Food Security, Agricultural Sector Resilience, and Economic Integration: Case Study of ASEAN+3

Putra Yudhatama[1]*, Fitri Nurjanah[1], Cassya Diaraningtyas[1], and Mohamad Dian Revindo[2]

Abstract: The issue of food security has been increasingly critical in many parts of the world. In many countries people are facing food crisis and it has severe impact on their economies. Ensuring food security has become a global challenge with various dimensions. This study aims to examine the impact of intraregional trade on food security in the Association of Southeast Asian Nations (ASEAN) and three additional countries (China, Japan, & South Korea), known as ASEAN+3. Using panel data regression analysis, the results show that intraregional trade and the level of trade openness have positive and significant effect to increase food security as it increases food production level in ASEAN+3 countries. In pursuing food security, ASEAN needs to enhance and accelerate its future cooperation agenda. The ASEAN member countries need to support the realization of ASEAN vision 2025, which will create a more dynamic and resilient ASEAN, capable of responding and adapting to various challenges through robust national and regional mechanisms to overcome various issues, including food security.
Keywords: Food Security; Intraregional Trade; Food and Agriculture; ASEAN+3; COVID-19
JEL Classification: Q17, Q18

AFFILIATION:
[1] Department of Economics, Faculty of Economics and Business, Universitas Indonesia, West Java, Indonesia
[2] European Studies Program, Graduate School of Strategic and Global Studies, Universitas Indonesia (SKSG UI), Jakarta Capital Special Region, Indonesia

*CORRESPONDENCE:
putra.yudhatama@ui.ac.id

Introduction

The food security issue has increasingly become a concern of the global society. The rising of food prices, a decline in agricultural production land, and climate change contribute to the global food crisis problem. The food crisis problem is quite varied, ranging from increasing numbers of people starving, malnutrition, stunting, and lower productivity in the agriculture and food sector (FAO, 2019). The increasing urgency of the food crisis' problem pushes the global community to pursue long-term sustainable development. Therefore, the food crisis problem has been incorporated in the Sustainable Development Goals (SDGs) on the second goal, which is to Eradicate Hunger (FAO, 2019). More specifically, this second goal looks to overcome hunger and malnutrition and encourage productivity and investment in the agriculture and food sectors.

As an intra-regional cooperation organization that houses ten countries in the Southeast Asia region, ASEAN also faces challenges in food and agriculture sectors. In 2017, there were still 60.3 million people, or around

9.39% of the total ASEAN population, who had malnutrition problems (FAO, 2019). This number is also quite large compared to 821 million people in the world with malnutrition problems. The problem of stunting is also still acute in ASEAN, as indicated by the average prevalence or tendency of children to experience stunting in ASEAN, which was 25% in 2018 (UNICEF, WHO, & World Bank Group, 2019). The number implies that of 10 babies born, about 2-3 had the chance to exhibit stunting problems.

However, countries in ASEAN have also shown an improvement in tackling the food sufficiency problems. From 2000 to 2019, the average prevalence rate and the number of malnourished people in ASEAN continued to exhibit a declining trend (FAO, 2019). Besides, ASEAN's seriousness in overcoming food problems is also reflected in the adoption of food security issues in the ASEAN Vision 2025 and the ASEAN Agenda in 2030. Further, ASEAN also pursues to promote food security as one of the priority policies of cooperation between its member countries (United Nations, 2017).

Taking into consideration those problems of the food and agriculture sectors in ASEAN, this study aims to examine the food and agriculture developments in each ASEAN country and investigate the empirical relationship between increasing regional cooperation and food security in the ASEAN. This study also attempts to investigate the impact of the COVID-19 pandemic, which has severely affected the global economic and food security, on the ASEAN region and observe how it affects ASEAN's future challenges and agendas. Researches on similar topic have been limited, with the exception of Herath, Liang, and Yongbing (2014), Bezuneh and Yiheyis (2014), and Tinta et al. (2018). This study aims to fill the research gap in the extant literature and its main research contributions are twofold. First, this study expands Herath et al. (2014) analysis on ASEAN countries to include three of its largest trading partners (China, Japan, & South Korea). Hence, this study examines the food security issue in the context of more recent concept of regional economic cooperation. Second, this study differs to those three earlier studies in that it attempts to incorporate the impact of the COVID-19 pandemic on the food security level. The pandemic period is crucial in food security analysis as it has led many countries towards trade contraction and protectionism, which in turn may threaten global food security.

Food security is fundamental to human security and sustainable development (Desker, Caballero-Anthony, & Teng, 2013). The conceptualization of food security has evolved over the years from 'the volume and stability of food supplies' at the global and national levels to 'adequate nutrition and welfare' at the individual level (FAO, 2003). According to the prevailing view, food security is said to be achieved "when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food, which meets their dietary needs and food preferences for an active and healthy life" (FAO, 2003). This definition may be interpreted to suggest that food security can only be achieved if following four primary dimensions are fulfilled: availability, physical access, economic access, and utilization (Teng & Escaler, 2010). Gill et al. (2003) explain those four dimensions of food security as follows. Food availability refers to the supply of food coming from domestic production, import, and food aid. Food access relates to adequate resources of people to obtain food, the affordability of the food supply the seasonal and

sudden hazards to food security, and at a certain extent, the issue of intra-household gender discrimination. Food utilization relates to a broader aspect of the health situation of the people and the culture and livelihood of societies. For food security objectives to be realized, all four dimensions must be fulfilled simultaneously. The FAO often adds a fifth dimension, stability, to emphasize the importance of the four dimensions' stability over time (Desker et al., 2013).

Studies that discuss the relationship of regional trade cooperation and food security with quantitative methods are still rare as most studies of food security were carried out descriptively. Among few studies that have discussed the relationship is one by Tinta et al. (2018), which looked at the impact of the cooperation relations between countries, global supply chains (as well as global value chain), and international trade on food security in the countries of the Economic Community of West African States (ECOWAS). This study used two models in its estimations. The first model employed real GDP per capita while the second model utilized per capita dietary energy supply as the dependent variables. The results suggested that in ECOWAS countries the trade openness, indicating a country's degree of openness to international trade, did not significantly affect economic growth. It might due to the fact that imports by ECOWAS were not oriented towards capital and industrial goods, which were more encouraging for the countries' growth. However, intra-community trade and per capita domestic value-added positively affected increasing economic growth. Hence, intra-community trade is an essential variable in a country's economic growth. Further, the study also reported that international trade was positively correlated to the per capita dietary energy supply, while intra-regional trade showed no significant correlation. Backward integration positively affected food security, indicating that participating in the value chains had a spillover effect on food security. Therefore, the combined impact of intra-regional trade and value chain trade could increase economic growth and food security.

Another study conducted by Bezuneh and Yiheyis (2014) empirically examined the effect of trade liberalization on food availability in developing countries using alternative estimation methods. Measures of trade liberalization can include, among other things, reducing or eliminating trade barriers such as tariffs, quotas, import and export license requirements, foreign exchange controls, export subsidies, and taxes. Econometric analysis of panel data was drawn from 37 countries with independent variables including GDP per capita (in a constant USD), irrigated land as a percentage of cropland, price of imported food , foreign exchange reserves in months of imports, and political instability. Food availability was represented by the daily food energy supply per capita. Daily energy supply per capita was represented by the food balance using country-level data on food produced domestically and imported, including food aid, available for human consumption, minus non-food use. The results showed that trade liberalization had a short-term negative effect on food availability in the sample countries. Delayed results were found not to be significantly positive. The sum of the two different results failed to support the view that the medium and long-term effects of trade liberalization on food availability were favorable.

