

<b>Nama Pengusul</b>	<b>Ndan Imang</b>
<b>Judul Artikel</b>	<b>Adoption level Adoption Level of Indigenous Communities to Agricultural Technology in East Kalimantan: problem and adaptive solution</b>

## Tahapan korespondensi

No	Tanggal	Tahapan Korespondensi	Halaman Bukti
1	15 Nov 2019	Email dari <b>Reviewer X</b> untuk saran perbaikan	Hal-2
2	15 Nov 2019	Email dari <b>Review C</b> untuk saran perbaikan	Hal-8
3	25 Nov 2019	Mengirim hasil Perbaikan Artikel atas saran Revisi dari <b>Reviewer X</b> dan <b>Reviewer C</b>	Hal-14
4	13 Februari 2020	Menerima email dari Reviewer A yang berisi Saran perbaikan	Hal-19
5	13 Februari 2020	Mengirim hasil perbaikan Artikel ke Reviewer A	Hal-25
6	24 Februari 2020	Keputusan Editor Jurnal "BIODIVERSITAS" untuk Accepted dan Publikasi	Hal-31

**15 November 2019**

Ndan Imang:

We have reached a decision regarding your submission to Biodiversitas Journal of Biological Diversity, "Adoption level Adoption Level of Indigenous Communities to Agricultural Technology, Problem and Adaptive Solution in East Kalimantan, Indonesia: none".

Our decision is: Revisions Required

Smujo Editors  
[editors@smujo.id](mailto:editors@smujo.id)

Reviewer C:  
 Recommendation: Revisions Required

Reviewer X:

Dear Dr.

Thank you for choosing me as a scientific reviewer for this article.

There are many notes on this article, including:

1. Summary needs to be clarified.
2. Introduction: should need to add an explanation to it because it is very brief.
3. Results and discussion need to be arranged.
4. There is no explanation of the researchers and the components of the search form.
5. There is very few referensses.

Recommendation: Revisions Required

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2 Attachments • Scanned by Gmail

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*Saran Perbaikan Reviewer X 15 Nov 2019*

## **Adoption level of indigenous communities to agricultural technology, problem and adaptive solution in East Kalimantan, Indonesia**

**Abstract.** The economic and cultural background of the indigenous people of the Dayak Borneo was traditional shifting cultivation, hunting-gathering. Since 1980s, Indonesian central government promoted Resettlement Program by relocating them in down rivers to encourage and to improve their agricultural and economic life. The purposes of the study are to assess adoption level of two indigenous Dayak communities to agricultural technology, to assess causes and problems to adopt agricultural technology, and to seek adaptive strategy for implementation of agricultural technology. Data were collected by interviewing 54 respondents. A descriptive qualitative approach was used for data analysis. Some important findings were: (1) adoption levels of 60% respondent in both villages were *low* and 40% at *middle* level; (2) the low of adoption level caused by multiple-factors: low performance of the extension officer, cultural 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, the low performances of the extension officer caused by the lack support from government; (3) adaptive strategy to improve agricultural extension level are: government should support the extension officers with appropriate visual and material supports, appropriate training and communication skill. 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 education background and traditional way of agriculture. Theoretical implications of course to provide specific further information for research related agricultural extension.

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

**INTRODUCTION**

Since 1980s, Indonesian central government demanded the indigenous people living in remote upper rivers and isolated areas to move down river through the “resettlement program”. One of the largest in population of the Borneo indigenous people is the Dayak, with the population of around 500,000 persons (Kueng and Imang, 2007). They were originally living in Kalimantan plateau hundreds of years. In their ancestor land, they have huge land for traditional farming mainly shifting cultivation (locally called *ladang*), and also have huge virgin forest for hunting, fishing and gathering. Imang et al (2018) explained that the Indigenous Dayak have around 4-7 plots of land 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, and government will help them to develop a new settlement or new village for the people. Since then, thousands of indigenous people moved to the new settlement and merging in one or more larger villages. After moved down and living near town they facing limited area for agricultural activities. Some of the new settlements are Pampang 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 them to increase land productivity by implementing agricultural technology. Compared to neighbor farmers of other ethnics such as the Javanese, Buginess, Sundanese, Imang (2010) found that the Kenyah Dayak people seems to left behind in adopting agricultural technology. In order to improve agriculture productivity and to change the behavior of farmers, Indonesian government implementing extension program (*Penyuluhan Pertanian*). According to Roger and Shoemaker (1971), extension had an important role to disseminate a technology to farmers.

The purposes of the research are: (1) to assess adoption level to agricultural technology; (2) to assess causes and problems to adopt agricultural technology; and (3) to seek adaptive strategy for implementation of agricultural technology.

**MATERIALS AND METHODS**

Research was conducted in two urbanized villages of indigenous Dayak people: Pampang and Sungai Bawang in June to August 2019. Data were collected through individual interview with 27 respondents in Pampang and 27 respondents in Sungai Bawang. Questions were related to some aspects of agricultural technology of rice farming, cacao, oil palm and vegetable gardens: soil processing, seed treatment, fertilizer, disease and pest control, weed control. For a better adoption level, we also asked some question 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. Based on the accumulation of Likert-score, the level of adoption is categorized in three ranks as shown on this table.

**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 and site**

The indigenous Dayak moved to Pampang and Sungai in some small groups since 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 year, and education level of 87% respondents is Elementary School and below. Population of each village respectively is around 1907 persons and 1610 persons.

**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 vegetables garden.

**Comment [a1]:** Introduction: should need to add an explanation to it because it is very brief and Summary needs to be clarify.d

**Comment [a2]:** There is no explanation of the researchers a

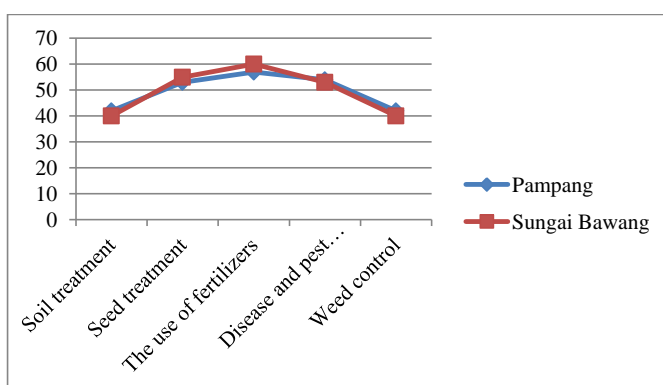
**Comment [a3]:** Results and discussion need to be arranged.

