The Effect of Economic Growth, Agricultural Land, and Trade Openness Moderated By Population Density on Deforestation in OIC Countries

Annisa Rahma Febriyanti, Ririn Tri Ratnasari*, & Akhmad Kusuma Wardhana

Department of Sharia Economics, Airlangga University, Surabaya, 60286, Indonesia

Abstract

Deforestation is a serious environmental problem in the OIC countries. From 1990 to 2016 based on 2019 OIC Environment Report data, compared to other groups outside the OIC, the OIC deforestation rate reached >10% on average, which was much higher. The focus of this study examines the effect of economic growth, agricultural land, and trade openness moderated by population density on deforestation. This study uses a quantitative approach and a Moderated Regression Analysis technique with a sample of 15 OIC countries from 2010-2019 taken from the purposive sampling method. The test results clarify that economic growth and agricultural land have a significant effect on the rate of deforestation, while the effect of trade openness is not significant on the rate of deforestation. From the results of the moderating variable, only agricultural land which has a significant effect on deforestation is moderated by population density. These results confirm Kuznets' environmental theory and environmental externality theory, and can be used as material for the government's evaluation to reduce deforestation rates and maintain forest sustainability according to SDG's No.15 agenda by considering demographic aspects such as population density. This study is limited to the 15 OIC countries that are the research sample due to their high forest fluctuations. s evaluation to reduce deforestation rates and maintain forest sustainability according to SDG's No.15 agenda by considering demographic aspects such as population density. This study is limited to the 15 OIC countries that are the research sample due to their high forest fluctuations. s evaluation to reduce deforestation rates and maintain forest sustainability according to SDG's No.15 agenda by considering demographic aspects such as population density. This study is limited to the 15 OIC countries that are the research sample due to their high forest fluctuations.

Keywords: agricultural land; deforestation; economic growth; trade openness.

1. Introduction

Forests have an important role in the life of living things in the world. Forests act as food providers, habitats for various species, clean water providers, and other places to live for biodiversity and absorb carbon dioxide emissions. The existence of forests is able to protect the earth from the climate crisis effectively and without the need to spend a lot of money (United Nations, 2020). Forests have complex ecosystems not only consisting of trees, but also the habitat for most of the living things in the world. Forests provide 80% habitat for amphibians, 75% for bird species, and 68% for mammals (Food and Agriculture Organization, 2020).

Protection of forest ecosystems is included in the agenda of Sustainable Development Goals No. 15 which consists of protecting, restoring and promoting sustainable use of terrestrial ecosystems, including preserving forests. However, in enforcing forest protection, there are various kinds of problems related to the forest environment, one of which is deforestation which is a change or conversion of forests by means of deforestation to be converted into human activities. The conversion of forest functions can be in the form of clearing agricultural land, building housing, or clearing livestock land. In addition, as the human population increases, natural forests are decreasing and in the long term will be replaced by artificial forests (Harris & Roach, 2018). However, replanting is not easy when compared to the number of trees that have been cut down. This is reinforced by Safrilsyah & Fitriani (2014)that restoring the condition of ecosystems that have been damaged takes a very long time. The global rate of deforestation is statistically very volatile. In the last 10 years (2010-2020) there has been a decrease in forest area change from various regions (Food and Agriculture Organization, 2020). On the other hand, the gap between forest area and land area is getting wider and the world population continues to grow as evidenced in the figure 1.

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*Corresponding author.
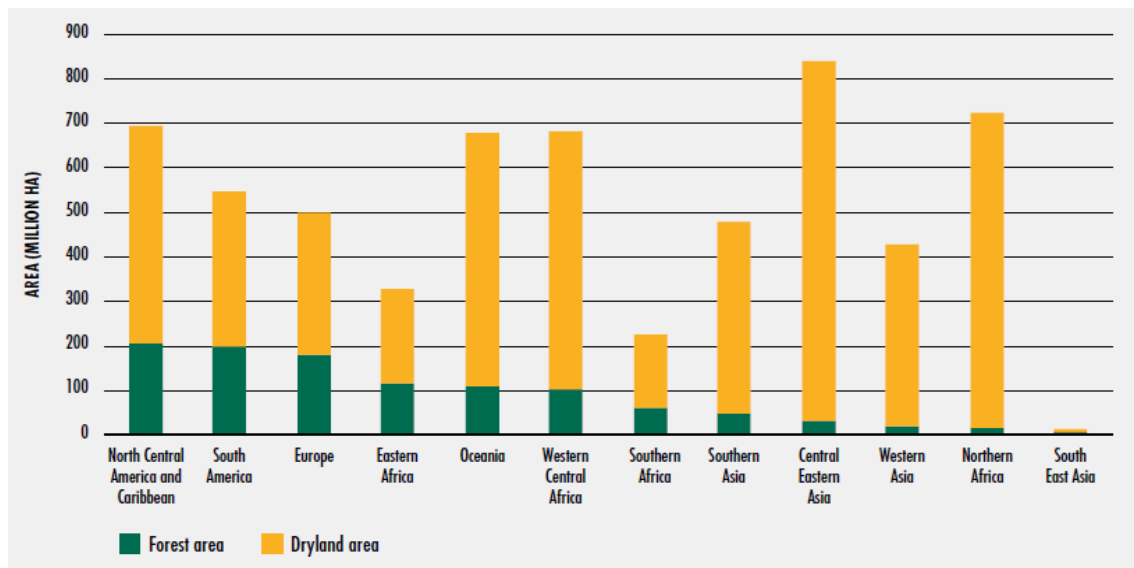E-mail address*: ririnsari@feb.unair.ac.id