Another study was carried out by Herath et al. (2014) investigated whether an agreement (free trade agreement) by ASEAN (AFTA) influenced each member country's food security. Due to limited data, this study only used six ASEAN member countries: Indonesia, Laos, Malaysia, Philippines, Thailand, and Vietnam. In this study, food security was defined as the availability of food from the economy, measured using per capita daily dietary energy supply. The regression model the key variables included per capita of real GDP, agricultural land area, foreign reserves, imported food prices, and political stability. The main finding suggested that AFTA had a positive influence in reducing the member states' food insecurities. After the AFTA program, the ASEAN countries' daily dietary energy supply per capita level increased over time. The food security level was also influenced by a nation's political stability level, per capita income, agricultural land, and foreign reserves.

This remainder of the paper is organized as follows. The next section describes employed research method including the data and the estimation strategy. It is the followed the results and discussions section that discusses the latest food indicators, existing cooperation, impacts of intraregional economic integration and pandemic into food security, and the challenge in upcoming years for ASEAN+3's food security, while the last section concludes.

Research Method

By adopting the model developed by Tinta et al. (2018) and Herath et al. (2014) with some adjustments, we aim to estimate the impact of regional trade integration and trade openness on ASEAN countries' food security levels. We used the Average Value of Food Production (constant 2004-2006 I$/cap, 3-year average) to approximate the indicator of availability on food security. Average Value of Food Production was obtained from the database Food and Agricultural Organization (FAO). The independent variables used to indicate regional trade cooperation and liberalization consisted of intra-regional trade (intra-trade) and openness level. The intra-trade variable was obtained from the trade value (exports & imports) of each member country with the rest of ASEAN region in USD, obtained from UNCTAD. Meanwhile, the trade openness variable was measured by the portion of trade value to GDP in each country, obtained from the World Bank.

Likewise, referring to Tinta et al. (2018) and Herath et al. (2014), we added control variables to help explain the independent variables' effect on the dependent variables related to the agricultural sector's characters and socioeconomic indicators of a country. Control variables comprised Agricultural Land Area and Political Instability (obtained from the FAO database). The rest of the control variables included Population Growth, Agricultural Value Added, Real Gross Domestic, and Employment in Agriculture, all taken from the World Development Indicator by the World Bank.

This model was estimated with panel data regression method using data from 2002-2013 in ASEAN+3 countries. Three member states were intentionally added to observe the potential for broader regional cooperation between ASEAN and China, Japan, and Korea

and the links between the two intra-member trade regions. Some variables were converted into log form to simplify the analysis process. The final equation form of the model for estimation is as follows.

$$ln\_AVFOODP_{it} = \alpha + \beta_1 ln\_Openness_{it} + \beta_2 ln\_IntraTrade_{it} + \beta_j X_{it} + \varepsilon$$

Where:
X = Control variable
ε = Error or residual
X_{it} represents the control variable consisted of (see Table 1 for the definition of each variable):

$$X_{it} = ln\_AGRIHA_{it} + ln\_AVACONS_{it} + EIAGRI_{it} + POPGROWTH_{it} + POLIS_{it} + ln\_REALGDP_{it}$$

Using the Hausman test to determine whether the data suits the regression model panel employing random effect or fixed effect, we concluded that the null hypothesis was rejected (p-value was less than the 5% significance level). Hence, the model used the Fixed Effects method is appropriate (appendix 1). We then tested heteroskedasticity using the modified Wald test (Appendix 2), which results revealed that the model experienced homoskedasticity as indicated by the p-value higher than 5%. Table 1 presents the description and operationalization of independent variables as well as their expected signs.

Table 1 Description of the Variables

Variable Name	Description	Measurement	Data source	Expected Sign
AVFOODP	Average Value of Food Production	The average value of food Production using constant price 2004-2006 $/cap utilizing a 3-year average method	FAO	(Dependent)
Openness	Trade openness level	The portion of trade value to GDP in each country	World Bank	+
Intra-Trade	Regional trade cooperation and liberalization consist of intra-regional trade.	The value of trade (exports and imports) carried out by each member country to the ASEAN region in USD	UN Comtrade	+
AGRIHA	Agricultural Land Area	Agricultural area in 1000ha	FAO	+
AVACONS	Agricultural Value Added	Value-added at constant year prices	World Bank	+
EIAGRI	Employment in Agricultural Sector	Percentage of Total Employment	World Bank	+
POPGROWTH	Population Growth	Percentage of annual population growth	World Bank	-
POLIS	Political Stability	An index that measures political stability and absence of violence/terrorism	FAO	+
REAL GDP	Real Gross Domestic Product	GDP at constant year prices	World Bank	+

Source: Data processed.

Result and Discussion

Food and Agriculture Characteristics Southeast Asian Countries

Despite situated in the same region in Southeast Asia, the ASEAN member countries have diverse characteristics, including in terms of food and agriculture sectors. This section, provides descriptive comparison of several indicators in the food and agriculture sectors among ASEAN countries using FAO and the World Bank data.

Agricultural Area

The first compared indicator is the agricultural area, indicating countries' food production level. It is represented by the portion of the agriculture area to the total land use in a country. Figure 1 shows a description of the development of the agricultural land percentage in ASEAN+3 member countries. China consistently occupied the first position with the highest percent of agriculture area among other ASEAN+3 countries, with a range of 54.6% - 56.1%, then followed by Thailand and the Philippines alternately in the period 2000-2017. Meanwhile, the last position was occupied by Singapore. This figure has tended to be stable over the past 17 years. Vietnam was a country with an accumulation of additional agricultural land by 11% from 2000-2017. Conversely, Japan, South Korea, and Singapore experienced a downward trend, despite marginal in magnitude.
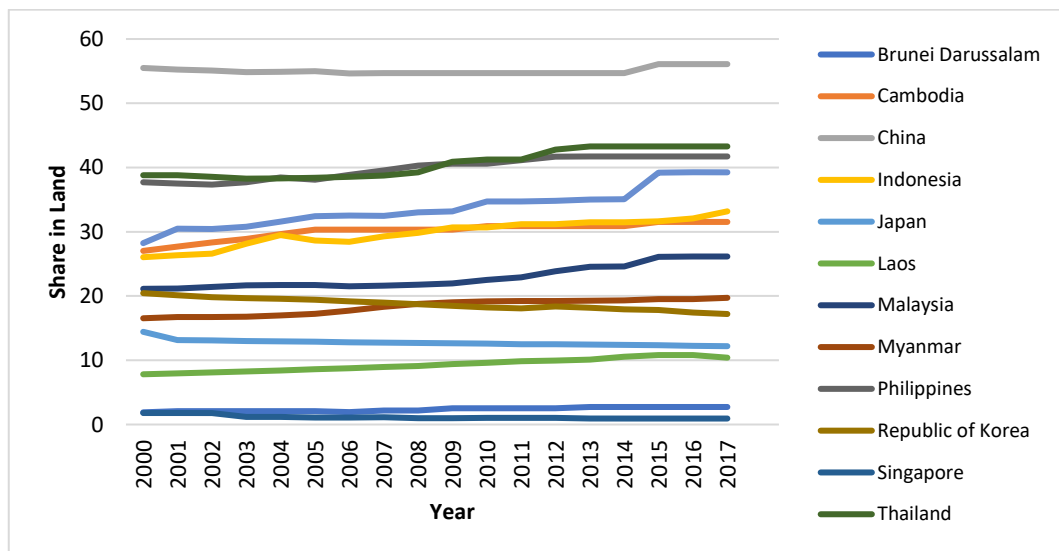

