DEVELOPING A MODEL OF STRATEGIC FARMING TECHNIQUES FOR FARMERS WITH SMALL-SCALE ARABLE LANDS

Ryan R. Pecson, MAEd[1], Jay M. Lampa, MAEd[2], Enrico B. Dimarucut[3]

[1,2,3] *Department of Education (DepEd) – Division of Pampanga, Philippines*

ABSTRACT

The study concentrated on the strategic farming techniques of farmers with small-scale arable lands. Specifically, the study provided data on the profile of the farmers including their age and years of farming; and the strategic farming techniques in terms of adaptive management, cooperation, ecology-based strategy, economics-based strategy, holistic and complex systems thinking, knowledge and science, and subsidiary. Meanwhile, the study used the quantitative research design of descriptive survey in gathering data on the 30 farmers with small-scale arable lands as the respondents who were selected using the purposive sampling technique. Moreover, the survey questionnaire used in data gathering was based on a systematic review on sustainable agriculture. Statistics such as frequency, percentage, mean, standard deviation, t-test, and ANOVA/F-test were used in treating the data gathered. The results indicated that the farmer-respondents are aged 40-52 years old and had been farming their small-scale arable lands for 3-27 years; they preferred the strategic farming techniques, particularly the cooperation opportunities; there is no significant difference in the strategic farming techniques of farmers when grouped according to their age and years of farming; and the study proposed a model of strategic farming techniques as an output to guide the farmers in improving their farming practices.

Keyword: *Arable Land, Agricultural Practices, Farmers, Small-scale Farmlands, Strategic Farming*

1. INTRODUCTION

The adoption and diffusion of sustainable agricultural practices (SAPs) has become an important issue in the development-policy agenda, especially as a way to tackle land degradation, low agricultural productivity and poverty [1]. The employment of agricultural practices and methods are very obliging to farmers on their farm. In the way that efficient farming is possible through these agricultural practices. These practices help on battling the perennial problems in the agriculture sector and economics sector of the country such as the poverty, and the agricultural productivity following the economy.

Among environmental problems, SAPs are important in achieving better agricultural productivity and food security status of small-scale farms [2]. Through these sustainable agricultural practices, small-scale farmers made an opportunity to produce more goods despite of having a small-scale of farmland. However, producing enough food to address the needs of a growing populace has dependably been the best worry of food policy-makers around the world. Hence, SAPs resolved the worries of food policy-makers around the world [3].

Improving agricultural sustainability is fundamental to food security and poverty reduction [4]. Literature depicted that SAPs to lessen the poverty incidences. From 10% in 2015, poverty declined into 8.6% in 2018 [5]. From extreme poverty into declining, SAPs made a contribution in lessening it. Thus, Small-scale farmers played a vital role in food security and poverty lessening [6]. This is just evident that since then, small-scale farms are small yet terrible in battling against numbers of problems in the world, especially on lessening the poverty and agricultural issues.

In the case of the Philippines, it is an agrarian country. Previously, there were more farmlands, but now, the sizes of arable lands are relatively small. During the pre-Spanish period, everyone had the access to the fruits of the soil. Then encomienda or Royal Land Grants was introduced when the Spaniards came to the Philippines, where, the system grants that encomiendieros must defend from external attack, maintain peace and order within, and support the missionaries. Moreover, the encomienderos were acquired the right to collect tribute to the natives. Yet, it came to abuse where, tribute became land rents to a few powerful landlords and the native farmers who once had their freedom in lands became tenants. After the Spaniards, Americans came and proposed a comprehensive registration of land titles. Maximum of 16 has. for private individuals and 1,024 has. for corporations were set. Under the Spaniards and Americans, landlord and tenants' relationship were made. Eventually, it provided the purchase and lease of haciendas and their sale and lease for tenants. On the era of Hukbalahap, those who supported the Japanese lost their lands to peasants while those who supported Hukbalahap earned fixed rentals in favor of the tenants. For the new republic of the Philippines, lots of republic acts swarmed on the sector of agriculture. Large tenanted rice and corn lands were distributed over 200 has. for individuals and 600 has. for corporations. During the regime of President Marcos, he limits the tenanted rice and corn lands into seven hectares. More Presidents had pasts who brought agrarian laws on the distribution of lands to tenant farmers dividing a large land into small pieces. Aside from the distribution of lands, the introduction of new era produced commercial buildings such as malls, marketing facilities, and the construction of roads resulted the deflation on the space of farmlands [7].

