

Sustainable Vegetable Oil Systems and SDG Indicators in Major Producing Countries

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Abstract: This study examines the relationship between vegetable oil systems and Sustainable Development Goals (SDGs) indicators in major producing countries. The research focuses on palm oil and soybean oil as strategic global commodities that contribute to food security, employment, and economic sustainability. Secondary data were collected from international databases, including the World Bank, FAOSTAT, and USDA, covering major producer countries over a multi-year period. The analysis evaluates the interaction between vegetable oil production, trade dynamics, and selected SDG indicators related to poverty reduction, food availability, inequality, and economic growth. The findings indicate that vegetable oil development plays an important role in supporting national economic performance and improving several SDG indicators, although the impacts differ across countries depending on production structure, export orientation, and domestic policy conditions. Palm oil-producing countries showed stronger contributions to employment generation and export growth, while soybean-producing countries demonstrated greater stability in food supply systems. The study concludes that sustainable vegetable oil governance is essential to balance economic development, environmental sustainability, and social welfare in achieving the SDGs. These findings provide important insights for policymakers in designing sustainable agricultural and trade policies.

Keywords: Food systems; Palm oil; SDGs; Soybean oil; Sustainable vegetable oil.

Introduction

Vegetable oils have become strategic agricultural commodities due to their important role in food systems, industrial development, and global trade. Among various vegetable oils, palm oil and soybean oil dominate international markets because of their high production capacity and wide utilization in food, bioenergy, and manufacturing sectors. The increasing demand for vegetable oils is closely associated with population growth, urbanisation, and changing consumption patterns worldwide (Murphy et al, 2021). In many developing countries, the vegetable oil sector also contributes significantly to employment generation, export earnings, and rural development (Qaim et al, 2020). Consequently, the sustainability of vegetable oil

systems has become an important issue in achieving the Sustainable Development Goals (SDGs).

The Sustainable Development Goals emphasize the integration of economic, social, and environmental dimensions of development. Agricultural commodities such as palm oil and soybean oil are strongly linked with several SDGs, particularly poverty reduction, food security, decent work, and economic growth (United Nations, 2023b). Previous studies reported that agricultural trade expansion may increase national income and improve welfare indicators when supported by effective governance and sustainable production systems (Rahut et al, 2022). However, rapid expansion of vegetable oil production may also generate environmental pressure, land-use change, and inequality if sustainability principles are not adequately

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implemented (Meijaard et al, 2020). Therefore, understanding the interaction between vegetable oil dynamics and SDG indicators is essential for designing balanced agricultural policies.

Palm oil-producing countries such as Indonesia play a dominant role in the global vegetable oil market. Indonesia contributes substantially to global palm oil exports and provides livelihoods for millions of smallholder farmers (Purnomo et al, 2020). At the same time, soybean-producing countries such as Brazil and the United States maintain important positions in global food supply chains due to their high soybean productivity and export competitiveness (FAO, 2024). Differences in production structures, trade orientation, and policy frameworks among producing countries may create varying impacts on SDG achievement. Several studies indicated that commodity-based agricultural growth could improve employment and economic growth, although the distribution of benefits often differs among regions and socioeconomic groups (Rasul 2021; Santika et al. 2019; Santika et al, 2021).

Recent global challenges, including climate change, food insecurity, and market volatility, have increased international attention toward sustainable agricultural systems. The vegetable oil sector faces growing pressure to adopt environmentally responsible production practices while maintaining productivity and economic contribution (OECD and FAO, 2023). In addition, sustainability certification, traceability systems, and international environmental standards have become increasingly influential in determining market access and competitiveness of vegetable oil commodities (Hospes et al, 2019). These conditions indicate that the future development of palm oil and soybean oil industries cannot be separated from sustainability considerations and SDG commitments.

Based on these issues, this study aims to examine the relationship between palm oil and soybean oil dynamics and selected Sustainable Development Goals indicators in major producing countries. The study focuses on understanding how vegetable oil production and trade systems contribute to poverty reduction, food availability, inequality, and economic growth. The findings are expected to provide scientific insights for policymakers and stakeholders in strengthening sustainable agricultural development and improving the contribution of vegetable oil sectors toward SDG achievement.

Method

This study employed a quantitative explanatory research design to analyse the relationships between vegetable oil systems and Sustainable Development Goals (SDGs) indicators in major producing countries.