Figure 1. Proportion of Forest Area compared to Dry Area by Region in 2015
(Food and Agricultural Organization, 2019)

Figure 1 shows the proportion of forest to dry land areas. If you look at the picture, there is an imbalance where the portion of the forest area is much smaller than the area without forest, especially in Oceania, West Central Africa, South Asia, East Central Asia, West Asia, North Africa, and even Southeast Asia. In fact, a further consequence of deforestation is the climate crisis and the loss of biodiversity that threatens to become extinct (Angelsen & Kaimowitz, 1999). If the human population continues to increase but the number of forests will continue to decline, it will have an impact on decreasing air quality.

Environmental problems arise from human interaction activities with the environment. In general economics, the goal of humans in carrying out economic activities is to achieve maximum satisfaction and profit, where natural wealth is one of the input factors for producing goods and services. This makes the use of natural resources a natural and free thing to do without taking into account the impacts and risks that will arise in the future. According to Forest Watch Indonesia (2019), there is an injustice behind deforestation where political economy policies sacrifice the existence of forests in favor of investment, conversion of forest functions to agricultural land and mining in the context of economic development.

When viewed from an Islamic perspective, it is necessary to know that economic activity has 5 basic values, namely: Tawhid, Khilafah, Prophethood, Justice, and Ma'ad (Adinugraha, 2013). Islamic economics as a behavioral science is based on Islamic values so that in carrying out economic activities it is always guided by the Qur'an and Hadith. Allah SWT has ordered humans to utilize all the resources in the universe by always protecting and preserving nature. That is, in managing resources, humans are ordered not to damage. This is in line with Islam as a mercy for the entire universe. The command of Allah SWT to humans as caliphs has been stated in the QS. Al-A'raf verse 74 which shows that Allah SWT has ordered humans as caliphs to manage all resources in the world that has been created by Allah SWT but is still required to be grateful without being excessive and destructive.

Previous research has several times discussed the determinants of deforestation in a country, mainly related to economic growth, but there are still differences in results. The Environmental Kuznets Curve (EKC) states that initially economic growth has the effect of increasing environmental degradation until it reaches a point where people realize the need for better environmental quality so that environmental degradation will decrease (Nikensari et al., 2019). Previous research has shown that there is a directly proportional relationship between economic growth and deforestation (Ahmed et al., 2015; Faria & Almeida, 2016; Nathaniel & Bekun, 2020; Yameogo, 2021). However, there is some conflicting research that economic growth has no significant effect on deforestation (Handalani, 2019). In addition, there are also those who find that state income as proxy for GDP has a negative effect on deforestation which is actually proxy for agricultural land, meaning that when GDP increases, deforestation will decrease (Faria & Almeida, 2016). These findings are different from previous findings, so that researchers are motivated to re-examine the effect of economic growth on deforestation.

Food and Agriculture Organization (2020) stated that the main cause of forest loss is the expansion of agricultural land. Besides that, Sunderlin & Resosudarmo (1997)stated that the shifting behavior of farmers, by establishing on former forest land or by replacing fields on forest land can be the cause of deforestation. Another factor that influences deforestation is trade openness. The existence of trade openness has a positive and significant effect on deforestation (Leblois et al., 2017; Faria & Almeida, 2016). However, in another study that examined over a significant research period, the findings of trade openness actually had a significant negative effect on deforestation (Nathaniel & Bekun, 2020; Yameogo, 2021).

Several previous studies have focused on countries with more and denser populations. The study shows that the influence and interaction between population and deforestation can vary from country to country, so there needs to be an interaction between exogenous variables (Angelsen & Kaimowitz, 1999). Population is one of the factors that can accelerate the rate of deforestation (Handalani, 2019; Hoang & Kanemoto, 2021). In developing countries endowed with forest resources, rural populations migrate as access to land is improved, and convert forests to agricultural land, harvesting trees for firewood and other forest products (Leblois et al., 2017). Novelty in this study uses population density which moderates the relationship between exogenous variables and endogenous variables by interacting with exogenous variables.