Nevertheless, regardless of whether and how the small-scale farmers can survive due to globalization is a fervently debated topic [6]. Back then, on how will the small-scale farmers stand out under globalization was still a debated topic. The farmers working a small-scale farmland in developing countries have to handle the risks of the small business and face heavy challenges in a large amount of time. Even though facing the challenges of globalization, the small-scale farmers continue to thrive by adapting to some changes. Globalization offers a new opportunity and at the same time new risks. In light of these risks and others, millions of small farmers around the globe are simply not making it [8]. Yet, the SAPs became essential to farmers with small-scale of farmland on achieving better agricultural productivity [2]. Thus, SAPs help the small-scale farmers for a better productivity of crops.

Likewise, most poor Filipinos work in agriculture as laborers or small-scale producers. Their main source of income depends on agriculture [9]. Farmers with small-scale farms had their hard time taking the risks due to the globalization and integrations of international markets. According to the 2012 Census of Agriculture, 89.9 percent of farms in the Philippines measures one up to three hectares belonging on the small-scale [10]. Therefore, there are lots of farmers handling a small-scale land that experience challenges and able to adopt the SAPs in tilling their lands.

Different strategies had emerged in SAPs. Yet, the concept of sustainable agriculture is very vague and ambiguous in its meaning, which renders its use and implementation extremely difficult [11]. The Philippines is known as an agricultural country yet due to the passing of ages, economy is growing that the small-scale farmers cannot cope and stay on poverty [12]. Most of the small-scale farmers are poor and cannot afford the integration of technology in order to catch up with the developing economy.

With such realities in mind, the study aimed on creating a model of strategic farming techniques containing different SAPs for the farmers to apply on their small-scale arable lands, leading to the increase on their crop production; to educate further the farmers to make their lands more arable; and to come up with empirical practices responsive to the needs of the farmers. Thus, the study contributed in addressing some of the perennial issues in agriculture as experienced by the Filipino farmers with small-scale arable lands.

1.1 Statement of the Problem

This study analyzed the different strategic farming techniques utilized by the farmers with small-scale arable lands in one of the municipalities in the Province of Pampanga, Philippines.

It also answered the following questions:

1. What are the profile of farmers with small-scale arable lands in terms of:
   1.1 age; and
   1.2 years as farmers?
2. What are the strategic farming techniques of farmers with small-scale arable lands on:
   2.1 adaptive management;
   2.2 cooperation;
   2.3 ecology-based strategy;
   2.4 economics-based strategy;
   2.5 holistic and complex systems thinking;
   2.6 knowledge and science; and

2.7 subsidiary?

3. Is there any significant difference in the strategic farming techniques of farmers with small-scale arable lands and their profile?
4. Based on the results of the study, what model of strategic farming techniques be proposed?

1.2 Hypothesis

The listed null hypothesis that there is no significant difference in the strategic farming techniques of farmers with small-scale arable lands and their profiles was tested at 0.05 level of significance.

2. METHOD

2.1 Research Design

The study utilized the descriptive survey of quantitative research in gathering pertinent data on the strategic farming techniques of the farmers with small-scale arable lands in creating a model of strategic farming techniques.

2.2 Respondents

The respondents of the study were composed of selected 30 farmers in one of the municipalities in the Province of Pampanga. There are 5 or 16.67% farmers with 0.500 ha. to 0.999 ha. arable lands, while there are 25 or 83.33% with 1.000 ha. to 2.999 ha. arable lands. This indicated further that the farmer-respondents in the study only have 0.50 to 3.00 ha. of tillable lands.

