding local wisdom in agriculture which could help in sustaining the environment. Meanwhile, the observation method involved observing geographical location, plantations areas, non-verbal events and informants' behaviours. Observation is one of the methods used to obtain information in understanding events which took place around us, both consciously and unconsciously (Chua, 2006). We

went to the plantation fields to watch how informants practice agricultural activities (Table 2). Some of the information which garnered close attention was:

- (1) the location of orchards/plantation fields;
- (2) Tress around orchards/plantation fields;
- (3) Working methods of farmers in the orchards/plantation fields;
- (4) Types of mixed crops planted in the orchards/plantations; and
- (5) The interaction of farmers with crops (talking, caressing, whistling, singing, reciting poetry and eliminating the pests). Both visual recordings and photographs were done during the interviews and observations (Fig.2).

Fig. 2. Observing the orchards and plantation fields at the research locations (local wisdom in agriculture to sustain the environment) at the foot of Mount Kinabalu. A) trees are left to grow in between the plantation fields; B) farmers uproot grasses among rice plants using traditional methods while talking to the rice plants; C) lay the barriers in steep areas; D) help researchers to observe while interviewing the informants; E, F) highland vegetables planted as companion planting.





Source: Minah S., Joseph, A.D.

The data analysis in qualitative research consists of data preparation and organization which requires the creative and intellectual process of researchers (Rasid & Raman, 2012). The data, which is given themes during the coding process, will be represented in the forms of charts, tables or discussions (Creswell, 2007). Initially, we would listen to the video and audio recordings of the interviews a few times. This is followed by transcribing the interviews word by word. We would read the transcriptions repeatedly and isolate information by looking for units of meanings in words, phrases, sentences, thinking styles of research informants, and other details which were noticed during observations. We code each piece of information found and relevant to the research questions. This is in line with the explanation by Rasid & Raman (2012), the final phase of analysing data is giving an interpretation, which is to involve the process of providing meaning and value to the analysis, explaining relationship forms and patterns, in addition to the connection and origins of the emerging dimensions.

Results

Data from observations and interviews regarding local wisdom in agriculture can be seen in Table 2 and Table 3.

Table 2: Details from observations at Bundu Tuhan, Kiau Nuluh and Tiong Gondohon villages.

Details	Bundu Tuhan	Kiau Nuluh	Tiong Gondohon
Location	Located in hill	Located in hill slopes	Located at hill slopes
orchards/ plantation fields	slopes with inclination within 25° - 30°	with inclination Within 30° - 50°	with inclination within 30° - 50°
Types of plants	Highland vegetables and hillside paddy	Pineapples, bananas, hillside paddy, onions, cucumbers and local fruits	Rubber, bananas, hillside paddy, corns, cucumbers, Pumpkins, and local fruits
Trees around orchards/ plantation fields	Secondary plants like bamboo and soft-stem plants	Secondary plants like bamboos, and soft and hard stem plants	Secondary plants like bamboos, and soft and hard stem plants
Ways to work on the orchards/plantation fields	Use traditional equipment (blunt machete, machete, hoe, rake, spade) and modern (tractors, grass cutters)	Use traditional equipment (blunt machete, machete, hoe) and modern (tractors, grass cutters)	Use traditional equipment (blunt machete, machete, hoe) and modern (tractors, grass cutters)
Interaction of farmers with crops	Talking with vegetables while uprooting grasses and throwing away the caterpillars (heard curses about caterpillars eating the vegetables)	No observations	Talking with the rice plants while weeding and stripping off the paddy leaves

Secondary plants were left to grow around the plantation fields, especially at the water source area at all three research locations (Fig 2A). Most farmers still use traditional equipment such as machetes, hoes, and spades in agricultural activities. Heavy equipment such as chainsaws are used while cutting down trees and grass cutters are used at rubber estates.

Table 3: Excerpt from interviews of informants related to their beliefs and local knowledge in agriculture.

