DO INSTITUTIONS MATTER FOR AGRI-FOOD IMPORTS AND EXPORTS BETWEEN CHINA AND AFRICA? A GRAVITY MODEL ANALYSIS°

AS INSTITUIÇÕES SÃO IMPORTANTES PARA AS IMPORTAÇÕES E EXPORTAÇÕES AGRO-ALIMENTARES ENTRE A CHINA E ÁFRICA? UMA ANÁLISE DO MODELO GRAVITACIONAL

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Abstract

This paper aimed to study the role of institutional quality on agri-food imports and exports between China and 48 African countries during the 2001-2021 period. The gravity model of trade was employed by assessing the Generalised Least Square and the Poisson Pseudo-Maximum Likelihood estimators, which included zero trade flows for panel data. The main results reveal that voice and accountability, control of corruption, and the rule of law enhance agri-food exports and imports between China and Africa, while political instability favours agri-food exports to China. In addition, the economic size of China, the trade cost (distance), and the population of African countries also encourage these agri-food exports and

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imports. Moreover, access to sea, exchange rate policy, and the economic size of African nations deplete China's agri-food imports from this continent. We showed the mechanism through which each institutional variable affects agri-food imports and exports between China and Africa.

Keywords: Africa-China Trade, food market, gravity model, institutions.
JEL codes: F1, F10, F14.

Resumo

O presente documento tem por objetivo estudar o papel da qualidade institucional no comércio agroalimentar (importação e exportação) entre a China e 48 países africanos durante o período 2001-2021. Foi utilizado o modelo gravitacional do comércio, estimando os estimadores Generalised Least Square (GLS) e Poisson Pseudo-Maximum Likelihood (PPML), que incluem fluxos comerciais nulos para dados de painel. Os principais resultados mostram que a voz e a responsabilização, o controlo da corrupção e o Estado de direito aumentam os fluxos comerciais agro-alimentares. A instabilidade política incentiva as exportações agro-alimentares para a China. Além disso, a dimensão económica da China, o custo do comércio (distância) e a população dos países africanos também incentivam o comércio agroalimentar entre a China e as economias africanas. Por outro lado, o acesso ao mar, a política cambial e a dimensão económica dos países africanos reduzem as importações agro-alimentares da China provenientes de África. Mostrámos o mecanismo através do qual cada variável institucional afecta os fluxos comerciais agro-alimentares da China para os países africanos.

Palavras-chave: Comércio Africa-China, mercado alimentício, modelo gravitacional, instituições.
JEL Codes: F1, F10, F14.

INTRODUCTION

Trade is an imperative element of economic expansion of any nation (Federici & Marconi, 2010; Kalaitzi & Chamberlain, 2020; Singh, 2010) and is a major source of income for farmers and those working in the food supply chain. Moreover, it broadens consumer options and reduces global food insecurity. Trade in agri-food goods has significantly expanded over the last 20 years, reaching over 7% in real terms, each year between 2001 and 2019. Agri-food trade is not only growing but also becoming universal (Abdullahi et al., 2021b). An increasing share of this trade takes place in global value chains (GVCs), while agricultural and food processing value chains spanning a myriad of countries connect agri-food industries and other sectors of the economy around the world. Similarly, agri-food trade revenues support the financing of economic and social development programs, thereby boosting people's livelihood and the agricultural GDP of the exporting nation (Shafiullah et al., 2017). Furthermore, this trade quantitatively enhances sustainable economic growth by providing secure and reliable supplies of foreign income, which reduce pressure on the balance of payments, help create jobs, curtail dependence on foreign aids, and offer expertise. Several studies, such as those of Abdullahi et al. (2022), Assem et al. (2010); Kea et al. (2019), Mahmood and Munir (2017), Shahriar et al. (2019a), have shown that expanding agri-food trade has a substantial positive effect on economic growth[1].

Agriculture is the biggest sector of the economy of several African nations (Abdullahi et al., 2021c; Ya & Pei, 2022). The continent has enormous food and agri-food potential; however, the region's agricultural output has barely kept pace with population increase, as productivity growth has lagged behind (Siméon et al., 2022). In recent decades, Africa has become a net food importer. The basic explanations for this are population growth, low and deteriorating agri-food productivity, policy changes, poor institutions, and infrastructure (Ekeocha et al., 2021).

Despite these, China was Africa's biggest business partner and traded substantially with nations in this region in the last two decades. On average, China's commerce with this continent as a whole has been on the rise and is estimated to be around 15% to 20% of Africa's total trade volume (Oqubay & Lin, 2019). Thanks to trade, aids, and investments from China, this region has grown steadily (Obobisa et al., 2021; Yanne Sylvaire et al., 2022). According to Andrew (2015), in 2013 China's investment in Africa reached USD 1.45 trillion. Similarly, their

[1] For more details about the benefits of international trade for African countries, see Abendin, Duan and Nsiah (2021).

trade in agri-food has grown rapidly in recent years (Guan et al., 2020; Zhang et al., 2010). Precisely, China's agri-food trade with 54 African countries has significantly increased since the turn of the 21st century. More than twice as much agricultural and food was exchanged between these regions from 2010 to 2021. In addition, China accounted for nearly 5% of the total agri-food trade from Africa. Although this figure seems to be small, this trade volume surged by more than 1300% over the 21-year period (2001-2021), reaching USD 7.797 billion in 2021 from USD 0.570 billion in 2001. This exceeds the global average of 417% for the same period (UNCTAD 2023).

On the other hand, the current Russia-Ukraine war has significant implications for agri-food trade between China and African countries (Ben Hassen & El Bilali, 2022). Since Russia and Ukraine are among the major global grain exporters, any disruptions to their exports may lead to rises in global food prices, which could impact the affordability and availability of imported grains for African nations. China, faced with potential shortages, may increase its demand for agri-food products from Africa, providing economic opportunities but also risks of overreliance on a single market (Jagtap et al., 2022). In sum, the war's geopolitical dynamics and climate change further amplify the complexity of ensuring food security in the region.

For their part, institutions are intended to resolve bilateral trade uncertainties and shape the system that supports economic activity (Bandura, 2021). In this sense, strong and well-run institutions can reduce the risks inherent in international trade and boost global trade (De Groot et al., 2004; Ngouhouo et al., 2021), by strengthening property and consumer rights, democracy, and rule of law. In doing so, a country's exports gain reputation and improve product quality (Levchenko, 2007). In addition, trading partners are often located in different countries, may not even speak the same language, and their currencies vary, making international trade far more complicated than domestic one. They sign agreements to reduce uncertainty in bilateral trade, and the parties' own institutional frameworks determine how the agreement is implemented (Kamal & Zaki, 2018). As a result, the strength of institutions is key to protect global trade. Improved institutional quality is expected to reduce transaction costs and, thus, have a favourable impact on global trade. Contrarily, ineffective institutions can obstruct international trade (Oshota & Wahab, 2022). In this line, transactions related to international trade are more expensive than they should be due to corruption, insufficient market information, and weak contract enforcement (Verwaal & Donkers, 2003). Hence, exporters' global competitiveness is affected as a result of higher transaction costs, which also increase the selling price of imported goods (Abdullahi et al., 2021d).