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

No	Agricultural Technology	Score/Criteria	
		Pampang	Sungai Bawang
1	Soil treatment	42/low	40/low
2	Seed treatment	53/middle	55/middle
3	The use of fertilizers	57/middle	60/middle
4	Disease and pest control	54/middle	53/middle
5	Weed control	42/low	40/low

Source: individual interview (2019)

Table above shows that adoption levels of agricultural technology in Pampang and Sungai Bawang Villages at 40% low level, 60% at middle level. Picture below shows two lines are very close each other. It means that their responses are almost similar.

**Fig 1.** Trend of adoption levels at two villages

#### Soil treatment

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

Respondents argue that they not used to plow the soil because this kind of work may cause back pain, and even head pain. They 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 not feel comfortable with it.

#### Qualified seed and treatment

Qualified seed is recommended seed according some criteria: for example rice, purity of variety 98%, sprout quality of 80%, not expire seeds and treatment by submerged seeds in salted water for one hour before to plant, and dormancy-break. Table above shows that adoption level to qualified seed was at middle level. At the research sites, some respondents said that they used recommended seed but no appropriate treatment 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 of respondents used seeds from previous harvest or from other. They claimed that there's no clear information from extension officer about the advantages of the certified seeds. So far the farmers not so concern of the purity or not of the seed, because they haven't know difference of the product.

#### Fertilizer

Fertilizer application functions to improve the growth and strength of plant which is in turn to improve production. Table 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 just when it available (mostly given for free through project scheme), some respondents used organic fertilizer (on their own way) 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 just for subsistence, so that as long as the rice is enough for one year consumption, it is regard as enough. 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 protect soil erosion and to hold the humus as natural fertilizer.

*Diseases and pest control*

For pest and weed control, most of the respondents applied pesticide and herbicide that available in agriculture shop nearby. Even, the respondents also used manual way for example to capture and kill grasshopper at night. However, nobody of the respondents used chemical way for disease control.

*Weed control*

The purpose of weed control is to protect and to prevent the weeds to grow and sprouting which is conducted at certain level, whether using manual way or chemical/herbicide. In this case, the respondents mostly used Round up and Gramoxone. This part is to know how respondents following recommended safe way for weed control as follows: wear long sleeve shirts, work gloves, safety goggles along with long pants as well as covered shoes, and wind direction. Table 2 shows that adoption level to safe weed control was at *low* level. Respondents didn't so concern of the dangerous of the herbicide to health because the extension officer neither notice the danger of the herbicides. During they applying the herbicide, most the respondents wore long sleeve shirts and mouth masker, but they didn't wear covered shoes. The respondents were also not concern of the wind direction that may cause them to inhale herbicide through noses.

**Cause of low adoption level**

In order to explore why adoption level to agricultural technology were 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. Data on table below shows that adoption level in Pampang Village 70% of the respondents was at *low* level and only 30% at *middle* level. Similarly, in Karang Mumus village 60% of respondents were at *low* level and the rest 40% at *middle* level.

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

No	Responses of respondents to extension officers' performance	Score and Criteria	
		Pampang	Sungai Bawang
1	Intensity of extension	30/low	40/low
2	Follow-up of extension	43/low	44/low
3	Visual tool for extension	38/low	43/low
4	Media of extension	51/middle	49/middle
5	Communication technic	44/low	47/middle
6	Demonstrate economic advantages	43/low	44/low
7	Observebility of output	48/middle	47/middle
8	Complexity of the extension	60/middle	57/middle
9	Trialability	44/low	43/low
10	Influence of old culture	40/low	39/low

Source: individual interview (2019)

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 evident of new technology. Regarding the frequency, Effendy and Hutapea (2010) also suggested that farmers considered not effective if the frequency of field extension only once a month. It mentioned on the Indonesian Law No. 16/2006 regarding Agricultural Extension System that Extension Officers should have capability, skill and working spirit to improve agricultural development.

Regarding the method, respondents complain that the extension officer didn't use visual media for the extension, only oral method so that it was difficult to understand and even boring. Respondents also complain to the complexity to understand the material provided by extension officer. Extension officer neither provides actual examples (calculation) of the advantages of the agricultural technology, so that the respondents with low education were difficult to adopt the new technology. Respondents need extension officer could demonstrate every material in a very easy and clear method. An important thing for the farmers is that, the extension officer must convince the famers 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 to adoption level of tomato production packages. In regard to importance of visual tool for extension activity, Atikunde and Idowu (2019) suggested that the effects of visual tool 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 expectation of the respondents/farmers as the target group, and what and how Extension Workers should improve their skill and competency for more effective extension in the future.

**Table 4.** Expectations of respondents to method of agricultural extension

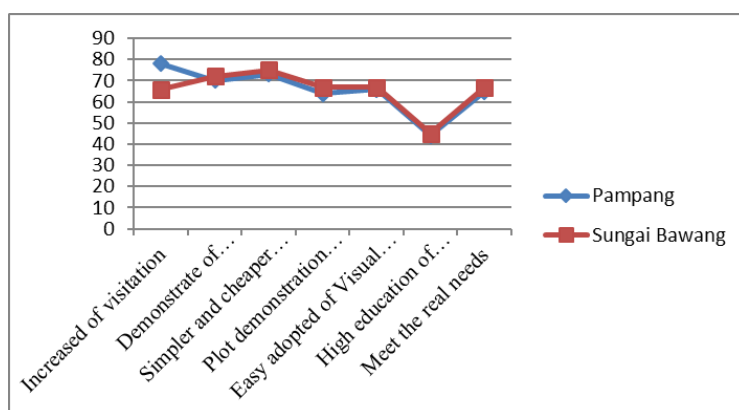
No	Expectation of respondents	Score	Criteria
1	Increased of visitation	78/high	66/high
2	Demonstrate of economic advantages	70/high	72/high
3	Simpler and cheaper technology	73/high	75/high
4	Plot demonstration with farmers	64/middle	67/high
5	Easy adopted of Visual method	66/high	67/high
6	Education of extension agent	44/low	45/low
7	Meet the real need of farmers	65/high	67/high

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

Source: individual interview (2019)

Table above shows that in order to increase adoption level of farmer to agricultural technology, expectation of 63% of respondents in Pampang was *high* for 5 aspects. Similarly, in neighbor village Sungai Bawang, expectation of 86% of respondent was also *high* for 6 aspects. It indicates that such aspects should be put on the high priority to improve field extension 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 is really needed. Extension officer also need to adjust the method with the background of the respondents. Regarding extension method, Oyedeji and Christiana (2019) mentioned that extension officer should use preferred method by farmers such as farmers visit, home visit, contact farmers and method demonstration.

