

# Analyzing the Role of Government Agriculture Expenditure, Extension services and Agricultural Credit on Real Agricultural GDP in ASEAN Countries.

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The purpose of the study was to analyze the impact of Government Agriculture Expenditure (GAE), Extension services (AES) and Agricultural Credit (AGC) on Real Agricultural GDP (RAG) of ASEAN countries. For this purpose, short-term and long-term impacts of GAE, AES and AGC were analyzed on the RAG of ASEAN countries by collecting panel data for last 30 years. The panel data of 30 years was used to analyze these relationships for which the panel ARDL approach was used. This study is based on the secondary data extracted from the databases of respective countries. The macroeconomic data for those countries was put into analysis in which the descriptive test, panel unit root test, cointegration test and ARDL modelling were applied to check the short-term and long-term relationships. The findings of the current study revealed that there is significant impact of AES, GAE and AGC on RAG of ASEAN countries in long run however, it also reported that there is no significant short-term impact of GAE and AGC on RAG. However, the AES significantly influenced the RAG in short run in the current results. The study will be beneficial for researchers and policymakers because it suggests the role of AES, GAE and AGC on RAG.



**Key words:** *Government Agriculture Expenditure, Extension services, Agricultural Credit, Real Agricultural GDP, ASEAN Countries.*

## Introduction

Agriculture has an exceptional part in the socioeconomic progress of ASEAN countries, since most of these nations have their origins in farming cultures. In future prospective, it is apparent that to fulfil the aims cherished in the ASEAN countries' 2025 vision, it would be essential for governments to do trades that donates to the GDP of entire region (Azanza, 2019). The report of World Bank recommended that there exists a considerable opportunity for hastening broad-based agrarian development aided by the government expenditure by encouraging efficiency, expertise and invention, improved water management, better-quality supervisory administration and agrarian policies for trade, as well as smarter regime for subsidies (Chung, Sun, & Vo, 2019).

In the rural agricultural context of ASEAN countries, information transmission remains to be one of the conducts for refining productivity and economy. Implementing the technology in everyday practice of farmers is significant, however, without an awareness and understanding of the procedure, use of the equipment and how to advertise the productions, cultivators cannot greatly upturn yield and cost-effectiveness (Greenville & Kawasaki, 2018). Governments as well as aid agencies continue to play a significant part in serving to distribute information through extension services. Furthermore, agricultural credit is also a back bone for the agricultural sector, as it is a nonmonetary commotion for the rustic inhabitants in ASEAN republics (Chasanah, Mulyo, & Darwanto, 2017). The sector of agriculture is more contingent on the credit as compared to any other economic sectors, due to the seasonal disparities in the agriculturalists revenues and a shifting drift to commercial farming from subsistence. Credit provides farmers with chance to make more currency and advance their living standard (Ligon & Sadoulet, 2018).

Agriculture has occupied and endures to play a significant component in the economy of ASEAN countries, despite its deteriorating influence on the area's GDP throughout the previous two eras (Nasrudin & Budiyo, 2017). It is observed as a significant carter for societal, comprehensive development and a significant basis of export remunerations in sustenance of financial expansion; a backer of diet convenience to its residents for non-staple as well as staple food options; and a foundation of direct occupation through agriculture-associated activities that add considerable value to the economy. All ASEAN republics at any rate doubled over their GDPs throughout the years of 2000 and 2015 shown in Figure 1 below (Selvarajan, Ab-Rahim, & Awg-Marikan, 2018):