Our study focused on the role of institutions in determining agri-food imports and exports between China and Africa because of the interconnectedness of the international trade system and the potential for partner countries to benefit from an externally based policy. Accordingly, it can be significant that partner countries have high-quality institutions. However, each nation has its own set of domestic institutional rules, objectives, and achievements. In this sense, numerous investigations provided a comprehensive picture of institutional quality on a global scale at the country level (Bakhsh et al., 2021; Hasiner & Yu, 2019; Lin et al., 2020). In several ways, our research sought to contribute to ongoing discussions about bilateral trade. First, unlike previous studies on the role of institutions in merchandise or agricultural trade, the focus of this article was on agri-food trade (imports and exports) between China and African countries. Second, we examined the possibility that a country's institutional quality has an important effect on its bilateral economic relationships. Third, our methodology differs from that of prior research in that we employed Generalised Least Square (GLS) and Poisson Pseudo-Maximum Likelihood (PPML) techniques simultaneously to test the stability of our findings. These approaches have never been adopted at the same time in the context of African agri-food trade. Lastly, we used several dimensions that capture the institutional quality of agri-food imports and exports between China and African countries.

The remaining of this paper is structured as follows. Section 1 presents the relevant empirical literature. In Section 2, we analyse the empirical model and estimation techniques. Section 3 describes the brief agri-food trade relations between China and the selected African countries. The results and their discussion are provided in Section 4. We conclude the study and offer some policy implications in the last section.

I. LITERATURE REVIEW

Recent years have seen growing interest in empirical research and policy debate on the impact and significance of institutions on international trade flows. The connection between bilateral trade, institutional quality, and other characteristics has been extensively analysed (Bojnec et al., 2014; Engemann et al., 2022; Fałkowski et al., 2018; Khalid, 2016; Lee et al., 2022; Nyamah et al., 2022; Soeng & Cuyvers, 2017). For example, an empirical study by Oshota and Wahab (2022) used the negative binomial pseudo-maximum likelihood estimator to investigate the impact of the quality of national institutions on the volume of trade between member countries of the Economic Community of West African States (ECOWAS).

They analysed a dataset covering the period from 2000 to 2018. Their findings indicated that, for both importing and exporting nations, a reduction in corruption, a strong rule of law, and an effective government are associated with increased trade among member countries. The authors suggested that ECOWAS nations should improve their institutional frameworks to combat corruption, promote the rule of law, and enhance government effectiveness.

Moreover, Ya and Pei (2022) used the gravity model on a panel data set during 2010-2019 to examine the factors that influence agricultural trade between China and 58 African countries. Their findings indicated that the Belt and Road strategy contributes to a sustainable trade relationship between China and its partners. The study further showed that the human capital index could improve agricultural trade between China and Africa. In a similar vein, Abreo et al. (2021) observed that the institutional quality of Colombia and the institutional distance between this nation and its trade allies have an effect on the success of its exports. In addition, Ngouhouo et al. (2021) examined the factors affecting trade openness in Sub-Saharan African (SSA) countries by focusing on the role played by domestic institutions. The study employed the Generalised Methods of Moments (GMM) on a panel of 36 SSA nations over the 1996-2017 period. The authors demonstrated that SSA countries' trade openness increased as a result of improvements in government efficiency, regulatory quality, and the rule of law.

Using a data set spanning 2013-2018, Bakhsh et al. (2021) adopted an expanded gravity model approach to evaluate the impact of institutional quality on China's trade with 65 Belt and Road nations. Based on fixed effects and the PPML, the authors found that lower levels of citizen participation, government transparency, and political stability in Belt and Road countries hinder Chinese exports and identified a statistically significant influence of institutions on Chinese imports from those economies. For their part, Guan et al. (2020) conducted a case study of trade between China and Africa. The authors examined the factors affecting such trade using the gravity model on a panel data set during the 2000-2016 period. Their findings revealed the consequences of economic recession, suggesting that the structure of the African product exported to China should be enhanced and trade agreements, protected.

Moreover, Ambetsa et al. (2019) indicated that the corruption index, remittances from the diaspora, Foreign Direct Investment (FDI), and population all have major effects on East African countries' ability to trade with one another. These results were obtained using a Panel Ordinary Least Squares (POLS) and random effects. In addition, Gil-Pareja et al. (2019) examined the impact of impro-

ving international trade law on bilateral trade by employing the structured gravity model. The authors showed that economies with lower institutional quality that are working to enhance their institutions may face greater export diversity in the complex goods market. Furthermore, they proposed a policy to address the economic implications of making better trade regulations.

For the years 1990-2013, Hasiner and Yu (2019) used a gravity model to evaluate the impact of exporting countries' institutions on China's beef imports. The authors stated that, when GDP rises, China imports more beef products from nations with higher living standards and greater physical proximity. In other words, there is a favourable correlation between the institutions of the exporting country and China's meat imports. On the other hand, Shahriar et al. (2019a) showed that Belt and Road institutions, China's World Trade Organisation (WTO) membership, and contiguity stimulate China pork exports. The authors obtained these results using the GLS and Heckman model.

For their part, Álvarez et al. (2018) investigated how the quality of a nation's institutions influences the flow of sector-specific bilateral trade, and whether this impact has been growing or diminishing over time. Their research demonstrated that both the institutional conditions in the destination country and the institutional disparity between exporting and importing nations are significant factors in bilateral trade. Furthermore, the influence linked to the destination country's institutional conditions evidenced a moderate increase over time. The study also validated the notion that institutional quality plays a role in trade, regardless of whether considering the importing country's institutional quality or the institutional difference between the exporting and importing economies. What is more, Martínez-Zarzoso and Marquez-Ramos (2018) indicated that bilateral export flows are affected by the level of governance in both the exporting and importing nations. The authors observed that the Middle East and North Africa (MENA) region favours trading with other countries that have a similar regulatory quality and rule of law. These results were obtained using the gravity model with time-variant multi-lateral resistance and pair fixed effects.