Forest problems also occur in countries with Islamic cooperative organizations. According to the OIC Environment Report data in 2019, OIC experienced a higher deforestation rate from 1990-2016 when compared to other organizations. This study takes the subject of the Organization of Islamic Cooperation countries consisting of Muslim countries with developing economies in the world and having a variety of natural resources. The OIC countries have prioritized sustainability in the national development agenda, but economic growth has not been driven by the sustainable use of natural resources because they still have a high level of environmental damage (Organization of Islamic Cooperation, 2019). The majority of previous studies also only examined deforestation within the scope of one country as a sample and limited research on environmental issues, especially deforestation, even in the OIC countries. In addition, the different results of previous studies have led to the need for further research on the factors that influence deforestation, especially in the OIC countries. This has resulted in the author being interested in researching using Moderated Regression Analysis (MRA), which so far has not been found in previous studies. Based on the background and several previous studies that have been described previously, this study focuses on the relationship between economic growth, agricultural land, and trade openness moderated by population density with deforestation in the OIC countries from 2010 to 2019.

2. Theoretical Basis

2.1. Kuznets Curve Ens Environmental Theory

The Environmental Kuznets Curve theory states that there is an inverted U-shaped relationship between per capita income and environmental degradation (Usenata, 2018). In the early stages of economic growth, environmental degradation increases. However, after some time per capita income reaches a certain amount, a turning point occurs where the relationship becomes inversely related due to increasing environmental awareness. EKC theory focuses on environmental degradation such as air pollution and deforestation (Mosconi et al., 2020). The stages of the EKC theory are divided into 3 stages, namely the pre-industrial economy, the industrial economy, and the post-industrial economy where the economy is dominated by the service sector (Nikensari et al., 2019).

2.2. Environmental Externalities Theory

Externalities are defined as impacts that affect the well-being of people outside of market transactions (Harris & Roach, 2018). The externalities can be in the form of positive and negative externalities. Air pollution is an example of a negative externality. Environmental externalities are benefits or costs that are realized through changes in the physical and biological environment (Owen, 2004). The basis of environmental economics comes from the theory of negative externalities (Yuniarti, 2019). The existence of a country's economic growth that actually reduces environmental sustainability can lead to large costs, especially for economic growth itself.

2.3. Deforestation

The Regulation of the Minister of Environment and Forestry of 2017 Number 70 defines deforestation as the permanent transition of forested areas to non-forested areas. FAO in Suyadi (2013) defines deforestation as the permanent or temporary loss of forest area. Deforestation can result from the intentional removal of forest cover used for agriculture, urban development, or impacts from grazing (Tejaswi, 2007). If traced from its impact, deforestation

can have a positive or negative impact. The positive impact is to increase income, especially from food agriculture and international trade through product exports (Damnnyag et al., 2011). The negative impact of deforestation is an increase in the earth's air temperature (Ahmed et al., 2015). Deforestation also has an impact on economic activities and livelihoods that depend on forests, causing silting, erosion, drought, and flooding (Annan, 2013 inIbrahim et al., 2015).

2.4. Deforestation in Islamic Perspective

Islam has given clear attention to environmental problems. The universe and all its contents have been created in such a way by Allah SWT in order to maintain the balance and survival of the living creatures of His creation. According to Sharia, it is the obligation of mankind to regulate and be responsible for environmental sustainability (Ahmed & Monjur, 2010). From an Islamic perspective, the environment or nature is a blessing from Allah SWT. This is stated in QS. Al – Jasiyah: 13.

$$\text{لَكُمْ ا السَّمٰوٰتِ ا الْأَرْضِ ا اِنَّ لِكَ لَاٰيٰتٍ لِّقَوْمٍ}$$

Translation: And He has subjected to you all that is in the heavens and what is in the earth (as a mercy) from Him. Indeed, in this there are signs (of Allah's greatness) for those who think (Quran Ministry of Religion).

The interaction between nature and humans in life is something that will continue to occur throughout human life on earth. However, at one time humans can lose the vision and values of Islam in interacting with the environment. From initially only using it for the necessities of life, but then causing damage, for example polluting the soil, air, and water by deforestation, industrial waste spills, and the release of chemical substances (Barkah et al., 2022).

Rasulullah SAW has recommended planting trees as a form of harmonious life between Muslims and all living things, which means that the Prophet not only wants the welfare of the community but also the preservation of the quality of the environment (Suhendra, 2013). Al - Qaradawi gave the reasons why tree planting was carried out, namely first, from planting the tree it will provide benefits and secondly there is an aspect of beauty (Suhendra, 2013). Therefore, tree planting is closely associated with alms which will be rewarded later. So it can be said that Islam strictly prohibits deforestation (deforestation) because it will hinder the creation of benefits.

2.5. Deforestation in OIC Countries

The Organization of Islamic Cooperation is a cooperative organization that includes Islamic countries or Muslim countries in the world in the political, social, economic, cultural, and even scientific fields (Isrofil & Sukmana, 2020). OIC countries have large natural resources and the majority are in a desert climate so that it affects the availability of water and the agricultural sector. Regarding environmental quality, the OIC countries are still less focused on this, one of which is the problem of deforestation (Organitation of Islamic Cooperation, 2019). From 1990 to 2016 based on 2019 OIC Environment Report data, compared to other groups outside the OIC, the OIC deforestation rate was much higher, reaching >10% on average. If broken down into several regions, the largest deforestation occurred in the ECA (Europe and Central Asia) and SA (South Asia) regions reaching more than 20% and 25%, respectively. Then from several countries in the two regions, the 10 countries with each country's deforestation rate reaching > 25% are Togo, Nigeria, Uganda, Mauritania, Pakistan, Niger, Mali, Chad Benin, and Comoros.