Figure 1 Agricultural Land (% of total land) in ASEAN+3
Source: FAO

Agriculture Value Added

The next compared indicator is agriculture value-added, calculated as the portion of value-added products from the agricultural sector to total output or GDP. The process of increasing commodity value added was to transform raw or semi-finished agriculture

products into a new product with a higher market value. Figure 2 displays that in general ASEAN+3 member countries experienced a decline in the value-added of the agriculture sector, caused by a shift to the manufacturing and service industries. Countries that still had high dependence on the agriculture sector were Myanmar (24.6%), followed by Cambodia (22%), and Laos (15.8%). Meanwhile, Singapore became the country with the lowest share of the agricultural sector's added value to GDP (0.025%), followed by Japan (1.7%) and South Korea (1.9%).
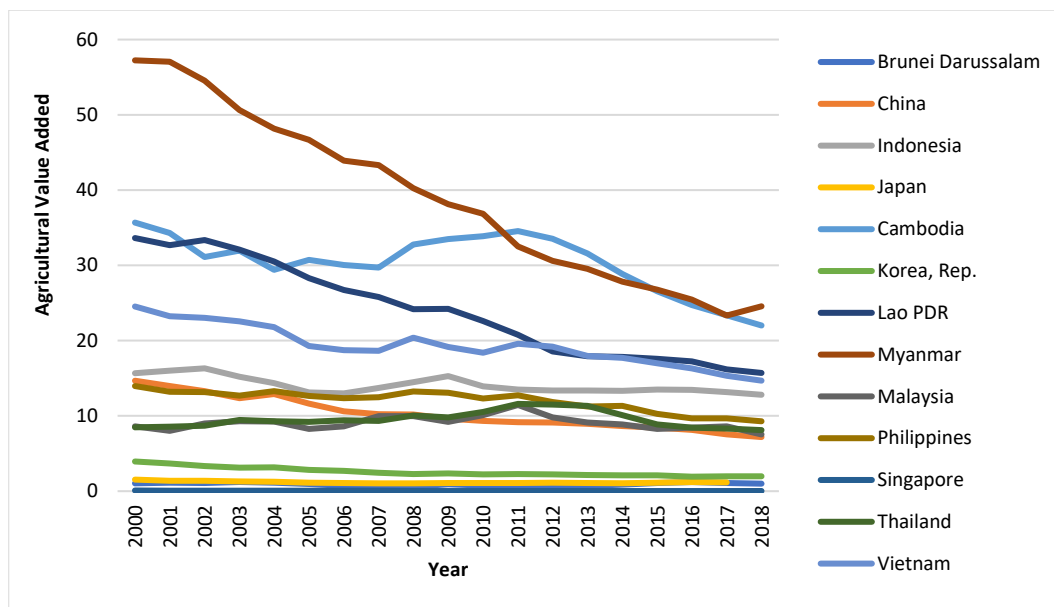

Figure 2 Agricultural Sector Value Added (% of GDP) in ASEAN
Source: World Bank

Average Value of Food Production

The average value of food production is represented by the average value of a country's food production divided by the amount of population, measured in dollars per capita, with a three-year average calculation. Figure 3 exhibits the average value of food production of all ASEAN members from 2000 to 2015. The figure shows that Singapore had the lowest average but stable value of food production among other countries, mainly due to low domestic food production and agriculture. Meanwhile, Malaysia ranked first with the highest average food production value, followed by Thailand and Laos, while Indonesia was in the middle order. Figure 3 also presents that most countries initially experienced an upward trend in the average value of food production and tended to decline after 2015.
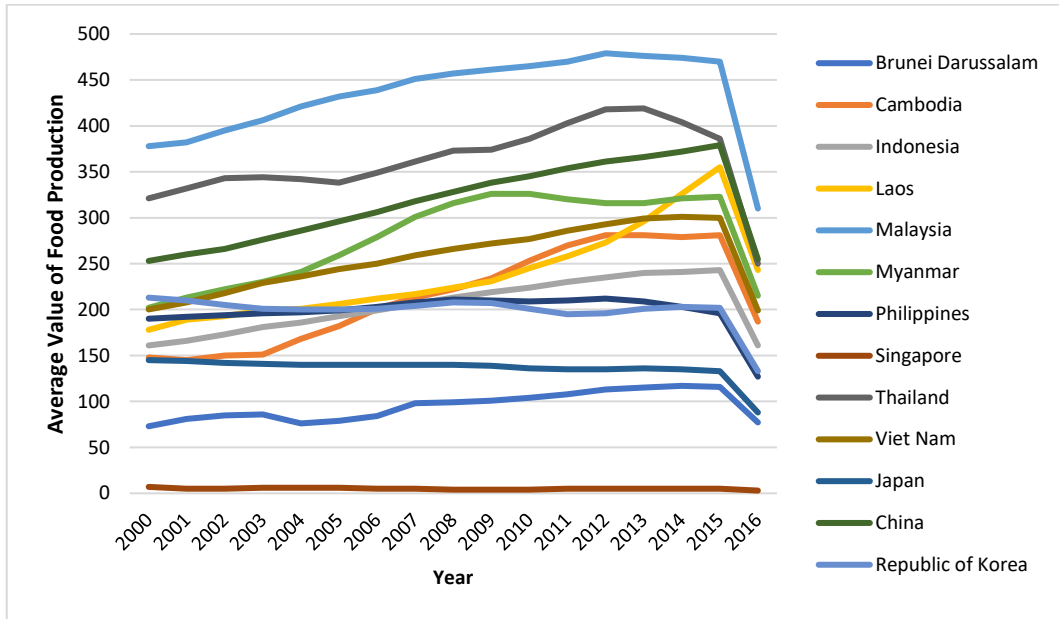
Figure 3 Average Value of Food Production in ASEAN, Average Value of Food Production (constant 2004-2006 I$/cap) (3-year average) (1$ per person)
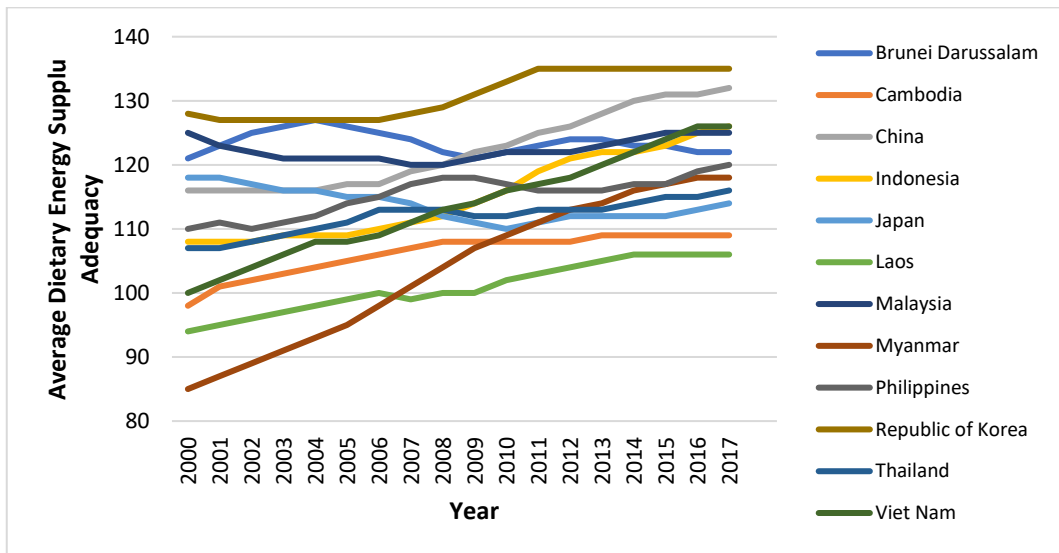Source: FAO