Table 1: Respondents of the Study

Arable Lands	Frequency	Percentage
0.500 ha. to 0.999 ha.	5	16.67
1.000 ha. to 2.999 ha.	25	83.33
Total	30	100.00

2.3 Instrument

The study utilized the survey questionnaire in collecting the needed data. The survey questionnaire contained the following parts: the profile of the farmers in terms of age and years of farming and the strategic farming techniques containing adaptive management, cooperation, ecology-based strategy, economics-based strategy, holistic and complex systems thinking, knowledge and science, and subsidiary. The said strategies were adapted [11] in the drafting the survey questionnaire. Other concepts and ideas were added to suit the statements in the local of the study. A translated copy in the Filipino language was provided to aid the respondents in answering the survey questionnaire.

2.4 Statistical Treatment

The data gathered were tallied and computed using descriptive statistics such as frequency, percentage, mean, and standard deviation (SD), while the inferential statistics such as t-test and ANOVA/F-test as inferential statistics were applied in testing the hypothesis.

3. RESULTS AND DISCUSSION

3.1 Profile of the Farmers with Small-scale Arable Lands

The age of the farmers was grouped into three (3) ranges: 9 or 30% of the farmers are aged 27-39 years old; 14 or 47% of the farmers are aged 40-52 years old; and 7 or 23% of the farmers are aged 53-64 years old. The results indicated that the Filipino farmers are generally aging.

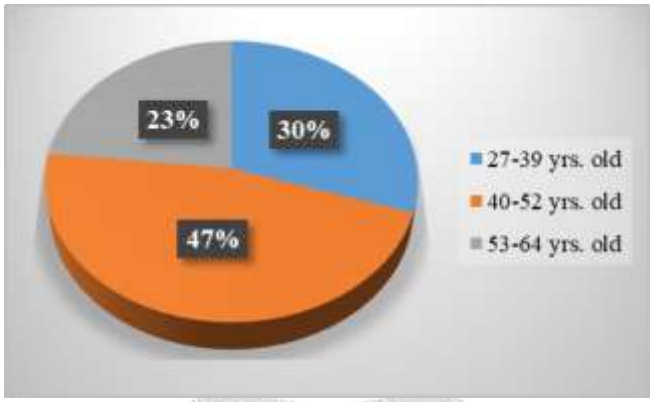

Chart 1: Profile of the Farmers with Small-scale Arable Lands in terms of Age

Their years as farmers were grouped into two (2) ranges: 8 or 26.67% of the respondents have 28-50 years of farming experiences; and 22 or 73.33% of the respondents had been farming for 3-27 years. The data also revealed that there are considerably beginning farmers than experienced ones.

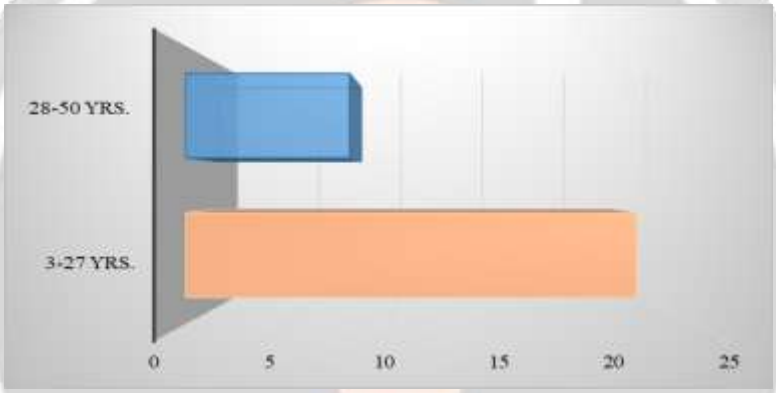

Chart 2: Profile of the Farmers with Small-scale Arable Lands in terms of Years of Farming

