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The Impact of Agricultural credit and Extension Services on Crop Productivity in Indonesia: A Time Series Analysis

Yusro Hakimah[a*], Sumarni[b], Mala Ganatri[c], Ursula Damayanti[d], Haryono[e], [a]Faculty of Engineering, Universitas Tridinanti Palembang, Palembang, Indonesia, [b]Faculty of Economics, Universitas Borobudur, Jakarta, Indonesia, [c]Faculty of Economics, STIE International Golden Institute, Jakarta, Indonesia, [d]Faculty of Agribusiness, Universitas Tridinanti Palembang, Indonesia, [e]Faculty of Economics and Business, University of Bhayangkara, Surabaya, Indonesia, Email: [a*]yusrohakimah@yahoo.co.id

The purpose of the current study was to analyse the impact of Agricultural credit and agricultural extension services (AES) on crop productivity. The current study was performed in Indonesia for which the past 30 years data was used to run a time series analysis. Since, the purpose of the current study was to analyse the relationship of AES and Agricultural credit with crop productivity through time series analysis, the sample observations were decided through purposive sampling. The thirty years of data for key variables was extracted from official databases of the country and the analysis was completed through EViews. The descriptive test, unit root test, heteroscedasticity test and OLS regression modelling was applied to the data of Indonesia. The results of the current study revealed that there is significant but negative impact of agricultural credit on crop productivity but there is no significant impact of AES on crop productivity. It means that the agricultural credit is a significant predictor of crop productivity. The current study and findings will have important theoretical and practical implications because they will set guidelines about how crop productivity in Indonesia can be enhanced through AES and agricultural credit.

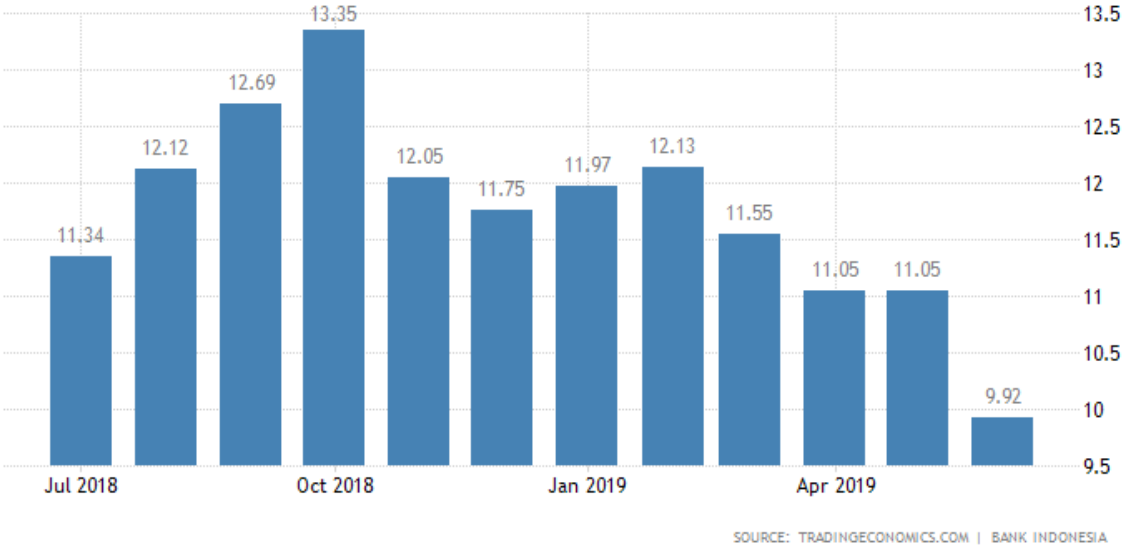
Key words: *Agricultural credit, Extension Services, Crop Productivity, Indonesia.*