Table above also shows that formal education level of extension officer not an important factor for respondents to adopt the technology as long as the extension officer can deliver extension in a good way. Figure 2 below indicates that respondents in the two villages gave almost similar responses to extension workers' perform.



**Fig 2.** Trend of the expectation of the respondents to extension process

Figure 2 above shows that the two lines have the same trend for most of the aspects. It implicitly shows the similarity expectations of two communities on what should be taken by extension officer in transferring agricultural technology to indigenous communities.

### Response of extension officer to government support.

The low of adoption level is not necessary caused by the low response from the farmers and extension officer, but also because of the lack of government support for extension program. In order to find necessary support from government, five Extension Officers were interviewed, and the answers accumulation of Likert-score is shown table below.

**Table 6.** Government support needed for extension officer

No	Government support for Extension Officer	Likert-score	Criteria
1	Financial support for field extension	10	fair
2	Technical skill support for improved	7	Un-satisfactory

extension			
3	field operational support/motor bike	12	fair
4	Future good career	11	fair
5	Material /media support from government	7	Un-satisfactory

Source: individual interview (2019)

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

Table above indicates that none of the extension officers 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 need a secure job career for the future. The extension workers also need improved skill through advance training on extension skill. As mentioned above that the respondents need visual tool for extension so that it easier for them to understand, so that the extension worker also need appropriate material or media support for extension activity such personal computer (laptop), LCD, and even portable generator for field extension.

**Conclusion and recommendation**

Adoption levels of most of the respondent in both villages were low and the graphic trends of adoption levels were almost similar among two villages. The low of adoption level caused by multiple-factors such as low performance of the extension officer, extension couldn't demonstrate and to convince respondents about the advantages of the new technology, old cultural and subsistence background of the respondents. The respondents with low education level need comparative-excursion to successful farmers. On the other hand, the extension officer excused that the low of adoption level were also caused by the lack of necessary government support caused them not so effective in field extension; farmers with low education 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 already familiar with the respondents and using existed local materials.

Practical implication of the study is that the government can develop more effective method of extension for indigenous communities with low education 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 agricultural extension.

**ACKNOWLEDGEMENT**

I would like to express my gratitude to the University of Mulawarman, particularly Faculty of Agriculture for providing small research-incentive for selective Lecturers. We would also thanks to the people of the two villages for their strong support during field survey.

**REFERENCES**

Akintunde, Moruf Abiola and Oladele, Oladimeji Idowu. 2019. Use of Information Communication Technologies among Agricultural Extension Officers in Lesotho: Journal of Agricultural Extension Vol. 23 (3) July, 2019

Efendy, J. and Hutapea, Y. (2010) Analisis Adopsi Inovasi Pertanian berbasis Padi di Sumatera Selatan dalam Perspektif Komunikasi (Analysis of Agricultural Innovation Adoption based Rice in South Sumatra in Communication Perspective).

Imang, N., Rujehan, Naomi, N,D. 2018. Assessment of daleh Swidden agriculture as an innovative alternative to conventional swidden under conditions of external pressure on local forest management in Kalimantan, Indonesia. Biodiversitas Vol. 19 (3) May 2018.

Kueng, J., and Imang, N., 2007. *Kajian Kearifan Traditional Suku Punan Basap di Kabupaten Kutai Timur, Indonesia* (Traditional Knowledge of the Basap Punan in East Kutai District, Indonesia).

Oyedeki, Y.T., and Christiana, A. O. 2019. Farmers' Assessment of the Effectiveness of Extension Communication Methods Used in Ogbomoso Agricultural Zone of Oyo-State, Nigeria. Journal of Agricultural Extension Vol. 23 (3) July 2019.

Rogers, E.M. and F.F. Shoemaker, 1971. *Communication of Innovations: A Cross-Cultural Approach*. 2nd Edn., Free Press, New York, USA., Pages: 476.

Worku, A., A. 2019. Factors Affecting Diffusion And Adoption Of Agricultural Innovations Among Farmers In Ethiopia Case Study Of Ormia Regional State Westsern Sewa. Journal of Agricultural Extension Vol. 7 (2).

Comment [a4]: Very few references

*Saran Perbaikan Reviewer C (25 November 2019)*

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

**Abstract.** The economic and cultural background of the indigenous people of the Dayak Borneo was traditional shifting cultivation, hunting and gathering. Since 1980s, Indonesian central government promoted Resettlement Program by relocating them in down rivers to encourage and to improve their agricultural and economic life. The objectives of the study re to: assess adoption level of two indigenous Dayak communities of agricultural technology, assess causes of problems against adoption of agricultural technology, and seek adaptive strategy for implementation of agricultural technology. Data were collected by interviewing 54 respondents and descriptive qualitative approach was used for data analysis. Some important findings were: (1) adoption levels of 60% in both villages were *low* and 40% at *middle* level; (2) the low level of adoption was caused by multiple-factors: low performance of the extension officers, cultural 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, low performances of the extension officers caused by the lack support from government; (3) adaptive strategy to improve agricultural extension level are: government should support the extension officers with appropriate visual and material supports, appropriate training and communication skill. 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 education background and traditional way of agriculture. Theoretical implications of course to provide specific further information for research related agricultural extension.

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

### INTRODUCTION

Since 1980s, Indonesian central government demanded the indigenous people living in remote upper rivers and isolated areas to move down river through the “resettlement program”. One of the largest in population of the Borneo indigenous people is the Dayak, with the population of around 500,000 persons (Kuong 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 mainly shifting cultivation (locally called *ladang*), and also have huge virgin forest for hunting, fishing and gathering. Imang et al (2018) explained that the Indigenous Dayak have around 4-7 plots of land 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, and government will help them to develop a new settlement or new village for the people. Since then, thousands of indigenous people moved to the new settlement and merging in one or more larger villages. After moving down and living near town they facing limited area for agricultural activities. Some of the new settlements are Pampang 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, Buginess, Sundanese. Imang (2010) found that the Kenyah Dayak people seems to left behind in adopting agricultural technology. In order to improve agriculture productivity and to change the behavior of farmers, Indonesian government implemented extension program (*Penyuluhan Pertanian*). According to Roger and Shoemaker (1971), extension had an important role to disseminate a technology to farmers.

The objectives of the research were: (1) to assess adoption level of agricultural technology by the respondents; (2) to determine causes and problems to adopt agricultural technology; and (3) to identify adaptive strategy for implementation of agricultural technology.