3.2 Strategic Farming Techniques of Farmers

Table 2: Strategic Farming Techniques of Farmers

Items	Mean	SD	Interpretation
A. Adaptive Management	**2.75**	**0.49**	**Preferred**
1. Adaptation to various technologies and other best practices that can be applied to farming	2.70	0.47	Preferred
2. Learning and experimentation of effective measures to increase the crop production	2.77	0.43	Preferred
3. Management, integration and redesign of equipment and methodologies in farming	2.50	0.68	Preferred
4. Prevention of diseases that may strike the crops	2.93	0.37	Preferred
5. Substitution of other crops for sustainability of farming	2.83	0.38	Preferred
B. Cooperation	**2.85**	**0.40**	**Preferred**
1. Collaboration and communication with the government and other groups to promote farming	2.90	0.31	Preferred
2. Participation to various farming activities, expos, and training/seminars	2.80	0.48	Preferred
C. Ecology-based Strategy	**2.62**	**0.52**	**Preferred**
1. Diversification by recognizing the biodiversity of environment in farming	2.63	0.49	Preferred
2. Ecological principles protecting and conserving the environment while farming	2.60	0.56	Preferred

D. Economics-based Strategy	**2.59**	**0.54**	**Preferred**
1. Capital asset maintenance, e.g. tools, equipment, technology	2.60	0.56	Preferred
2. Demand-orientation which focuses on the production of crops/products based on the demands of the consumers	2.27	0.52	Moderately Preferred
3. Efficiency of operation by maximizing the use of technology and other capital for a better yield in crops	2.80	0.41	Preferred
4. Quality-orientation which focuses on the quality of produce agricultural crops/products	2.70	0.53	Preferred
E. Holistic and Complex Systems Thinking	**2.36**	**0.53**	**Preferred**
1. Long-term perspective in managing the farm lands	2.37	0.49	Preferred
2. Scale-sensitivity which adheres to the maximizing the scale of production	2.23	0.50	Moderately Preferred
3. Systemic thinking which focuses on the strategic decisions and actions towards efficient farming	2.47	0.57	Preferred
F. Knowledge and Science	**2.59**	**0.62**	**Preferred**
1. Innovation in the use of farming techniques/strategies/methods	2.83	0.46	Preferred
2. Use of modern technologies	2.80	0.41	Preferred
3. Traditional use of effective measures in farming	2.13	0.68	Moderately Preferred
G. Subsidiary	**2.79**	**0.46**	**Preferred**
1. Decentralization of farming processes through subsidies	2.80	0.48	Preferred
2. Independence in farming the lands through subsidies	2.83	0.38	Preferred
3. Local/regional/national in farming through subsidies	2.73	2.73	Preferred
Composite	**2.65**	**0.54**	**Preferred**

Among the strategic farming techniques, cooperation has the highest mean of 2.85 with a standard deviation of 0.40 showing the responses of the respondents are merely the same and preferred by them. Cooperation is needed by the farmers and shown in terms of programs, seminars, training, and other help from the government. Among the items, the farmers preferred the most the prevention of diseases that may strike the crops (2.93). On the other side, holistic and complex systems thinking got the lowest mean of 2.36 and a standard deviation of 0.53 among the categories of strategic farming techniques, showing that their responses are also quite affirmative from one other and they also preferred the said strategic farming technique. The least rated of the farmers in all the items is the traditional use of effective measures in farming (2.13) described as moderately preferred by them. Meanwhile, the overall mean of 2.65 and the standard deviation is 0.54 indicated commonalities with their responses given.