2.6. Economic growth

Economic growth is part of macroeconomics which discusses economic phenomena in a broader study (aggregate) (Mankiw, 2016). Economic growth is a change in the amount of production of goods and services in a general period of 1 year(Ivic, 2015). Kuznets defines economic growth as an increase in production capacity in the long run for a country to provide economic goods for its people, which can be due to technological advances, institutional development, and various existing demands (Ahmad Ma'ruf, 2008). Indicators in describing economic growth are often in terms of GDP growth, per capita income and gross national income (Beik & Arsyianti, 2019).

2.7. Agricultural land

Land is an area on the earth's surface that includes the entire biosphere which is cyclical and has an influence on life related to its use (Juhadi, 2007). Land is also an economic resource whose availability is limited and its use must be directed at activities that are in accordance with its physical characteristics (Irawan & Ariningsih, 2015). Agricultural land is land that has physical properties and is suitable for agricultural activities (Isa, 2006). In general, agricultural land can be divided into dry land and paddy fields where rice fields have benefits for producing food such as vegetables, fruits, and so on (Irawan & Ariningsih, 2015).

2.8. Trade Openness

Trade Openness (TO) is the ratio of international trade consisting of exports and imports measured as a proportion of GDP (Alotaibi & Mishra, 2014; Cahyadin & Prastity, 2015; Faria & Almeida, 2016). The existence of trade openness brings the economy to grow and develop to the multinational level (Agusalim & Pohan, 2018). Mentioned byTaiwo & Olalekan (2021)that countries with developing economies actually benefit from foreign trade in terms of technology because the cost of imitating innovation is lower than the cost of innovation in developed countries.

2.9. Population Density

Population density measures the ratio of the number of humans to the area or physical space in which humans live. Another definition of population density is the average number of individuals per geographical unit of an area or the ratio between the total population and the area. Population density is useful in assessing areas that are overpopulated or underpopulated. The population density of an area is not always evenly distributed where an area with a higher population density will find it more difficult to improve the quality of life of its population (Yunianto, 2021). This is because population density can affect aspects of both the economy, health, and education (Antara & Suryana, 2020). In addition, population density also greatly affects environmental aspects, because areas with a denser population will put a strong pressure on natural resources (Akhirul et al., 2020).

2.10. Hypothesis Development

2.10.1. Economic Growth with Deforestation

Previous research has discussed a lot about economic growth with deforestation. Some result in positive relationship directions. Economic growth increases deforestation significantly (Ahmed et al., 2015; Faria & Almeida, 2016; Nathaniel & Bekun, 2020). This shows that the environment is a key factor of economic growth but on the other hand the use of forests for development will continue to occur and increase deforestation (Caravaggio, 2020). In the long term this influence will decrease as awareness of the environment increases but remains significant (Ajanaku & Collins, 2021). However, on the other hand it takes a very long time to replant the forests that have been lost so that when compared with the fast economic growth, deforestation will still occur. According to Haupt & Lupke (2007)One of the challenges faced by afforestation and reforestation is in terms of methodologies and procedures that are not easy, such as proving the feasibility of land for replanting.

H1: Economic growth has a significant effect on deforestation

2.10.2. Agricultural Land with Deforestation

Food and Agriculture Organization (2020) stated that the main cause of forest loss is due to the expansion of agricultural land. Community agricultural activities are an important factor influencing deforestation (Leblois et al., 2017). Agricultural land has a significant effect on deforestation (Handalani, 2019; Ajanaku & Collins, 2021; Yameogo, 2021). The increase in land used for plantations and agriculture will sacrifice the existence of forests. Population pressure causes the need for food to increase which results in forest conversion. Even strengthened in research from Ibrahim et al. (2015) that deforestation is caused by the consumption of firewood and the area of land used for agricultural food production.

H2: Agricultural land has a significant effect on deforestation

2.10.3. Trade Openness with Deforestation

Several previous studies discussed the effect of trade openness on deforestation. Trade openness has a significant effect on deforestation (Tsurumi & Managi, 2014; Leblois et al., 2017; Faria & Almeida, 2016). The more open international trade, the higher the production income per capita so that it affects deforestation (Tsurumi & Managi, 2014). Especially if the commodity being traded is by taking over the function of the forest and logging the forest, for example forest or agricultural products that are cleared by converting forests. However, several previous studies have also found different and even contradictory results from the general theory, namely that trade openness actually has a negative and significant effect on deforestation (Ahmed et al., 2015).

