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Agricultural Technology Adoption in Indonesia: The Role of the Agriculture Extension Service, the Rural Financing and the Institutional Context of the Lender

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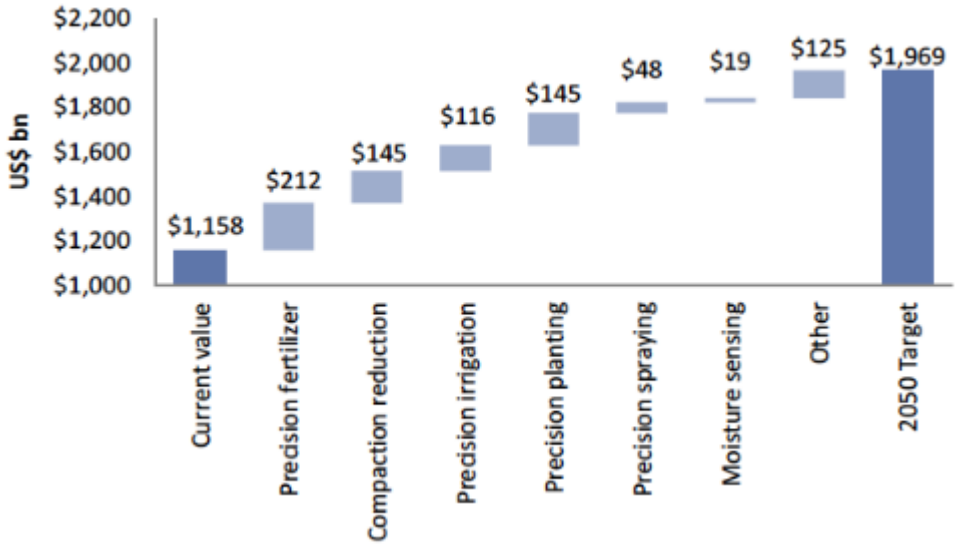
The purpose of this study is to assess the role of the Agriculture Extension Service (AES), Rural Financing and Institutional Context of Lender (ICL) in the agricultural technology adoption (ATA). For this purpose, the current study examined the impact of AES, rural financial and ICL on ATA by collecting data for Indonesia. The time series approach was adopted to complete the study because the relationships were examined over the time period of thirty years. The secondary data about the macroeconomic variables included in this study was collected from official databases and archival. The key tests applied in the current study include the descriptive test, unit root test, co-integration test, heteroscedasticity, and regression equation. The findings of this research revealed that AES has significant positive impact on ATA at first lag while the other two independent variables showed significant impact on ATA at that level. Rural financing has significant positive impact on ATA however, the ICL has significant negative impact on ATA. It means that all hypotheses of the current study are true. The results further revealed that RF and ICL have significant and positive long-term impacts on ATA while the AES has no significant impact on ATA in long-term. Furthermore, it is indicated that AES and RF have significant short-term impacts on ATA while ICL does not show significant impact on ATA in the short-term. The present research will provide different implications for theory and practice by emphasising the role of AES, rural financing and ICL in technology adoption in agriculture.

Key words: *Agriculture Extension Service, Rural Financing, Institutional Context of Lender, agricultural technology adoption, Indonesia.*

Introduction

Attaining production advancement in the agricultural segment is only possible through the expansion and distribution of enhanced agricultural technologies for the smallholder agriculturalists (Ariho, Makindara, Tumwesigye, & Sikira, 2016). Rural agriculturalists yielding from small portions of land are accredited to their circumstances, for example the deficiency of sufficient financing, lack of admittance to suitable markets, non-existence of ample extension services etc. (Benjamin, 2018). Among these constrictions, insufficient extension amenities have been recognised as the primary limiting feature for the development of the agricultural arena and for the adoption of technology by farmers (Nugraha & Osman, 2017). Therefore, agricultural extension nowadays verves further than the transmission of expertise and enhancement in output, but correspondingly, it comprises of enhancement in agriculturalists' executive and methodological expertise by means of training, enablement and instruction (Cafer & Rikoon, 2018).