Based on a data set consisting of 109 Vietnamese exporting companies, Ngo et al. (2016) examined how domestic institutional characteristics impact their export performance. Their findings revealed a positive correlation between all four institutional characteristics and export performance. This connection becomes more pronounced when dealing with exporters who are larger in scale, have more experience, focus on foreign markets, and employ direct export methods. These results were achieved using chi-square. Moreover, Francois and Manchin (2013)

claimed that trade depends on both the quality of institutions and the accessibility of well-established transportation and communication infrastructure for exporters and importers. The study centred on exports originating from developing nations and indicated that the limited quality of institutions and infrastructure in the South also hampers market access for exports from the North.

Using the augmented gravity model, Horsewood and Voicu (2012) showed that the level of corruption does not hinder cross-border trade between Bulgaria and Romania. Despite this, the authors suggested that eradicating bribery and punishing individuals and businesses that break the rules allow boosting trade between these countries. The study by Faruq (2011) focused on exploring the connection between a nation's institutional framework and the quality of its exports. Employing the POLS method, the author identified a positive correlation between a stronger institutional environment and higher export quality. Among the various institutional aspects examined in this study, corruption emerges as the factor most consistently linked to export quality.

In sum, the evidence from the aforementioned studies points to a clear and strong link between institutional quality and trade. Thus, this paper hypothesised that the quality of institutions has an undetermined effect on the volume of agri-food trade between China and African countries. For the purposes of this study, we chose four governance indicators based on previous literature (Abreo et al., 2021; Bakhsh et al., 2021; Engemann et al., 2022; Soeng & Cuyvers, 2017; Lin et al., 2020; Oshota & Wahab, 2022). Each indicator characterises a particular dimension of quality of institutions, which aims at representing a complete picture of the quality of the institutional environment in a country, rather than specific institutions. They include the following aspects:

1. Voice and Accountability (Acc.): This assesses the extent to which citizens can act to select their government, as well as the sovereignty of relational and media expression.

1. Control of Corruption (Corr.): It determines the extent to which administrative power will not be used for illegitimate personal gain, specifically any type of corruption.

1. Political Stability (PI): It means the probability that the administration will not be dethroned by forceful and illegal means.

1. Rule of Law (RL): It describes the degree to which the administration and officials have the self-confidence to stand by the community's rule and emphasise the agreement implemented in the administration offices.

II. EMPIRICAL MODEL AND ESTIMATION TECHNIQUES

Since the introduction of the gravity model in international economic studies and based on the seminal work of Tinbergen (1962), several researchers have applied the model in different directions to analyse trade flows between two or more countries. Thus, this is the most popular empirical tool in international trade studies (Anderson & Van Wincoop, 2003; Boughanmi et al., 2021). The gravity model takes into account trade flows between two nations as a function of their respective economic masses and distances from one another. It assumes that the amount of trade between two countries is inversely proportional to their distance and positively correlated with their economic mass or size, which is typically measured by GDP (Anderson, 1979). To represent this, the following mathematical expression can be used:

$$Trade_{ij} = \frac{GDP_i * GDP_j}{Dis_{ij}} \tag{1}$$

The multiplicative form of Equation (1) can be rewritten as shown below:

$$Trade_{ij} = GDP_i^{\beta} * GDP_j^{\Upsilon} * Dis_{ij}^{-\delta} \tag{2}$$

where $Trade_{ij}$ indicates the flow of agri-food trade (imports or exports) from China (i-country) to an African country (j-country), GDP_i and GDP_j are the GDP of China and the African nation, respectively, and Dis_{ij} is the distance between the capital city of China (Beijing) and that of the African country. The gravity model can be expressed in logarithmic form as follows in Equation (3):

$$lnTrade_{ij} = \alpha + \beta lnGDP_i + \Upsilon lnGDP_j + \delta Dis_{ij} + \mu_{ijt} \tag{3}$$

Although this model proved effective in explaining overall trade patterns, it lacks the specificity needed when analysing trade at the sector or product level (Anderson & Yotov 2010). The traditional framework, based solely on aggregated

domestic income, cannot adequately account for sector- or product-specific influences. As a result, the gravity model has undergone further development to provide a more detailed structural definition, which also seeks to uncover the factors driving specific trade flows (X_{nj}). Beyond the physical movement of goods, trade can also be characterised by the movement of money. The expenditures from country n to country j for a particular product can be viewed as a fraction (π_{nj}) of the total expenditures within n (X_n).

$$X_{nj} = \pi_{nj} + X_n \tag{4}$$

The main issue in the context of structural gravity is to account for the share of total domestic expenditures in a specific trade flow. Equation (4) leads to (5). Here, the imports in country n are explained by the total production in country j (Y_j), an index of market potential in j (Ω_j), the degree of competition in that market (Φ_n), and bilateral accessibility (φ_{nj}). While the index of market potential covers the maximum possible sales from j in the world (and in the domestic market), the degree of competition captures the sum of all export capabilities (and domestic production) to n:

$$X_{nj} = \frac{Y_j X_n}{\Omega_j \, \Phi_n} \varphi_{nj} \tag{5}$$

The gravity model used in this paper was subjected to two estimating procedures. They included pooled GLS regression (applying either country-pair fixed effects or random effects, depending on the Hausman (1978) and the PPML technique. Thus, two estimation approaches were explored for robust and sensitivity tests on the estimates. Additionally, the PPML also served to address the zero-trade problem, which could otherwise generate selection bias.

The Hausman test was used to choose between fixed effects and random effects models. The Hausman analysis essentially tests whether the regressors are correlated with the distinctive errors (μ_i) in the empirical model (Janot et al., 2016). The null hypothesis cannot be rejected if they are not (*i. e.*, when the p-value is greater than 0.05). This is true for all of our regressions, which is why we only provided findings from the random effects estimator rather than the fixed effects one. Nonetheless, because trade flows between different sets of countries are quite heterogeneous, the GLS could be mis-specified in the gravity equations (Menke, 2014). As a result, the PPML proposed by Santos Silva and Tenreyro (2006, 2011) is the main technique for this study. The PPML is also supported by the tendency of log-linearised gravity models to be misleading in the presence of heteroscedasticity

due to Jensen's inequality. The researchers further argued that only a few authors in the empirical literature have approached this matter using other methodologies. Furthermore, the PPML addresses the issue of heteroscedasticity and the fact that sometimes takes the value of zero, in which case $Trade_{ij}$ is not defined (Philippidis et al., 2013). Thus, the PPML model used in this study is expressed as follows:

$$Trade_{ij} = \alpha + \beta lnGDP_i + \Upsilon lnGDP_j + \delta Dis_{ij} + \mu_{ijt} \quad (5)$$

II.1. Data sources and definition of the study variables

The data set we included in the econometric analysis consists of annual panel data for China and 48 African countries, and it ranges from 2001 to 2021 (21 years)[2]. The value of imports and exports of agri-food of these nations and the exchange rate between their currencies were extracted from the United Nations Conference on Trade and Development (UNCTAD). The distance between Beijing and an African capital and access to sea data were collected from the French Centre for Research and Expertise on the World Economy (CEPII). Data on population were obtained from the World Development indicators (WDI). Lastly, the institutional quality data (Acc., Corr., PI, and RL) came from the World Governance Indicators (WGI). Table 1 shows the detail description and expected signs of the variables used in this study. The estimation started with summary statistics and pairwise correlation analysis of our variables. The results of the summary statistics are presented in Table 2 and those of the correlation analysis, in Table 3. The highest correlation coefficient is 0.761. Our variables are not multicollinear. Multicollinearity occurs when the correlation coefficient exceeds 0.8 (Gujarati, 2019). Thus, we proceed with the actual estimates as multicollinearity is not a concern.