**Figure 1.** ASEAN Agriculture GDP tree map for 2018

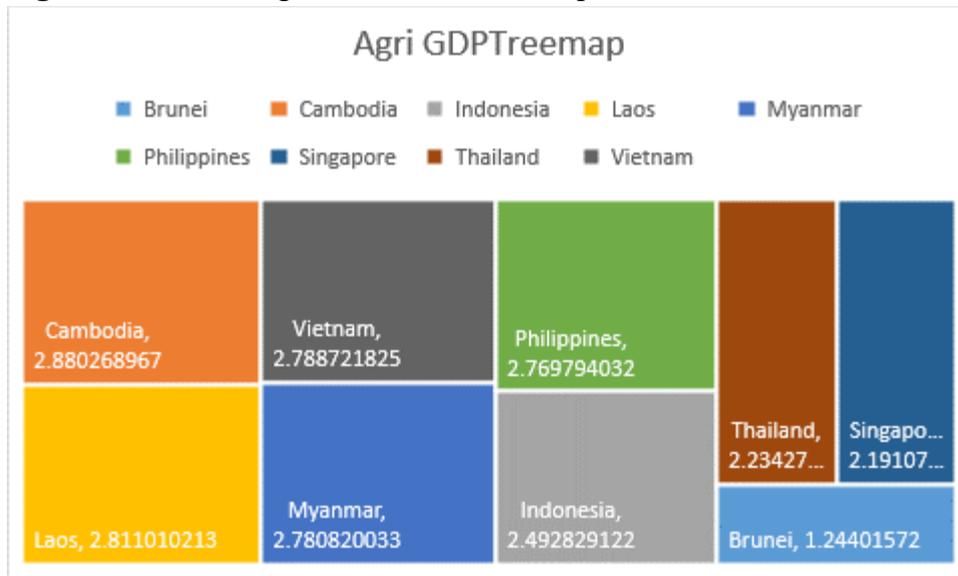


Figure 1 presents the tree map of real agricultural GDP participation in 2018. Cambodia participated by 2.88 in 2018 as a highest agricultural contribution for its economic growth. In most ASEAN countries, agriculture is an important sector for their GDP; however, importance is not given for the implementation of extension services, agricultural credit and government expenditure (Ligon & Sadoulet, 2018). These are vital for the economic stability of the entire region, since their adoption has altered the course of agricultural GDP throughout the years. The issue is persistent in most ASEAN countries as well as other international republics such as Brazil, India, Uganda and Africa as all these countries are constantly aiming to improve their GDP for national trade (Nasrudin & Budiyanto, 2017). Therefore, their intervention and the subsequent affect are necessary to research.

Gaps were identified in the literature review, since panel data was not obtained for ASEAN countries. Most studies researched the role of extension services, government expenditure and agricultural credit in agricultural GDP separately and therefore, their effect was not researched in a single study (Azanza, 2019). Hence, thorough exploration is prerequisite in this area, where the present study will emphasize assessing the influence the role of extension services, government expenditure and agricultural credit in agricultural GDP of ASEAN countries. The research questions formulated for the current study are provided below:

1. To find the role of government agricultural expenditure in the agricultural GDP of ASEAN countries
2. To determine the contribution of agricultural extension services in the agricultural GDP of ASEAN countries
3. To assess the role of agricultural credit in the agricultural GDP of ASEAN countries.

Fundamental governmental expenditure in agricultural research and development, selling of yields as well as livestock products and water supervision strategies and organizations, can provide superior productivity for the agricultural sector (Visetnoi & Nelles, 2018). It will help to provide operative agricultural business growth and extension services to the framers and associations to safeguard improved administration, productivity as well as abiding sustainability. The prominence of credit obtainability can be understood by the account that average input expenses per hectare are meaningfully greater for agriculturalists with agricultural credit, irrespective of their asset level. Advanced agricultural expenditures are apparently linked with greater output and economic progress (Singh & Joshi, 2016). The influence of formal credit on agrarian yield in ASEAN republics is optimistic and noteworthy for the rural economy. Therefore, it must be the key policy of government to meet the expenditure, extension services and credit requirements of the farming community of ASEAN countries, for the improvement of agricultural GDP (Wang, Wilson, Tran, Dao, & Chan, 2016).