The research framework was developed based on the concepts of agricultural sustainability, international trade, and macroeconomic interactions, which explain that commodity production, trade performance, and socio-economic indicators are interconnected within a dynamic system (Pindyck and Rubinfeld, 2018). The study focused on palm oil and soybean oil as major global vegetable oil commodities with significant contributions to food systems and sustainable development.

The study utilised secondary data obtained from internationally recognised databases, including the Food and Agriculture Organization (FAOSTAT), the World Bank Open Data, and the United States Department of Agriculture (USDA). The dataset covered major vegetable oil-producing countries over a multi-year observation period to capture long-term trends and structural changes in production, trade, and sustainability indicators. The variables analysed included vegetable oil production, export performance, domestic consumption, poverty indicators, food availability, inequality indicators, and economic growth indicators.

Data analysis was conducted using a quantitative econometric approach. Prior to estimation, all variables were standardised into comparable measurement units. Logarithmic transformation was applied to several variables to stabilise variance and improve model interpretation through elasticity values (Gujarati and Porter, 2009). Stationarity and data consistency tests were also performed to ensure the reliability of the estimation results (Enders, 2015).

The analytical model consisted of interrelated equations representing production systems, trade dynamics, and SDG indicators. The general form of the model is expressed as follows:

$$Y_1 = \alpha_0 + \alpha_1 P + \alpha_2 X + u_1 \quad (1)$$

$$Y_2 = \beta_0 + \beta_1 Y_1 + \beta_2 Z + u_2 \quad (2)$$

where Y_1 and Y_2 represent endogenous variables associated with vegetable oil systems and SDG indicators, while P , X , and Z denote exogenous variables such as international prices, exchange rates, and macroeconomic indicators. The terms u_1 and u_2 represent stochastic error terms.

Considering the interdependence among variables, the estimation process employed the Two-Stage Least Squares (2SLS) method to obtain consistent and unbiased parameter estimates in the presence of simultaneity (Greene, 2018; Wooldridge, 2016). Model estimation and statistical analysis were conducted using Statistical Analysis System (SAS) software through the PROC SYSLIN procedure. Diagnostic tests were performed to evaluate model validity, including

multicollinearity, autocorrelation, and heteroskedasticity tests. Model performance was assessed using the coefficient of determination (R^2), F-statistics, and significance levels of the estimated parameters.

This methodological approach provides a systematic framework for understanding how vegetable

oil production and trade dynamics influence sustainable development indicators in major producing countries. The approach also enables comprehensive evaluation of the role of agricultural commodity systems in supporting sustainability and SDG achievement. In this study, there are 50 functions, depicted in Figure 1.