### MATERIALS AND METHODS

Research was conducted in two urbanized villages of indigenous Dayak people: Pampang and Sungai Bawang in June to August 2019. Data were collected through individual interview with 27 respondents in Pampang and 27 respondents in

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Sungai Bawang. Questions were related to some aspects of agricultural technology of rice farming, cacao, oil palm and vegetable gardens: soil processing, seed treatment, fertilizer, disease and pest control, weed control. For a better adoption level, we also asked some question 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. Based on the accumulation of Likert-score, the level of adoption is categorized in three ranks as shown on this table.

**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 in some small groups since 1980s to 1992. The main livelihoods of villagers in the new settlement are farmers of rice, cocoa, 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

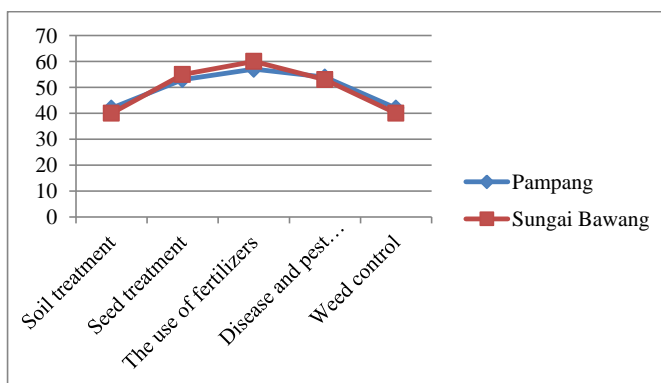
Adoption level in this study is how far the respondents adopting and practicing agricultural technology particularly in rice farming, cocoa garden, oil palm garden and vegetables garden.

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

No	Agricultural Technology	Score/Criteria	
		Pampang	Sungai Bawang
1	Soil treatment	42/low	40/low
2	Seed treatment	53/middle	55/middle
3	The use of fertilizers	57/middle	60/middle
4	Disease and pest control	54/middle	53/middle
5	Weed control	42/low	40/low

Source: individual interview (2019)

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



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

### 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 sun rise 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 were low.

Respondents argue that they are not used to plow the soil because this kind of work may cause back pain, and even headache. 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 seed according to some criteria: for example rice, purity of variety 98%, sprout quality of 80%, not expired and treatment 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 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 not so concern of the purity or not of the seed, because they haven't know 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 just when it 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 regard 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 humus 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 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 method of weed control as follows: wear long sleeve shirts, work gloves, safety goggles along with long pants as well as covered shoes, and wind direction. Table 2 shows that adoption level to safe weed control was at *low* level. Respondents were not so concerned of 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 mask, but they didn't wear covered shoes. The respondents were also not concerned of 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 were 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. Table 3 shows that adoption level in Pampang Village 70% of the respondents was at *low* level and only 30% at *middle* level. Similarly, in Karang Mumus village 60% of respondents were at *low* level and the rest 40% at *middle* level.

Table 3. Response of respondents to extension officer performance

No	Responses of respondents to extension officers' performance	Score and Criteria	
		Pampang	Sungai Bawang
1	Intensity of extension	30/low	40/low
2	Follow-up of extension	43/low	44/low
3	Visual tool for extension	38/low	43/low
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5	Communication technic	44/low	47/middle

6	Demonstrate economic advantages	43/low	44/low
7	Observeability of output	48/middle	47/middle
8	Complexity of the extension	60/middle	57/middle
9	Trialability	44/low	43/low
10	Influence of old culture	40/low	39/low

Source: individual interview (2019)

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 the Indonesian Law No. 16/2006 regarding Agricultural Extension System that Extension Officers should have capability, skill and working spirit to improve agricultural development.

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 to the complexity to understand the material provided by extension officer. Extension officer neither provides actual examples of the advantages of the 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 tool for extension activity, Akintunde and Idowu (2019) suggested that the effects of visual tool 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 expectation of the respondents and how Extension Workers should improve their skill and competency for more effective extension service in the future.

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

No	Expectation of respondents	Score	Criteria
1	Increased visitation	78/high	66/high
2	Demonstrate of economic advantages	70/high	72/high
3	Simpler and cheaper technology	73/high	75/high
4	Plot demonstration with farmers	64/middle	67/high
5	Easy adopted of Visual method	66/high	67/high
6	Education of extension agent	44/low	45/low
7	Meet the real need of farmers	65/high	67/high

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

Source: individual interview (2019)

Table above 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. 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 officer should use preferred method 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.

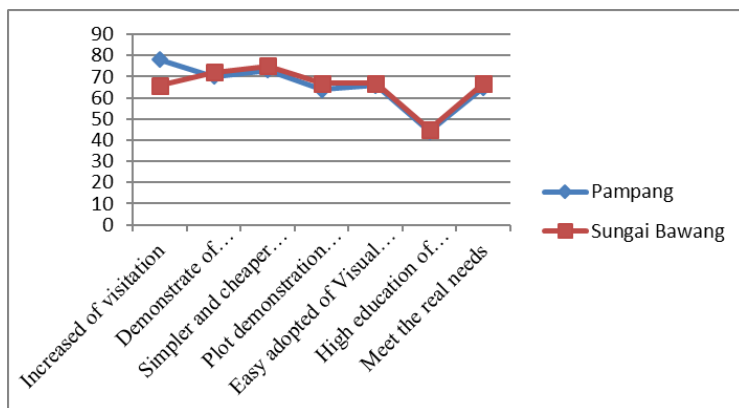


Figure 2. Trend of the respondents' expectations of extension process

**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 6.

Table 6. Government support needed by extension officers

No	Government support for Extension Officer	Likert-score	Criteria
1	Financial support for field extension	10	fair
2	Technical skill support for improved extension	7	Un-satisfactory
3	field operational support/motor bike	12	fair
4	Future good career	11	fair
5	Material /media support from government	7	Un-satisfactory

Source: individual interview (2019)

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

Table 6 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 a secured job and career for the future. The extension workers also need improved skill through advance training on extension skill. As mentioned above that the respondents need visual tool for extension so that it easier for them to understand, so that the extension worker also need appropriate material or media support for extension activity such personal computer (laptop), LCD, and even portable generator for field extension.

Comment [MA06]: Not in table 6

Comment [MA07]: Make this clearer

**Conclusion and recommendation**

Adoption levels of most of the respondent in both villages were low and the graphic trends of adoption levels were almost similar among two villages. The low of adoption level caused by multiple-factors such as low performance of the extension officer, extension couldn't demonstrate and to convince respondents about the advantages of the new technology, old cultural and subsistence background of the respondents. The respondents with low education level need comparative-excursion to successful farmers. On the other hand, the extension officer excused that the low of adoption level were also caused by the lack of necessary government support caused them not so effective in field extension; farmers with low education 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 already familiar with the respondents and using existed local materials.