Average Dietary Energy Supply Adequacy (%)

Figure 4 Average Dietary Energy Supply Adequacy in ASEAN (%) (3-year average)
Source: FAO

Average dietary energy supply adequacy (ADESA) represents the percentage of average nutritional food requirements (Average Energy Dietary Requirements/ADER). The average calorie supply of each country or region for food consumption is normalized by the

estimated average food energy requirements for its population to provide an adequate food supply index in terms of calories. If the ADESA number is higher than 100, the food supply of a country is higher than needed, and vice versa. Based on Figure 4, South Korea had the highest ADESA value compared to other ASEAN+3 countries, with a rate of 135% in 2017. Meanwhile, Laos had the lowest ADESA value in 2017. Myanmar showed the most significant progress, successfully increased the ADESA value by 33% from the most protruding position in 2000 to outperform Laos, Cambodia, Japan, and Thailand in 2017.

Cooperation in the Food and Agriculture Sector in Southeast Asian Countries, both within the framework of ASEAN (ASEAN+3)

There is several established cooperation in the food and agriculture sector in ASEAN+3, consisting of 1) Crafting Food Security Blueprint: ASEAN Integrated Food Security (AIFS) Framework and the Strategic Plan of Action on Food Security (The SPA-FS); 2) Building Mechanisms for Emergency Food Reserve: ASEAN Plus Three Emergency Rice Reserve (APTERR); and 3) Building Capacity: ASEAN Food Security Information System (AFSIS).

The first cooperation was created by the ASEAN Food Security Reserve (AFSR) on October 4, 1979, to reduce the impact of natural disasters on food security in the form of the ASEAN Emergency Rice Reserve (AERR). In this agreement, ASEAN established a rice reserve to alleviate poverty and eradicate malnutrition in the regional area without changing the global market's usual trade. However, for 30 years, the AERR agreement was not put to good use (Trethewie, 2013). Indonesia experienced severe food shortages and its imports drastically increased due to drought and forest fires caused by El-Nino. Technically, this state of emergency should have been protected by AFSR approval. However, at that time, Indonesia instead obtained a loan from the International Monetary Fund and the World Bank and not from utilizing the AERR (Yoshimatsu, 2014). Policymakers were aware of the weaknesses of AFSR and made more efforts to revolutionize their policies and programs to improve regional food security.

ASEAN recognizes that regional development does not occur when it is a vacuum; countries can benefit greatly from strengthening and deepening relations with their East Asian neighbors. Finally, the emergence of the ASEAN+3 collaborated was agreed upon on November 28, 1999. The ASEAN+3 Emergency Rice Reserve (APTERR) collaboration joined forces between ASEAN member countries and an additional three countries: The People's Republic of China, South Korea, and Japan. This collaboration was signed on October 7, 2011, and entered into force on July 12, 2012. The primary keys of the APTERR collaboration are as follows: (1) APTERR was established to meet emergency requirements and achieve humanitarian goals; (2) APTERR consists of an allocation of rice and physical stock of rice. ASFR and APTERR are the results of joint efforts to achieve food security in the Asian region. Table 2 depicts the implementation of the Tier 3 APTERR program since 2013.

Table 2 Implementation of the APTERR Tier 3 Programs Since 2013

Year	Program	Recipient Country	Beneficiaries	Quantity (MT)
2013	Rehabilitation program for Typhoon Pablo's victims	Japan	Philippines	230
2013	Drought and flood	Japan	Lao People's Democratic Republic	400
2014	Emergency response to Super Typhoon Haiyan	PRC	Philippines	800
		Thailand		5000
		Malaysia		350
		Japan		580
2015	Preposition of stockpiled rice reserve	Japan	Cambodia	210
			Philippines	240
2016	Preposition of stockpiled rice reserve	Japan	Philippines	225
			Lao People's Democratic Republic	225
2017	Rehabilitation program for Typhoon Ketsana victims	Lao People's Democratic Republic	Myanmar	500
			Cambodia	250
2017	Preposition of stockpiled rice reserve	Japan	Myanmar	500

APTERR = ASEAN Plus Three Emergency Rice Reserve, PRC = People's Republic of China
Source: APTERR Secretariat

ASEAN created second cooperation to maintain food resilience in the form of ASEAN Integrated Food Security (AIFS). This cooperation collaborated between countries in the ASEAN region due to increased food prices in 2007/2008 (ASEAN, 2009). In order to make those collaboration more concrete and detailed, the ASEAN Ministers on Agriculture and Forestry (AMAF) formed an ad-hoc task force to develop a more detailed work plan, including the Strategic Plan of Action on Food Security (SPA-FS) for the ASEAN Region. This collaboration aimed to ensure that long-term food security for ASEAN countries could be fulfilled and improve the farmers' livelihoods in the ASEAN region. The methods adopted in the SPA-FS are: 1) Increasing food production; 2) Reducing post-harvest losses; 3) Promoting a conducive market and trade in agricultural commodities and inputs; 4) Ensuring food stability; 5) Promoting the availability and accessibility of agricultural inputs; 6) Operating regional food emergency assistance arrangements. Rice, corn, soybeans, sugar, and cassava are priority commodities for food security in the ASEAN region. Other essential commodities, especially new alternatives for staple foods, can be identified during AIFS Frame and SPA-FS implementation. The AIFS Framework includes four components: (1) Food security and emergency/under-assistance; (2) Development of sustainable food trade; (3) Integrated food security information system; and (4) Innovation in agriculture.

ASEAN+3 made the latest cooperation in October 2020 in the form of the ASEAN Food Security Information System (AFSIS). The aims of this project are based on increasing concerns about food security in East and Southeast Asia. This collaboration's main objective is to strengthen food security in the region through systematic collection, analysis, and dissemination of information-related food security. The AFSIS application focuses on developing human resources through sharing knowledge and joint technical cooperation between ASEAN members. It allows member countries to provide accurate

and timely information needed to develop regional food security information. It also provides the development of early warning and information on commodity prospects to facilitate food security policies and program management.

Estimation Results on the Impacts of Intra Regional Economic Integration on Food Security

Descriptive statistics for all variables in this study are shown in Table 3. The average values of food production per capita (AVFOODP) in ASEAN+3 countries were $ 230. The Openness level (OPEN) in ASEAN+3 was relatively high with an average of 111.14%, with the highest value showed by Singapore with an average value of 437.3% of GDP. The average level of ASEAN intra-regional trade (INTTRA) was 39.9 billion US dollars in each country. The agricultural sector's added value to GDP at constant 2010 prices in the ASEAN region amounted to 67.3 billion US dollars. Furthermore, the average area of agricultural land (AGRIHA) was 49,936,640 ha. Population growth (POPGR) in ASEAN+3 showed an average of 1.135%.

Table 3 Descriptive Statistics of All Variable

Variable	Obs.	Mean	Std.Dev.	Min	Max
AVFOODP	195	230	114.568	3	479
OPEN	195	111.14	90.228	.167	437.327
INTTRA	195	3.99e+07	5.16e+07	83447	2.79e+08
AGRIHA	195	49936.64	136000	.66	529000
AVACONS	195	6.73e+07	1.45e+08	79435	7.16e+08
EIAGRI	195	31.472	23.458	.55	80.158
POPGR	195	1.135	.74	-1.47	5.32
POLIS	195	-.088	.898	-2.09	1.5
REALGDP	195	1.11e+09	2.09e+09	4010000	9.49e+09

Source: Data processed.