Introduction

In Indonesia, there is an unpretentious apprehension regarding food provision and security in the near future. Currently, Indonesia has a total of 270.63 million population to feed, and therefore it is the fifth most populated country on Earth (Oyinbo et al., 2019). It is expected that due to the rising population, a growing demand of food per person as well as a cumulative plea for biofuels, constricted provisions of natural resources, plus climate change might raise worldwide and national food expenses (Benjamin, Blum, & Punt, 2016). Rising food expenses can be predictable to upsurge poverty occurrence in Indonesia. There is a total of 25.95 million people in Indonesia categorised as "poor". Rising crop productivity is therefore significant for upholding food security and justifying the hazard of increasing food costs, while simultaneously refining the standards of living for the poor people of Indonesia (Tothmihaly & Ingram, 2019).

Agricultural credit is deliberated as a main strategic resource to increase the crop production to greater horizons, which subsequently increases the standards of living for poor and rural farming municipalities (Ugochukwu, Emma-Ajah, Kanu, & Osondu, 2018). Therefore, it has an essential part in the development of a nation's economy. Agricultural credit has two common sources, comprising of formal and informal. Formal credit is obtained through central banks, which is mainly provided with the affiliation of political support. Whereas, informal sources generally involves village shop keepers, input providers, commission agents, relatives or friends. Credit obtained from shopkeepers, commission agents, or input suppliers, demonstrates most baneful effects out of all the resources on the poor and rural society (Alwarritzi, Nanseki, & Chomei, 2016). A study recommends that these loans additionally aggravate the level of poverty due to the high interest rate. It is a common rehearsal that the trifling farmers acquire credit in form of currency or materials such as fertilisers, seeds, and pesticides. Therefore, these are knotted credits in the nous that agriculturalists acquiring them have to supply their yield to the respective commission agents, offering the worth of their yield in much lower prices than the common market (Abdallah, 2016).

Figure 1. Time Series of Agricultural Credit in Indonesia



In agricultural-dependent markets, extension programmes are one of the main channels for distributing the required agricultural information for farm technologies, assisting rural adult knowledge as well as helping agriculturalists in evolving their managerial and technical skills (Martey, Wiredu, Etwire, & Kuwornu, 2019). Extension programmes usually help in increasing the crop productivity, revenue of the farm, decrease poverty or curtail the expected food insecurity. Although, Indonesia has a vast interest and contribution to the agricultural sector, the crop productivity is not maintained to its full potential due to the lack of farmers' skills and knowledge required for the upheaval of crop productivity (Schut et al., 2016).

In poor countries such as Indonesia, increasing crop productivity is vital to meet the nutritional demands of a large population. However, crop productivity is declining due to the lack of credit, capital, extensions and resources (Alwarritzi, Nanseki, & Chomei, 2016). The issue prevails in Indonesia as well as other countries such as Pakistan, India, Ethiopia, South Africa, etc. whose population is rising day by day, and where there is no economic stability. The provision of agricultural credit and extension services is therefore vital for crop productivity in Indonesia (Tothmihaly, & Ingram, 2019).

By reviewing the literature, it was evident that crop productivity was a focus of attention in Indonesia for a couple of years. However, most studies focused on either agricultural credit or extension services to analyse their impact on crop productivity. Therefore, the impact of both agricultural credit and extension services has not been assessed for crop productivity in Indonesia. For that reason, thorough research is required in this domain, where the current research will focus on evaluating the impact of agricultural credit and extension services on

crop productivity in Indonesia. The research questions formulated for the current study are given below:

1. To analyse the impact of agricultural credit on crop productivity in Indonesia.
2. To evaluate the impact of extension services on crop productivity in Indonesia.