Comment [MA08]: It is better you are specific about your respondents, famers or extension officers, see previous discussions.

Comment [MA09]: Same issue

Practical implication of the study is that the government can develop more effective method of extension for indigenous communities with low education 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 agricultural extension.

### ACKNOWLEDGEMENT

I would like to express my gratitude to the University of Mulawarman, particularly Faculty of Agriculture for providing small research-incentive for selective lecturers. We would also like to thank the people of the two villages for their strong support during field survey.

### REFERENCES

- Akintunde, Moruf Abiola and Oladele, Oladimeji Idowu. 2019. Use of Information Communication Technologies among Agricultural Extension Officers in Lesotho: Journal of Agricultural Extension Vol. 23 (3) July, 2019
- Efendy, J. and Hutapea, Y. (2010) Analisis Adopsi Inovasi Pertanian berbasis Padi di Sumatera Selatan dalam Perspektif Komunikasi (Analysis of Agricultural Innovation Adoption based Rice in South Sumatra in Communication Perspective).
- Imang, N., Rujehan, Naomi, N.D. 2018. Assessment of daleh Swidden agriculture as an innovative alternative to conventional swidden under conditions of external pressure on local forest management in Kalimantan, Indonesia. Biodiversitas Vol. 19 (3) May 2018.
- Kueng, J., and Imang, N., 2007. *Kajian Kearifan Tradisional Suku Punan Basap di Kabupaten Kutai Timur, Indonesia* (Traditional Knowledge of the Basap Punan in East Kutai District, Indonesia).
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- Worku, A., A. 2019. Factors Affecting Diffusion And Adoption Of Agricultural Innovations Among Farmers In Ethiopia Case Study Of Ormia Regional State Westsern Sewa. Journal of Agricultural Extension Vol. 7 (2).

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### *Jawaban email dari Author ke Reviewer C dan X*

Dear Editor of Biodiversitas

I would be grateful for the very constructive comments from the Reviewers. I have already revised the Article accordingly based on comments and recommendations from Reviewers and editor. Some of my revisions and notes are as follows:

- (1) Summary: I already clarified some information on the Summary
- (2) Introduction: I have added some information and explanation so that it easier to understand
- (3) Result Discussion: Some Reviewers already arranged this part including English revision. Thank you for Reviewer to improve the English. I also already revised some information in accordance with Table.
- (4) I added 2 (two) references related to the topic.

If there any other comment from Reviewers or Editor, I would be happy to revise it. And if the Reviewers and Editor already satisfied with my revision, I would be happy if this Article would be published soon on BIODIVERSITAS Journal at your convenience.

Bests

Ndan Imang

***HASIL PERBAIKAN ATAS ATAS SARAN DARI REVIEWER X DAN REVIEWER C (25 NOVEMBER 2019)***

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

**Abstract.** The economic and cultural background of the indigenous people of the Dayak Borneo was traditional shifting cultivation, hunting and gathering. Since 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 down river with limited farming area, they are of course need more productive of agriculture and therefore government promoted agricultural extension. The objectives of the study re to: assess adoption level of two indigenous Dayak communities of agricultural technology, assess causes of problems against adoption of agricultural technology, and seek adaptive strategy for implementation of 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: (1) adoption levels of 60% in both villages were *low* and 40% at *middle* level; (2) the low level of adoption was caused by multiple-factors: low performance of the extension officers, cultural 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, low performances of the extension officers caused by the lack support from government; (3) adaptive strategy to improve agricultural extension level are: government should support the extension officers with appropriate visual and material supports 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 education background and traditional way of agriculture. Theoretical implications of course to provide specific further information for research related agricultural extension.

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

### INTRODUCTION

Since 1980s, Indonesian central government demanded the indigenous people living in remote upper rivers and isolated areas to move down river through the “resettlement program”. One of the largest in population of the Borneo indigenous people is the Dayak, with the population of around 500,000 persons (Kuong 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 mainly shifting cultivation (locally called *ladang*), and also have huge virgin forest for hunting, fishing and gathering. Imang et al (2018) explained that the Indigenous Dayak have around 4-7 plots of land 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 down river 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 facing limited area for agricultural activities. Some of the new settlements are Pampang 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 Dayak people seems to 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: (1) to assess adoption level of agricultural technology by the respondents; (2) to determine causes and problems to adopt agricultural technology; and (3) to identify adaptive strategy for implementation of agricultural technology.

### MATERIALS AND METHODS

Research was conducted in two urbanized villages of indigenous Dayak people: Pampang and Sungai Bawang in June to August 2019. Data were collected through individual interview 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, weed control. For a better adoption level, we also asked some question 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. Based on the accumulation of Likert-score, the level of adoption is categorized in three ranks as shown on this table.

**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 in some small groups since 1980s to 1992. The main livelihoods of villagers in the new settlement are farmers of rice, cocoa, 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

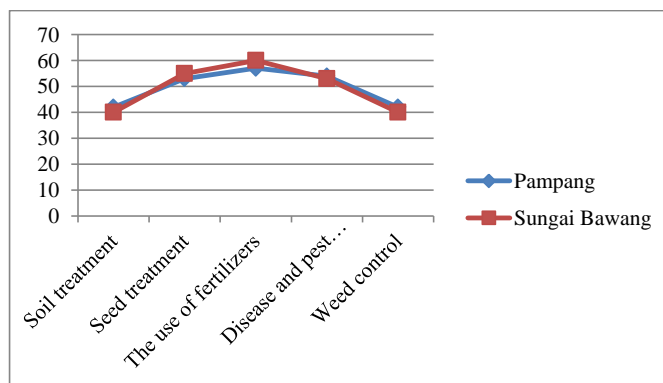
Adoption level in this study is how far the respondents adopting and practicing agricultural technology particularly in rice farming, cocoa garden, oil palm garden and vegetables garden.

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

No	Agricultural Technology	Score/Criteria	
		Pampang	Sungai Bawang
1	Soil treatment	42/low	40/low
2	Seed treatment	53/middle	55/middle
3	The use of fertilizers	57/middle	60/middle
4	Disease and pest control	54/middle	53/middle
5	Weed control	42/low	40/low

Source: individual interview (2019)

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



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

### 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 sun rise 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 were low.