H3: Trade Openness has a significant effect on deforestation

2.10.4. Population Density Moderates Effect of Economic Growth on Deforestation

The results show that the correlation and interaction between economic growth and population density can cause environmental damage(Wafiq & Suryanto, 2021). In developing economies endowed with forest resources, rural

populations migrate as access to land is improved, and convert forests to agricultural land, harvesting trees for firewood, timber and other forest products.(Leblois et al., 2017). According toHakeem (2017)population density will increase investment in infrastructure development such as transportation, communication, and so on and the presence of population density can increase the production of goods and services so that it affects the environment. Studies show that the influence and interaction between population and deforestation will vary from country to country, so there is a need for interactions between other exogenous variables and population density.(Angelsen & Kaimowitz, 1999). In this case, population density can be a variable that strengthens the relationship between economic growth variables and deforestation.

H4: Population density moderates the effect of economic growth on deforestation

2.10.5. Population Density Moderates Effect of Agricultural Land on Deforestation

Population density is often cited as a factor that puts pressure on natural resources, including forests. Deforestation is more prominent in tropical areas with high population explosions because countries with high population densities place greater pressure on the existence of forests to be converted.(Ajanaku & Collins, 2021). The demand for agricultural land increases in line with the population explosion, resulting in deforestation(Yameogo, 2021). This shows that a population explosion can strengthen agricultural land clearing thereby increasing deforestation.

H5: Population density moderates the effect of agricultural land on deforestation

2.10.6. Population Density Moderates Effect of Trade Openness on Deforestation

Population density is an important factor in the pattern of trade and development of a country. Densely populated settlements can increase exports of products, especially manufactured goods of a country, which also take advantage of natural resources(Keesing & Sherk, 1971). The results of previous studies also found that the export of forest-based products increased deforestation, especially in densely populated areas(Ibrahim et al., 2015). Densely populated settlements increase the economic activity of an area with the availability of human production factors, thereby increasing forest utilization(Keesing & Sherk, 1971).

H6: Population density moderates the effect of Trade Openness on deforestation
Based on the development of the previous hypothesis, the analysis model can be described in figure 2.
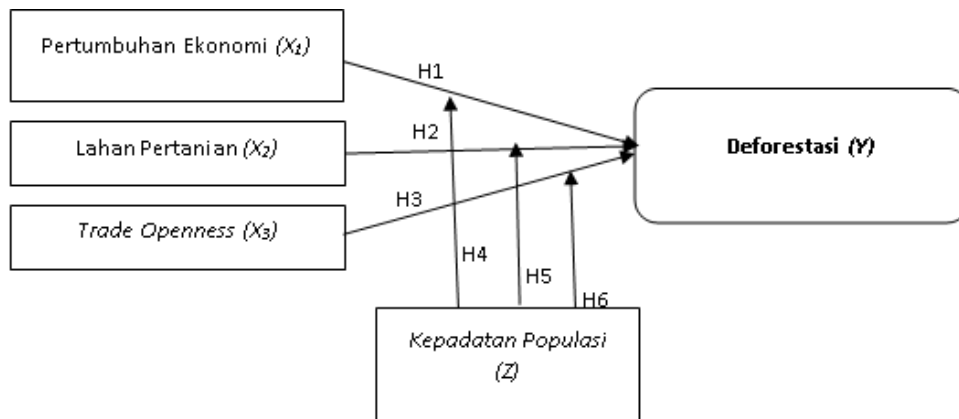

Figure 2. Research Analysis Model (in *Indonesia*)

3. Method

3.1. Research Approach and Variable

Quantitative method as an approach in this research. Quantitative methods are carried out by testing selected samples from certain populations which are then collected using research instruments and analyzed with statistical tools to prove the hypothesis.(Sugiyono, 2013). Deforestation as an endogenous variable, while the exogenous variable consists of economic growth, agricultural land, and trade openness, and the moderator variable is population density. The operational definition of each variable is further described in table 1.

Table 1. Variable Operational Definition

No	Variable	Definition	Indicator	Reference	Source
1.	Deforestation (Endogenous Variable)	Annual rate of forest decline	Deforestation Rateit = log(Forest$i,t-1$) – log(Forestit)	Caravaggio (2020)	World Bank Data
2.	Economic growth (Exogenous Variable)	The market value of a country's goods and services divided by its population	GDP Per capita (Current)	Faria (2016), Yameogo (2021), Khan (2019)	SESRIC
3.	Agricultural land (Exogenous Variable)	Land area used for agricultural land	Agricultural Area (Ha)	Yameogo (2021), Leblois et al. (2016)	SESRIC
4.	*Trade Openness* (Exogenous Variable)	Total International Trade Volume divided by gross domestic product	$TR(\%) = \dfrac{Expor + Impor}{GDP}$	Ahmed et al., (2014), Faria (2016)	SESRIC
5.	Population Density (Modating Variable)	Total population divided by the area of a country	Population per km2	Ahmed et al. (2014), Yameogo (2021)	SESRIC

3.2. Data source

The secondary data in this paper were obtained from the official websites of the World Bank and SESRIC. From table 1, the deforestation indicator is calculated manually using the formula used by Caravaggio (2020) because the deforestation index data on FAOStat is only limited until 2017. The data also limited which had full data only from 2015.

