

## Short Communication:

# Adoption level of indigenous communities on agricultural technology in East Kalimantan, Indonesia: Problem and adaptive solutions

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**Abstract.** Imang N. 2020. *Short Communication: Adoption level of indigenous communities to agricultural technology: problem and adaptive solutions in East Kalimantan, Indonesia. Biodiversitas 21: 1160-1164.* The economic and cultural background of the indigenous people of the Dayak Borneo was traditional shifting cultivation, hunting, and gathering. Since the 1980s, Indonesian central government promoted Resettlement Program by relocating them in down rivers to encourage and to improve their agricultural and economic life. By living in downriver with limited farming areas, they, of course, need more products of agriculture and therefore government promoted agricultural extension. The objectives of the study are to: assess adoption level of two indigenous Dayak communities on agricultural technology, assess the causes of problems on adoption of agricultural technology, and seek adaptive strategy in implementing agricultural technology. Data were collected by interviewing 54 respondents that were selected randomly and descriptive qualitative approach was used for data analysis. Some important findings were: (i) adoption level of 60% i.e. *Low* level and 40% i.e. *middle* level in both villages; (ii) the low level of adoption was caused by some factors, such as: low performance of the extension officers which was caused by the lack support from government, and the background of the farmers; farmers with low education background need visual media to understand the extension and to see the evidence of the new technology; (iii) adaptive strategies to improve agricultural extension level such as: government should support the extension officers with appropriate visual and material support such as LCD projector, portable generator, appropriate training and communication skill that suitable with socio-cultural background of the respondents. The extension officers also need to understand the cultural background of the respondents. Practical implication is that the government can develop more typical effective method of extension for indigenous communities with low educational background and traditional way of agriculture. Theoretical implications, of course, are to provide specific further information for research related to agricultural extension.

**Keywords:** Adoption, agriculture, Dayak, extension, indigenous, Swidden agriculture

## INTRODUCTION

Since the 1980s, Indonesian central government demanded the indigenous people living in remote upper rivers and isolated areas to move downriver through the "resettlement program". One of communities with the largest populations of the Borneo indigenous people is Dayak, with a population of around 500,000 persons (Kueng and Imang, 2007). They were originally living in Kalimantan plateau for hundreds of years. In their ancestor land, they have huge land for traditional farming namely shifting cultivation (locally called *ladang*), and also have huge virgin forests for hunting, fishing, and gathering. Imang et al (2018) explained that the Indigenous Dayak has around 4-7 plots of land which are equal to 7-20 ha for practicing shifting cultivation (*ladang*). The purposes of this government program were to relocate the people to more accessible settlement areas in downriver with good access, and government will help them to develop a new settlement or new village for the relocated people. Since then, thousands of indigenous Dayak people moved to the new settlement and merging in one or more larger villages.

After moving down and living near town, they face limited areas for agricultural activities. Some of the new settlements are Pampang Village (formerly part of Sungai Siring Village) and Sungai Bawang Village. However, in the new settlements, they have limited land for farming compared to land they had in their original villages. This situation, of course, demands increasing land productivity by implementing agricultural technology. Compared to neighbor farmers of other ethnics such as the Javanese, Buginese, Sundanese, Imang (2010) found that the Kenyah Dayaks people seem to be left behind in adopting agricultural technology. In order to improve agriculture productivity and to change the behavior of farmers from traditional shifting cultivation to more sustainable and productive agriculture, Indonesian government implemented extension program (*Penyuluhan Pertanian*). According to Roger and Shoemakers (1971) and supported by Memon et al. (2014), agricultural extension is essentially a message delivery system organized to convey the latest findings of agricultural; research to farmers. Effective communication is, therefore, the prime requirement in extension work (Memon et al. 2014).

The objectives of the research were: (i) to assess adoption level of agricultural technology by the respondents; (ii) to determine causes and problems to adopt agricultural technology; and (iii) to identify adaptive strategy for implementation of agricultural technology.

**MATERIALS AND METHODS**

**Study area**

Research was conducted in two urbanized villages of indigenous Kenyah Dayaks people in East Kalimantan, Indonesia, i.e.: Pampang or Budaya Pampang Village (Samarinda City) and Sungai Bawang Village (Kutai Kartanegara District) from June to August 2019.