Respondents argue that they are not used to plow the soil because this kind of work may cause back pain, and even headache. 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 seed according to some criteria: for example rice, purity of variety 98%, sprout quality of 80%, not expired and treatment 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 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 not so concern of the purity or not of the seed, because they haven't know 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 just when it 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 regard 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 humus 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 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 method of weed control as follows: wear long sleeve shirts, work gloves, safety goggles along with long pants as well as covered shoes, and wind direction. Table 2 shows that adoption level to safe weed control was at *low* level. Respondents were not so concerned of 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 mask, but they didn't wear covered shoes. The respondents were also not concerned of 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 were 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. Table 3 shows that adoption level in Pampang Village 70% of the respondents was at *low* level and only 30% at *middle* level. Similarly, in Karang Mumus village 60% of respondents were at *low* level and the rest 40% at *middle* level.

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

No	Responses of respondents to extension officers' performance	Score and Criteria	
		Pampang	Sungai Bawang
1	Intensity of extension	30/low	40/low
2	Follow-up of extension	43/low	44/low
3	Visual tool for extension	38/low	43/low
4	Media of extension	51/middle	49/middle
5	Communication technic	44/low	47/middle
6	Demonstrate economic advantages	43/low	44/low
7	Observeability of output	48/middle	47/middle
8	Complexity of the extension	60/middle	57/middle
9	Trialability	44/low	43/low



10 Influence of old culture 40/low 39/low

Source: individual interview (2019)

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 only once a month. It was mentioned in the Indonesian Law No. 16/2006 regarding Agricultural Extension System that Extension Officers should have capability, skill and working spirit to improve agricultural development.

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 to the complexity to understand the material provided by extension officer. Extension officer neither provides actual examples of the advantages of the 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 tool for extension activity, Akintunde and Idowu (2019) suggested that the effects of visual tool on access to information had a highly significant positive impact on the use of information and communications technology by extension officers.

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

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Table above 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 officer should use preferred method 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.

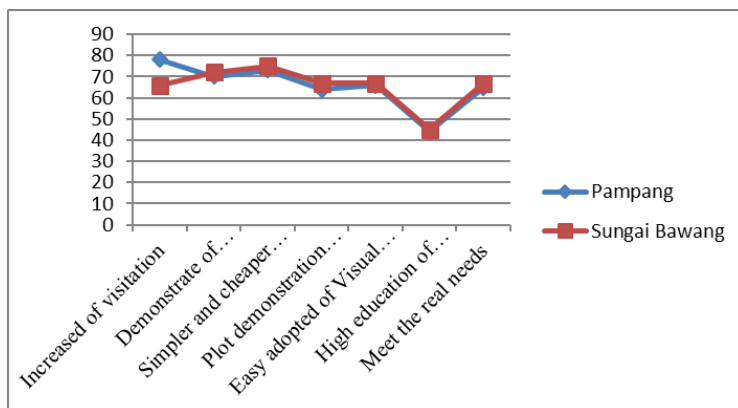


Figure 2. Trend of the respondents' expectations of extension process

**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 6.

Table 6. Government support needed by extension officers

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

Table 6 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 skill through advance training on extension skill. As mentioned above that the respondents need visual tool for extension so that it easier for farmers to understand. Beside that, the extension workers are also need appropriate material or media support for extension activity such personal computer (laptop), LCD. In order to support the use of the media for example LCD, the extension need portable generator for field extension. As for information, electricity connection is not available in this area so that portable generator is crucial.

Comment [MAO10]: Not in table 6

Comment [MAO11]: Make this clearer

**Conclusion and recommendation**

Adoption levels of most of the respondent in both villages were low and the graphic trends of adoption levels were almost similar among two villages. The low of adoption level caused by multiple-factors such as low performance of the extension officer, extension couldn't demonstrate and to convince respondents about the advantages of the new technology, old cultural and subsistence background of the respondents. The 87% of respondents with low education level (Elementary School and even not finish Elementary School) need comparative-excursion for successful farmers. They need to experience real success other than know the theory. On the other hand, the extension officer excused that the low of adoption level were also caused by the lack of necessary government support caused them not so effective in field extension; farmers with low education 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 already familiar with the respondents and using existed local materials.

Comment [MAO12]: It is better you are specific about your respondents, famers or extension officers, see previous discussions.

Comment [MAO13]: Same issue

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### REFERENCES

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- Lawal, A., Kakara, A.T., Abdullahi, A.H., Alhaji, A.J.. Data Management Capabilities of Extension Personnel in Kaduna Agricultural Development Agency Kaduna State, Nigeria. Journal of Agricultural Extension Vol. 23(4) October 2019.
- Memon, I., Panhwar, K., Chandio, R., Bhutto, A. and Khooharo, A. (2014). Role of Mass Media in Dissemination of Agricultural Technology among the Farmers of Jaffarabad District of Balochistan. Journal of Basic & Applied Sciences, 2014, 10, 525-531.
- Oyediji, Y.T., and Christiana, A. O. 2019. Farmers' Assessment of the Effectiveness of Extension Communication Methods Used in Ogbomosho Agricultural Zone of Oyo-State, Nigeria. Journal of Agricultural Extension Vol. 23 (3) July 2019.
- Rogers, E.M. and F.F. Shoemaker. 1971. Communication of Innovation: a cross-cultural Approach. 2<sup>nd</sup> Edn., Free Press, New York, USA... Pages 476
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**SARAN PERBAIKAN DARI REVIEWER A (13 FEBRUARI 2020)**

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

NDAN IMANG \*

Faculty of Agriculture/Center for Social Forestry (CSF), Universitas Mulawarman, \*email: imangndan15@gmail.com

Manuscript received: xxx. Revision accepted: xxx January 2020.

**Abstract.** Imang N. 2020. *Adoption level of indigenous communities to agricultural technology: problem and adaptive solutions in East Kalimantan, Indonesia. Biodiversitas 21: xxxx.* The economic and cultural background of the indigenous people of the Dayak Borneo was traditional shifting cultivation, hunting, and gathering. Since 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: (1) adoption level of 60% i.e. *Low* level and 40% i.e. *middle* level in both villages; (2) 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; (3) 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 education 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 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 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 Dayak 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

Research was conducted in two urbanized villages of indigenous Dayak people: Pampang and Sungai Bawang in June to August 2019. 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. Based on the accumulation of Likert-score, the level of adoption is categorized in three ranks as shown on this table.

**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 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 vegetables garden.

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

No	Agricultural Technology	Score/Criteria	
		Pampang	Sungai Bawang
1	Soil treatment	42/low	40/low
2	Seed treatment	53/middle	55/middle
3	The use of fertilizers	57/middle	60/middle
4	Disease and pest control	54/middle	53/middle
5	Weed control	42/low	40/low

Source: individual interview (2019)

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.