3.3 Significant Difference in the Strategic Farming of Farmers with Small-scale Arable Lands when Grouped According to Their Profile

3.3.1 Significant Difference in the Strategic Farming of Farmers with Small-scale Arable Lands when Grouped According to Their Age

Table 3: Significant Difference in the Strategic Farming of Farmers with Small-scale Arable Lands when Grouped According to Their Age

Sub-variables	Groups	Mean	SD	F-value	p-value	Remarks	Decision
Adaptive Management	53 - 64	2.77	0.60	1.05	0.38	Not Significant	Accept H_0
	40 - 52	2.77	0.46				
	27 - 39	2.80	0.46				
Cooperation	53 - 64	2.79	0.43	2.20	0.26	Not Significant	Accept H_0
	40 – 52	2.82	0.48				
	27 - 39	2.94	0.24				
Ecology-based Strategy	53 - 64	2.79	0.43	5.21	0.11	Not Significant	Accept H_0
	40 - 52	2.54	0.58				
	27 - 39	2.61	0.50				
Economics-based Strategy	53 - 64	2.43	0.57	1.02	0.40	Not Significant	Accept H_0
	40 - 52	2.64	0.55				

	27 - 39	2.64	0.49				
Holistic and Complex Systems Thinking	53 - 64	2.24	0.54	0.75	0.51	Not Significant	Accept H_0
	40 - 52	2.38	0.54				
	27 - 39	2.41	0.50				
Knowledge and Science	53 - 64	2.62	0.59	0.01	0.99	Not Significant	Accept H_0
	40 - 52	2.57	0.67				
	27 - 39	2.59	0.57				
Subsidiary	53 - 64	2.76	0.44	3.91	0.08	Not Significant	Accept H_0
	40 - 52	2.71	0.55				
	27 - 39	2.93	0.27				
Overall	**53 - 64**	**2.58**	**0.08**	**1.18**	**0.31**	**Not Significant**	**Accept H_0**
	40 - 52	**2.64**	**0.07**				
	27 - 39	**2.70**	**0.13**				

It can be seen on the table that there are no significant differences between the age of the farmers and their strategic farming techniques in terms of adaptive management (f=1.05, p=0.38), cooperation (f=2.20, p=0.26), ecology-based strategy (f=1.05, p=0.38), economics-based strategy (f=1.02, p=0.40), holistic and complex systems thinking (f=0.75, p=0.51), knowledge and science (f=0.01, p=0.99), and subsidiary (f=3.91, p=0.31). These data were attested further by the overall results (f=1.18, p=0.31) indicating no significant difference. These attested further that no matter the ages of the farmers are, either young or old, they have considerably the same level of preferences in the use of strategic farming techniques; that they are affirmative to their usage. Another highlight of the results is that the young farmers are generally have slight higher ratings on their preferences on the use of strategic farming techniques that the old ones.

3.3.2 Significant Difference in the Strategic Farming of Farmers with Small-scale Arable Lands when Grouped According to Their Years of Farming

Table 4: Significant Difference in the Strategic Farming of Farmers with Small-scale Arable Lands when Grouped According to Their Years of Farming

Sub-Variables	Groups	Mean	SD	t-stat	p-value	Remarks	Decision
Adaptive Management	28 – 50	2.78	0.42	-0.85	0.44	Not Significant	Accept H_0
	3 – 27	2.73	0.52				
Cooperation	28 – 50	2.78	0.43	1.44	0.39	Not Significant	Accept H_0
	3 – 27	2.88	0.40				
Ecology-based Strategy	28 – 50	2.56	0.51	3.67	0.17	Not Significant	Accept H_0
	3 – 27	2.64	0.53				
Economics-based Strategy	28 – 50	2.61	0.49	-0.33	0.76	Not Significant	Accept H_0
	3 – 27	2.58	0.56				
Holistic and Complex Systems Thinking	28 – 50	2.26	0.45	0.96	0.44	Not Significant	Accept H_0
	3 – 27	2.40	0.55				
Knowledge and Science	28 – 50	2.74	0.59	-4.61	0.04	Significant	Reject H_0
	3 – 27	2.52	0.62				
Subsidiary	28 – 50	2.85	0.36	-0.62	0.60	Not Significant	Accept H_0
	3 – 27	2.76	0.50				
Overall	**28 – 50**	**2.66**	**0.08**	**-0.55**	**0.59**	**Not Significant**	**Accept H_0**
	3 – 27	**2.64**	**0.07**				