## **Literature Review**

### ***In-Put and Out-put Theory and Economy Theory of Agriculture***

Research studies by Benito, Mi, Taylor, Petta and Burkard (2017), explain the mind set of various people regarding. While agriculture was defined in different ways, there were common facts such as; the production of the food, fibre and other goods by the systematic growing of harvesting, farming and growing of crops, plants and animals with the help of farmers and other labours. Economist (Ozbay, 2019) describes the theoretical framework that focuses on the development of agricultural growth and how agriculture can best contributes to overall economy growth and to both the modernization factor in farming and agricultural sector. However, the theorists put more emphasis on agriculture in the development of an economy. The development of an economy depends upon the growth of the agriculture sector. The Input-Output theory and Economic theory includes the national wealth as an essential part of the agriculture (Combes, Kerckhoff, & Sarovar, 2017). The physiocrats believe that the fate of the economy is regulated by productivity in agriculture and its surplus is diffused throughout the system in a network of transaction (Rocco & Colombo, 2016). The theoretical evidences (Czyżewski & Matuszczak, 2016), relates the agricultural expenditure, extension services and agriculture credit on behalf of the government that further promotes the liability and performance of growth of agricultural GDP as an output. Therefore, agricultural GDP (Capalbo & Antle, 2015) also enhances the growth of agriculture productivity and farming in the agriculture sector. The production of GDP per annum of agriculture-based countries, highly develops a relationship between agriculture expenditure, investment and credit under the criteria of environmental and economic condition. Input-Output theory relates itself especially with investment and expenditure in the agriculture sector by the government's side. However, facts and figures (Tefera, Bijman, & Slingerland,

2017) explain the operation of agriculture sector that is being displayed as the productive sector of the economy and the generator of surplus amount of food, crops, livestock and cattle upon which the entire sector depends.

### ***Government Agricultural Expenditure and its impact on Agricultural GDP***

Studies by Anwer, Farooqi and Qureshi (2015), analyze the reasons behind the government agricultural expenditure which contributes almost 70% in the gross domestic product of the countries annual earning rate because of the agricultural sector. Many agricultural based economies try hard to focus on the annual production of crop yield which can be used to feed people of the country especially in rural areas where farmers and their families have a poor lifestyle, otherwise production of crops provides sufficient surplus of raw materials that are used by the industries while, major crops are available for the export and trading purpose (Anwer et al., 2015). Governmental agricultural expenditure has incurred in the public sector therefore, it refers to expenses incurred by the government at various levels which include the Federal, State and Local. Agricultural sector overshadows all other economic sectors that widely contribute in the development of annual GDP of a State. However, studies by Chandio, Yuansheng and Magsi (2016) suggest that agriculture provided the main stimulus to the national economic growth despite the small firm holdings and primitive productive system. Government Agriculture expenditures basically depend on the resources that are required by the farmers to promote the annual growth using sufficient and best quality fertilizers, good quality pesticides and proper water irrigation system that will be required by the agriculture sector to ensure better crop yield. The government has to spend a major portion of its budget or an expenditure on the agricultural sector to promote agricultural sector and livestock farming. Studies by Ijirshar (2015), also suggest the fact that if more will be the expenditure by the government than eventually more will be the GDP outcome gained from the performance of the farmers and competitive advantages of the industry. Government has to decide its expenditure in the agricultural industry on yearly basis so that, famers and labours should design their strategies in a way where government-based expenditure can be utilized for increasing the growth rate of crops productivity (Tabor, 2015). Many Countries that are dependent on the agricultural industries should widely contribute in the development of agriculture sector by involving government related agricultural expenditure that will somehow, causes a rise in the development or growth of GDP. As studies Winoto and Siregar (2016), believe that input-output theory clearly analyze the rate of increased government spending in the form of the expenditure in the agricultural sector because there is a need to find the extent to which the government expenditure as an input has effected agricultural production as an output. Thus, the following hypothesis is proposed:

**H1:** Governmental Agricultural expenditure has a significant impact on Agricultural GDP.

### ***Agricultural Extension Services and its impact on Agricultural GDP***

As per studies by Benfica, Cunguara and Thurlow (2019), agricultural extension services influence the rate of GDP per capita. Agricultural extension contributes in the agricultural sector, agricultural industry and agricultural GDP, that further promotes the generation of total crop production per year. The agriculture sector has to keep pace for the demands of its products by the customers, suppliers and landowners. Studies, suggest the involvement of agricultural extension services enhance the performance (Ferroni & Zhou, 2017) of the farmers and labours involved in the agriculture sector, extension services also provide education, awareness, use of latest technology and reforms related to agricultural policies that would probably influence the affectivity and efficiency of farmers, which further influences the rate of GDP of the Country. Economy can be highly affected by the introduction of extension services within the agricultural industry in positive way. Therefore, much agricultural industry utilizes extension services of all types (Social, economic, environment and legal) for the sufficient productivity of crops which will further enhance the GDP rate of the country. As per different researches Sertoglu, Ugural and Bekun (2017) the explanation of the function of input-output theory, involves government spending through the availability of extension services in agricultural sector, therefore it is needed to accurately find the input of the government which can enhance the GDP rate. Extension services also decide the forms of crops that would be grown while, it also decides the types of crops that are largely required by the customers and which crop are more in demand. Studies Bachewe, Berhane, Minten and Taffesse (2018), analyse the effect of input-output theory on the development of extension services that contribute in the economic growth of many Asian Countries. Many government institutions also decide the insurance policies of the farmers and labours which are elaborated further and decided by extension services that works for the benefits and welfare of the poor farmers. Additionally, if these farmers are given equal rights and shares in the agricultural yield of crops and livestock than they will focus on increasing the rate of GDP per year, more than the previous years. Thus, the following hypothesis is proposed:

**H2:** Agricultural extension services have a significant impact on agricultural GDP.

### ***Agricultural Credit and its impact on Agricultural GDP***

Studies by Abdallah (2016), define the agricultural credit that plays an important role in making the GDP sustainable. Agricultural credit is known as a credit vehicle that is used to finance agricultural transactions, including loans, profits, investment, foreign exchange, bills and bank acceptances. These can be further utilized by the agricultural industries to enhance the technology used in agricultural farming and livestock breeding; it also helps in making the industry more sustainable in performance and in capabilities. This would directly increase the rate of the GDP of the Country's economy (Maitra, Mitra, Mookherjee, & Visaria, 2017).

This type of financing is required as well as adopted by the farmers to meet the specific economical needs of the farmer's, which are determined by planting, harvesting and marketing cycles. Researchers by Hananu, Abdul-Hanan and Zakaria (2015), analyzes the effects of theoretical framework regarding input-output approaches within the field of agriculture and crop production. Agricultural credit is a type of financial support that is required by the farmers from the government or banking sector or otherwise from the higher authorities of agriculture industries to facilitates themselves and also increase the crop yield and livestock's yield through introduction of the latest technology, methods and techniques. Studies by Hartarska, Nadolnyak and Shen (2015) believe that agriculture credit is an important part of the broader and widespread agricultural business. It is considered as one of the most important sources of agricultural business that influences the development of GDP. Commercial activities that are related to farming and farming businesses are collectively supported by the Agricultural credit financial status. This type of financial status largely benefits the growth of GDP per capita because of the involvement of various business steps that deliver the agricultural goods to the market that includes production, processing, marketing and distribution. It is considered an important element of the economic and financial sector; it is basically required by those companies who consist of arable land highly enriched with soil fertility and multiple natural resources. Studies (Saqib, Kuwornu, Panezia, & Ali, 2018), elaborates the role of agricultural credit that allows the agricultural business to take place by supplying farmers with the financial credit that might not otherwise be available to them. The financing is required by the farmers and labours to secure the seeds productivity, availability of equipment and land needs to operate a successful farm. Studies (Hartarska et al., 2015), analyze the role of financial credit systems used by developed States. Due to the global competition between different farming and agricultural industries, use of credit financing is very important to enhance the rate of GDP. Thus, the following hypothesis is proposed:

**H3:** Agricultural credit has a significant impact on agricultural GDP.

## **Methodology**

### ***Sample and Data***

The current study has been completed in ASEAN context because the data collected was about the AGC, AES, GAE and RAG of ASEAN countries for last 30 years. The panel data was collected from the databases of "World Bank Group" for respective years. The current study adopted ARDL approach.

### ***Definition and Measurement of Variables***

Following are the dependent, independent and control variables of this study:

*Dependent variables:* There is one dependent variable in the current study named “real agricultural growth” (RAG) which was measured by taking the proportion of agriculture in GDP of respective country.

*Independent variables:* There are three independent variables in this study named “government agricultural expenditure (GAE), Agricultural extension service (AES) and agricultural credit (AGC)”. The GAE was measured by taking the percentage of agricultural expenditure of each country while AES was measured as a dummy variable. The AGC was measured as the credit made for agriculture in each country.