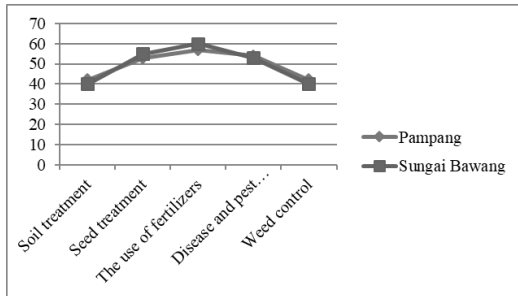


Figure 1. Trend in adoption levels of two villages

*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 didnot 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 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 was at *low* level and only 30% at *middle* level. Similarly, in Karang Mumus village, 60% of respondents was at *low* level and the rest 40% at *middle* level.

Table 3. Response of respondents to extension officer performance

No	Responses of respondents to extension officers' performance	Score and Criteria
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		Pampang	Sungai Bawang
1	Intensity of extension	30/low	40/low
2	Follow-up of extension	43/low	44/low
3	Visual tool for extension	38/low	43/low
4	Media of extension	51/middle	49/middle
5	Communication technic	44/low	47/middle
6	Demonstrate economic advantages	43/low	44/low
7	Observability of output	48/middle	47/middle
8	Complexity of the extension	60/middle	57/middle
9	Trialability	44/low	43/low
10	Influence of old culture	40/low	39/low

Source: individual interview (2019)

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.

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 tool 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.** Expectations of respondents on method of agricultural extension service delivery

No	Expectation of respondents	Score	Criteria
1	Increased visitation	78/high	66/high
2	Demonstrate economic advantages	70/high	72/high
3	Simpler and cheaper technology	73/high	75/high
4	Plot demonstration with farmers	64/middle	67/high
5	Easy adopted of Visual method	66/high	67/high
6	Education of extension agent	44/low	45/low
7	Meet the real need of farmers	65/high	67/high

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

Source: individual interview (2019)

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.

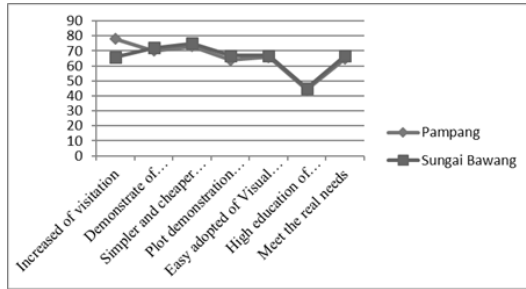


Figure 2. Trend of the respondents' expectations of extension process

**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 6.

Table 6. Government support needed by extension officers

No	Government support for Extension Officer	Likert-score	Criteria
1	Financial support for field extension	10	fair
2	Technical skill support for improved extension	7	Un-satisfactory
3	field operational support/motorbike	12	fair
4	Future good career	11	fair
5	Material /media support from government	7	Un-satisfactory

Source: individual interview (2019)

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

Table 6 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 activity 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.

**Conclusion and recommendation**

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-exursion 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 education 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 education 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.

**ACKNOWLEDGEMENTS**

I would like to express my gratitude to the University of Mulawarman, particularly the Faculty of Agriculture for providing small research-incentive for selective lecturers. We would also like to thanks the people of the two villages for their strong support during field survey.

**REFERENCES**

Akintunde, Moruf Abiola and Oladele, Oladimeji Idowu. 2019. Use of Information Communication Technologies among Agricultural

**Comment [a14]:**

References:  
 -80% should come from scientific journal published in the last 10 yrs.  
 -Max 10% for References in local language (Bahasa Indonesia)

- Extension Officers in Lesotho: Journal of Agricultural Extension Vol. 23 (3) July, 2019
- Effendy**, J. and Hutapea, Y. 2010. Analisis Adopsi Inovasi Pertanian berbasis Padi di Sumatera Selatan dalam Perspektif Komunikasi (Analysis of Agricultural Innovation Adoption based Rice in South Sumatra in Communication Perspective). [Indonesian]
- Imang, N., Rujehan, Naomi, N.D. 2018. Assessment of Daleh Swidden agriculture as an innovative alternative to conventional swidden under conditions of external pressure on local forest management in Kalimantan, Indonesia. Biodiversitas Vol. 19 (3) May 2018.
- Kueng, J., and Imang, N., 2007. *Kajian Kearifan Tradisional Suku Punan Basap di Kabupaten Kutai Timur, Indonesia* (Traditional Knowledge of the Basap Punan in East Kutai District, Indonesia).
- Lawal, A., Kakara, A.T., Abdullahi, A.H., Alhaji, A.J.. Data Management Capabilities of Extension Personnel in Kaduna Agricultural Development Agency Kaduna State, Nigeria. Journal of Agricultural Extension Vol. 23(4) October 2019.
- Memon, I., Panhwar, K., Chandio, R., Bhutto, A. and Khooharo, A. (2014). Role of Mass Media in Dissemination of Agricultural Technology among the Farmers of Jaffarabad District of Balochistan. Journal of Basic & Applied Sciences, 2014, 10, 525-531.
- Oyedeji, Y.T., and Christiana, A. O. 2019. Farmers' Assessment of the Effectiveness of Extension Communication Methods Used in Ogbomoso Agricultural Zone of Oyo-State, Nigeria. Journal of Agricultural Extension Vol. 23 (3) July 2019.
- Roger**, E.M. and F.F. Shoemaker. 1971. Communication of Innovation: a cross-cultural Approach. 2<sup>nd</sup> Edn., Free Press, New York, USA..., Pages 476
- Warku**, A., A. 2019. Factors Affecting Diffusion And Adoption Of Agricultural Innovations Among Farmers In Ethiopia Case Study Of Ormia Regional State Western Sewa. Journal of Agricultural Extension Vol. 7 (2).
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*Hasil Revisi terhadap saran dari Reviewer A*

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

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Manuscript received: xxx. Revision accepted: xxx January 2020.

**Abstract.** *Imang N. 2020. Adoption level of indigenous communities to agricultural technology: problem and adaptive solutions in East Kalimantan, Indonesia. Biodiversitas 21: xxx.* The economic and cultural background of the indigenous people of the Dayak Borneo was traditional shifting cultivation, hunting, and gathering. Since 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: (1) adoption level of 60% i.e. *Low* level and 40% i.e. *middle* level in both villages; (2) 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; (3) 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 education 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 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,

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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). Regarding the importance of agricultural technology for farmer, Mulimbi *et al.*, (2019) found that empowering farmers to increase productivity by educating them on conservation agriculture (CA) could contribute to reducing vulnerability, alleviating food insecurity, and fighting poverty. Ansari and Tabassum (2018) described conservation or sustainable agriculture as a broad term that addresses a multitude of social, environmental, and economic aspects and covers many different areas within agricultural production (dairy, livestock, poultry, etc.) and beyond. In line, Hailu *et al.*, (2014) mentioned that production and productivity can be realized when technologies are widely been used and diffused among farmers. This statement was also supported by Melesse (2018) who found that adoption of agricultural technologies could alleviate poverty among farmers in Ethiopia.