2 The list of countries considered in this study is provided in Appendix A.

Table 1. Description, expected sign, and source of the variables used in the study

Variable	Definition	Unit	Exp. Sign	Source
Export	Agri-food export flow from China to African countries	USD 1000		UNCTAD
Import	Agri-food import flow from African countries to China	USD 1000		UNCTAD
GDP_i	GDP of country i at time t	USD 1000	+	WDI
GDP_j	GDP of country j at time t	USD 1000	+	WDI
Dis_{i_j}	Distance between Beijing and an African capital	Kilometres	-	CEPII
$Exch_{i\_j}$	Exchange rate	Yuan/currency	+	UNCTAD
Pop_i	Population of exporting country	1000 persons	+/-	WDI
Pop_j	Population of importing country	1000 persons	+/-	WDI
Sea_j	Dummy variable equal to one for j countries with sea port	Binary	+	CEPII
$Acc._j$	Voice and accountability indicator (estimate-value) of importing country	Index	+/-	WGI
$Corr._j$	Control of corruption indicator (estimate-value) of importing country	Index	+/-	WGI
PI_j	Political stability and absence of violence/terrorism (estimate-value) of importing country	Index	+/-	WGI
RL_j	Rule of law indicator (estimate-value) of importing country	Index	+/-	WGI

Source: Authors' compilation.

Table 2. Summary statistics of the variables used in the study

Variable	Mean	Std. Dev.	Min.	Max.	Skewness	Kurtosis
$lnExport$	8.841	2.582	-4.075	12.865	1.062	4.277
$lnImport$	7.827	3.500	-4.711	13.502	-0.930	3.668
$lnGDP_i$	29.387	0.830	27.923	30.507	-0.440	1.766
$lnGDP_j$	23.215	1.523	19.788	27.076	0.234	2.634
$lnDis_{i\_j}$	9.263	0.145	8.930	9.447	-0.693	2.348
$lnExch_{i\_j}$	2.705	2.482	-2.615	8.442	-0.237	2.268
$lnPop_i$	21.021	0.033	20.964	21.069	-0.082	1.721
$lnPop_j$	16.185	1.319	13.052	19.179	-0.260	2.492
Sea_j	0.728	0.445	0.000	1.000	-1.026	2.052
$Acc._j$	-0.622	0.719	-2.226	0.983	0.258	2.434
$Corr._j$	-0.648	0.586	-1.628	1.245	0.803	3.339
PI_j	-0.567	0.837	-2.699	1.224	-0.156	2.438
RL_j	-0.679	0.610	-0.188	1.024	0.385	2.752

Source: Authors' estimation.

Table 3. Results of the pairwise correlation analysis of the study variables

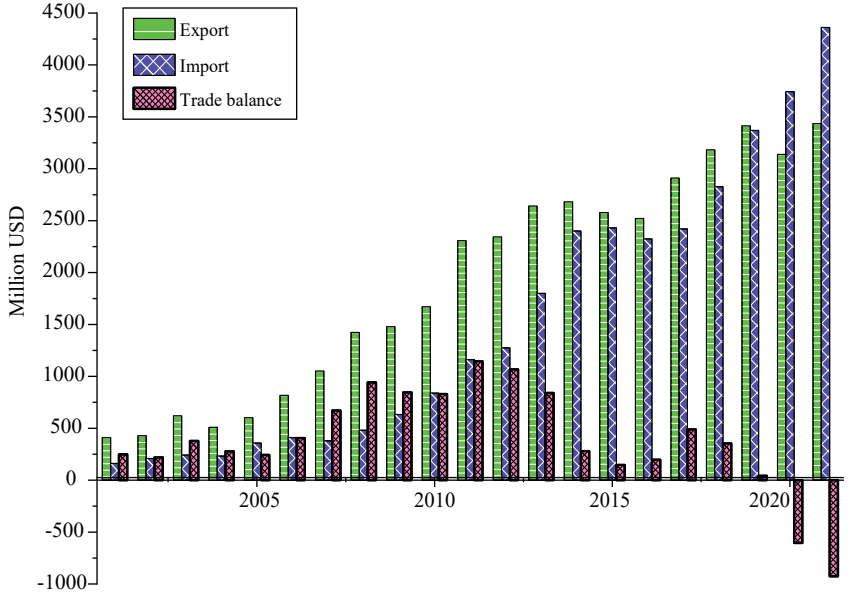
Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
$lnExport$	1.000												
$lnGDP_i$	0.268***	1.000											
$lnImport$	0.437***	0.241***	1.000										
$lnGDP_j$	0.596***	0.315***	0.303***	1.000									
$lnDis_{i\_j}$	0.081	0.031	0.000	-0.198***	1.000								
$lnExch_{i\_j}$	-0.134***	-0.229***	0.114***	-0.269***	0.153***	1.000							
$lnPop_i$	0.433***	0.231***	0.098***	0.291***	-0.000	0.117***	1.000						
$lnPop_j$	0.394***	0.314***	0.112***	0.072***	-0.234***	-0.015	0.114	1.000					
Sea_j	0.439***	-0.142***	-0.003	-0.150***	0.035	-0.084***	-0.003	-0.109***	1.000				
$Acc._j$	0.182***	0.288***	0.041	0.078	0.359***	-0.126***	0.045	-0.061	0.037	1.000			
$Corr._j$	0.028	0.315***	-0.025	0.007	0.045	-0.295***	-0.026	-0.222***	-0.009	0.682***	1.000		
PI_j	-0.059	0.014	-0.074	-0.161***	0.199***	-0.213***	0.082	-0.485***	0.153***	0.545***	0.634***	1.000	
RL_j	0.129***	0.237***	0.013	0.146***	-0.004	0.274***	0.012	-0.139***	0.005	0.761***	0.087***	0.710***	1.000