**Procedures**

Data were collected through individual interviews with 27 respondents in Pampang and 27 respondents in Sungai Bawang. Questions were related to some aspects of agricultural technology of rice farming, cocoa, oil palm and vegetable gardens: soil processing, seed treatment, fertilizer, disease and pest control, and weed control. For a better adoption level, we also asked some questions related to the problems on technology adoption from respondents' perspective and from extension officers' perspective. Likert-score was used to quantify the answers and presented on tables and graphics (Likert 1932; Carifio and Perla 2007; Derrick and White 2017). Based on the accumulation of Likert-score, the level of adoption is categorized in three ranks as shown on Table 1 (Likert 1932).

**Table 1.** Rank and criteria of adoption level

Score	Adoption level	Criteria
27-44	Low	Awareness and interesting
45-63	Middle	Evaluation
64-81	High	Trial and adoption

**RESULTS AND DISCUSSION**

**Characteristic of respondents**

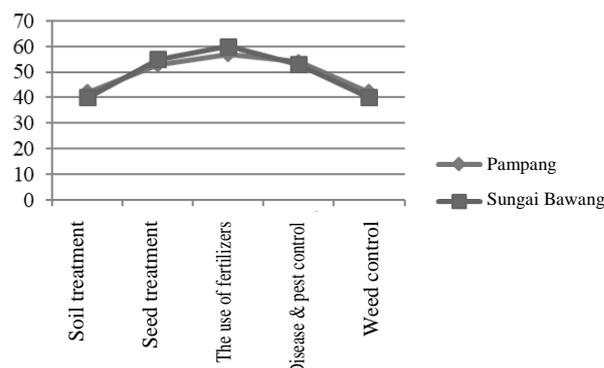
The indigenous Dayak moved to Pampang and Sungai Bawang in some small groups from 1980s to 1992. The main livelihoods of villagers in the new settlement are farmers of rice, cacao, oil palm, and vegetables, traditional hand-crafts. Average age is 54 years, and majority (87%) have education level of elementary school and below. Population of each village is around 1907 persons and 1610 persons respectively.

**Adoption level**

Adoption level in this study is how far the respondents adopting and practicing agricultural technology, particularly in rice farming, cacao garden, oil palm garden, and vegetable garden.

**Table 2.** Adoption level to agricultural technology

Agricultural technology	Score/criteria	
	Pampang	Sungai Bawang
Soil treatment	42/low	40/low
Seed treatment	53/middle	55/middle
The use of fertilizers	57/middle	60/middle
Disease and pest control	54/middle	53/middle
Weed control	42/low	40/low



**Figure 1.** Trend in adoption levels of two villages

Table 2 shows the adoption levels of agricultural technology in Pampang and Sungai Bawang Villages are at 40% i.e. *low* level, and at 60% i.e. *middle* level. Figure 1 shows two graphs that are very close to each other. It means that their responses are almost similar.

*Soil treatment*

Soil treatment is the process in which soil is loosed and made soft using machines, human-power by plowing or animal-power so that sunrise can penetrate deeper to soil, to improve the structure and texture of soil so that it can improve soil fertility. Table 2 shows that adoption level to soil treatment in both villages was low.

Respondents argue that they are not used to plow the soil because this kind of work may cause back pain, and even headaches. They are not used to bow while working for long time. For soil treatment, they usually just remove and burn some small branches. They had experience that the better the burning process, the more fertile the soil. Imang (2010) mentioned the same thing that Kenyah Dayak people in Batu Majang village were also not familiar with hoe to plow their rice field because they are not comfortable with it.

*Qualified seed and treatment*

Qualified seed is recommended according to some criteria: for example, rice, 98% purity of variety, sprout quality of 80%, not expired and treatment was done by submerging seeds in salted water for one hour before planting, and dormancy-break. Table 1 above shows that adoption level of qualified seed was at *middle* level. At the research sites, some respondents said that they used

recommended seed but it was not appropriately treated before planting, and some used their own seed from the previous harvest or just bought from any seed seller. Similarly, for cacao and oil palm seeds or seedlings, most respondents used seeds from previous harvest or from other sources. They claimed that there's no clear information from extension officer about the advantages of the certified seeds. So far the farmers were not so concern about the purity of the seed, because they did not know the difference of the product.