In the fixed-effect model, the intra-trade and openness' estimated coefficient signs are all as expected and significant at 1% level (see Table 4). The primary variable, showing the level of intra ASEAN+3 trade volume to the total trade of a member country (log Intra Trade) influenced the value of food production per capita positively in each member country. It indicated that economic integration in the form of trade within the ASEAN+3 region can support member countries' domestic food security. Meanwhile, the following variable, openness, as measured by the portion of the total trade value to total GDP, showed a positive effect on the average food production in each member country. It signified previous finding that the more open a country in international trade, the more it would ensure food security. Both findings align with Tinta et al. (2018), Latifah and Susamto (2016) and Wardani (2016) study that argued that the intra-trade and openness variables positively affected the country's food security.

The first control variable, population growth, was significant at the 5% level. Hence, the higher the population growth correlates to the lower the average per capita food production value. A percentage point increase in population growth would reduce the average value of food production by 4.96%. It showed that high population growth would reduce a country's food security because more people needed greater food availability,

which reconfirms the study carried out by Tinta et al. (2018). The area of agricultural land variable also had a positive influence at 1% level. An increase in the land area of 1% would increase the average value of food production by 0.37%. It means that the more extensive a country's agricultural land, the more abundant food availability to guarantee the country's food security. This finding is in line with Tinta et al. (2018) and Herath et al. (2014). The next variable is that real GDP, which significantly affected per capita food production with a negative coefficient. It indicated that if the level of real GDP rose by 1 percent, the value of food production per capita would decrease by 0.46 percent. This condition could be explained by the decreasing portion of the agriculture sector to GDP over time and shifting focus to the industrial and service sectors. The last control variable, Percentage of Employment in Agricultural Sector and Political Stability, did not significantly affect the food production value per capita in each member country, even at a significance level of 10%. Finally, constants on this model had significance at the 10% level, showing that this model had an intercept on its application.

Table 4 Estimation Results of Economic Integration Model toward Food Security

Variables	ln_AVFOODP
Openness	0.00178***
	(0.000574)
Log (Intra Trade)	0.156***
	(0.0331)
Control Variable	
Log (Agriculture Land Area)	0.376***
	(0.137)
Log (Agriculture Value Added)	0.791***
	(0.176)
Employment in Agricultural Sector	0.00377
	(0.00409)
Population Growth	-0.0496**
	(0.0213)
Political Stability	0.0348
	(0.0319)
Log (RealGDP)	-0.466***
	(0.103)
Constant	-4.660**
	(2.062)
Observations	195
Number of Years	13
R-squared	0.434
*** p<0.01, ** p<0.05, * p<0.1	

Source: Data processed.

The Impact of the COVID-19 Pandemic on Food Security in the ASEAN+3 Region

Before the COVID-19 pandemic, the issue of global food security had already become a critical problem. Various countries and international institutions already address the rising food prices due to extreme weather and climate changes in their agenda. However, the sudden existence of the COVID-19 pandemic apparently endangered global food security. The emergence of a pandemic can trigger an increase in global food prices, which can in turn trigger a food crisis, especially in developing countries (Reinhart & Subbaraman, 2020). A lockdown policy has affected the supply and demand of food ingredients directly

in various countries, including Southeast Asian countries. From the demand side, lockdown policy and social restrictions instigate households to increase their demand for food for stock purpose. On the supply side, lockdown makes it challenging to carry out food production activities, including in the agriculture sector, which causes the decreasing supply. With market mechanisms, simultaneous increases in demand and decreases in supply have led to increased food prices, while changes in the quantity of equilibrium will depend on the amount of existing demand and supply (Mankiw, 2014); Parkin, 2012).

The issue of food security also occurred previously during the global financial crisis in 2008-2009, causing a significant increase in global food prices. The nominal world price index of food data by the FAO (Figure 5) shows that the financial crisis resulted in significantly increased food prices until 2011. The food crisis prompted many countries to take action on protectionism, especially in the food sector, by banning the export of food products to maintain domestic food stock. The World Bank (2019) estimates that food protectionism measures taken by food-exporting countries would contribute about 40% of the increase in global wheat prices and a 25% increase in corn prices at that time. This protective action would be far more detrimental to food-importing countries.
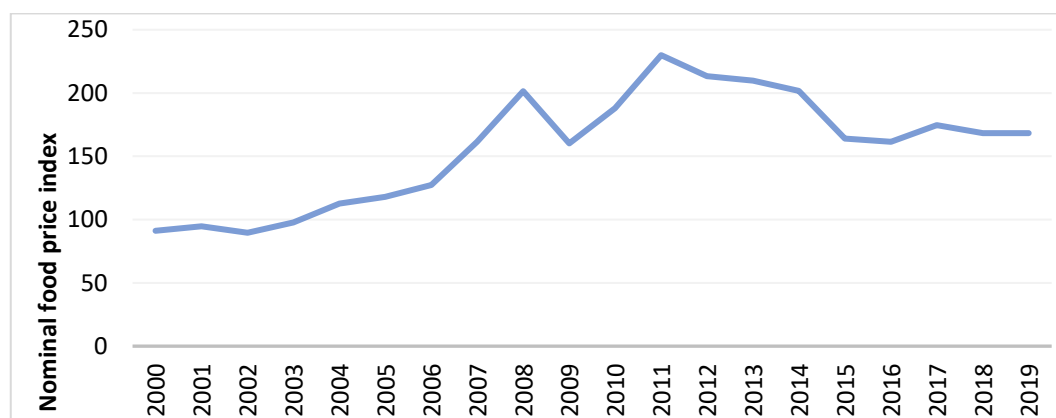

Figure 5 Nominal Food Price Index
Source: FAO

According to the World Bank (2020) study, the COVID-19 pandemic will cause shocks to the economic crisis in all countries, including ASEAN countries. This shock is reflected in the contraction of GDP experienced by various countries. Figure 6 displays that the World Bank (2020) revised its initial growth projections across ASEAN countries, with the scenario that the impact of the COVID-19 virus could be controlled to a very severe degree. Meanwhile, the Philippines, Malaysia, Indonesia, Singapore, and Thailand are predicted to experience negative economic growth if the impact of COVID-19 on the economy is very severe. Significant shocks to the ASEAN economy can reduce the people's welfare and consumption level. It can directly impact the increasing number of poor people who have difficulty accessing food which prices have increased dramatically, which in turn indirectly triggers food security problems in various countries. Besides, the lockdown policy that several countries have adopted in ASEAN makes it difficult for people with weak economies to earn income, making them unable to access food needs. Barrett