The research period taken is starting from 2010-2019. According to a press release from the National Oceanic and Atmospheric Administration, 2016 was the hottest year in 137 years in which greenhouse gases were recorded with the highest number including CO_2 concentrations.

3.3. Population and Sample

The population in this study are OIC (Organization Islamic Cooperation) countries taken from purposive sampling as one of non-probability sampling which selects samples based on the special characteristics of the sample which are in line with certain objectives in the study (Muhammad, 2008). The sampling criteria are as follows:

a)   Available data for each indicator from 2010-2019
b)   Data fluctuates for at least 4 consecutive years (Not stagnant for more than 4 years)

The 15 OIC member countries were selected, namely Algeria, Azerbaijan, Guinea-Bissau, Gabon, Guyana, Indonesia, Kazakhstan, Kyrgyzstan, Morocco, Mozambique, Niger, Pakistan, Tunisia, Turkey, and Uzbekistan.

3.4. Data Analysis Technique

By using SPSS version 25, the data were processed using the Moderation Regression Analysis (MRA) technique. This technique is a type of multiple regression that interacts moderating variables with exogenous variables (Liana, 2009). The reason for using MRA is because of the existence of moderating variables in this study. Moderating variables can strengthen or weaken the relationship between exogenous and endogenous variables. As for when translated into equations are:

$$Y = \beta_0 + \beta_1 X1 + \beta_2 X2 + \beta_3 X3 + \beta_4 * Z + \beta_5 X1 * Z + \beta_6 X2 * Z + \beta_7 X3 * Z$$

Y represents the level of deforestation as an endogenous variable, X1 as economic growth, X2 represents agricultural land, X3 as Trade Openness, and Z is a moderating variable of population density. In this study using the classical assumption test, namely normality test, heteroscedasticity test, multicollinearity test, and autocorrelation test based on Ghozali (2018). Then partially test the hypothesis, namely the t test and the coefficient of determination.

4. Discussion Result

4.1. Descriptive statistics

Table 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Economic growth	150	1120.67	9894.48	4829.56	3147,12
Agricultural land	150	9703.00	62300.00	33761.06	16128.02
Trade Openness	150	25.31	146.82	72.43	29.31
Population Density	150	3.81	88.40	40.46	26.20
Deforestation	150	-.0077447	.0071664	-.00022	.00315
Valid N (listwise)	150				

Source: SPSS (processed)

Based on the descriptive statistics in table 2, it can be seen from the economic growth that it has a range from 1120.67 to 9894.48 with an average of 4829.56. The highest economic growth value is in Turkey and the lowest is in Kyrgyzstan. On the other hand, agricultural land has a minimum value of 9703 from Tunisia and a maximum value of 62300 from Indonesia with an average of 33761.06. The Trade Openness variable has a range of 25.31 to 146.82 from Pakistan and Guyana. The minimum value of the moderating variable is the population density of 3.81 and the maximum value of 88.40 comes from Guyana and Turkey. The lowest deforestation value at -0.0077 came from Albania and the highest value was 0.0071 from Pakistan.

4.2. Classic Assumption Test Results

4.2.1. Normality test

The results of the normality test using the Kolmogorov-Smirnov can be seen in table 3.

Table 3. Kolmogorov-Smirnov. Normality Test Results

	N	Test Statistics	Sig. (2 tails)
Unstandardized Residual	150	0.057	0.200

Source: SPSS (processed)

Table 3 shows a significance value of 0.200 (> 0.05) so it can be concluded that the residual data is normally distributed.

4.2.2. Multicollarity Test

The multicollinearity test aims to test the existence or absence of a linear relationship between exogenous variables in the regression model(Ekananda, 2018). The multicollinearity test in this study uses the Tolerance (TOL) and Variance Inflating Factor (FIV) assessment based on Ghozali (2018) which is shown in table 4.

A variable is said to have a high level of multicollinearity if the tolerance value is equal to or below 0.1 (Ghozali, 2018) and the VIF result exceeds 10 (Gujarati & Porter, 2015). It can be seen from table 4 where the tolerance value for all variables is more than 0.1 and the VIF number is not more than 10, so there is no multicollinearity.

4.2.3. Heteroscedasticity Test

This test aims to detect the emergence of variance from disturbance or non-constant error for each observation (Ekananda, 2018). A good regression assumption is that the error variance is constant/homoscedastic. The plot graph used in this paper between the predicted value of the dependent variable and its residual based on Ghozali (2018).