#### Fertilizer

Fertilizer application functions to improve the growth and strength of plant which is in turn to improve production. Table 2 shows that adoption level to the use of fertilizer is at middle level. Regarding the middle-level of adoption, we identified some responses as follows: respondents used fertilizer only when it was available (mostly given for free through project scheme), some respondents used organic fertilizer (on their own) during the soil treatment/preparation; and some argued that in Swidden agriculture practice, they do not apply fertilizers but the harvest is good as long as the weather or rainfall is enough. Another reason is that the rice is just for subsistence, so that as long as the rice is enough for one-year consumption, it is regarded as enough. This is an example of traditional knowledge on how to improve soil fertility. Kueng and Imang (2007) found that the Basap Dayak constructed simple terrace using trees in order to prevent soil erosion and to hold the hummus as natural fertilizer.

#### Disease and pest control

For pest and weed control, most of the respondents applied pesticide and herbicide that are available in agriculture shop nearby. The respondents also used manual way, for example, to capture and kill grasshopper at night. However, none of the respondents used chemical way for disease control.

#### Weed control

The purpose of weed control is to protect and prevent weeds from growing and sprouting whether using manual

method or chemical/herbicide. In this case, the respondents mostly used Round up and Gramoxone. This part is to know how respondents follow recommended safe methods of weed control as follows: wearing long-sleeve shirts, working gloves, safety goggles along with long pants as well as covered shoes, and considering wind direction. Table 2 shows that adoption level to safe weed control was at *low* level. Respondents were not so concerned about the dangers of herbicide to health because the extension officer did not notice the danger of the herbicides. During application of the herbicide, most respondents wore long sleeve shirts and mouth masks, but they didn't wear covered shoes. The respondents were also not concerned with the wind direction that may cause them to inhale herbicides.

#### Cause of low adoption level

In order to explore why adoption level to agricultural technology was mostly at *low* level in both villages, it is important to know the reasons from the respondents' perspective or responses to the performances of extension workers. Concerning the adoption level, Table 3 shows that, in Pampang Village, 70% of the respondents were at *low* level and only 30% at *middle* level. Similarly, in Sungai Bawang Village, 60% of respondents was at *low* level and the rest 40% at *middle* level.

Respondent claimed that intensity or frequency of field extension by extension worker was low, only one or three times a year in sporadic way. Respondents expected that extension should be conducted at least once a month with a regular schedule. Respondents also needed field excursion to learn from other successful farmers because they need visual evidence of new technology. Regarding the frequency, Effendy and Hutapea (2010) also suggested that farmers considered extension not effective if the frequency of visits of field officers is only once a month. It was mentioned in Indonesian Law No. 16/2006 regarding Agricultural Extension System that Extension Officers should have capability, skill, and working spirit to improve agricultural development.

**Table 3.** Response of respondents to extension officer performance

Responses of respondents to extension officers' performance	Score and criteria	
	Pampang	Sungai Bawang
Intensity of extension	30/low	40/low
Follow-up of extension	43/low	44/low
Visual tool for extension	38/low	43/low
Media of extension	51/middle	49/middle
Communication technic	44/low	47/middle
Demonstrate economic advantages	43/low	44/low
Observability of output	48/middle	47/middle
Complexity of the extension	60/middle	57/middle
Trialability	44/low	43/low
Influence of old culture	40/low	39/low

Regarding the method, respondents complain that extension officers do not use visual media for the extension, only oral method so that it was difficult to understand and always boring. Respondents also complain about the complexity to understand the material provided by extension officer. Extension officers neither provide actual examples of the advantages of agricultural technology, hence, respondents with low education find it difficult to adopt the new technology. Respondents expect extension officers to demonstrate every material in a very easy and clear method. An important aspect for the farmers is that the extension officer must convince the farmers about the economic advantages of the new technology through demonstration plot and simple calculation. Regarding the relation between education level and innovation adoption, Warku (2019) found that education level had significant influence on adoption level of tomato production packages. In regard to importance of visual tools for extension activity, Akintunde and Idowu (2019) suggested that the effects of visual tools on access to information had a highly significant positive impact on the use of information and communications technology by extension officers.

**Alternative and adaptive solution**

In order to improve the adoption level of the farmers to agricultural extension, it is very important to explore the needs and expectations of the respondents and how Extension Workers should improve their skill and competency for more effective extension services in the future.