Figure 1. Agricultural Technology Adoption, Increase and Global Crop Value



For farmers, financing is usually small, however it is required from time to time. For farmers with a lower income, rural financing can be attained by means of loans from friends and family, personal savings, loans from consumers or dealers, or informal breadwinners like credit associations or rotating savings (Lakitan et al., 2018). On the other hand, financing can be retrieved through co-ops, microfinance governments or through state banks. For numerous

smallholder agriculturalists, institutional lending can be problematic due to the shortage or inaccessibility of possessions that can be covenanted as security, low financial schooling, the deficiency of a vigorous base of assets to aid ease shocks or the incomplete assortment of risk extenuation choices for example insurance schemes (Deichmann, Goyal, & Mishra, 2016).

In Indonesia, agriculturalists likewise face limitations in institutional financing due to having small areas of residence, being unacquainted with the lending policy, less right of entry to plot with lawful designations, as well as underutilisation or under adoption of the technology to their lands (Magruder, 2018). Government credit packages to agriculturalists have an extended antiquity in Indonesia. They instigated with the 'Bimas program' during the 1970s, which sustained throughout the 1980s through the program, Kredit Usaha Tani. Presently, there are numerous government credit packages which are directed at agriculture and technology adoption, the most significant of these programs are KPNRP, KKPE, KUR or KUPS (Linh, Long, Chi, Tam, & Lebailly, 2019).

It is evident from the literature that agricultural technology adoption is practiced all around Indonesia, however, agriculturalists are more likely to implement numerous technologies at once as supplements or alternatives, or to exploit their predictable advantage from the adoption choices while they are constrained by the restricted financing and low knowledge or skills (Linh, Long, Chi, Tam, & Lebailly, 2019). Rural and institutional funding along with extension services prove to be one of significant restriction for technology adoption. The problem is prevailed in Indonesia as well as internationally in republics such as Uganda, Vietnam, Brazil, Myanmar, South Africa, etc., due to the lack of awareness and implementation of technological advancement (Benjamin, 2018). Therefore, the agricultural extension service, and rural and institutional financing is imperative for the adoption of technological services in Indonesia as well as in many developing countries.

Through reviewing the literature, it was evident that agricultural technology adoption has been a focus of attention in Indonesia for a couple of years. However, most studies focused on either rural or institutional financing or extension services to analyse their impact on agricultural technology adoption. Therefore, the impact of both rural and institutional financing along with extension services has not been assessed for their impact on agricultural technology adoption in Indonesia. For that reason, thorough research is required in this domain, where the current research will focus on evaluating the impact of both rural and institutional financing along with extension services on agricultural technology adoption in Indonesia.. The research questions formulated for the current study are given below:

1. To analyse the role of agricultural extension services for agricultural technology adoption in Indonesia.

2. To evaluate the role of rural financing for agricultural technology adoption in Indonesia.
3. To determine the institutional context of lender for agricultural technology adoption in Indonesia

Rural and institutional agriculture financing are advantageous in eliminating rising scarcity and increasing communal wealth. Among the formal financial institutions, *'Bank Perkreditan Rakyat'* are an important source of financing in rural areas in Indonesia (McIntosh & Mansini, 2018). The higher the extension intensity, the higher the farmer's chance to adopt the agricultural technology (Wilcox, 2018). The agricultural extension service has also been required for curtailing food insecurity and diminishing rural poverty by means of technological and managerial dissemination of knowledge. Therefore, the higher the rural and formal institutional financing and agricultural extension services, the greater the probability of farmers adopting agricultural technology (Tomich, Kilby, & Johnston, 2018).