*** p<0.01.
Source: Authors' estimations.

III. BRIEF AGRI-FOOD TRADE RELATIONS BETWEEN CHINA AND AFRICA

China and Africa have developed a long-term partnership with mutual benefits over the past five decades. Currently, China has trading ties with nearly every African country. Both have used each other's strengths to trade on a mutually beneficial basis (Oqubay & Lin, 2019). Figure 1 depicts agri-food trade relations between China and Africa. We can observe that, over the study period (2001-2021; 21 years), agri-food trade between them has increased at an exponential speed. The market is valued at USD 3.439 billion. Moreover, the figure clearly shows that agri-food trade substantially improved in the years 2005-2010 and 2015-2021. It should be noted that China recorded a negative trade balance in its trade with African countries, but this only occurred in 2020 and 2021 perhaps due to the Covid-19 pandemic. In general, both China's imports and exports from this region evidence tremendous growth. For example, these imports and exports increased from USD 0.160 billion and USD 0.409 billion in 2001 to USD 4.361 billion and USD 3.435 billion in 2021, respectively.

Figure 1. Agri-food trade relations between China and Africa



Source: Own elaboration using data from the UNCTAD.

It is worth acknowledging that global price variability in agri-food commodities between 2001 and 2021 had several effects on agri-food trade between China and Africa. On the one hand, when prices were low, African countries often benefited from increased exports of commodities such as oil, minerals, and agricultural products to China. On the other, when prices were high, China's demand for these commodities might have decreased due to cost concerns. This price volatility likely encouraged trade diversification, with African nations seeking to balance their export portfolios and reduce dependence on a single market. Additionally, it may have driven both China and African countries to invest in agricultural technology and infrastructure to improve food security and decrease vulnerability to international price swings. Overall, price variability likely prompted adjustments in trade strategies, investment priorities, and commodity choices during this period.

Undoubtedly, China has traded with most African countries in this area; yet, it has done so with some nations more than others. According to Table 4, South Africa is by far the leading partner of China in agri-food, with a total trade value of USD 391.22 million, followed by Zimbabwe and Morocco with USD 335.31 million and USD 217.53 million, respectively. Zimbabwe is also the top import market for China, with a market value of USD 331.55 million, followed by South Africa (USD 202.39 million) and Ethiopia (USD 190.34 million). The top destination for Chinese agri-food is Morocco, with a value of USD 197.35 million, followed by Zimbabwe (USD 188.82 million) and Nigeria (USD 182.37 million). In terms of China's share in the total agri-food trade of the top trading partners, Togo, Zimbabwe, and Nigeria have the highest percentage share, while this figure for South Africa, Egypt, Morocco, Cote D'Ivoire, and Ghana is less than 1%.

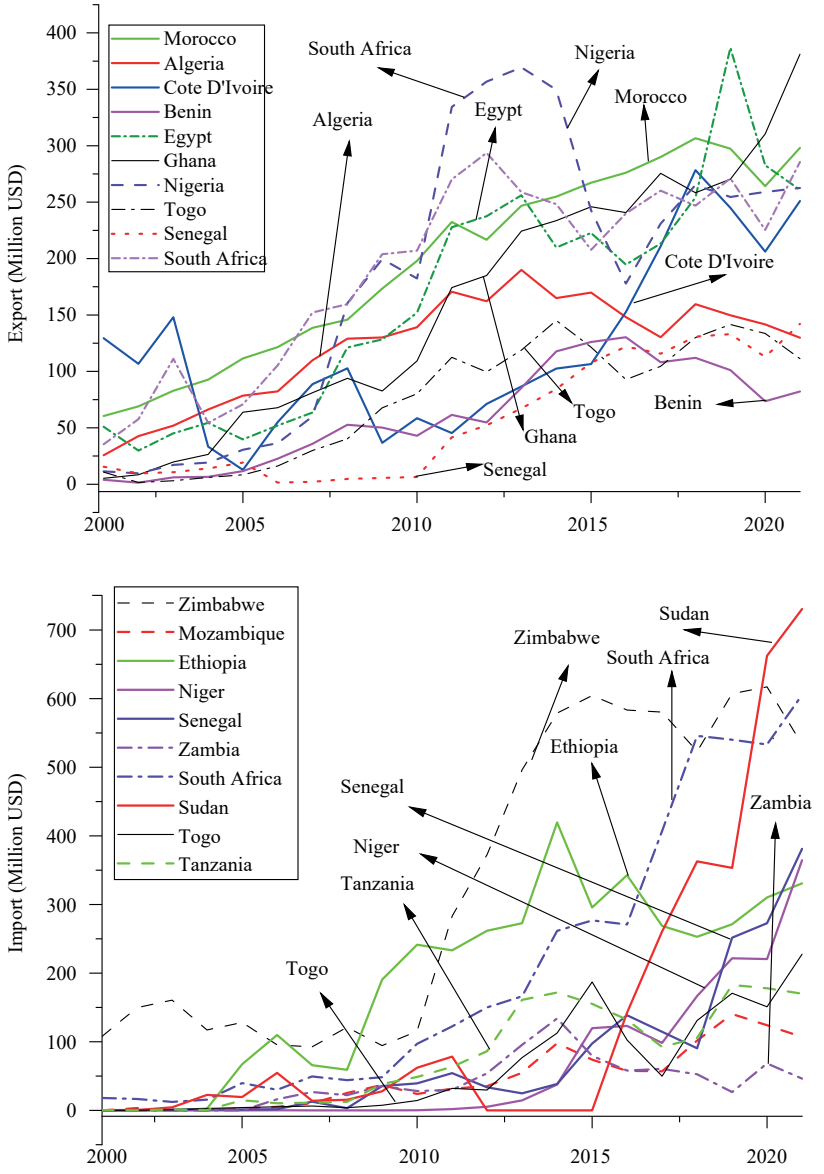
Table 4. China's top ten African partners in agri-food

Country	Export (million USD)	Import (million USD)	Trade (million USD)	Share of China (%)
South Africa	188.82	202.39	391.22	0.24
Zimbabwe	3.76	331.55	335.31	4.16
Morocco	197.35	20.18	217.53	0.39
Egypt	165.88	38.03	203.91	0.26
Ghana	159.91	38.10	198.01	0.92
Ethiopia	7.07	190.34	197.41	1.35
Nigeria	182.37	10.85	193.22	2.60
Sudan	28.72	133.89	162.61	1.22
Cote D'Ivoire	120.41	23.26	143.67	0.85
Togo	75.01	62.66	137.67	4.25

Source: Authors' computation.