Table 4. Multicollinearity Test Results

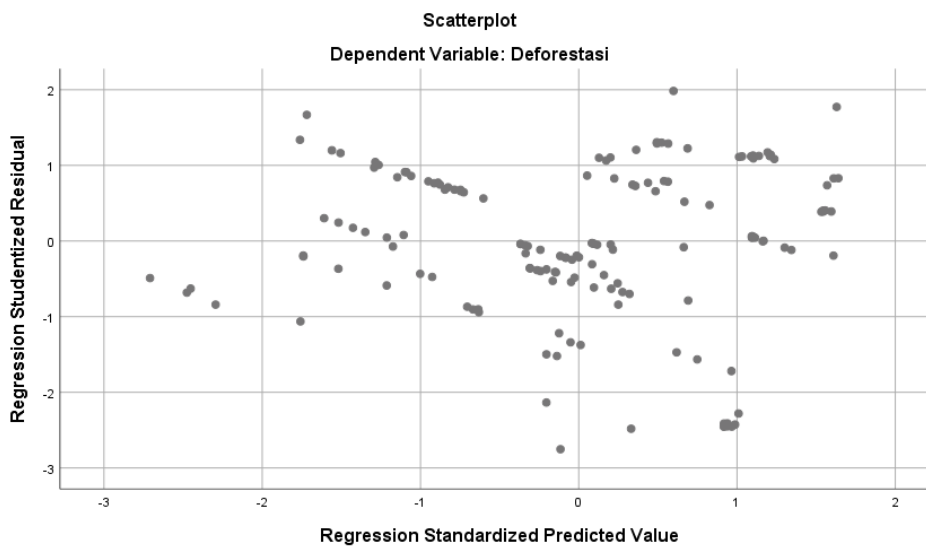| Model	Collineary Statistics	
	Tolerance	VIF
(Constant)		
Economic Growth (X1)	0.813	1,230
Agricultural Land (X2)	0.725	1,380
Trade Openness (X3)	0.660	1.514
Population Density (Z)	0.690	1,449
X1*Z	0.527	1,897
X2*Z	0.649	1.542
X3*Z	0.501	1,998

Source: SPSS (processed)

Figure 2. Heteroscedasticity Scatterplot
Source: SPSS (processed)

It can be seen in Figure 2 that the spread of the points either above or below the value 0 and irregularly forms a pattern, so it can be interpreted that the regression is homoscedastic.

4.2.4. Autocorrelation Test

The autocorrelation test aims to detect in the regression a correlation between the confounding error in period t and the previous period (t-1). The Durbin-Watson test is used with the condition that the value is between -2 and 2 (Chasanah & Rusmita, 2019).

Table 5. Durbin Watson Autocorrelation Test Results

Model	Std. Error of the Estimate	Durbin-Watson
1	0.0026767910	0.427

Source: SPSS (processed)

Table 5 shows the Durbin-Watson value of 0.427, which number is between the Durbin Watson value of -2 and also 2 so it is interpreted that there is no autocorrelation found in the regression equation.

4.3. Hypothesis Testing and Analysis

4.3.1. Hypothesis t-Test Results

Table 6 shows the significance level of the variables of economic growth and agricultural land respectively 0.002 and 0.001 which is below 5% (0.05), so based on these results accept Hypothesis 1 and Hypothesis 2. Deforestation is significantly affected by economic growth. Likewise, agricultural land has a significant effect on deforestation rates in OIC member countries. Meanwhile, the Trade Openness variable has a significance level of 0.547 which is above 5%. Based on these results, this study rejects Hypothesis 3, which means that Trade Openness has no significant effect on deforestation rates in OIC member countries.

Table 6. Results of Moderation Regression Analysis (MRA)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.003	.001		3.145	.002
	Economic growth	-3.349E-7	.000	-.374	-3.171	.002
	Agricultural land	-1.919E-8	.000	-.312	-3.337	.001
	Trade Openness	-6.654E-6	.000	-.062	-.599	.550
	Population Density	-1.588E-5	.000	-.329	-1.290	.199
	X1_Z	-5.022E-10	.000	-.049	-.332	.741
	X2_Z	8.786E-10	.000	.778	4.573	.000
	X3_Z	-2.689E-7	.000	-.243	-1.294	.198

Coefficients^a

Source: SPSS (processed)

4.3.2. Hypothesis t-Test Results with moderating variables

Table 6 shows the test results by interacting exogenous variables with moderating variables. It can be seen that the significant level of interaction between economic growth and population density (X1_Z) is 0.741 (> 0.05), so this study rejects H4 i.e. economic growth moderated by population density has no significant effect on deforestation. Then the interaction of agricultural land with population density shows a significance level of 0.000 so that it can be interpreted that population density variables are able to moderate the relationship between agricultural land variables and deforestation (H5 is rejected). The significant value of 0.198 was obtained in the interaction of trade openness with population density where the figure was above 5%.

4.4. Coefficient of Determination (R^2)

Table 7. Coefficient of Determination Test Results

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.696a	.485	.459	.0023039333

Source: SPSS (processed)

Table 7 shows the percentage of R^2 of 48.5%. From this percentage, it shows that the deforestation variable can be explained by exogenous variables of 48.5%. Then 51.5% is explained by other variables not included in this study. Then if you look at the SSE (Standard Error of Estimate) above, 0.00230 indicates the regression model can predict the endogenous variables better because the SSE value is getting smaller. This justification is in accordance with Chasanah & Rusmita (2019).