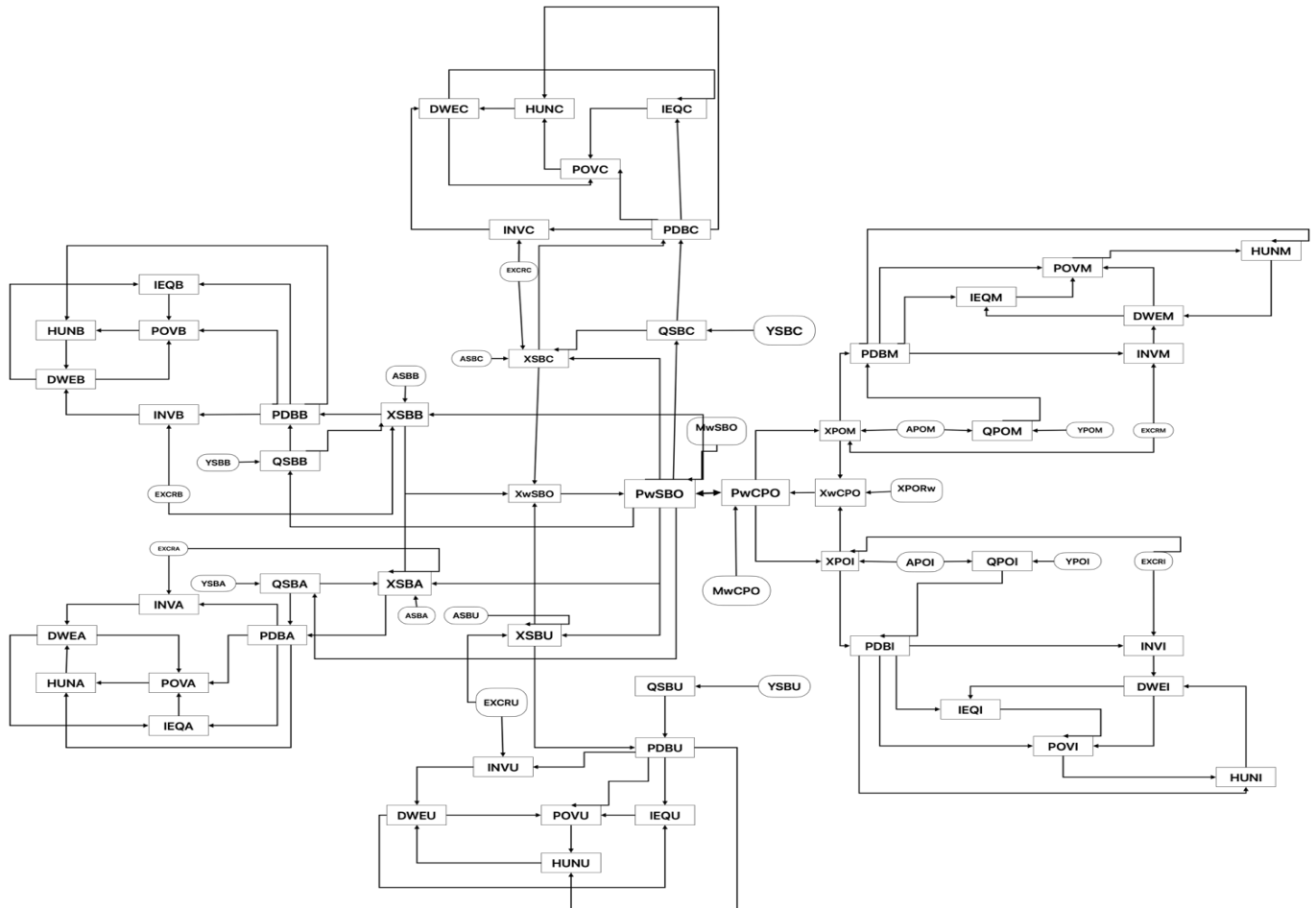


Figure 1. Linkage diagram

Description:
 ○ = Variable exogenous
 □ = Variable endogenous

Result and Discussion

Development of SDGs Indicators Poverty

The results indicate that poverty levels generally declined across major vegetable oil-producing countries during the observation period. China demonstrated the most substantial reduction, where the proportion of people living below USD 3 per day declined sharply from around 62% in 1994 to approximately 5.2% in 2024. Indonesia also showed a significant improvement, with poverty decreasing from approximately 47% to 8.5% during the same period. Malaysia maintained relatively

low poverty levels and achieved a stable downward trend throughout the observation years.

In contrast, Argentina and Brazil exhibited more fluctuating poverty dynamics, particularly during periods of economic instability. Brazil nevertheless experienced a long-term decline from around 35% to 13%, indicating gradual socio-economic improvement. The United States maintained the lowest poverty incidence among the observed countries, although the reduction trend was relatively limited compared with developing producer countries.

These findings suggest that expansion of vegetable oil industries contributed positively to economic activity, employment opportunities, and income

generation, particularly in developing economies with strong export-oriented agricultural sectors. Countries with more stable production and export structures

tended to achieve more consistent poverty reduction outcomes.