*Control variables:* There is only one control variable in this study named as “arable land” (GAE) which was measured by taking percentage of arable land in total land.

### ***Methodological Framework***

Since, the current study examined the short-term and long-term impacts of AES, GAE and AGC on RAG of ASEAN countries, the panel ARDL approach was used in this used to run regression modelling.

### ***ARDL Modelling***

In the present research, the ARDL modelling was performed in which the impacts of AES, GAE and AGC on the RAG were analyzed in long-run as well as short-run. Since, the ARDL modelling imposes some conditions on panel data, different tests were applied on the data before running ARDL modelling. The “Autoregressive Distributed Lag” (ARDL) method is a useful method which is used to assess the “short-term and long-term relationships between variables” in a model. The current study tested following ARDL model:

$$\Delta RA_{it} = \alpha_i + \sum_{j=1}^{m-1} \beta_{ij} \Delta AE_{i,t-j} + \sum_{l=0}^{n-1} \varphi_{il} \Delta AES_{i,t-l} + \sum_{r=0}^{p-1} \gamma_{ir} \Delta AC_{i,t-r} + \sum_{u=0}^{s-1} \theta_{iu} \Delta ARL_{i,t-u} + \delta_1 AE_{i,t-1} + \delta_2 AES_{i,t-1} + \delta_3 C_{i,t-1} + \delta_4 ARL_{i,t-1} + \varepsilon_{1it}, \quad (1)$$

To test this model, the PMG test was used to analyze the panel data of ASEAN countries. The “panel unit root test” and “cointegration test” are the key conditions in ARDL modelling that was fulfilled through tests before ARDL modelling. The null hypothesis in the cointegration test was, “There is no co-integration in the data” and the alternative hypothesis in this test was “there is cointegration in the data”

$$H_0: \delta_1 + \delta_2 + \delta_3 + \delta_4 + \delta_5 = 0$$

$$H_1: \delta_1 + \delta_2 + \delta_3 + \delta_4 + \delta_5 \neq 0$$

The co-integration test was followed by the long-term relationship assessment model through which the long-term impacts of GAE, AES and AGC on RAG were checked. The ARDL model for the long-term relationships of the current study is as follow:

$$RA_{it} = \mu_i + \sum_{j=1}^{m-1} \lambda_{1j} GAE_{i,t-j} + \sum_{l=0}^{n-1} \lambda_{2l} AES_{i,t-l} + \sum_{r=0}^{p-1} \lambda_{3r} AC_{i,t-r} + \sum_{u=0}^{s-1} \lambda_{4u} ARL_{i,t-u} + v_{1i,t}, \quad (3)$$

The short-term impacts of AGC, AES and GAE on RAG were analyzed through the ‘error correction terms.’ The ‘coefficients of long-term relationships’ are assumed to remain the same through the data for each country. The ‘error correction terms’ for the current model is as follows:

$$\Delta RA_{it} = \alpha_i + \sum_{j=1}^{m-1} \beta_{ij} \Delta AE_{i,t-j} + \sum_{l=0}^{n-1} \phi_{il} \Delta AES_{i,t-l} + \sum_{r=0}^{p-1} \gamma_{ir} \Delta AC_{i,t-r} + \sum_{u=0}^{s-1} \theta_{iu} \Delta ARL_{i,t-u} + aECT_{t-1} + e_{1i,t}, \quad (5)$$

This model was used to check the ‘short-term relationship’ between current variables. " $e_{ki,t}$ " is the ‘residual’ and " $ECT_{t-1}$ " is the ‘error correction term’ which shows the ‘long-run equilibrium relationship’ between variables.

### ***Panel Unit Root Test***

The ‘panel unit root test’ was applied in the current data to check whether the data is stationery or not. For this purpose, the methods of ADF Fisher Chi-square (ADF Fisher) and Levin, Lin & Chi (LLC) unit root tests were used because the current study involved the macroeconomic variables as its key variables. In this test, the null hypothesis is that, ‘the data is not stationery’ while the alternative hypothesis is that ‘the data set is stationery’.

### **Findings**

The results of the current study encompassed the descriptive, co-integration, panel unit root and ARDL regression analysis.

### ***Descriptive statistics***

The descriptive statistics of this study have been presented in Table 1 below which the mean value, skewness, kurtosis and std. deviation have been presented for each variable.