Literature Review

Impact of agricultural extension services on agricultural technology adoption

Extension services provide the farmers and other people related to agriculture with the latest information and education about farming, so that they can improve their agricultural practices and enhance their technical skills. This is not only confined to the technology of farming practices, it also includes the management skills of the farmers so that they can interact in their respective markets in a better way, communicate with relevant people effectively and reach better and more efficient markets. Studies have shown that extension services result in high productivity due to the use of modern technology (Mwangi & Kariuki, 2015). Such services provide information about the latest technology to the agriculturists, who apply them and in return get higher profits. This also enhances the living standards of people (Nohmi, Elias, Ishida, & Yasunobu, 2018). Extension service providers make sure that more and more people get aware of the modern technologies and use them in their agricultural practices. They also make sure that people totally understand the procedures to use the new technology by practically showing them the process of usage. Extension services also provide opportunities for adult farmers to get their required education and knowledge about the latest agricultural practices. Farmers use this knowledge for better use of technology. They not only use technology themselves but also tell other people about it and spread the word (Rehman, Jingdong, Khatoon, Hussain, & Iqbal, 2016). Extension service providers also identify the problems faced by farmers and immediately try to solve them. They develop certain communities which guide farmers about the latest farming methods and get access to better markets for higher levels of profits. Extension service providers take feedback from farmers about the technology they use for farming and provide that feedback to the technology

developers, so that they can make their technology up-to-date (Awotide, Karimov, & Diagne, 2016).

In less developed countries, where earning depends on land and natural resources, agricultural development plays a very important role for eliminating poverty because most of the population in these countries depend on this source of income (Nugraha & Osman, 2017). International organisations of certain developed countries develop and provide technologies to less developed countries for high productivity and higher profits. Although most of the people use extension services to overcome low productivity issues, this rate is lower because of illiteracy and unawareness in farmers. Sometimes, farmers hesitate to change from the traditional farming practices and thus show no interest in extension services and modern technology. Sometimes, even extension service providers do not co-operate with the farmers in gaining knowledge about latest technology.

Nigeria is the largest cassava producer in the world (Wossen et al., 2017). Cassava generates income for most of the people living in rural area of Nigeria. This shows the importance of this crop in that particular region. As an important crop, cassava needed special attention in terms of agricultural extension services to increase its productivity and thus reduce poverty. In the late 1960s the extension service was confined to commodities but in the 1980s its focus shifted towards food self-sufficiency and it was included as an Agricultural Development Project (ADPs). Services provided by ADPs included identifying expert farmers and introducing new farming practices to them, introducing modern technology, and helping them to pass this information on to their fellow farmers. With a few changes, it was the best extension service in Nigeria. Similarly, more efficient and effective extension services were introduced in Nigeria, whose aim was to provide participatory, demand driven and market oriented extension services. These extension services resulted in a high-level of awareness and use of modern technologies. As agricultural extension services promote the use of modern technology, we can say that it has a significant impact on the agricultural technology adoption.

H1: AES has significant impact on ATA

Impact of Rural financing on agricultural technology adoption

Rural financing refers to giving credit to poor rural people for farming purposes (Meyer, 2015). As we know that in rural areas specifically, the farmers are financially unstable. Without any credit they do not have enough productivity to gain higher profits. According to a study in Ethiopia, almost 90% of the country's agricultural production is achieved by smallholder farmers, but they are still poor and have even less than one hectare land (Abate, Rashid, Borzaga, & Getnet, 2016). They cannot invest enough to enhance the productivity of crops. This shows that they really need a proper credit system. Banks are unable to meet this

need because the farmers do not require larger transactions and rural areas do no possess enough banks to meet this need. Since 1960s many policies were introduced to overcome this problem but all of them failed in increasing productivity and reducing poverty (Schewe & Stuart, 2015). During 1960 to 1974, almost half of the agricultural credit was distributed through two intermediaries, the grain enterprises and primary co-operatives. They received the credit from the state banks and were meant to provide funds to poor farmers at lower rates, but this effort to provide smallholder farmers with enough credit failed miserably. The reason behind this failure was that, most of the percentage of load was received by wealthy farmers and poor farmers were left with only 7.5 % of allotted credit (Meyer, 2015). This mismanagement of credits resulted in the failure of the above mentioned intermediaries. Similarly, during the socialist era (1974 to 1991), specialised financial institutions were introduced, but they failed in providing credit to smallholder farmers too. The reason behind the failure of these institutions was that the larger farms which were run by the state received most of the percentage of credit and again the smallholders were left with a smaller percentage; not enough to invest in their farming practices and yield higher profits (Asfaw, Di Battista, & Lipper, 2016).