(2020) has found that lockdown measure raises major disruptions to food supply chains toward the availability, pricing, and quality of food.
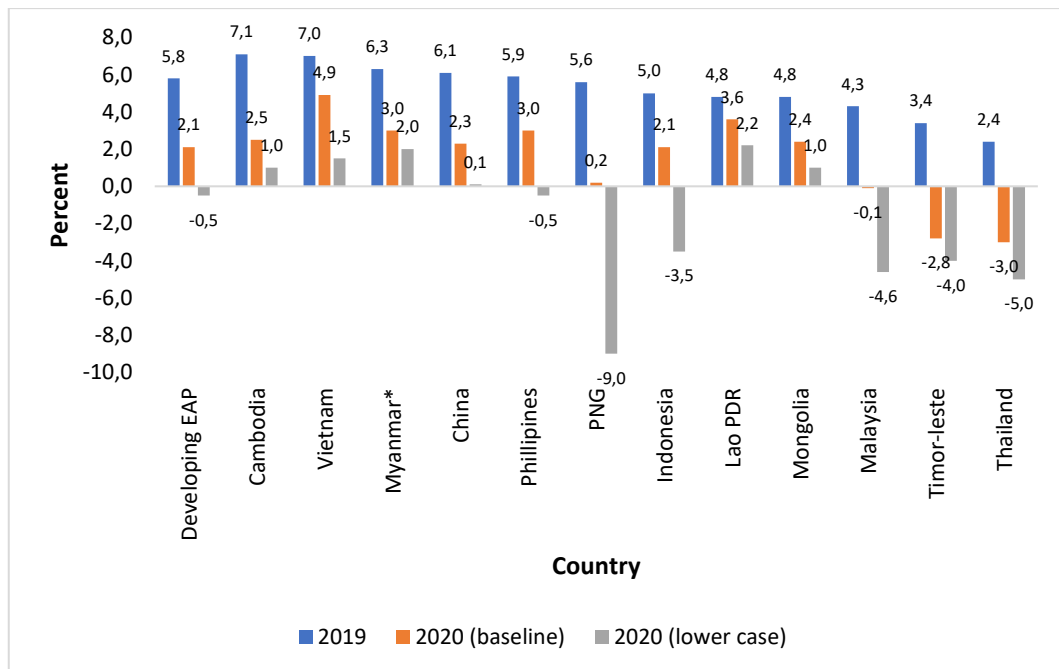

Figure 6 Growth Forecast as a Result of Pandemics
Source: World Bank, 2020

According to Galanakis (2020), four critical issues must be addressed related to the industry and the global food supply chain in the current era of the pandemic. They are the availability of bioactive foodstuffs and basic food needs; prevention of the virus spread in the process of food distribution; food safety in the middle of a lockdown policy; and sustainable food systems in anticipation of policies if a similar crisis occurs in the future. Therefore, ASEAN should strengthen cooperation and mitigation of the food system in the current era of the COVID-19 pandemic as a collective organization. ASEAN also needs to encourage integration and openness in food trade between countries to encourage food security realization in all ASEAN countries.

Challenges in the Future of ASEAN's Food Security

Even though ASEAN's various agreements and cooperation have been initiated, there are still many challenges ahead that need to be addressed by ASEAN+3. The challenges ahead of ASEAN+3 can be identified from three channels: the demographic channel, the agricultural sector's transformation, and resource degradation.

From the demographic channel, ASEAN had a population in 2019 estimated at 649.1 million and is predicted to continue to increase. The increasing population shows that a country's need for food availability is also increasing. Figure 7 presents a decrease in

population growth, and Figure 8 exhibits an increase in each ASEAN member country's population.
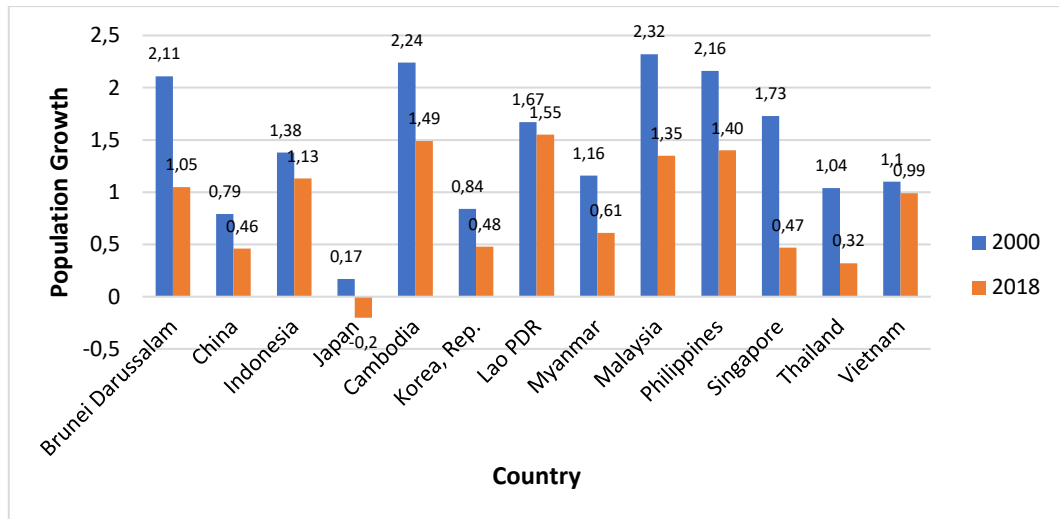

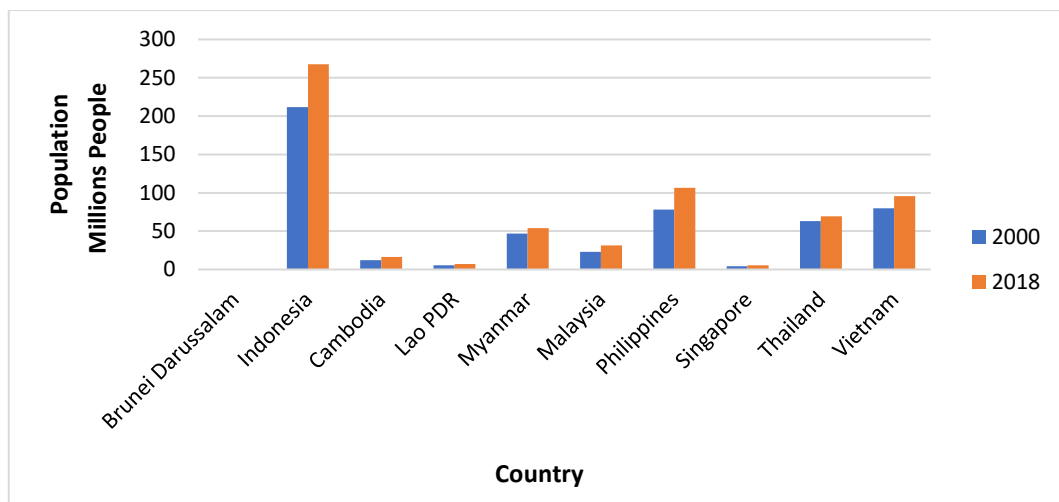**Figure 7** Population Growth in ASEAN
Source: World Bank