Therefore, it is rational that agricultural credit, momentary as well as ordeal loans has optimistic consequence on crop yield and productivity (Abdallah, 2016). The positive association among agricultural credit and crop productivity empowers the agriculturalists to purchase basic materials essential for farming such as fertilisers, herbicides, fungicides, quality seed, composts, insecticides, and subsequent harvest upsurge due to well-timed and adequate submission of resources (Oyinbo et al., 2019). Moreover, agricultural extension services have also been required for curtailing food insecurity and diminishing the rural poverty by means of technological and managerial dissemination of knowledge (Elahi, Abid, Zhang, ul Haq, & Sahito, 2018). Agricultural extensions help farmers stay up-to-date with modern techniques of farming, and help ease their labourr. By means of modern practices, the yield of crops will increase, which consequently upsurges the trade and stabilises the nation's economy (Ugochukwu, Emma-Ajah, Kanu, & Osondu, 2018).

Literature Review

The agriculture sector is one of the major sectors contributing to the GDP of developing and underdeveloped countries (e Saqib, Ahmad, Panezai, & Ali, 2016). The agricultural sector contributes to more than 15% of total GDP in Indonesia and provides employment opportunities to more than 45% of the total population. On the basis of data shared by the Central Bureau of Statistics agricultural sector is one of the most influential sectors responsible for economic growth. Stats show that one of the major problems in Indonesia is poverty like many other Asian countries as more than 46% of total population is classified below the poverty line and most of these people living below the poverty line belong to the occupation of agriculture (Nuryartono, 2007). Lack of financial resources essentially required for making timely investments is the most lethal trap pushing the farmers below this poverty line. Farmers have very low access to agricultural loans because of lesser amount of financial institutions that may channel financial assistance to farmers. Lack of interest shown by the formal institutions in providing agricultural credit is because of the risky nature of farming businesses. Also, is the lack of education necessary for understanding the loaning procedures, non-availability of reasonable collateral, the high cost involved in undertaking transactions and the low profit margins are the biggest constraints to the availability of agricultural credit for the farmers in Indonesia (Herliana, Sutardi, Aina, Aliya, & Lawiyah, 2018). Although farmers are facing many problems, the agricultural sector is the biggest contributor to Indonesia's economic growth, and productivity has increased with the passage of time, but

for the long-term sustainability of such fruitful and productive gains it is a challenge to revive productivity expansions between rural producers. Productivity gains are crucial for the growth of agricultural income but the research and extension system has faced a noticeable decline which would be very crucial in the long run. The Government practices for the reorganisation of an Indonesian extension system has created argumentative impact on the system. Elimination of the mid-level guidance and gradual decrease in the allocated funds has produced some adverse effects (Koh & Ghazoul, 2010).

Agricultural credit and crop productivity

Several research studies carried out to find out the impact of agricultural credit on crop productivity suggest that availability of funds and credit helps in enhancing both the quality and quantity of crop yield (Bashir, Mehmood, & Hassan, 2010). As finance is the key constituent of all economic activities including agriculture, higher rates of production and output cannot be obtained without using higher quality inputs. High-end inputs require substantial amount of funds to carry out all the essential operations. In the case of agricultural business, better and higher crop yields can only be obtained when required resources are readily available at the disposal of agriculturalists. Farmers arrange these financial resources from their personal savings which are mostly very small or negative in the amount most of the time. The majority of farmers particularly the smaller households find it challenging to secure the essential inputs like the better breed of seeds, improved fertilisers, quality pesticides, modern technology etc. from their own savings. Thus, to achieve the desired rate of production and quality of crops, agricultural credit is one of the most useful tools (Bashir et al., 2010). In order to improve the living standards of rural population, especially the farmers, agricultural credit is a long-term and tested tool as it can help push productivity - which consequently has a positive impact on the overall economy. As a return on investment cycle for this business is long and funds are required at every stage, such as for the preparation of land, cultivation of seeds, harvesting of crop etc., these are accomplished over a period of several months. On one hand each phase requires a certain amount of resources while earnings are available even after the crops are sold in the market. Therefore, farmers have to maintain a reasonable amount of reserves to meet the needs at the right time which is practically a hard task to accomplish. Availability of credit at the time of need helps to effectively complete the consumption and production cycle of farmers more efficiently (Saleem & Jan, 2011). Agricultural credit can be obtained from both formal and informal sources. Evidence suggests that informal loans have an adverse effect on the rural economy as the interest rates on these kind of loans is immensely high. Small household farmers generally rely on informal credit providers which offer cash or inputs like seeds, fertilisers, and pesticides tied to the condition that the farmer will sell their products to credit providers on rates lower than the market. Although these informal credit providers have negative impact on the overall wellbeing of the farmers and agricultural productivity, they are more