After economic reforms, the agricultural credit reduced more and thus smallholder farmers suffered. According to a recent study, there was shortage of three billion credits in the economic system. The sector that suffered by this shortage the most was agriculture. In spite of their higher percentage in GDP i.e. 41%, the loan percentage provided them was just 14%. This difference in percentages shows smallholder farmers are not getting credit to agriculture which results in the miserable condition for smallholder farmers. Ethiopia's neighbouring countries also had similar conditions (Benjamin, 2018). At present, FCS and MFIS are the only two institutions which are providing credit to smallholder farmers. These institutions give almost two thirds of total credit to smallholder farmers. These institutions also act as the intermediaries between banks and smallholder farmers which helps the farmers to have easy access to the banks. Studies have shown that since the revival of microfinance 2000, the agricultural credit share has significantly increased. Although the credit limit has increased for smallholder farmers to be invested in agriculture, it does not necessarily result in an increase in technology adoption. This is due to farmers using the credit amount for other purposes instead of agriculture. However, this is just a possibility. We can further investigate this suggestion with research to establish a firm conclusion. From the above discussion it is clear that rural financing is significant for agricultural technology adoption (Deichmann, Goyal, & Mishra, 2016).

H2: Rural financing has significant impact on ATA

Impact of Institutional context of lender on agricultural technology adaption

As we already know that access to financial and banking services is difficult for smallholder farmers because banks and other financial institutions consider them as high risk borrowers. They also have strict conditions for credit lending and high interest rates. Framers are unaware of banking services and usually it becomes difficult for them to repay the credit on time. So, it is difficult for the farmers to borrow or loan. In addition, financial institutions don not consider harvest time or sales of crops and just begin receiving repayments immediately, which is difficult for smallholder farmers (Dong, 2018b).

Studies have shown that in Ethiopia just like other developing countries, basic financial institutions have failed to provide services to poor households and smallholder farmers. So, in order to survive, smallholder farmers and other low income households rely only on farm credit systems (FCS) and microfinance institutions (MFIS) for all types of financial services (Dong, 2018a). They provide small loans to farmers and also educate them about financing. Around 2012, about 7000 saving and credit institutions were dedicated to providing financial services to almost one million people in Ethiopia. Just like other credit institutions around the globe, FCS provides facilities for farmers, labourers and employees in that region. These are the people that create the demand and supply of credit. FCS uses the bilateral model of lending credit. This contract is between the credit lending institution and the person who is borrowing the credit. The liability to repay the credit is on the borrower as well as the one who has co-signed the contract that is also the member of that particular institution (Elias, Nohmi, & Yasunobu, 2016).

National and international NGOs also take part in the development of financial institutions. MFIs were established in 1990 when government and non-government credit institutions were transformed and then the economy was reformed. Around 2012, 30 MFIs were dedicated to serve about 2.3 million people in Ethiopia. MFIs are registered and regulated by the National Bank of Ethiopia (NBE). They are owned by people, public bodies, NGOs or may be a combination of these three (Guo, 2017). FCS function in specific locations, while MFIs function in larger areas and are based on external funding. There are two types of loans used in these institutions: bilateral lending and joint liability lending. As the name implies, group lending is contracted with groups, however, the credit is given to an individual. When the individual defaults, the group is liable to pay for loans. This type of lending is the most commonly used type of lending in MFIs in Ethiopia (Khandker & Samad, 2016). As we have seen in this discussion that FCS and MFIs resemble each other because they both target the same people i.e. poor, rural and smallholder farmers, but at the same time they are different from each other. Their infrastructure, ownership, types of credit lending etc. are different from each other. Thus, the context of institutions that lend credit have an important impact on

agricultural technology adoption. This adoption may differ in farmers borrowing credits from either FCS or MFIs (Kuehne et al., 2017).