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.

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### Adoption level

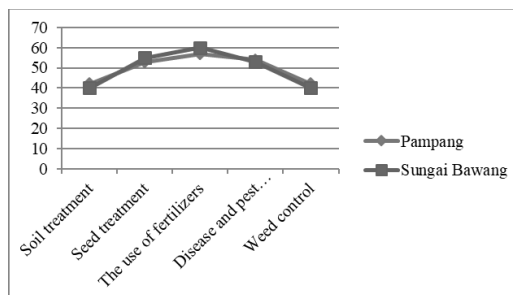
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In order to improve the adoption level of the farmers to agricultural extension, it is very important to explore the needs and expectations of the respondents and how Extension Workers should improve their skill and competency for more effective extension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

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

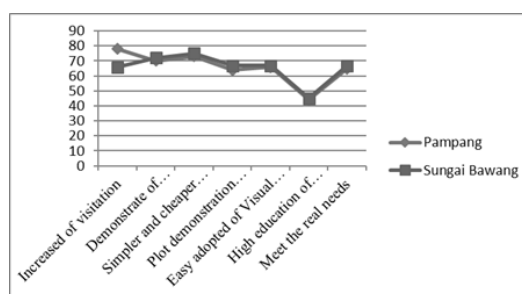
No	Expectation of respondents	Score	Criteria
1	Increased visitation	78/high	66/high
2	Demonstrate economic advantages	70/high	72/high
3	Simpler and cheaper technology	73/high	75/high
4	Plot demonstration with farmers	64/middle	67/high
5	Easy adopted of Visual method	66/high	67/high
6	Education of extension agent	44/low	45/low
7	Meet the real need of farmers	65/high	67/high

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

Source: individual interview (2019)

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.



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

#### 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 6.

**Table 6.** Government support needed by extension officers

No	Government support for Extension Officer	Likert-score	Criteria
1	Financial support for field extension	10	fair
2	Technical skill support for improved extension	7	Un-satisfactory
3	field operational support/motorbike	12	fair
4	Future good career	11	fair
5	Material /media support from government	7	Un-satisfactory

Source: individual interview (2019)

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

Table 6 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 activity 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.

**Conclusion and recommendation**

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. This is similar with Mwangi and Kariuki (2015) who found that agricultural technologies are seen as an important route out of poverty in most of the developing countries. However the rate of adoption of these technologies has remained low in most of these countries.

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-exursion 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 education 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 education 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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**REFERENCES**

Akintunde, Moruf Abiola and Oladele, Oladimeji Idowu. 2019. Use of Information Communication Technologies among Agricultural Extension Officers in Lesotho: Journal of Agricultural Extension Vol. 23 (3) July, 2019

Ansari, S.A., and Tabassum, S. 2018. A New Perspective on the Adoption of Sustainable Agricultural Practices: A Review. Current Agriculture Research Journal, Vol. 6 No. (2), Pp 157-165

Efendy, J. and Hutapea, Y. 2010. Analisis Adopsi Inovasi Pertanian berbasis Padi di Sumatera Selatan dalam Perspektif Komunikasi (Analysis of Agricultural Innovation Adoption based Rice in South Sumatra in Communication Perspective). [Indonesian]

Hailu, B.K.; Abrha, B.K; Weldegiorgis, K.A. 2014. Adoption And Impact Of Agricultural Technologies On Farm Income: Evidence From Southern Tigray, Northern Ethiopia. International Journal of Food and Agricultural Economics. Vol. 2 No. (4) Pp 91-106.

Imang, N., Rujehan, Naomi, N.D. 2018. Assessment of Daleh Swidden agriculture as an innovative alternative to conventional swidden under conditions of external pressure on local forest management in Kalimantan, Indonesia. Biodiversitas Vol. 19 (3) May 2018.

Kueng, J., and Imang, N., 2007. *Kajian Kearifan Tradisional Suku Punan Basap di Kabupaten Kutai Timur, Indonesia* (Traditional Knowledge of the Basap Punan in East Kutai District, Indonesia).

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References:  
 -80% should come from scientific journal published in the last 10 yrs.  
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- Lawal, A., Kakara, A.T., Abdullahi, A.H., Alhaji, A.J.. Data Management Capabilities of Extension Personnel in Kaduna Agricultural Development Agency Kaduna State, Nigeria. *Journal of Agricultural Extension* Vol. 23(4) October 2019.
- Melesse, B. 2018. A Review on Factors Affecting Adoption of Agricultural New Technologies in Ethiopia. *Journal of Agricultural Science and Food Research*. Vol. 9 Issue 3.
- Memon, I., Panhwar, K., Chandio, R., Bhattu, A. and Khooharo, A. (2014). Role of Mass Media in Dissemination of Agricultural Technology among the Farmers of Jaffarabad District of Balochistan. *Journal of Basic & Applied Sciences*, 2014, 10, 525-531.
- Mulimbi, W., Lawton, N., Bruce, D., Snell, H. and Huang, Q. 2019. Factors Influencing Adoption of Conservation Agriculture in the Democratic Republic of the Congo. *Journal of Agricultural and Applied Economics*, Vol 9 , pp 622–645.
- Mwangi, M and Kariuki, S. 2015. Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *Journal of Economics and Sustainable Development*, Vol. 6 No. 5.
- Oyediji, Y.T., and Christiana, A. O. 2019. Farmers' Assessment of the Effectiveness of Extension Communication Methods Used in Ogbomoso Agricultural Zone of Oyo-State, Nigeria. *Journal of Agricultural Extension* Vol. 23 (3) July 2019.
- Roger, E.M. and F.F. Shoemakers. 1971. *Communication of Innovation: a cross-cultural Approach*. 2<sup>nd</sup> Edn., Free Press, New York, USA..., Pages 476
- Schimmelpfennig, D., and Ebel, R. 2016. Sequential Adoption and Cost Savings from Precision Agriculture. *Journal of Agricultural and Resource Economics*, 41(1): pp 97–115
- Warku, A., A. 2019. Factors Affecting Diffusion And Adoption Of Agricultural Innovations Among Farmers In Ethiopia Case Study Of Ormia Regional State Western Sewa. *Journal of Agricultural Extension* Vol. 7 (2).

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