**Table 1:** Descriptive statistics

Variables	AES	AGC	ARL	GAE	RAG
Mean	1.420000	46.19240	13.41265	7.365255	2.427665
Median	1.000000	35.73000	14.74380	7.485246	2.657309
Maximum	2.000000	157.8800	32.90336	10.44257	3.593948
Minimum	1.000000	4.980000	0.759013	3.724939	-1.575336
Std. Dev.	0.496045	34.64955	10.08351	1.556276	0.681346
Skewness	0.324176	1.703039	0.237480	-0.155860	-2.635728
Kurtosis	1.105090	5.269991	2.002921	2.435109	14.06258

The findings of Table 2 are indicating that the mean values of GAE, AGC, AES, RAG and ARL are all ranging between their minimum and maximum values therefore, it is indicated that there is no outlier in their data. The descriptive statistics are further revealing that values of skewness and kurtosis for GAE, AGC, AES, RAG and ARL are also falling within acceptable range (i.e. -1 to +1 and 1 to 3 respectively). Hence, it can be stated that the data of all variables is normal and in a position to be used for further analysis.

### ***Panel Unit Root Test***

In this study, the “panel unit root test” was applied to check the stationery of the data as this study is based on macroeconomic data. Table 2 shows the results found regarding this test:

**Table 2:** Panel Unit Root test

Variables	ADF Test		LLC Test	
	At level	1 <sup>st</sup> difference	At level	1 <sup>st</sup> difference
AES	32.0343***	45.5022***	-3.09829***	-7.40760***
AGC	57.9914***	38.8859***	-8.10598***	-8.28055***
ARL	33.2776***	37.1779***	-16.6095***	-8.50960***
GAE	31.8269**	52.9478***	-0.59171	-3.30127***
RAG	40.9363***	49.3626***	5.60979	10.4075*

Note: \* indicates p-value<0.1, \*\* indicates p-value <0.05 and \*\*\* indicates the p-value<0.01. The statistics of “ADF Fisher Chi-square (ADF Fisher) and Levin, Lin & Chi (LLC) unit root tests” and p-values against them (<0.05 and <0.01) indicated that there the data set of present study is stationery at level and first level.

### ***Cointegration Analysis***

The co-integration test was applied because the condition of stationery data is followed by the presence of co-integration in the data. The results presented in Table 3 show the co-integration results:

**Table 3:** Co-integration Test

Alternative hypothesis: common AR coefs. (within-dimension)					
				Weighted	
		Statistic	Prob.	Statistic	Prob.
Panel v-Statistic		-0.744976	0.7719	-2.216387	0.9867
Panel rho-Statistic		2.120425	0.9830	2.290984	0.9890
Panel PP-Statistic		-10.62002	0.0000	-11.96125	0.0000
Panel ADF-Statistic		-4.721249	0.0000	-5.120709	0.0000
Alternative hypothesis: individual AR coefs. (between-dimension)					
		Statistic	Prob.		
Group rho-Statistic		3.833998	0.9999		
Group PP-Statistic		-14.98782	0.0000		
Group ADF-Statistic		-7.119053	0.0000		

The insignificant values of “Panel rho-Statistic” and “Group rho-Statistic” show there is co-integration in the data. Similarly, the p-value ( $<0.05$ ) against the statistics of “group PP statistics”, “panel PP statistics” and “Panel ADF-Statistic” is confirming the presence of co-integration in the data. It means that the null hypothesis of co-integration is rejected.

### *Heteroscedasticity Test*

This test was used to assess the heteroscedasticity issue in the data. The results are presented in Table 4 below:

**Table 4:** Heteroscedasticity test

	Value	Df	Probability
Likelihood ratio	132.5422	10	0.4537

Table 4 indicates that the p-value against the statistics of the heteroscedasticity test is more than 0.05 meaning the null hypothesis was not rejected. Hence, there is no issue of heteroscedasticity in the data.