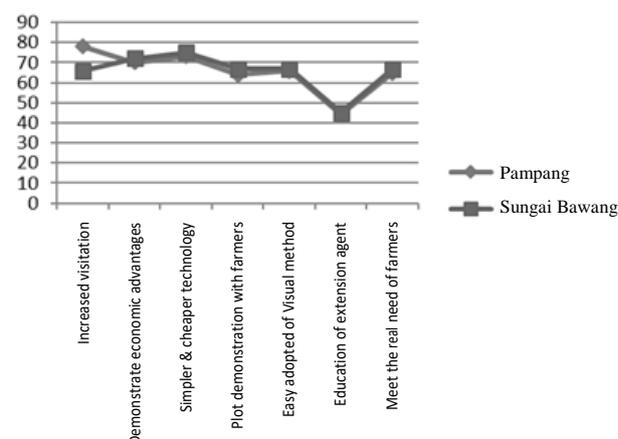
Table 4 shows that in order to increase adoption level of agricultural technology by farmers, respondents in Pampang scored *high* for 5 aspects. Similarly, in neighboring village of Sungai Bawang, respondent also scored *high* for 6 aspects. It indicates that such aspects should be put on the high priority to improve field extension service in the future. For the indigenous people with low education and background of hunting and gathering and traditional shifting cultivation, an innovative-breakthrough of simple extension and easier to understand method is really needed. Lawal et al. (2019) suggested that the respondents who were mostly educated agreed that knowledge of mathematics/statistics is the most important requirement for data management. Extension officers also need to adjust the method to suit the background of the respondents. Regarding extension method, Oyedeji and Christiana (2019) mentioned that extension officers should use preferred methods by farmers such as farmers visit, home visit, contact farmers and method demonstration.

Table 4 also shows that formal education level of extension officers is not an important factor for respondents to adopt the technology as long as the extension officer can deliver extension in an understandable way. Figure 2 indicates that respondents in the two villages were similar in their responses to extension workers’ performance.

**Response of extension officers to government support**

The low adoption level is not necessarily caused by low response from the farmers and extension officers, but also

because of the lack of government support for extension program. In order to discover necessary support extension officers needed from government, five Extension Officers were interviewed, their responses were presented in Table 5. This table indicates that none of the extension officers is satisfactory with government supports to conduct field extension. They complained because they were not provided with necessary skill or training, field extension facility and future career guarantee. Some of the extension officers were unsatisfied with the prolonged contractual-job with government. They also need future good career for the future. The extension workers also need improved skills through advance training on extension skills. As mentioned above that the respondents need visual tool for extension so that it is easier for farmers to understand. Besides that, the extension workers also need appropriate material or media support for extension activities such as personal computer (laptop) and LCD (Liquid Crystal Display). In order to support the use of the media for example LCD, the extension needs portable generator for field extension. As for information, electricity connection is not available in this area so that portable generator is crucial.



**Figure 2.** Trend of the respondents’ expectations of extension process

**Table 4.** Expectations of respondents on method of agricultural extension service delivery

Expectation of respondents	Likert-score	Criteria
Increased visitation	78/high	66/high
Demonstrate economic advantages	70/high	72/high
Simpler and cheaper technology	73/high	75/high
Plot demonstration with farmers	64/middle	67/high
Easy adopted of Visual method	66/high	67/high
Education of extension agent	44/low	45/low
Meet the real need of farmers	65/high	67/high

Note: score: 27-45: low; 46-64: middle; 65-81: high

**Table 5.** Government support needed by extension officers

Government support for extension officer	Likert-score	Criteria
Financial support for field extension	10	Fair
Technical skill support for improved extension	7	Unsatisfactory
field operational support/motorbike	12	Fair
Future good career	11	Fair
Material/media support from government	7	Unsatisfactory

Note: Likert-score: 5-8: unsatisfactory; 9-12: fair; 13-15: satisfactory

To conclude, adoption levels of most of the respondents in both villages were low and the graphic trends of adoption levels were almost similar among two villages. The low adoption level caused by multiple factors such as low performance of the extension officers, extension couldn't be demonstrated to convince respondents about the advantages of the new technology, old cultural and subsistence background of the respondents. 87% of respondents with low education levels (Elementary School and even not finishing Elementary School) need comparative-excursion for successful farmers. They need to experience real success other than knowing the theory. On the other hand, the extension officer excused that the low adoption level was also caused by the lack of necessary government support which leads to ineffectiveness practice in field extension; farmers with low educational background need visual media to understand the extension. Another adaptive way to practice agricultural technology is that the extension officer should explore and practice the traditional knowledge and wises that were already familiar to the respondents and use existing local materials.

Practical implication of the study is that the government can develop more effective method of extension for indigenous communities with low educational background and traditional way of agriculture. The Dayak indigenous community of Kalimantan itself is estimated covering more than one million people. Theoretical implications, of course, to provide specific further information for research related to agricultural extension.

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