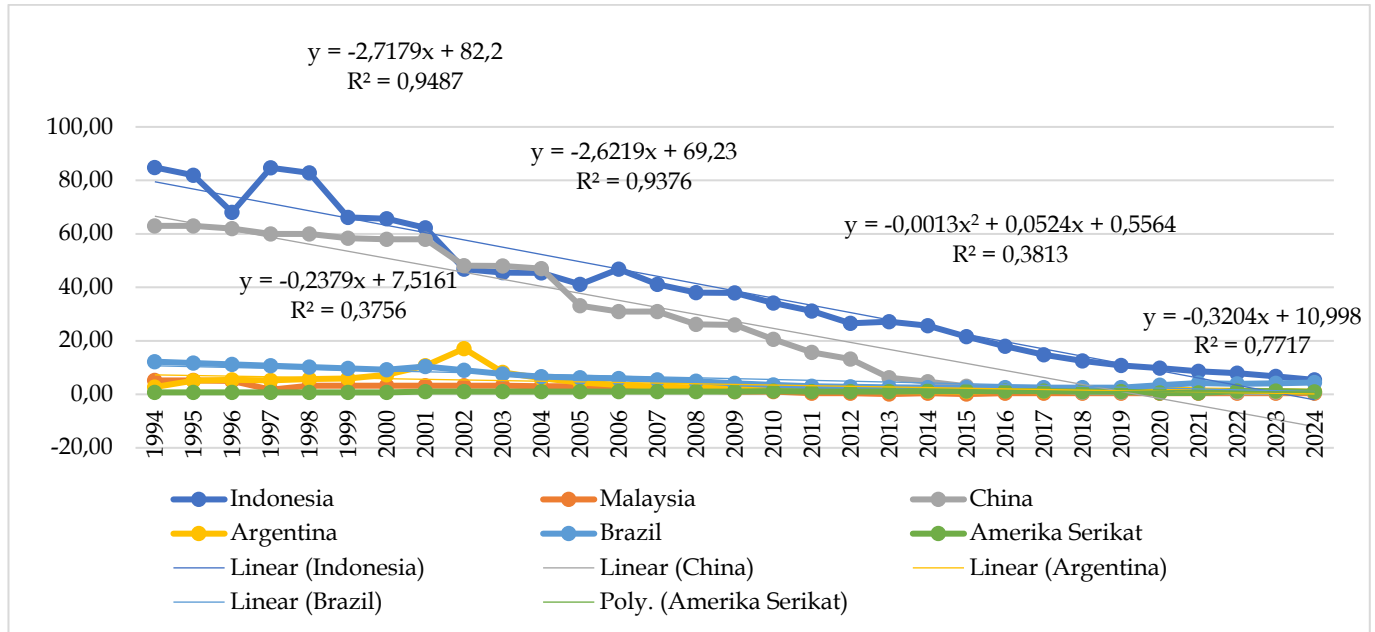


Figure 2. Poverty Rate Trends in Major Producing Countries, 1994–2024

Hunger

The prevalence of undernourishment declined in most countries during the study period. China recorded the strongest improvement, followed by Indonesia and Brazil. The reduction in hunger levels reflects improvements in food availability, agricultural productivity, and economic access to food resources. Malaysia maintained relatively low undernourishment rates throughout the period, while the United States

exhibited the most stable food security condition among the observed countries.

Although the overall trend was downward, some countries experienced temporary fluctuations caused by external economic shocks and domestic structural challenges. The findings indicate that agricultural commodity development, including vegetable oil production, plays an important role in strengthening food systems and supporting SDG targets related to hunger reduction.