popular among smaller farmers because of the unavailability of formal credit. In fact, the unavailability of formal loans has compelled farmers to rely on these short-term and non-productive loans (McIntosh, Sarris, & Papadopoulos, 2013). On the other hand, it is evident from several studies that formal lending institutions have a slow but positive impact on productivity but limited availability is a factor which hinders its efficiency. High cost of transactions, limited knowledge of the farmers to take advantage from formal credit services, high risk involved in the business limits the availability of credit from the formal institutions to the small-scale farmers.

H1: Agricultural credit has significant impact on crop productivity.

Extension services and crop productivity

Extension services are a system which facilitates the farmers and other agricultural actors to get access to timely information, necessary education and modern technologies to help them interact with relevant stakeholders and enhance their technical and managerial skills (Danso-Abbeam, Ehiakpor, & Aidoo, 2018). Several research studies prove that extension and research payoff in terms of higher productivity in the long run (Asres Elias, Nohmi, Yasunobu, & Ishida, 2013). Extension services provide information about technologies and new techniques to the agricultural communities which, when adopted and implemented properly, can enhance productivity which consequently increases the income. As a result of these improved economic activities the standard of living is enhanced (Bonye, Alfred, & Jasaw, 2012). Extension service providers, after creating a new technology regarding the agricultural field, are making efforts to profligate its rate of adoption and closely monitor the process to eliminate any hindrance. It also makes sure that the farmers can fully understand the process of using the latest techniques by giving demos where required. The knowledge acquired by the farmers is further shared throughout the community. Problems faced by the farmers in their daily life are also identified and inquired through extension services (Alemu, Maertens, Deckers, Bauer, & Mathijs, 2016). Extension services are not bounded to technology creation and transfer only but also go beyond to help in developing agricultural communities, guiding them in production and processing of crops, helping them get access to better markets and trade facilities and collaborating to work together for long-term and sustainable management of natural resources. Extension services also provide solutions in problems like saving farmers getting disadvantaged because of non-competitive market structure or unavailability of agricultural credit (A Elias, Nohmi, & Yasunobu, 2016). On the other hand, extension services also involve provision of valuable feedback on behalf of farmers to the technology developers to further enhance the systems as per the needs. Private organisations related to agricultural businesses, research institutions, universities and relevant educational institutes, government institutions and experiment centres all individually, or sometimes in collaboration, conduct agricultural research and explore the knowledge of the

field. In third world countries where land and natural resources are the main source of earning agricultural development, it is considered to be the key player for eliminating poverty as major portion of the population earn their livelihood through this source. In order to overcome and get rid of the poverty trap a boost in agricultural productivity is considered to be the area of prime focus (Baloch & Thapa, 2018). By virtue of its nature, extension services are responsible for increasing the effectiveness and efficiency of agricultural and all other related activities to increase the productivity. Still government and private investment in development and research for agricultural knowledge in many developing countries is less prioritised. As a result, there is a lessened tendency to allocate sufficient resources for the education, extension and research of new techniques and improvement of older techniques in expectation of higher productivity and better profit margins. Most of these less developed countries depend on other developed countries for the transfer of latest technologies and knowledge. Some international organisations also help in developing the techniques to get higher productivity of certain crops. But as a whole the major shift is toward the reliance upon adaptive research studies in these regions (Muyanga & Jayne, 2008). In order to overcome the problem of low productivity many countries have been trying to improve and use new technologies, fertilisers and irrigation systems but the rate of adoption has been lowered because of a lack of knowledge in the farmers and the outcomes have been different than desired. Studies show that failure of extension services in some cases to enhance crop productivity is because of farmers themselves being reluctant to the change process and showing non-participation. The reason behind this misunderstanding from farmer's side is because another factor playing a parallel role which is complete lack or low rate of formal education in the communities. Another factor which can play its role is the non-compliance of extension services with the small agricultural households needs (Lee, An, & Kim, 2017).