H3: ICL has significant impact on ATA

Methodology

Data Collection and Methods

The present research aims to analyse the role of Agriculture Extension Service (AES), Rural Financing (RF) and Institutional Context of Lender (ICL) in the technology adoption context of Indonesia. The population of the current study consists of the time series macroeconomic data of Indonesia. The secondary data was collected for some variables and the primary data was collected for RF, ICL and technology adoption from the farmers of Indonesia. The data was collected for the past thirty years from the database of the World Bank Group and then a time series analysis was completed on the data.

Variables Definition and Measurements

The present study includes dependent, independent and control variables in the study. There is one dependent variable which is the agricultural technology adoption (ATA). The data about this variable was collected from the farmers through survey questionnaire. There are three independent variables in the current study that are Agriculture Extension Service (AES), Rural Financing (RF) and Institutional Context of Lender (ICL). The AES is a dummy variable which was assigned the value of 1 or 2 based on the presence of AES in Indonesia. The RF and ICL were again measured through survey questionnaires in which the questions were asked from farmers of Indonesia.

Besides dependent and independent variables, there are three control variables included in the current study that are: crop production (CP), arable land (ARL) and real agricultural growth (RAG). The Crop production was measured as the total crop production in Indonesia. Arable land was measured as the percentage of arable land in total land area of Indonesia. RAG was measured as the proportion of GDP accounted by the agriculture. All the data was available on the World Bank Group database.

Modelling and Methodological Framework

The current study analysed the impact of AES, RF and ICL on technology adoption in agriculture of Indonesia. The time series ARDL approach was adopted to analyse the data. Time series analysis is very important in determining the lags at which the relationships between variables are significant. The current relationships were also tested through similar approaches in which short-term as well as long-term impacts of ICL, RF and AES on ATA

were found and the lags were identified on which AES, RF and ICL significantly influenced the ATA. The regression equation for the current model is as follow:

$$ATA_t = \beta_0 + \beta_1 AES_{t-1} + \beta_2 RF_{t-1} + \beta_3 ICL_{t-1} + \beta_4 CP_{t-1} \beta_5 ARL_{t-1} + \beta_6 RA_{t-1} + u_{it} \quad (1)$$

Unit Root Test

Before applying regression test, the data was analysed by applying the unit root test. This test enabled the researcher to ensure that the data is valid. The unit root test is necessary in macroeconomic data. The present research adopted ADF Fisher Chi-square (ADF Fisher) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) to perform the unit root test. The unit root test can be explained through the following equation:

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

Where ΔY_{t-i} indicated the lag difference, the β_1 denoted the constant term and t showed the time trend. In unit root test, the error term is made serially independent by adding lag difference terms. In unit root test the following are the null and alternative hypotheses,

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

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

Analysis and Results

The time series data collected from Indonesia was subjected to analysis through EViews and the descriptive statistics, unit root, heteroscedasticity, co-integration, and ARDL time series analysis were performed in order to get authentic results about the relationships.

Descriptive Statistics

The descriptive statistics of the data (see Table 1) were found through EViews that revealed the data is normal and adequate. To assess the normality and appropriateness of data, the statistics of skewness, kurtosis, mean value and std. deviation were found and interpreted.

Table 1: Descriptive Statistics

	ATA	AES	RF	ICL	CP	ARL	RAG
Mean	3.580000	1.400000	4.000000	3.400000	106.1820	13.08920	2.380394
Median	3.500000	1.000000	4.000000	3.500000	106.6100	13.07705	2.408482
Maximum	4.500000	2.000000	5.000000	4.500000	143.4300	13.27578	2.698389
Minimum	2.500000	1.000000	3.000000	2.500000	67.62000	12.97217	1.998242
Std. Dev.	0.606905	0.500000	0.577350	0.577350	27.39898	0.105845	0.209201
Skewness	-0.310921	0.408248	0.331456	0.232019	0.078532	0.296724	-0.220444
Kurtosis	2.217824	1.166667	1.953125	2.246094	1.448362	1.696848	2.046754

The descriptive statistics are showing that the mean value of ATA, AES, RF, ICL, CP, ARL and RAG are all falling between their minimum values and maximum values so, there is no outlier in the data. The value of skewness for ATA, AES, RF, ICL, CP, ARL and RAG are also ranging between -1 and +1. The value of kurtosis of ATA, AES, RF, ICL, CP, ARL and RAG are all ranging from 1 to 3 so, there is normality in the data. Hence, the data is adequate and appropriate for further analysis. The standard deviation is also acceptable for all variables of this study.