Figure 8 Total Population in ASEAN
Source: World Bank

There is also a problem of declining and aging workforce in the agricultural sector in ASEAN+3. In addition, rural populations engaged in the agricultural sector experienced a downward trend in Southeast Asia, from 66% in 1980 to 50% in 2010 and was expected to decrease further to 45% by 2020 (Desker et al., 2013). Because labor is an essential input to food production, this decline in agricultural populations poses a threat to food production capacity. World Bank data revealed that the percentage of workers in all ASEAN countries' agricultural sectors tended to decrease from 2000-2019. The most

significant decline occurred in Myanmar while Brunei Darussalam was the only ASEAN country with an increase in the agricultural sector's percentage of workers.
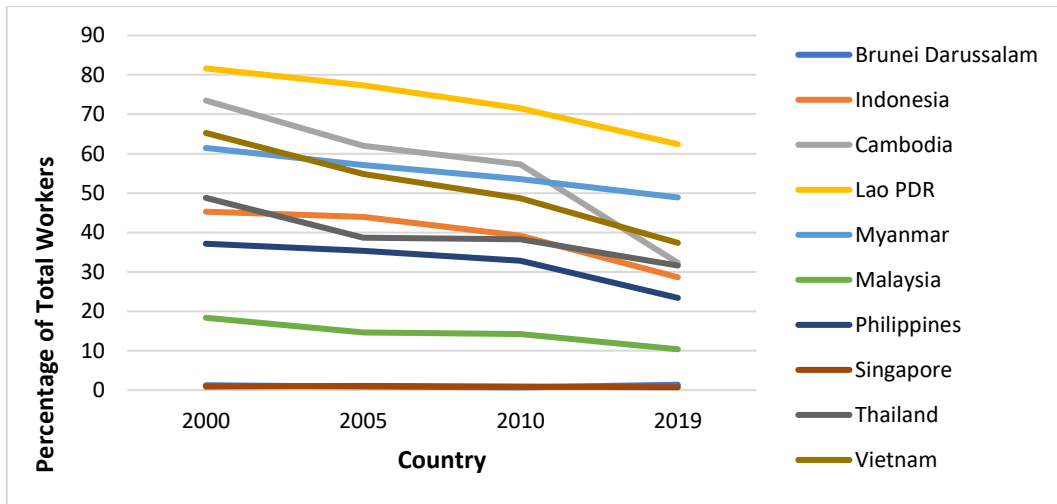

Figure 9 Labor (% of Total Workers) in The Agriculture Sector
Source: World Bank

The second channel of ASEAN+3 food security challenges is the agricultural sector's transformation that reduce the agricultural sector's contribution to economy due to shifting focus to the industrial and service sectors. It is indicated by a decrease in productivity in the agricultural sector and reduced agricultural land. Figure 10 points out that the agriculture's value-added, forestry and fisheries sectors to GDP in ASEAN countries tended to decline from 2000-2018. The significant decrease was observable in Laos and Myanmar, with a decline by 50% over the last two decades.
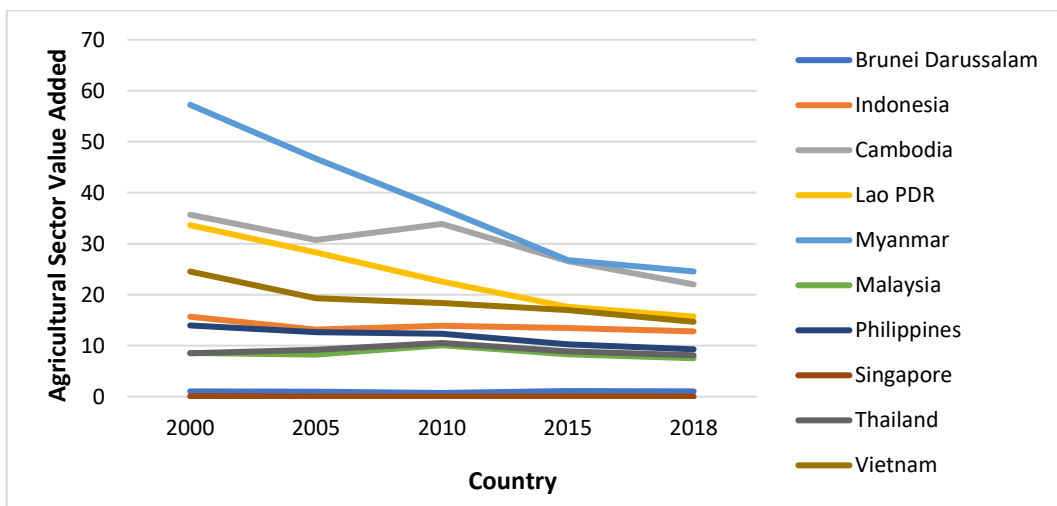

Figure 10 Agricultural Sector Value Added (% of GDP) in ASEAN
Source: World Bank

The dramatic loss of agricultural land is also a significant challenge for agricultural production and significantly influences food supply and availability. Teng and Oliveros (2015) linked loss of agricultural land due to rapid urbanization. FAO projections showed the difference between a stagnant and declining rural population and a swollen urban world population. This shift encouraged agricultural land conversion to non-agriculture, expansion of infrastructure, land use adjustments, and all activities that moved land from the agricultural sector (Regmi, 2014). The third and final channel that challenges ASEAN, adding pressure to agricultural sustainability, is the land and water resources that are already under significant pressure (Desker et al., 2013). The agricultural sector is inherently vulnerable to risks and uncertainties due to the environment's highly volatile nature (Teng & Oliveros, 2015).

Agenda for Future Cooperation

In achieving food security and agriculture, ASEAN needs to carry out a future cooperation agenda. It is reflected in the ASEAN Vision 2025 point 6 to create a more dynamic and resilient ASEAN, capable of responding and adapting to various challenges that arise through robust national and regional mechanisms to overcome various issues, food, and energy security. According to a study by Asian Development Bank (2016) related to the ASEAN Vision 2030, ASEAN needs to improve ASEAN's comparative advantage in agricultural products. ASEAN also requires taking the initiative to assist fellow members in regulating and managing food production, supply chains, and trade networks and connecting food security with regional prosperity. ASEAN also needs to increase investment and collaboration in research and development in food production, and this should be enlarged to ASEAN+3 members. It is also necessary for active participation in preventing climate change and encouraging renewable energy in food production to maintain the quality and quantity of food in the ASEAN.

In essence, ASEAN needs to immediately implement various cooperation agendas that have been put forward related to food security and agriculture in concrete steps so that the food security objectives in the ASEAN region will soon be realized.

Conclusion

In terms of agriculture, the member countries have some similarities as well as their differences. ASEAN member countries share similarities in the average food availability that increases over time. However, they differ in the value-added of agricultural products. ASEAN member countries have had various regional collaborations to maintain the food security of member countries and enlarged cooperation has also been carried out with Japan, China, and South Korea (ASEAN+3).

This study explored the impact of regional trade integration and openness on international trade and other control variables in ASEAN+3 member countries (ASEAN, Japan, China, and South Korea) on food security utilizing panel data regression. This study revealed that the intra-trade and openness' estimated coefficient signs were as expected

and significant. The regional cooperation of ASEAN+3 that encourage intra-regional trade can help boosting food stocks. Intra-trade variable significantly influenced the level of food supply per capita in ASEAN+3 countries positively. Each country's level of trade openness also significantly affected the average value of food production. It indicates that increasing globalization plays a significant role in stimulating food security in ASEAN+3 member countries.

In addition to the two leading independent variables, the following control and independent variables are added: agriculture land area, value-added of the agricultural sector, employment in the agricultural sector, population growth, political stability, and real GDP. The agricultural land area and value-added of the agricultural sector had a positive and significant effect on food production's average value. Population growth and real GDP had a significant negative effect on the average value of food production. Meanwhile, the control variables of employment in the agricultural sector and political stability did not significantly affect food production.

The emergence of a pandemic has negatively affected output and every sector of the economy, including the food and agriculture sectors. The COVID-19 pandemic has worsened food security, especially in developing countries that depend on food imports from other countries. Going forward, ASEAN still has challenges related to food security and the agricultural sector. Therefore, the agenda of ASEAN cooperation in the future needs to emphasize concrete actions, such as the integration of food security in nutrition, social protection, and increased investment, technology, research, and development to support food and agricultural productivity.