Figure 2 illustrates the import and export trends of Chinese agri-food to its 10 largest regular partners between 2010 and 2021. Notably, Sudan significantly improved its agri-food imports, from less than USD 100 million in 2015 to more than USD 700 million in 2021. For its part, Ghana is currently the leading export destination for China's agri-food products.

Figure 2. Trend of the top 10 export and import markets for agri-food between China and Africa



Source: Own elaboration using data from the UNCTAD.

IV. RESULTS AND DISCUSSION

IV.1. Factors affecting agri-food export flows between China and African nations

We started by estimating the conventional gravity model for our panel data analysis. We also performed the Hausman test, and the results showed that employing GLS (random effects) panel data techniques with 48 African economies and a sample period of 2001-2021 is the best methodological choice for our estimate specifications. To control for the multilateral resistance term (MRT), the main flaw of the gravity model, time and country fixed effects were used. The PPML was also employed as a means to show the robustness of our estimation and to deal with a zero-trade value.

The factors affecting agri-food exports between China and Africa and various models were examined, as shown in Tables 5 and 6. The four dimensions that capture the institutional quality variable were investigated separately to eliminate overlapping impact results and demonstrate the mechanism by which each institutional quality influences such agri-food exports.

Table 5. GLS estimation for China's agri-food exports to Africa

Variables	(1)	(2)	(3)	(4)	(5)	(6)
$lnGDP_i$	0.983***	-0.408	-0.360	-0.381	-0.329	-0.328
	(0.107)	(1.365)	(1.409)	(1.393)	(1.400)	(1.340)
$lnGDP_j$	0.936***	0.0654***	0.664***	0.547***	0.611***	0.503***
	(0.103)	(0.126)	(0.133)	(0.135)	(0.138)	(0.137)
$lnDis_{i\_j}$	3.353***	3.579***	3.352***	3.306***	3.377***	3.422***
	(1.363)	(1.190)	(1.279)	(1.260)	(1.312)	(1.231)
$lnExch_{i\_j}$		-0.004	-0.036	-0.010	-0.037	-0.026
		(0.062)	(0.067)	(0.068)	(0.695)	(0.066)
$lnPop_i$		37.078	35.349	36.861	35.293	35.850

		(32.565)	(33.610)	(33.228)	(33.408)	(33.344)
$lnPop_j$		0.441***	0.428***	0.585***	0.535**	0.592***
		(0.167)	(0.168)	(0.173)	(0.180)	(0.171)
Sea_j		2.231***	2.240***	2.358***	2.223***	2.385***
		(0.369)	(0.370)	(0.374)	(0.386)	(0.367)
$Acc._j$			0.099			
			(0.141)			
$Corr._j$				0.728***		
				(0.163)		
PI_j					0.217**	
					(0.086)	
RL_j						0.669***
						(0.167)
Time fixed effects	yes	yes	yes	yes	Yes	yes
Country-pair effects	yes	yes	yes	yes	Yes	yes
Hausman	0.070	0.383	0.351	0.811	0.558	0.643
R^2	0.475	0.627	0.627	0.624	0.624	0.636
Observations	996	996	955	955	955	955
No. of countries	48	48	46	46	46	46
Rho	0.585	0.506	0.489	0.498	0.517	0.484

Standard errors in parentheses. *** p<0.01, ** p<0.05.
Source: Authors' estimation.

The results in Tables 5 and 6 show a number of factors including GDP_i, GDP_j, Dis_{i_j}, Pop_j, Sea_j, $Corr._j$, PI_j, and RL_j. All these variables are positive and statistically significant at 1% level, except PI_j with 5%. In addition, $Exch_{i\_j}$ and $Acc._j$ are highly significant at 1% level, only in the PPML with negative and positive coefficients, respectively. Similarly, PI_j is only significant in the GLS model. Depending on the estimation method, the model, and the mix of variables taken into account, the level of influence for a percentage rise in the size of GDP_i varies from 38% to 95%, while for GDP_j, from 7% to 94%. In other words, both GDP_i and GDP_j boost agri-food trade flows between China and African countries. Based on the Dis_{i_j} variable, each kilometre between China and the importing country increases agri-food exports from 162% to 358%. This also depends on the above factors. Bilateral trade is expected to decline due to trade costs. Nonetheless, in all of our estimates, Dis_{i_j} has a positive and statistically significant impact on China's agri-food exports to African nations. This result contradicts previous research (Bakhsh et al., 2021; Foo et al., 2020; Kea et al., 2019). According to the gravity literature, countries that are in close proximity appear to trade more, while those that are far apart trade less with each other, possibly due to the increased transportation costs associated with distance (Shahriar et al., 2021; Shahriar et al., 2019b). However, in the case of agricultural product, Dis in agricultural trade takes into account both transportation expenses and variations in climatic and growing conditions between trading partners (Ya & Pei, 2022). The greater the disparity in factor endowments between the two countries, the more different the manufactured goods will be, and the greater the bilateral trade interactions between these nations (Abdullahi et al., 2021a; Dreyer, 2014)[3].

Table 6. PPML estimation for China's agri-food export to Africa

Variables	(1)	(2)	(3)	(4)	(5)	(6)
$lnGDP_i$	0.514***	0.770***	0.821***	0.948***	0.810***	0.894***
	(0.052)	(0.209)	(0.210)	(0.208)	(0.209)	(0.209)
$lnGDP_j$	0.659***	0.409***	0.383***	0.341***	0.389***	0.331***
	(0.019)	(0.034)	(0.036)	(0.037)	(0.037)	(0.037)
$lnDis_{i\_j}$	1.903***	2.075***	1.624***	1.516***	1.809***	1.687***

[3] Yotov (2012) indicated that when the impact of distance on international trade is assessed compared to its effects within national borders, the distance puzzle disappears.

	(0.273)	(0.231)	(0.257)	(0.221)	(0.244)	(0.217)
$lnExch_{i\_j}$		-0.083***	-0.075***	-0.040***	-0.083***	-0.040***
		(0.014)	(0.015)	(0.014)	(0.014)	(0.014)
$lnPop_i$		-2.812	-4.086	-6.858	-3.656	-5.951
		(4.642)	(4.675)	(4.586)	(4.622)	(4.611)
$lnPop_j$		0.217***	0.232***	0.304***	0.241***	0.306***
		(0.035)	(0.036)	(0.037)	(0.044)	(0.037)
Sea_j		1.344***	1.386***	1.478***	1.382***	1.468***
		(0.124)	(0.126)	(0.125)	(0.129)	(0.124)
$Acc_{\cdot j}$			0.078***			
			(0.046)			
$Corr_{\cdot j}$				0.425***		
				(0.048)		
PI_j					0.030	
					(0.046)	
RL_j						0.401***
						(0.048)
Constant	-38.115***	13.275	43.116	98.582	32.376	79.639
	(2.961)	(92.071)	(92.910)	(90.874)	(91.742)	(91.443)
R^2	0.614	0.680	0.687	0.705	0.691	0.704
Observations	996	996	955	955	955	955

Standard errors in parentheses. *** p<0.01.
Source: Authors' estimation.