H2: AES has significant impact on crop productivity in Indonesia.

Methodology

Data Collection

The data for the current study has been collected from Indonesia for the past 30 years (1988 to 2017). The sample was decided through purposive sampling technique because the purpose of the current study was to examine the impact of "agricultural credit" (AGC) and "agricultural extension services" (AES) on the "crop productivity" through time series analysis. The data was collected from the Website of the "World Bank Group" from which the database and archive were accessed to collect 30 years of data for Indonesia.

Variables Definition and Measurement

The current study includes the following variables that have been measured through appropriate proxies.

Dependent variables. There is one dependent variable in the current study which is named as "crop productivity" (CP). The impact of independent variables on this variable has been analysed through the data of Indonesia. The data about CP has been taken from archive of the "World Bank Group" for the last 30 years.

Independent variables. There are two independent variables in this study that have been assessed in terms of their influence on the dependent variable in Indonesia. These two independent variables are named as "agricultural credit" (AGC) and "agricultural extension services" (AES). The AGC was measured by taking the percentage of allowances that government of Indonesia made for the development of agriculture. The AES was measured as a dummy variable which was assigned a value of 1 or 2 based on the presence of AES in the country in the respective year.

Control Variables. There are two control variables in the current study named as "Arable land" (ARL) and "Agricultural growth" (AGR). These two control variables were added in the model to get desired results. The AGR was measured by taking percentage of GDP accounted by agriculture. The ARL was measured by taking percentage of arable land of the total land in Indonesia.

Modelling and Methodological Approach

The current study developed an econometric model to see the impact of AES and AGC on the CP in Indonesia by using time series data for the last 30 years. The purpose of the current study was to analyse the relationships between variables over the time period therefore, the time series approach was best for the current study. The time series approach enables the researcher to determine the lags at which the relationship of the concerned variables is significant. Therefore, the current study used the time series analysis to determine the lags at which the AGC and AES significantly influenced the CP in Indonesia. The regression equation for this time series analysis is as follows:

$$CP_t = \beta_0 + \beta_1 AES_{t-1} + \beta_2 AC_{t-1} + \beta_3 AR_{t-1} + \beta_4 ARL_{t-1} + u_{it} \quad (1)$$

Unit Root Test

Before estimating the econometric model, the current study analysed the data to ensure that it is stationery. The "unit root test" was applied to see if the data was stationery or not. The unit

root test is very important for the analysis in which the macroeconomic or financial data is included. The current study applied the "unit root test" including the "Augmented Dickey-Fuller test (ADF) and Phillips Perron (PP)". The following equation for "unit root test" shows the mathematic explanation of the data.

$$\Delta Y_1 = \beta_1 + \beta_2 \, t + \alpha Y_{t-l} + \sum_{t=1}^{r} \rho_i \, \Delta Y_{t-i} + \mu_t \qquad (2)$$

Where "ΔY_{t-i}" indicates the "lag difference", the "β_1" indicates the "constant term" and 't' shows the "time trend". The "unit root test" is applied in time series analysis to make sure that "error term i.e. μ_t" is successively independent. This is done by adding the "lag difference terms". Following are the null and alternative hypotheses for "unit root test".

H_o: $\boldsymbol{\alpha = 0}$

H_1: $\boldsymbol{\alpha \neq 0}$

Results

The key tests that were applied in the current time series analysis are "Descriptive statistics, unit root test, heteroscedasticity test and OLS regression analysis."