Informants	Interview Excerpts
K5	Do <i>gawoi</i> prior to opening new land for agriculture. I managed to do <i>gawoi</i> . I don't have a religion. It means clear a small area. Request <i>Kinorohingan</i> for a dream that night.
K6	Yes, do <i>gawoi</i> first. The purpose is to chase the evil spirits on the soil. Request for a dream that night.
B1	Do <i>gawoi</i> on the land which is going to be cleared. Clean up a small area and request for a dream.
B2	Trees are not cut down during <i>gawoi</i> . Request for a dream from <i>Kinorohingan</i> that night.
B3	Do <i>gawoi</i> . The cleared area can fit only one person.
T10	The elders always mention about doing <i>gawoi</i> but I can't recall the methods.
T8	Yes. Our elders used to do <i>gawoi</i> too.
T9	Do <i>gawoi</i> before opening a new plantation. There are spells to be chanted. Request for a dream that night from <i>Kinorohingan</i> . If it is a good dream, the clearing of land can be continued.
T10	Do not cut down all trees while clearing the land. Leave three trees.
T11	Leave a few trees.
B2	Leave one or two trees.
T12	Before setting fire, clear around 3 to 6 feet of space around the plantation field to prevent fire from spreading into the forest.
B2	Clear the plantation field first. Set fire in the evening or morning.
T9	The fire can be set even in the evening. Burn according to the opposite wind direction to avoid fire from spreading into the forest.
T8	If you want to avoid fertile soil to erode, lay woods horizontally in between stumps.

T11	I dig holes at the bottom part of the steep section. Soil would erode into holes, if it rains.
	I have planted fruit trees and sweet potatoes there.
B4	I use compost from grasses. I put them into the soil.
B2	I make my own pesticides. I use dried chilies and garlics. Pound and soak them for a week before using.
B4	I also do my own pesticides, I use dried chilies, tobacco leaves and lemongrass.
K7	The land is steep in this village. So, we plant lemongrass, bamboo and fruits at river banks to prevent landslides.
K5	We used to plant <i>yoyogi</i> . The leaves can fertilize the soil.
T13	We do not cut down the trees at the river banks. We plant lemongrass and bamboo at steep areas.
B4	I use <i>gagamas</i> to throw away grasses, while looking closely and talking to at cabbage leaves.
B2	I also talk to plants. If I accidentally cut a paddy stalk, I would say, "Pity you, paddy. Don't be upset. Grow well."
B1	Do not be rough if you are chasing away the birds eating the rice. Take some soil and throw it towards the birds. Do not shout.
K6	Long time ago, used a rags. Making them into human forms to scare the birds.
T13	I would not shout to chase the birds. According to the belief, birds will be even more stubborn if we shout at them.

Elements of beliefs in agriculture which helps in sustaining the environment

The Dusun community of those days and some of the current generation practice the beliefs of their ancestors, such as *gawoi*, dreams, talking with plants, and chasing away the birds (Table 4) in agricultural activities. The beliefs of *gawoi* and dreams can stop humans from cutting down trees as they please. Talking with plants is believed to ignite the spirits of plants to continue growth. A good growth helps to reduce usage of pesticides and chemical fertilizers. Pests like birds can be avoided through an ethical belief, which is not to be rough with animals. This also avoids usage of pesticides which are dangerous for humans and nature.

Table 4: Elements of beliefs in agriculture which helps in sustaining the environment.

Gawoi Beliefs	Interpretations
	<i>Gawoi</i> ritual means to review or estimate a new land for agricultural purposes.
	This ritual is conducted by a shaman in an area of about a meter square feet.
	There will be no cutting down of trees, but the bushes around will be cleared.
	The <i>gawoi</i> ritual will be followed by chanting of spells seeking guidance from <i>Kinorohingan</i> (God) whether the area is suitable for agricultural activities.
Dreams	The shaman requests to <i>Kinorohingan</i> to give dreams to the land owner while stabbing the land with machete. The dream would be interpreted by elders with expertise in interpreting dreams. The agricultural activities would be continued if it is a good dream and vice versa.
Talking with plants	Farmers will talk to the plants with the purpose of igniting the spirits of plants in order for them to grow well. This activity is practiced while weeding is done using <i>gagamas</i> (blunt machete). Farmers would caress the leaves of the plants while uttering words of hopes, love, caring and pleads.
Chasing away Birds	Farmers who plant rice crops will chase away the birds which comes to eat the paddy fruits. Dusun community believes that all living being has spirits. Therefore, the birds should not be chased away by force, such as shouting, cursing and throwing stones. Farmers would make scarecrows using old rags which would be placed in the paddy fields to scare away the birds.