When an exchange rate rises under a direct pricing mechanism, the local currency loses value, increasing the export trade flow of domestic goods. A fall in the exchange rate supports an increase in the flow of domestic product imports (Igue & Ogunleye, 2014; Kohler & Ferjani, 2018; Nasrullah et al., 2020). The coefficient of bilateral $Exch_{i\_j}$ is between 0.04 and 0.083. The negative signs show that a percentage rise in the value of the yuan is expected to deplete China's agri-food export flows to African countries. This is in accordance with prior studies such as Shahriar et al. (2019a), who documented similar results between China and its meat-importing nations. Moreover, Engemann et al. (2022) reported that the exchange rate deters agri-food trade between SSA and the EU-28. For their part, Ya and Pei (2022) observed that trade between China and African nations is reduced by the exchange rate and distance.

Furthermore, the market size of countries involved in exchange of goods and services is proxied by their population (Gul et al., 2023). In this sense, Guan et al. (2020) described how the population coefficient of exporting and importing countries can be either positive, promoting demand from importing nations, or negative, increasing the ability to supply. This coefficient for an importing country determines that a percentage rise in Pop_j will result in an increase in agri-food export flows between 22% and 228%. This finding is in agreement with that of Abdullahi et al. (2021b), who evidenced that Nigerian agri-food exports are encouraged by a rise in the importing nation's population.

The dummy variable $sea_{i\ j}$ (access to sea) is positive and statistically significant only in the GLS models. The magnitude of the coefficient ranges from 138% to 148%. There are only 16 landlocked countries in Africa: Mali, Niger, Chad, Burkina Faso, the Central Africa Republic, South Sudan, Ethiopia, Uganda, Rwanda, Burundi, Malawi, Zambia, Zimbabwe, Botswana, Eswatini, and Lesotho. None of them is among the 18 top destinations of China's agri-food exports. Therefore, there is a trade cost attached to being a landlocked nation (Paudel & Cooray, 2018). Our investigation is in line with previous studies reporting a negative relationship between trade flows and landlocked importing nations (Balogh & Leitão, 2019; Boadu et al., 2021; Ngouhouo et al., 2021).

All the four institutional indices significantly explained the export flows between China and African countries. In the study by Soeng and Cuyvers (2017), Cambodia's exports to China were positively influenced by all institutional variables they used. In relation to our analysis, $Corr_j$. and RL_j are positive and highly significant at 1% level in both GLS and PPML models. This indicates that controlling corruption can enhance African countries' agri-food imports from China.

In addition, Bojnec et al. (2014) revealed that the indicators of legal framework, security of property rights, and freedom of international trade are the main focus of institutional quality in agro-food importing and exporting nations. This result is in agreement with Ngouhouo et al. (2021), who evidenced that RL_j boosts trade flows between SSA countries and their importing ones.

Furthermore, Engemann et al. (2022) demonstrated that an effective government selection, monitoring, and replacement (voice and accountability, political stability, and absence of violence/terrorism) in SSA countries —the institutional quality dimension most related to enhancing firms' investment and productivity and the stability of their business environment—has the greatest impact on the length of their export period.

IV.2. Factors affecting agri-food import flows between China and African nations

The outcomes obtained by using bilateral agri-food imports as a dependent variable are presented in Tables 7 and 8. Both GDP_i and GDP_j are highly significant determinants of China's agri-food imports from Africa with positive and negative signs, respectively. Hasiner and Yu (2019) reported similar results between China and its meat exporting partners. Here, also Dis_{i_J} is positive and statistically significant at 1% level only in the PPML model. Thus, the increase in physical distance between countries contributes to boosting imports between those involved. Moreover, Zhang et al. (2023) also identified a positive effect of distance between the United States and its bourbon whisky trading partners. As mentioned earlier, differences in climatic and cultivation conditions between trading partners encourage greater trade flow. This is because the farther apart two countries are from each other, the more their climatic conditions vary, leading to the development of different products. In turn, it is possible for them to import goods they cannot produce themselves (Dreyer, 2014).

On the other hand, $Exch_{i\_j}$, which is a proxy exchange rate policy, is a highly significant determinant of imports between China and African countries, with negative coefficients. The economics of exchange rates is often controversial (Abdullahi et al., 2022; Jiang & Liu, 2022). China's currency rate strategy is such a divisive and hotly contested topic that it frequently sparks intense debates across the globe (Wang, 2020; Xing, 2012). On average, a 1% increase in the value of the yuan would lead to a 33% and 46% reduction in agri-food imports between China and African countries. This result is in line with prior expectations that a decrease in the

exchange rate will encourage more agricultural trade. Earlier studies by Abdullahi et al. (2021a), Abdullahi et al. (2021b), and Ya and Pei (2022) support our findings.

Table 7. GLS estimation for China's agri-food imports from Africa

Variables	(1)	(2)	(3)	(4)	(5)	(6)
$lnGDP_i$	1.493***	1.497	1.304	1.208	1.352	1.202
	(0.216)	(2.489)	(2.627)	(2.576)	(2.593)	(2.591)
$lnGDP_j$	-0.601***	-0.333	-0.391	-0.539*	-0.307	-0.615**
	(0.203)	(0.251)	(0.264)	(0.277)	(0.274)	(0.280)
$lnDis_{i\_j}$	-2.324	0.776	1.720	2.350	2.876	2.571
	(2.652)	(2.249)	(2.231)	(2.361)	(2.363)	(2.257)
$lnExch_{i\_j}$		-0.330***	-0.442***	-0.425***	-0.456***	-0.440***
		(0.120)	(0.122)	(0.130)	(0.129)	(0.125)
$lnPop_i$		7.805	14.334	17.551	12.539	18.712
		(59.317)	(62.639)	(61.433)	(61.820)	(61.802)
$lnPop_j$		2.008***	2.002***	2.259***	1.929***	2.276***
		(0.333)	(0.322)	(0.349)	(0.352)	(0.343)
Sea_j		0.054	-0.215	-0.001	-0.185	0.025
		(0.700)	(0.654)	(0.705)	(0.703)	(0.682)
$Acc._j$			0.509*			
			(0.281)			
$Corr._j$				0.985***		
				(0.342)		

PI_j					-0.177	
					(0.182)	
RL_j						1.505***
						(0.342)
Time fixed effects	yes	yes	yes	yes	Yes	yes
Country-pair effect	yes	yes	yes	yes	Yes	yes
Hausman	1.000	0.941	0.054	0.694	--	0.125
R2	0.119	0.212	0.276	0.263	0.235	0.292
Observations	721	721	684	684	684	684
No. of countries	48	48	46	46	46	46
Rho	0.664	0.572	0.492	0.553	0.549	0.526

Standard errors in parentheses. *** p<0.01, * p<0.1.
Source: Authors' estimations.