This study has several important implications to policymakers and academics. Empirically, this study has proven that intra-regional trade cooperation can improve ASEAN food security. It can beused as a reference for policymakers to promote the agricultural sector's integration between ASEAN member countries. In order to do so, openness to cooperation needs to be increased, and the possibility of protectionism practices needs to be reduced. Moreover, ASEAN needs to immediately implement various cooperation agendas that have been formed related to food security and agriculture in concrete steps so that the food security objectives in the ASEAN region will soon be realized.

This study also identifies the food sector's potential and challenges for future research. This study found several problems in the agricultural sector that must be prioritized: land degradation and decreasing agricultural productivity. For academics, several implications can be taken. For example, future studies can focus deeper on the ASEAN's food integration urgency. Future studies can also provide an overview of the possibilities and strategies for increasing agricultural productivity and food security in ASEAN member countries.

Acknowledgments

Appendix

Hausman Test

	——— Coefficients ———			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	fe6	re6	Difference	S.E.
OPEN	.0017833	.0004329	.0013504	.0002969
ln_INTTRA	.1555955	.1939638	-.0383684	.0191913
ln_AVACONS	.791292	.4464438	.3448482	.1198092
POPGR	-.0495738	-.0500212	.0004475	.0072454
ln_AGRIHA	.3764167	.1655964	.2108203	.1230133
EIAGRI	.0037686	-.0113208	.0150893	.0028481
ln_REALGDP	-.4663538	-.6058583	.1395045	.0750036
POLINS	.0347817	.0501513	-.0153696	.0103387

```
                  b = consistent under Ho and Ha; obtained from xtreg
        B = inconsistent under Ha, efficient under Ho; obtained from xtreg

  Test:  Ho:  difference in coefficients not systematic

          chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                  =        43.44
         Prob>chi2 =      0.0000
```

Heteroskedasticity test

```
.  xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

HO: sigma(i)^2 = sigma^2 for all i

chi2 (13)  =       5.13
Prob>chi2  =      0.9722
```

References

ASEAN. (2009). ASEAN Integrated Food Security (AIFS) framework and strategic plan of action on food in the ASEAN region (SPA-FS) 2009-2013. Retrieved from https://www.asean.org/storage/images/archive/22338.pdf

Asian Development Bank. (2016). ASEAN 2030: Toward a borderless economic community. ASEAN 2030: Toward a borderless economic community. Brookings Institution Press.

Barrett, C. B. (2020). Actions now can curb food systems fallout from COVID-19. *Nature Food, 1*(6), 319–320. https://doi.org/10.1038/s43016-020-0085-y

Bezuneh, M., & Yiheyis, Z. (2014). Has trade liberalization improved food availability in developing countries? An empirical analysis. *Journal of Economic Development, 39*(1), 63-78. https://doi.org/10.35866/caujed.2014.39.1.003

Desker, B., Caballero-Anthony, M., & Teng, P. (2013). Thought/issues paper on ASEAN food security: Towards a more comprehensive framework. ERIA Discussion Paper Series. Retrieved from https://www.eria.org/ERIA-DP-2013-20.pdf

FAO. (2003). Trade reforms and food security: Conceptualizing the linkages. Rome. Retrieved from http://www.fao.org/3/y4671e/y4671e.pdf

FAO. (2019). The state of food security and nutrition in the world 2019. Safeguarding against economic slowdowns and downturns. Rome. Retrieved from http://www.fao.org/3/ca5162en/ca5162en.pdf

Galanakis, C. M. (2020). The food systems in the era of the Coronavirus (COVID-19) pandemic crisis. *Foods, 9*(4), 523-532. https://doi.org/10.3390/foods9040523

Gill, G. J., Farrington, J., Anderson, E., Luttrell, C., Conway, T., Saxena, N. C., & Slater, R. (2003). Food security and the millennium development goal on hunger in Asia. London. Retrieved from https://cdn.odi.org/media/documents/1892.pdf

Herath, H. M. S. P., Liang, C., & Yongbing, C. (2014). Impacts of Regional Trade Agreements (RTAs) on food security: A case of ASEAN Free Trade Agreement. *International Journal of Social Science & Interdisciplinary Research, 3*(3), 147-157 . https://doi.org/10.2139/ssrn.2463578

Latifah, M. N., & Susamto, A. A. (2016). Analisis kemungkinan dampak keterlibatan indonesia dalam Trans Pacific Partnership (TPP) terhadap kinerja perdagangan dan-daya saing ekspor. *Jurnal Ekonomi & Studi Pembangunan, 17*(1), 55-70. https://doi.org/10.18196/jesp.17.1.3635

Mankiw, N. G. (2014). *Principle of economics*. Cengage Learning.

Parkin, M. (2012). *Economics (10th ed.).* University of Western Ontario: Pearson.

Regmi, A. (2014). The push-pull effects of urbanization on agriculture. Paper presented at the reviving drylands dialogue: Bridging policy and research. CGIAR Consortium, held at the African Studies Centre, Netherlands.

Reinhart, C. M., & Subbaraman, R. (2020). How can we prevent a COVID-19 food crisis? Retrieved from https://www.weforum.org/agenda/2020/05/preventing-a-covid-19-food-crisis/

Teng, P. P. S., & Oliveros, J. A. P. (2015). Challenges and responses to Asian food security. *Cosmos, 11*(1), 3–20. https://doi.org/10.1142/s0219607715500019

Teng, P., & Escaler, M. (2010). The case for urban food security: A Singapore perspective. NTS Perspectives No. 4. Rajaratnam School of International Studies (RSIS). Retrieved from https://www.rsis.edu.sg/rsis-publication/nts/2570-the-case-for-urban-food-securi/#.YIoVXLUzbcc

Tinta, A. A., Sarpong, D. B., Ouedraogo, I. M., Al Hassan, R., Mensah-Bonsu, A., & Ebo Onumah, E. (2018). The effect of integration, global value chains and international trade on economic growth and food security in ECOWAS. *Cogent Food & Agriculture, 4*(1), 1-15. https://doi.org/10.1080/23311932.2018.1465327

Trethewie, S. (2013). The ASEAN Plus Three Emergency Rice Reserve (APTERR): Cooperation, commitment and contradictions (NTS Working Paper Series No. 8). Singapore. Retrieved from https://www.rsis.edu.sg/rsis-publication/nts/323-the-asean-plus-three-emergency/#.YIoW0bUzbcc

UNICEF, WHO, & World Bank Group. (2019). Levels and trends in child malnutrition: Key findings of the 2019 edition. Retrieved from https://www.who.int/nutgrowthdb/jme-2019-key-findings.pdf?ua=1

United Nations. (2017). Complementarities between the ASEAN community vision 2025 and the United Nations 2030 agenda for sustainable development: A framework for action. Bangkok. Retrieved from

https://asean.org/storage/2017/11/FINAL_Complementarities-Report-no-graphic-on-cover.pdf

Wardani, D. T. K. (2016). Regional integration and intra OIC trade: Lessons from Indonesia and Malaysia. *Jurnal Ekonomi & Studi Pembangunan, 17*(1), 8-15. https://doi.org/10.18196/jesp.17.1.2456

World Bank. (2019). Commodity markets outlook, April 2019. Wahington, DC. Retrieved from https://openknowledge.worldbank.org/handle/10986/3154

World Bank. (2020). World Bank East Asia and Pacific economic update, April 2020 : East Asia and Pacific in the time of COVID-19. Wahington, DC: World Bank. Retrieved from https://openknowledge.worldbank.org/handle/10986/33477

Yoshimatsu, H. (2014). *Comparing Institution-Building in East Asia: Power Politics, Governance, and Critical Junctures.* New York; Palgrave Macmillan.