Unit Root Test

The unit root test was applied to the data to avoid any error regarding fallacious regression. The unit root test was applied through two tests and the results were interpreted to find if the data was stationary or not. It is the condition of ARDL approach that the series in data can be both I(0) as well as I(1) so that, the approximation of a cointegrating vector is allowed. Since the current study includes the macroeconomic variables, the unit root test was needed for the analysis. Tables 2 and 3 present the unit root test at level and at first difference respectively.

Table 2: Unit Root Test at the levels of the variables

Variables	ADF (null: variables has a unit root)		KPSS (null: variable is stationery)	
	Test Statistic	Critical value at .05 level	Test Statistic	Critical value at .05 level
ATA	-0.16	-2.96*	0.63	0.48**
AES	0.52		0.88	
RF	1.18		0.79	
ICL	1.19		0.64	
CP	1.18		0.39	
ARL	1.12		0.46	
RAG	1.08		0.51	

Table 3: Unit root test at first differences of variables

Variables	ADF (null: variables has a unit root)		KPSS (null: variable is stationery)	
	Test Statistic	Critical value at .05 level	Test Statistic	Critical value at .05 level
ATA	-6.17	-2.96	0.06	0.48
AES	-7.78		0.21	
RF	-6.12		0.10	
ICL	-6.12		0.16	
CP	-5.34		0.19	
ARL	-6.11		0.11	
RAG	-5.09		0.05	

Tables 2 and 3 are indicating that both unit root tests i.e. ADF and KPSS are giving the same results for all variables. It is found through these tests that series ATA, AES, RF, ICL, CP, ARL and RAG have unit roots at level so, they are I(1). Hence, the condition for ARDL approach is fulfilled.

Co-integration test

It is found through unit root test that the data set is stationary therefore, there must be co-integration in the data. To check this co-integration, the test was applied. In this test, the null hypothesis is that there is no cointegration and the alternative hypothesis is that there is cointegration. This test was interpreted by looking at F-statistics, Akaike information criteria (AIC), and Schwarz information criteria (SIC). The minimum AIC and SIC determined that optimal lag value and the F-statistics higher than the upper bound critical value indicated the rejection of null hypothesis.

Table 4: Cointegration Test

Lag	Intercept			Intercept and trend		
	AIC	SIC	F	AIC	SIC	F
1	-2.110	-1.492	3.43	-2.101	-1.467	3.16
2	-2.131	-1.310	3.59	-2.110	-1.287	3.33
3	-2.110	-1.362	2.90	-1.993	-1.299	2.54
4	-2.172	-1.289	3.87	-2.167	-1.210	3.61
5	-2.103	-1.391	3.98	-2.100	-1.387	3.77
6	**-3.143**	**-1.689**	**5.91***	**-3.130**	**-1.691**	**5.88****
7	-2.732	-1.391	0.78	-2.693	-1.386	0.84

The results of table 4 revealed that the minimum AIC and SIC are observed at lag 6 and the F-statistics against them is also greater than upper critical value. It means that the null hypothesis is rejected and it is found that there is cointegration. After proving the presence of cointegration, the long-term equation of the current study has been estimated as follow:

$$ATA_t = \beta_0 + \sum_{i=0}^{p}\beta_{1i}AES_{t-i} + \sum_{i=0}^{q}\beta_{2i}RF_{t-i} + \sum_{i=0}^{r}\beta_{3i}ICL_{t-i} + \sum_{i=0}^{s}\beta_{4i}CP_{t-i} + \sum_{i=0}^{t}\beta_{5i}ARL_{t-i} + \sum_{i=0}^{v}\beta_{6i}RAG_{t-i} + \epsilon_t \quad (3)$$