Descriptive Statistics

Table 1 depicts the results found through descriptive analysis in which the values of mean, minimum, maximum, skewness and kurtosis were mainly calculated to check the adequacy of the data.

Table 1: Descriptive Statistics

Variable	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
CP	106.1820	106.6100	143.4300	67.62000	27.39898	0.078532	1.448362
AGR	2.380394	2.408482	2.698389	1.998242	0.209201	-0.22044	2.046754
ARL	13.08920	13.07705	13.27578	12.97217	0.105845	0.296724	1.696848
AGC	58.63360	53.98000	118.7300	2.430000	39.31884	0.092535	1.856117
AES	1.400000	1.000000	2.000000	1.000000	0.500000	0.408248	1.166667

The descriptive statistics depict that data for all variables of the current study including CP, AGR, ARL, AGC, and AES is normal and adequate because the mean values of CP, AES,

AGC, ARL, and AGR are all falling between the minimum and maximum values of respective variables therefore, it can be stated that there is no oilier in the data of any of these variables. Furthermore, the value of skewness for CP, AES, AGC, ARL, and AGR is falling within the acceptable range (-1 to +1) for all variables and the value of kurtosis for all of them ranged from 1 to 3. Therefore, it is confirmed that the current data for CP, AES, AGC, ARL, and AGR is normal and adequate.

Unit Root Test

The "unit root test" was applied on the current data because the CP, AES, AGC, ARL, and AGR are macroeconomic variables so, there was need to check whether the data set is stationery or not. Table 2 presents the results of "unit root test" including the "Augmented Dickey-Fuller test (ADF) and Phillips Perron (PP)".

Table 2: Unit Root Test

Variables	ADF		PP Test		Decision
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
CP	3.3821**	0.3499***	2.9912**	0.3295**	CP is stationery at order I(1)
DCP	-3.0832**	-9.2391	-3.0134**	-4.0012**	
AGR	0.5632**	-1.9931**	0.5632**	-1.7929**	AGR is stationery at order I(1)
DAGR	-6.4214	-5.9922	-6.4201	-5.8991	
ARL	-1.2094**	-2.0611**	0.43**	-2.0422**	ARL is stationery at order I(1)
DARL	-7.7289	-8.0011	-7.5821	-8.1130	
AGC	0.8174**	-2.0012**	0.8143**	-1.9821	AGC is stationery at order I(1)
DAGC	-5.0211	-5.0611	-5.2013	-5.0313	
AES	0.3019**	-1.9991**	0.3100**	-1.7821**	AES is stationery at order I(1)
DAES	-4.4982	-5.0124	-4.5012	-5.0124	

It is indicated from results of table 2 that all variables have "unit root" at level so, series CP, AGR, ARL, AGC, and AES are I(1).

Ordinary Least Square Regression Analysis

After ensuring the stationery, the OLS regression analysis was applied on the data of all variables which resulted in the following table.

Table 3: Results (Dependent Variable: CP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AES	1.949319	1.871436	1.041617	0.3100
AGC	-0.089163	0.023191	-3.844703	0.0010
ARL	-5.167787	24.62118	-13.20687	0.0000
AGR	-4.476003	12.94102	-2.662853	0.0149
C	0.906657	352.3733	12.61987	0.0000
R-squared	0.981990	Mean dependent var		106.1820
Adjusted R-squared	0.978388	S.D. dependent var		27.39898
S.E. of regression	4.027919	Akaike info criterion		5.801233
Sum squared resid	324.4826	Schwarz criterion		6.045008
Log likelihood	-67.51542	Hannan-Quinn criter.		5.868846
F-statistic	272.6250	Durbin-Watson stat		1.014752
Prob(F-statistic)	0.000000			

The results of table 4 are showing that AGC has significant and negative impact on CP because the p-value against its impact on CP is <0.05 and the t-statistics is >t-tabulated. This negative impact of AGC on CP is proved significantly however, there was no significant impact of AES on CP reported through the current results because the p-value against its effect on the CP was >0.05. It means that one unit increase in AGC causes the -0.089 times decrease in CP however, the increase or decrease in AES does not cause any significnat change in CP. The results of control variables are showing that both control variables have significnat but negative impact on CP because p-value against both of them are <0.05. Hence, the results revelaed that AGC significantly affects the CP but AES does not significantly influence the CP in Indonesia.