Local knowledge in agriculture which helps in sustaining the environment

Local knowledge is inherited from one to another generation for the purpose of continuation of heritage, splendour, sanctity, strength, and the spirit of togetherness. Table 5 shows the local knowledge of the Dusun community, staying in rural areas, in handling agricultural activities. A few trees are left to grow at the water catchment area and the plantation fields for the purpose of continuous water supply and to protect crops from being destroyed by storm. The activity of getting rid of rubbish, like branches and leaves around the plantations before burning them could help to save the forest from being burnt. The skills of setting fire with reversing techniques and wind direction are forms of local knowledge which could prevent fire from spreading to the forest.

The uniqueness of Malaysia as a tropical rainforest is not enough to help farmers to preserve the soil fertility and safety of their plantation fields. Heavy rainfall throughout the year accelerates the land erosion of the Dusun community which is at the foot of Mount Kinabalu. The fragility of land at hill slopes also causes landslides to happen. Thus, the activity of laying barriers and digging holes are a form of local knowledge inherited to collect fertile black soil from being washed away by rain to the bottom section. Bamboos, lemongrass and fruits are planted at steep edges to strengthen the land.

Frequently used soil loses its fertility. One of the local knowledge practiced by farmers to restore the fertility of soil is by making compost from grasses which grow on the raised planting beds. The grasses are cut and put into holes dug using spades. It would be covered with soil and left for a few days before plantation takes place. The stalk and leaves of *yoyogi* plants, which are planted in plantation fields, also helps to fertilize the soil. In addition, farmers have reduced the usage of chemical pesticides on plants by using organic pesticides. These organic pesticides are made of plants such as dried chillies, garlic, tobacco leaves, and lemongrass which are pounded and soaked for a week before used.

Table 5: Local knowledge in agriculture which helps in sustaining the environment.

Local Knowledge	Interpretation
Allowing trees to grow	Not all trees are cut during cutting down activities. Trees at river banks are allowed to grow to prevent landslides and issues with water catchment area. Two or three trees are left to grow in the cleared plantations area for the purpose of providing shade and for birds to perch.
Creating fire breaks surround the farms	Before setting fire to the plantations, farmers will clean up around 3 to 6 feet of the plantation field area. The place should be free of rubbish to avoid fire to spread to the forest area or someone else's plantations.
Burning	The act of burning the plantations will be done in between 9 to 10 am or 3 to 4 pm. It should not be done during long drought season. Farmers depend on wind direction. The upper part of the edge of the plantations which has high potential to receive strong wind using the reverse technique will be burnt earlier to avoid the fire to spread into the forest area.
Laying barriers	Farmers would lay woods in between stumps or thrust the wood in places without stumps. This method hinders fertile black soil from being eroded and heaps at the bottom section.
Digging holes	A few holes will be dug as deep and wide as 1 square feet at steep areas. The purpose is to stop fertile land from eroding to the bottom part which is not used for plantations. The holes will be planted with fruit trees and

	sweet potatoes.
Making compost	Compost is made from grasses which grows on the raised planting beds. The grasses would be put into the holes, dug using spades and covered with soil.
Making pesticides	Farmers made organic pesticides with plants like dried chilies, garlics, tobacco leaves and lemongrass. These products are mixed, pounded and soaked for a week before used.
Planting crops	Plants like lemongrass, bamboos and fruit trees are planted at the edge of steep banks to avoid landslides. <i>Yoyogi</i> plants are planted in plantation fields to fertilize the land through the dried leaves and stems.

The practices of farming generation towards beliefs and local knowledge in agriculture

The practices of beliefs and local knowledge in agriculture of three generations of farmers based on age categories (Table 6) were analysed based on the data (Table 3). Farmers over 71 years old have seen and practiced the *gawoi* ritual. Most of the informants do not practice *gawoi* anymore after embracing Christianity. One of the female informants; around 61 to 70 years old, who has not embraced any of the modern religions, still practices *gawoi* and dreams before opening any new land for agricultural purposes. The practices of talking to the plants and chasing away birds in a proper way are still practiced by informants aged within 50 to 60 years old. Most of the informants who are still practicing these beliefs are women.