4.5. Analysis

Based on the regression results, deforestation is significantly affected by economic growth (H1 is accepted). The results are in line withAhmed et al. (2015),Faria & Almeida (2016), andNathaniel & Bekun (2020). This is linear with the Environmental Externality Theory that a country's economic growth as part of human activity can cause

environmental changes (environmental degradation) which in this study is measured by deforestation. However, if you look at the direction of the negative relationship that is not in accordance with some literature on high economic growth, it will cause a decrease in forest values. This confirms the Environmental Kuznets theory at the adjustment stage where economic growth will be in line with environmental improvements. In addition, it was strengthened by the OIC Environment Report in 2019 that several countries as a result of the sample selection experienced a reduction in deforestation such as Indonesia, Gabon, Guyana, Guinea-Bissau, Tunisia, and Mozambique with Forest Coverage levels still above 25%.

Then when viewed from the relationship between agricultural land partially and deforestation, there is a significant effect (H2 Accepted). This is in line with Leblois et al., (2017),Handalani (2019),Ajanaku & Collins (2021), andYameogo (2021). However, if you look at the direction of the relationship, it has a negative direction between agricultural land and deforestation, which indicates that the clearing of agricultural land in the 15 OIC countries does not sacrifice forests. Whereas according to Leblois et al. (2017), agricultural activities carried out by communities contribute to deforestation, due to the opening of new agricultural land at the expense of the existence of forests. The relationship between Trade Openness and Deforestation was found to have no significant effect, thus rejecting H3. This is in line with Nathaniel & Bekun (2020) who found that trade openness had no significant effect on deforestation. According to Nathaniel & Bekun (2020), International trade activities do not always sacrifice the existence of forests if the commodities being traded are not the result of the conversion of forest functions. This indicates that in the OIC countries, deforestation is caused more by closed economic activities or domestic activities and not from international trade activities.

Based on regression using the moderating variable, of the three exogenous variables, only agricultural land has a significant effect, moderated by population density (H5 is accepted). In addition, it is proven that the direction of the relationship is positive after being moderated by population density. The implication of this result is that agricultural land will more strongly influence the rate of deforestation if it is moderated by population density. The OIC countries have had deforestation problems since 1990, the majority of which are dominated by the influence of agricultural activities according to *OIC Environment Report*ing 2019. According to Ajanaku & Collins (2021), a dense population will certainly require a lot of agricultural activities, both agricultural products and the opening of new agricultural land, so that it will affect deforestation. This also proves that agricultural land is indeed the main problem of deforestation in OIC countries according to the Food and Agriculture Organization (2020). The variable of economic growth is not proven to be moderated by population density (H4 is rejected). This is not in line with Wafiq & Suryanto (2021) which state that the interaction between economic growth and population density affects deforestation.

The results when viewed from an Islamic perspective, that in Islam is much regulated regarding the environment. Islam is a religion that *Rahmatan lil Alamin,* where all living things are created to live together side by side. Allah SWT created the entire universe including plants and trees in a neat and structured manner and gave it an obligation for humans as caliphs to maintain and prosper it (Ariyadi & Maimunah, 2017). If it is associated with the results of hypothesis 5 that the existence of agricultural land is moderated by a large population in an area causing deforestation, it means that human activities contribute to environmental destruction. This has been explained explicitly in QS Ar-Rum: 41 that the damage that occurs both on land and at sea is caused by human actions in the world. There is the term Al-Istishlah which refers to providing care and preservation of the environment including other living things on earth (Wardhana et al., nd). It also refers to sustainable use by not doing any damage and not overdoing it (Safrilsyah & Fitriani, 2014). This means that in utilizing forests, it is an obligation for humans as earth leaders and managers to pay attention to the needs of future generations.

5. Conclusion

Deforestation is one of the environmental problems that still exists in the OIC countries. This study resulted in a significant and direct relationship between economic growth and agricultural land with the rate of deforestation. This supports Kuznets' Environmental Theory and Environmental Externality Theory where human activities can have an impact on other aspects that are not directly involved in these activities. On the other hand, trade openness does not have a significant effect on deforestation, which indicates that deforestation problems are caused by activities in a closed economy or the activities of the domestic community of a country. The agricultural land variable has a significant effect on deforestation moderated by population density. Population density does not moderate the effect of economic growth and trade openness with deforestation. In the perspective of Islam, that humans in utilizing the

environment must have the principle of Al-Istishlah where by maintaining and caring for its sustainability so that it can be used sustainably in future generations.

This research has implications, namely that it can be used as an evaluation material for state policy makers as well as for the OIC in order to reduce deforestation rates and maintain the existence of forests which are in accordance with the vision of *Sustainable Development Goals* by united nation Number 15. The policy makers in question include ranks within the ministry of agriculture, the ministry of environment and forestry, as well as business actors who take advantage of the environment. It is necessary to implement regulations that focus on how to avoid excessive harvesting of forest products, tighten supervision over illegal logging, and strengthen pro-environmental economic development. In addition, a policy is needed in the context of population distribution by the government to regulate population density so that it is not concentrated in a certain area which will actually open up new agricultural land and increase deforestation. The limitations of this research are that it was carried out only by taking the OIC countries and the period taken before the COVID-19 pandemic.

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