### *ARDL Model*

The ARDL modelling was performed to see the short-term and long-term impact of GAE, AGC and AES on the RAG of ASEAN countries. Table 5 shows the details of ARDL regression results:

**Table 5:** ARDL Results (Dependent Variable: RAG)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
AES	0.038382	0.006675	5.750239	0.0000
GAE	0.284316	0.024768	11.47895	0.0000
AGC	-0.009013	0.000632	-14.27239	0.0000
ARL	0.217844	0.025084	8.684608	0.0000
Short Run Equation				
COINTEQ01	-1.081853	0.181353	-5.965457	0.0000
D(AES)	-0.089145	0.037003	-2.409150	0.0212
D(GAE)	-0.076366	0.088523	-0.862659	0.3940
D(AGC)	0.016156	0.016841	0.959305	0.3438
D(ARL)	-0.559850	0.504686	-1.109304	0.2747
C	-2.553725	1.167298	-2.187724	0.0353
Mean dependent var	0.036616	S.D. dependent var	0.665643	
S.E. of regression	0.245887	Akaike info criterion	-1.230106	
Sum squared resid	2.176581	Schwarz criterion	0.437203	
Log likelihood	125.5053	Hannan-Quinn criter.	-0.555316	

The ARDL results are revealing that the AES and GAE have significant and positive long-term impacts on RAG ( $p$ -value $<0.05$ ) while the AGC has significant but negative impact on the RAG of ASEAN countries. There was no significant impact of GAE and AGC on the RAG was found in short-run because the  $p$ -value against these short-term impacts is more than 0.05 however, the AES showed significant short-term impact on RAG ( $p$ -value $<0.05$ ).

### Discussion of Results

This study aimed to assess the impact of government agricultural expenditure (GAE) on real agricultural GDP (RAG) and the impact of agricultural extension services (AES) on RAG. This study also targeted the impact of agricultural credit (AGC) on RAG and took arable land (AL) as a control variable on RAG. The study has a detailed review of literature of all of these indicators and proposed some hypotheses. Those hypotheses were exposed to data analysis techniques and then results were suggested (Awokuse & Xie, 2015). These results will be discussed one by one in this section. The first hypothesis proposed was, “GAE has a significant impact on RAG.” According to the data analysis and the study of RC. Hunt, this hypothesis is accepted in terms of long run only, as GAE has a significant and positive

impact on RAG and in the short run the impact of GAE is insignificant on RAG. The second hypothesis proposed was, “AES has a significant impact on RAG.” This hypothesis is accepted in terms of long run only, as according to the results of the analysis and the study of X Liu, S Zhang, the impact of AES is positive and significant on RAG in the long run whereas, its impact is insignificant on RAG in the short run. The third hypothesis proposed was, “The impact of AGC is significant on RAG.” This hypothesis is accepted as talking about the long run only (Liu, Zhang, & Bae, 2017). The tests and analysis proved that the impact of AGC is significant on RAG in the long run only and in the long run it decreases RAG negatively. While, in the short run the impact of AGC is insignificant on RAG and RAG is not impacted by the decrease or increase of AC. Lastly, the study focused on the controlling impact of AL on RAG and the impact according to the analysis and the study of TO. Awokuse is insignificant in the short run while, it is significant in the long run (Yamauchi, 2016).

## **Conclusion**

The study aimed to know about the impact that AES, GAE, AGC and AL causes on RAG. The study was focused on the ASEAN countries. The methodology adopted was the panel data analysis methodology in which the data from the past thirty years about ASEAN countries was selected and collected and analyzed. The results showed the impact of GAE and AES on RAG in the long run is significant and positive and their impact in the short run is significant. The results also showed that the impact of AGC is significant and negative in the long run on RAG and is insignificant in the short run. The control variable AL impacts RAG significantly in the long run and insignificantly in the short run.

## ***Implications of the study***

The study has significantly contributed in increasing the literature material about the importance of presence of AES, GAE, AGC and AL for the improvement of RAG and keeping this in consideration, these variables can be applied practically in the agricultural sector in order to improve RAG. For this purpose these important indicators can be added into the policies of the agricultural sector.

## ***Limitations and future research indications***

This study was conducted with the help of the data of past thirty years whereas, a study conducted from the data of the recent years, like the data of past ten years can be more authentic and useful. This study is limited to the data of ASEAN countries only whereas, in the future the studies can be conducted by utilizing data from the information of other countries as well.

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