The practices of local knowledge such as allowing trees to grow, getting rid of rubbish, laying woods as barriers, digging holes, making compost, making organic pesticides, and planting crops at steep edges are still practiced by farmers; especially those around 50 to 60 years old. The Dusun community living in rural areas is still practicing the cultural heritage of previous generations. Informants think that such local knowledge should be retained because they are not against the beliefs of Christianity. They also realize that the local knowledge they has been practiced in agriculture can help in sustaining the environment.

Table 6: The practices of farming generations towards beliefs and local knowledge in agriculture.

Age group	50-60 years old		61-70 years old		Over 71 years old		Percentage
	Male	Female	Male	Female	Male	Female	
Kepercayaan							
<i>Gawoi</i>	-	1	1	1	1	4	61.54
Dreams	-	-	-	1	1	3	34.46
Talking with plants	-	1	-	-	-	1	15.38

Chasing away birds	-	1	-	-	-	2	23.08
Local Knowledge							
Allowing trees to grow	1	1	-	-	-	1	23.08
Creating fire breaks around the farm	1	-	-	-	-	1	15.38
Burning	-	-	-	-	1	1	15.38
Laying barriers	-	-	1	-	-	-	7.69
Digging holes	1	-	-	-	-	-	7.69
Making compost	-	1	-	-	-	-	7.69
Making pesticides	-	1	-	-	-	1	15.38
Planting crops	1	1	-	1	-	-	23.08

Discussion

Beliefs and local knowledge of rural farmers of the Dusun community in handling agricultural activities are based on the culture inherited from ancestors who were practicing animism. The animism beliefs emphasize that things are formed and takes place in weird and unearthly conditions, as well as having their own spirits and extraordinary powers. The generation aged 61 years and above had witnessed land opening rituals involving the animism beliefs like *gawoi* and dreams. This means that the farmers are not supposed to explore forests as they please without the rituals to avoid any unforeseen incidents. This is in line with the research by Hanafi (2005), who found that the Kadazan in Penampang district of Sabah, Malaysia did *babas* (peace) or *sogit* (penalty) rituals before opening new land, seeking permission from the soil spirit, and to prevent the forest from disturbing the works of cutting down trees and clearing the land. The beliefs of talking to the plants and chasing away the birds carefully are still being practiced by the generation aged 50 to 60 years old. Hanafi (2005) admits that the Kadazan farmers treat the *bambarayon* (rice spirit) very well through prayer and flattery. This is to ensure that the crops live and bear a lot of fruit. The practice of animism beliefs has given implications to the sustainability of the environment through the reduction of unnecessary logging and usage of fertilizers and chemical pesticides.

The Dusun farming' community still maintains a close relationship with both the visible and invisible nature for the purpose of harmony and prosperity of humans in the environment. This is similar with the research by Suchart et al. (2010), regarding the practice of collecting forest resources intelligently by a small Thailand community, living in the forest of Ban Nong Hua Khon. The uncontrolled collection of forest resources had stopped as a sign of respect and fear of sins towards the ancestral Don Pu Ta's spirits, acting as the guardians of the forest. Research by Ramle et al. (2014), found that the Semaq Beri tribes in Hulu Terengganu, Malaysia collect forest products in an orderly manner to avoid being reprimanded by the supernatural powers *Semaq hala*. These beliefs can prevent the extinction



of forest resources which are the treasures for the future generations. This suits Keesing's adaptive cultural system theory (1974), which sees humans as beings that should protect the adapted relationship with the ecosystem so that it lasts multiple lifetimes. Iman (2015) admits that this theory sees the culture as a system expanded by the society to fulfil the needs of their life or as an adaptation strategy to explain the environmental challenges.