It can be seen on the table that there are no significant differences on the farming strategies of farmers when grouped according to their years as farmers in terms of adaptive management (t=-0.85, p=0.44), cooperation (t=1.44, p=0.39), ecology-based strategy (t=3.67, p=0.17), economics-based strategy (p=-0.33, t=0.76), holistic and complex systems thinking (t=0.96, p=0.44), and subsidiary (t=-0.62, p=0.60). On the other hand, there is a significant difference on the knowledge and science (t=-4.61, p=0.04). This can be noted to the fact that there is a variation on the preferences of the farmers on knowledge and science based on their years of experiences as farmers; that the farmers with more experiences (28 – 50 years) preferred the use of the strategic farming techniques (2.74) than those

farmers with fewer experiences (3 – 27 years) with the mean of 2.52. On the other hand, the overall results indicated that there is still no significant difference between the years of experiences of the farmers and their general preferences in the use of strategic farming techniques (t=-0.55; p=0.59).

3.4 Model of Strategic Farming Techniques

Based on the results, the farmers are affirmative and optimistic with the use of strategic farming techniques. This proposed model of strategic farming techniques was crafted based on the highest rated techniques by the farmers in each of the categories. Highlighted herein are the best practices and the guidelines to better implement the said practice so that other farmers would be able to replicate the said practices on their arable lands.

Areas	Best Practices	Guidelines in Implementation
Adaptive Management	Prevention of diseases that may strike the crops	Removing infected leaves or plants Avoiding overhead watering, apply water to soil, and avoid wetting the foliage – groups of leaves
Cooperation	Collaboration and communication with the government and other groups to promote farming	Creating more cooperatives in the sector of agriculture. Partnering with NGOs, GOs, private institutions, and other agencies
Ecology-based Strategy	Diversification by recognizing the biodiversity of the environment in farming	Using organic farming Avoiding excessive use of chemical fertilizers Adaptation of environment-friendly technologies
Economics-based Strategy	Efficiency of operation by maximizing the use of technology and other capital for better yield in crops	Using empirically tested and technology-based machineries to maximize the full potential of crop production
Holistic and Complex Systems Thinking	Systemic thinking which focuses on the strategic decisions and actions towards efficient farming	Giving training and seminars to the farmers for information campaigns Intensifying farmer groups
Knowledge and Science	Innovation in the use of farming techniques/strategies/methods	Using technology-based farming Educating for the effective application of systematic strategic farming practices Giving farm-to-farm information campaigns
Subsidiary	Independence in farming the lands through subsidies	Giving more government and private institutions' assistance Providing more for loan grants

4. CONCLUSIONS

With the findings disclosed from the data gathered, the following conclusions were driven:

1. The farmer-respondents are aged 40-52 years old and had been farming their small-scale arable lands for 3-27 years.
2. The farmer-respondents preferred the strategic farming techniques, particularly in terms of cooperation opportunities.
3. There is no significant difference on the strategic farming techniques of farmers when grouped according to their age and their years of farming.
4. The study proposed a model of strategic farming techniques as an output to guide the famers in improving their farming practices.

5. RECOMMENDATIONS

For the conclusions of the study, the following were recommended:

1. Since there were few young farmers and old farmers are retiring, the young ones may be trained earlier to preserve and sustain the agricultural productivity of the arable lands of the country. In addition, the sharing of experiences and ideas of the farmers may be done for such purpose.

2. Government and cooperatives must give training and seminars to the farmers, in the form of sharing experiences, especially in the farmers with small-scale arable lands, focusing on holistic and complex systems thinking for them to become more adaptive with the latest trends, innovations, and technologies in strategic farming.
3. Farmers must be familiarized on the proper usage of strategic farming techniques to sustain and maximize the full potential of their small-scale arable lands, particularly in the advantageous use of knowledge and science in farming where deviation was accounted between the experienced and less experienced farmers.
4. The farmers should be oriented on the proper guidelines on the implementation of the best practices in the areas of strategic farming techniques to effectively apply the said techniques on their farms.
5. Another study on the application of the model in various farmers can also be realized as support for its effectiveness.