The African population is rising with an estimated growth rate of nearly 3%. Production and exports will increase as the population grows (Guan et al., 2020). Nigeria, Ethiopia, Egypt, DR Congo, and South Africa are the most populous countries in Africa and are also among China's top agri-food trading partners. The coefficients of Pop in j nations show that a percentage rise in will result in a decrease in China's agri-food import flows between 86% and 228%. Surprisingly, the variable access to sea is statistically significant with a negative effect only in the PPML model at 1% level.

For their part, $Corr._j$ and RL_j are the only institutional variables highly affecting agri-food imports between China and Africa with a statistical significance level

of 1%. Both boost African countries' agri-food imports from China between 99% ($Corr._j$) and 151% (RL_j). In this respect, Horsewood and Voicu (2012) suggested that the global corruption perception index encourages more international trade. Better institutions are represented by higher index numbers, which range from -2.5 to 2.5. Acc. positively affects agri-food at 1% significance level, with the effect being about 51%. Moreover, Boadu et al. (2021) showed that the quality of institutions for both Ghana and its trading partners significantly enhances trade efficiency between them. It is worth noting that none of the institutional variables are significant in the PPML model.

Table 8. PPML estimation for China's agri-food imports from Africa

Variables	(1)	(2)	(3)	(4)	(5)	(6)
$lnGDP_i$	1.114***	1.07***	1.104***	1.137***	1.126***	1.113***
	(0.136)	(0.437)	(0.412)	(0.421)	(0.421)	(0.416)
$lnGDP_j$	-0.289***	-0.293***	-0.150**	-0.197**	-0.174**	-0.164*
	(0.047)	(0.106)	(0.083)	(0.083)	(0.081)	(0.088)
$lnDis_{i\_j}$	0.313	2.205***	3.779***	3.557***	3.555***	3.514***
	(0.555)	(0.576)	(0.432)	(0.440)	(0.426)	(0.439)
$lnExch_{i\_j}$		-0.382***	-0.378***	-0.385***	-0.382***	-0.379***
		(0.025)	(0.024)	(0.024)	(0.024)	(0.024)
$lnPop_i$		8.471	4.645	4.398	4.340	4.583
		(8.995)	(8.575)	(8.782)	(8.816)	(8.641)
$lnPop_j$		0.922***	0.863***	0.902***	0.872***	0.868***
		(0.093)	(0.092)	(0.093)	(0.096)	(0.095)
Sea_j		-0.720***	-0.997***	-1.023***	-1.011***	-1.011***
		(0.157)	(0.116)	(0.116)	(1.116)	(0.115)

$Acc._j$			-0.095			
			(0.091)			
$Corr._j$				0.077		
				(0.113)		
PI_j					-0.022	
					(0.084)	
RL_j						-0.047
						(0.091)
Constant	-32.341	-228.293	-164.720	-157.828	-156.374	-160.926
	(6.640)	(177.652)	(169.464)	(173.909)	(174.696)	(171.176)
R2	0.140	0.510	0.610	0.598	0.604	0.607
Observations	721	721	684	684	684	684

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Source: Authors' estimation.

CONCLUSION

The aim of this study was to assess the impact of institutional quality on agri-food imports and exports between China and Africa during the 2001-2021 period. The gravity model of trade was employed by determining the GLS and PPML estimators. The results can be summarised in three different ways. First, the economic sizes of China and African countries, the population of African countries, and access to sea are positively associated with flows of China's agri-food exports to Africa. Second, the monetary policy of exchange rate discourages both agri-food imports and exports between China and Africa. Lastly, all the institutional variables (voice of accountability, control of corruption, political instability, and rule of law) boost both agri-food imports and exports between China and African nations.

Based on the above findings, we proposed the following policy suggestions that would help strengthen agri-food trade relations between China and Africa

and the sustainability of the industry. On the one hand, it is possible to promote Africa's agri-food exports to China by implementing economic policy reforms targeted at stimulating the economy of the continent. For instance, the African government should support business-friendliness to enhance the soundness of the investment environment, which would afterwards expand additional local output. China can also help African countries increase their economic sizes via technical training, knowledge transfer, infrastructure development, and investment, among other things. These activities would strengthen the economy of African nations and eventually boost trade with China. On the other hand, maintaining or increasing collaboration between China and African countries is essential for both parties to cement their ties and their economic and commercial cooperation in order to increase their agri-food trade. Moreover, China should consider reviewing its exchange rate policy, because a reduction in the exchange rate would lower domestic prices and increase foreign currency earnings. This would also allow the flow of domestic products to the international market, especially in developing countries such as those in Africa. What is more, the two parties should work together to have connectivity between them, thereby enhancing not only their trade, but also that between other regions of the world.

Furthermore, China and African countries should cooperate in developing a qualitative and effective institution. This would also attract more investment in agri-food production, processing, and trade, contributing to the growth of the sector. In this sense, China could use its Belt and Road Initiative to establish a trade promotion authority to facilitate trade with member nations. The authority should be responsible for promoting agri-food trade, identifying business opportunities, providing technical assistance, and resolving trade issues.

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Appendix A. List of countries involve in the study

S/No	Country	S/No	Country
1	Algeria	25	Liberia
2	Angola	26	Libya
3	Benin	27	Mali
4	Botswana	28	Madagascar
5	Burkina Faso	29	Malawi
6	Burundi	30	Mauritania
7	Cabo Verde	31	Mauritius
8	Cameroon	32	Morocco
9	Central Africa Republic	33	Mozambique
10	Chad	34	Namibia
11	Congo	35	Niger
12	Democratic Republic of Congo	36	Nigeria
13	Cote D'Ivoire	37	Rwanda
14	Djibouti	38	Senegal
15	Egypt	39	Sierra Leone
16	Equatorial Guinea	40	Somalia
17	Eritrea	41	South Africa
18	Ethiopia	42	Sudan
19	Gabon	43	Tanzania
20	Gambia	44	Togo
21	Ghana	45	Tunisia
22	Guinea	46	Uganda
23	Guinea Bissau	47	Zambia
24	Kenya	48	Zimbabwe