The farmers of the Dusun community, living at the foot of Mount Kinabalu, have expanded their local knowledge system through their observations and experiences with nature. Their lives, which assimilates with nature, provides them with the knowledge regarding change of weather, types of suitable crops to be planted, planting and harvesting seasons, creating traditional technologies and many others for the survival of their community. For instance, in the Dusun community technical skills such as working in the field, building houses, and hunting are based on the traditional wisdom of observing the movement of sun and moon (Rosliah et al., 2017).

The practice of not cutting down trees growing at the water catchment areas and steep edges are some of the Dusun community farmers' local knowledge. They understand the effects of cutting down trees which causes the water resource for domestic uses to be disrupted. The tendency of practicing shifting cultivation by most traditional Dusun community farmers provides them with experiences to be cautious in the burning plantation field activity to avoid it spreading to someone else's land and forests. They are also sensitive to the condition of rain throughout the year which causes the black fertile soil to erode to the bottom section which they are not working on. Therefore, the farmers lay long pieces of wood in between stubs as barriers to control the erosion as well as digging holes to collect the black soil.

The inability of Dusun community farmers to buy chemical fertilizers and pesticides encourages them to adapt the materials they have in their surroundings to be made into fertilizers and pest repellents. With the guidance from Dutch Missionaries who resided in Bundu Tuhan village in 1955, their local knowledge regarding agriculture had improved (Burrough, 1978). The generations of 50 year olds and above are still active in using grasses as compost for the purpose of fertilizing the plantation fields. At the same time, there are still some farmers who plant *yoyogi* to fertilize their plantation fields. The leaves of the plant are believed to restore the soil fertility. Using natural materials encourages the ecosystems' beneficial microbes, reduces pests and avoids the release of greenhouse gases. Methods used also have produced organic crops which are of high demand in local markets. This indirectly increases the income of rural farmers.

The sensitivity of the Dusun community towards their environment, which always faces landslides, led them to plant crops believed to strengthen the soil. They plant bamboos and lemongrass at river banks and the slopes of plantation fields. The plants have deep and strong



roots to function as soil stabilizers. Adapting to the ecological pressure too has provided local knowledge to the Dusun community in choosing multifunctional plants. Bamboo shoots and lemongrass can be eaten, besides providing additional income. In addition, bamboo plants can be used to build houses, cattle pens, kitchen utensils, handicrafts, and more.

Local wisdom functioning as knowledge resource and collection of the experiences of ancestors, inherited from one generation to another, faces globalization and modernization challenges. The farmers, whom used to adhere to the orders of clearing the forest using traditional equipment, had changed their thinking ways and behaviour in accordance with changes of time. Financial capabilities allow them to buy or rent bulldozers. They use machines to bring down trees and to loosen the ground. Many plant species are destroyed and black soil containing organic fertilizers erodes. The destruction of plants affects global warming, landslides, and drying of water catchment sources. The eroded black soil would be substituted with chemical fertilizers. The value of respect between man and nature is extinguishing.

Most of the older generation who defend the beliefs and local knowledge in agriculture have passed away. Farmers aged 70 and above also have become less productive. The animism beliefs like *gawoi* and dreams are no more inherited by the younger generation. Besides, most of the younger generation have embraced Christianity and Islam. The practice of animism beliefs is seen as being against their religions. However, local knowledge such as allowing trees to grow, getting rid of rubbishes, laying barriers, digging holes, making compost, making organic pesticides, and planting crops on steep slopes are still the basis of the Dusun community in sustaining the environment and inheriting it to the younger generation.

Conclusions

The interviews and observations we did concludes that beliefs and local knowledge inherited from ancestors plays an important role in the sustainability of the environment, especially at the foot of Mount Kinabalu. There are seven main details which can be highlighted through this research: trees are not cut down as pleased to open new agricultural land, animals cannot be treated roughly, crops must be taken good care of, burning of forest is done using the right techniques, using woods as barriers or digging holes to stop black soil from eroding to the bottom parts of farms, using natural materials to make compost and organic pesticides, in addition to planting plants with strong roots at the edge of banks. All the seven details can help the survival of the Dusun community farmers in the rural area because they have local wisdom in managing and cultivate the natural resources around them. In conclusion, the local wisdom in agriculture can complement science and technology knowledge to solve the ecosystem problems of this century.



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