6. REFERENCES

[1]. Teklewold, H., Kassie, M., & Shiferaw, B. (2013). Adoption of multiple sustainable agricultural practices in rural Ethiopia. Journal of Agricultural Economics, 64(3).
[2]. Nkomoki, W., Bavorová, M., & Banout, J. (2018). Adoption of sustainable agricultural practices and food security threats: Effects of land tenure in Zambia. Land Use Policy, 78, 532-538.
[3]. Jouzi, Z., Azadi, H., Taheri, F., Zarafshani, K., Gebrehiwot, K., Van Passel, S., & Lebailly, P. (2017). Organic farming and small-scale farmers: Main opportunities and challenges. Ecological Economics, 132, 144-154.
[4]. Adenle, A., Azadi, H., & Manning, L. (2018). The era of sustainable agricultural development in Africa: Understanding the benefits and constraints. Food Reviews International, 34(5), 411-433.
[5]. The World Bank (2018). Decline of global extreme poverty continues but has slowed: world bank. The World Bank Group. Retrieved from https://www.worldbank.org/news/press-release/2018/9/19decline-of-global-extreme-poverty-continues-but-has-slowed-world-bank
[6]. Fan, S., & Chan-Kang, C. (2005). Is small beautiful? Farm size, productivity, and poverty in Asian agriculture. Agricultural Economics, 32, 135-146.
[7]. Department of Agrarian Reform (2013). Agrarian reform history. Republic of the Philippines; Department of Agrarian Reform (Kagawaran ng Repormang Pansakahan). Retrieved from www.dar.gov.ph/about-us/agrarian-reform-history
[8]. Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2007, May). The future of small farms for poverty reduction and growth. International Food Policy Research Institute. Retrieved from http://lib.icimod.org/record/13062/files/4312.PDF
[9]. The World Bank (2018). Philippines' poverty rate declines; more well-paying jobs and opportunities needed. The World Bank Group. Retrieved from https://www.worldbank.org/news/press-release/2018/5/30philippines-poverty-rate-declines-more-well-paying-jobs-and-opportunitiesneeded
[10]. Philippine Statistics Authority (2015). Special report – highlights of the 2012 census of agriculture (20012 CA). Retrieved from https://psa.gov.ph/content/special-report-highlights-2012-census-agriculture-2012-ca
[11]. Velten, S., Leventon, J., Jager, N., & Newig, J. (2015). What is sustainable agriculture? A systematic review. Sustainability, 7(6), 7833-7865.
[12]. De Guzman, S. S. (2018, June 18). Agriculture is dying in the Philippines. Philstar Global. Retrieved from https://www.philstar.com/opinion/2018/06/18/1825542/agriculture-dying-philippines

BIOGRAPHIES

Ryan R. Pecson is a Ph.D. candidate of Guagua National Colleges, Guagua, Pampanga. He obtained his Master's Degree in Social Science at Bataan Peninsula State University-Main Campus. He is currently a Master Teacher in DepEd-Pampanga. He has taught in a State University and a consistent thesis adviser, critique, and panel member in the Master's Degree Program of the Graduate School of BPSU-Main Campus. He is also a published researcher and enthusiast in the areas of education, science and technology, social sciences, and gamification. He can be contacted at ryan.pecson001@deped.gov.ph

Jay M. Lampa is a Ph.D. student of Guagua National Colleges, Guagua, Pampanga. He obtained his Master's Degree in Educational Management in the same college. He is also a holder of Master Degree in English. He is currently the Principal of a public high school in DepEd-Pampanga. His research interests include educational management, leadership, and English education.

Enrico B. Dimarucut is a SHS student in a public high school in DepEd-Pampanga. He is an active members of student clubs, especially in research. His research interests include agriculture, engineering, and education.