Heteroscedasticity Test

The errors in a data set must be homoscedastic and they should not vary with the variations in independent variables. To check the heteroscedasticity of the data, “Breusch-Pagan-Godfrey” test was applied which provided following results.

Table 4: Heteroscedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.903465	Prob. F(4,20)	0.4806
Obs*R-squared	3.825995	Prob. Chi-Square(4)	0.4301
Scaled explained SS	2.197965	Prob. Chi-Square(4)	0.6994

The results of heteroscedasticity test are showing that p-value against Chi-Square as well as F-statistics is >0.05 which means that there is no heteroscedasticity issue in the data because null hypothesis is accepted which states that errors are homoscedastic.

Discussion

This study conducted with the aim to know about the impact of Agricultural Credit (AC) and Crop Production (CP). The aim was also to know about the relationship between Agriculture Extension Services (AES) and CP (Du Preez, Van Huyssteen, & Mnkeni, 2011). Another purpose of this study was to know about the impact of Real Agriculture Growth (RAG) on CP. The last aim of this study was to know about the relationship between Arable Land (AL) and CP. This study conducted a proportionate test and suggested some hypothesis. The very first hypothesis suggested that there is a significant but negative impact of AC on CP. This hypothesis was accepted. According to the study of "MIR KALAN SHAH" agriculture is the most important sector for any country. Agriculture finance is required in order to enhance production. AC is a must necessary thing for CP. This hypothesis suggested that the insignificant impact of AES on CP. This hypothesis was rejected. In account of the research, "DENNIS SEDEM EHIAKPOR" suggested that the better AES played a vital and important role for CP in the past few years, but nowadays people are not focusing on such type of facility and that is why the CP is declined (Bashir et al., 2010). This study looked the impact of RAG on CP, "ROBERT AIDOO" (food and agriculture department) suggested that the RAG helped in enhancing the CP. In developed countries, they use RAG capabilities and their CP enhanced as a result of their better doings for the agriculture system. So, impact is positive. Next the study looked at the impact of AL on CP. The impact was insignificant. According to the study of "department of foods and agriculture Peshawar university" the arable land when not treated carefully and not used properly caused the declined production of crops (Banse et al., 2011).

Conclusion

This study took place in Indonesia. The data was collected from the Internet, gathered from the economic development sites, and the data of the past 30 years was collected. The aim of this study was to know about the relationship between AC and CP, the aim was also to know

about the impact of AES on CP, the impact of RAG on CP, and the impact of AL on CP. This study conducted a test of the hypothesis. Two hypotheses got accepted and have positive impacts and the remaining were rejected. The hypothesis which was rejected was due to the insignificant and negative impacts. In this study, the data was collected by questionnaire.

Implications of the study

This study significantly contributes to the literature. It enhanced the data material about this topic. This study also contributed to practical life. The farmers related to this problem and can get a significant solution to their problems. They can have knowledge about the relationship of AC and CP, AES and CP, RAG and CP, AL and CP. Related people can know about the reasons for the acceptance and rejection of the suggested hypothesis by this study. It has also contributed to government strategies. The government can have knowledge about AC and how to manage the growth of the crop production and financial help which can be provided to the farmers in order to better the CP.

Limitations and future research indications

In this study, the data was collected through Internet sources, and the data of past 30 years was gathered. This study took place only in Indonesia. The reasons for the rejected hypothesis are not stated clearly. Future researchers can enhance the data material collected from the internet in order to get more suitable data. They can use more data collection tools. This study can be conducted outside Indonesia because the problems discussed in this paper are global.

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