After long-term equation, the following short-term equation was estimated through error correction model:

$$ATA_t = \delta_0 + \sum_{i=0}^{p}\delta_{1i}\Delta AES_{t-i} + \sum_{i=0}^{q}\delta_{2i}\Delta RF_{t-i} + \sum_{i=0}^{r}\delta_{3i}\Delta ICL_{t-i} + \sum_{i=0}^{s}\delta_{4i}\Delta CP_{t-i} + \sum_{i=0}^{t}\delta_{5i}\Delta ARL_{t-i} + \sum_{i=0}^{v}\delta_{6i}\Delta RAG_{t-i} + \lambda ECM_{t-1} + \pi_t \quad (4)$$

In equation 4, the ECM is the error correction term which is used to estimate the short-term impacts.

ARDL Model

After checking all normality, heteroscedasticity and co-integration aspects of the data, the regression model was tested and the following results were found about the relationships.

Table 5: ARDL Model (Dependent Variable: ATA)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
AES	0.201153	0.163632	1.229301	0.2425
AES(-1)	0.381867	0.143437	2.662270	0.0207
RF	0.167933	0.199871	2.840207	0.0172

ICL	-0.445211	0.193054	-2.306151	0.0398
CP	0.022053	0.030141	0.731655	0.4784
CP(-1)	0.037279	0.026832	1.389363	0.1900
ARL	1.780194	11.17759	0.159265	0.8761
ARL(-1)	16.08537	11.93985	1.347201	0.2028
RAG	1.534732	1.599899	0.959268	0.3564
RAG(-1)	2.990921	1.463072	2.044274	0.0435
C	7.886581	99.16247	-2.499818	0.0279
R-squared	0.874578	Mean dependent var		3.625000
Adjusted R-squared	0.759609	S.D. dependent var		0.575779
S.E. of regression	0.282303	Akaike info criterion		0.615180
Sum squared reside	0.956339	Schwarz criterion		1.204207
Log likelihood	4.617836	Hannan-Quinn criterion		0.771449
F-statistic	7.607034	Durbin-Watson stat		2.360805
Prob(F-statistic)	0.000738			

The results of regression proved that overall model is good because more than 75 percent variation in technology adoption was explained by the ATA, AES, RF, ICL, CP, ARL and RAG in the current model. The impact of AES on ATA is significant and positive at first lag while the impact of rural financing on ATA is significant and positive at level. The effect of ICL on ATA is significant but negative at level. All these effects are significant because t-statistics is >t-tabulated and p-value against all these effects is <0.05. The impact of all control variables on ATA is insignificant at level however RAG showed a significant impact on ATA at first lag. The impacts of the remaining control variables on ATA remained insignificant. The overall regression results are significant because the F-statistics are > F-tabulated and probability against it is also less than 0.01.

Table 6: Dependent Variable: ATA

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
	Long-term Equation			
AES	0.095432	1.965434	1.785443	0.0543
RF	0.231356	1.032145	2.053533	0.0031
ICL	0.132134	0.997642	3.635322	0.0000
CP	3.324456	0.964211	4.632254	0.0024
ARL	0.422211	1.042222	2.975433	0.0013
RAG	3.153222	1.094322	3.642111	0.0000
	Short Term Equation			
COINTEQ01	2.216123	1.645522	2.064662	0.0421

D(AES)	0.317243	0.946611	2.563661	0.0000
D(RF)	0.241115	2.643243	3.842321	0.0000
D(ICL)	2.074552	3.163551	0.734422	0.3846
D(CP)	0.125553	1.136633	2.363666	0.0452
D(ARL)	3.646611	2.461717	3.764666	0.0000
D(RAG)	0.533663	1.936553	1.999362	0.0283
C	1.2413	1.366361	2.144742	0.0103

The results regarding estimation of long-term equation depict that RF and ICL have significant and positive long-term impacts on ATA while the AES has no significant impact on ATA in long-term. The estimation of short-term impacts are indicating that AES and RF have significant short-term impacts on ATA while ICL does not show significant impact on ATA in short run.

Heteroscedasticity

The heteroscedasticity of the data is checked to see if the errors in the data are homoscedastic. The heteroscedasticity issue in the data causes the errors to variate according to the variations in independent variables. Therefore, the errors must be homoscedastic. The heteroscedasticity was checked in the current data through Breusch-Pagan-Godfrey test.

Table 7: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.627143	Prob. F(6,18)	0.7067
Obs*R-squared	4.322567	Prob. Chi-Square(6)	0.6331
Scaled explained SS	0.912357	Prob. Chi-Square(6)	0.9887

The results presented in table 7 showed that the null hypothesis about the heteroscedasticity i.e. there is no heteroscedasticity in the data is accepted because p-value is more than 0.05. Hence, the errors are constant throughout the data.

Discussion

This study is completed the objective to know about the affiliation between Agriculture Extension Services (AES) and Agricultural Technology Adoption (ATA) (Schneider & Gugerty, 2011). The aim of this study was also to find out about the relationship between Rural Financing (RF) and ATA. The objective was also to find out about the association between Institutional Context of Lender (ICL) and ATA, between Crop Production (CP) and ATA, between Real Agriculture Growth (RAG) and ATA, between Arable Land (AL) and ATA. This study suggested the following hypothesis: the hypothesis number one suggested that there is a significant and positive impact of AES on ATA. This hypothesis is accepted.

Margarita Genius researchers, stated in that research the positive impact of AES on ATA and suggested that technological changes in agriculture system enhanced the productivity of the crops. The second hypothesis suggested that there is a significant impact of RF on ATA. This hypothesis was also accepted. According to a study by PHOEBE KOUNDORI heavy machinery parched through the RF and this resulted in the improved production of crops through ATA. The next hypothesis recommended that the impact of ICL is positive on ATA. The hypothesis got accepted as well (Genius, Koundouri, Nauges, & Tzouvelekas, 2013). Many researchers stated the positive impact of these variables on each other. The study administered the impact of CP. CELINE GAUGES suggested that information transmission resulted in the economic and timely production of better crops. So, the impact is significant between these two variables. This study focused on the impact of RAG on ATA. This impact is positive. VANGELIS a famous researcher of agriculture sciences suggested that technological adoption helped in increased ploughing and increased and better output through ATA. The study also focused on the impact of AL on ATA. The American journals of agriculture economics suggested that the exact AL resulted in effectiveness and quality production of the crops through ATA. So, the impact is significant. (Aker, 2011).

Conclusion

The aim of this study was to know about the relation between AES and ATA, between RF and ATA. The aim was also to know about the association between ICL and ATA. The objective was to know about the impact of CP on ATA, RAG on ATA, AL on ATA. In this research secondary data was used. This study is conducted by gathering the data of the past 30 years through the internet. The data was collected through different economic forums sites. This study was conducted according to the Indonesian context. This study revised some hypothesis and the results showed the positive impacts. Every hypothesis was accepted in this study. The reasons for accepting every hypothesis is stated above.

Implications of the study

This research significantly contributed to the literature. It enhanced the data about this topic on the internet. Through this study, many people related to the agricultural sector can get beneficial data and they can implement this research in their own farming households. This study significantly contributed to government policies. They can make policies regarding the agricultural sector. They can formulate and implement the policies and get improved results. This study is important for the agricultural sector of Indonesia and any other country around the world as well.

Limitations and future research indications

In this research, no primary data was collected. This study involved a secondary collected data-based study; the future researcher can get primary data through different data collection tools. The primary data may help them in collecting more suitable data about this problem. They can use this when mediating variables rather than controlling variable in this study. The data was collected for the past thirty years. The future researchers can search the latest data of the past ten years, in order to get the latest results about the topic.

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