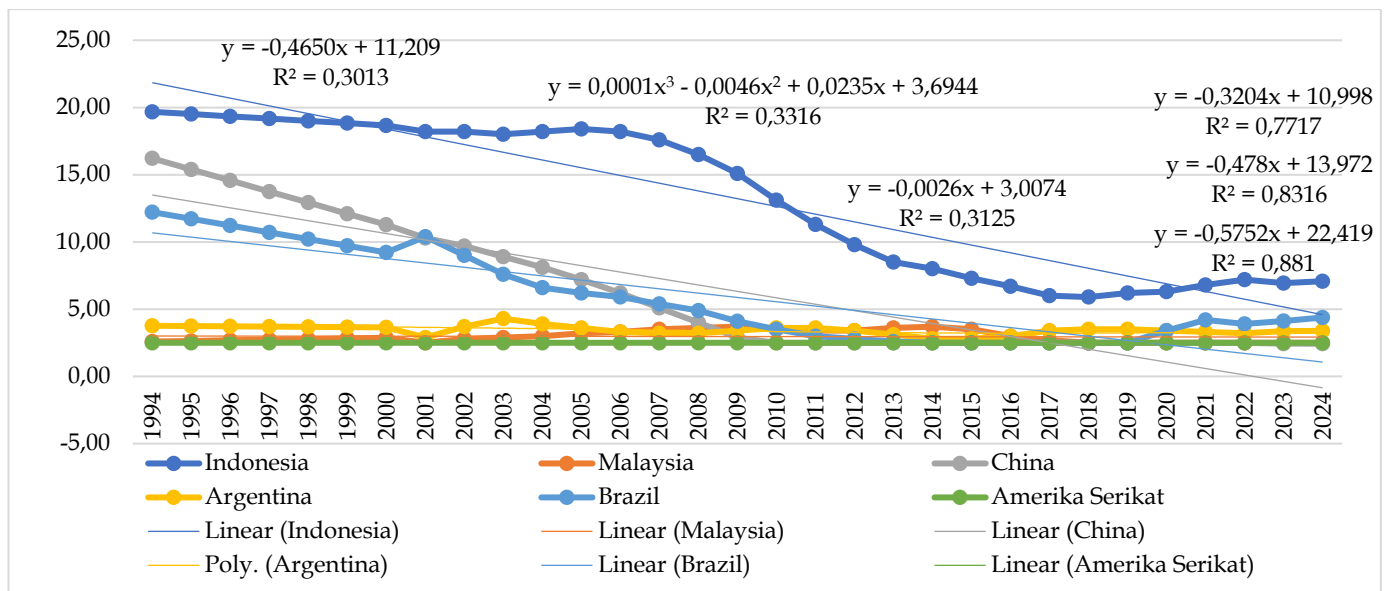


Figure 3. Hunger Trends in Major Producing Countries, 1995–2020

Inequality

Income inequality showed heterogeneous patterns across countries. Brazil and Argentina experienced gradual declines in the Gini Index, indicating improvements in income distribution over time. Malaysia also recorded relatively stable reductions in inequality. Conversely, China and Indonesia initially experienced increasing inequality during periods of rapid economic growth before showing partial improvement in later years.

The United States exhibited a mild upward trend in inequality, reflecting persistent income concentration despite relatively stable economic growth. These findings imply that economic expansion generated by vegetable oil industries does not automatically guarantee equitable income distribution. The effectiveness of redistribution policies, labour absorption, and institutional governance strongly influence inequality outcomes across countries.

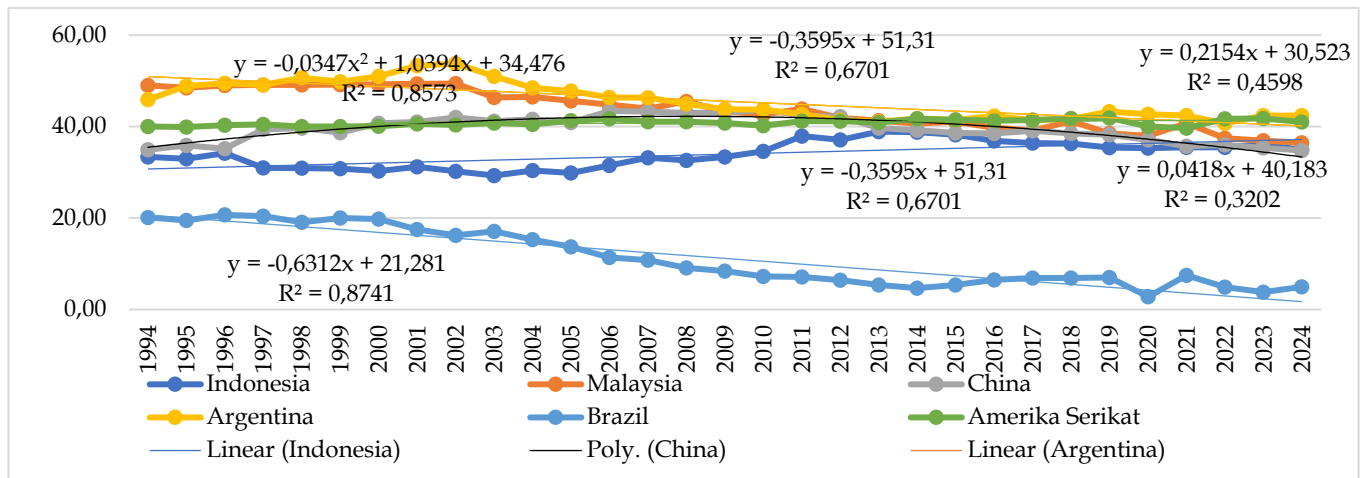


Figure 4. Development of Inequality in Major Producing Countries, 1995–2020

Decent Work and Economic Growth

Economic growth and decent work indicators varied considerably among countries. China achieved the highest and most stable economic growth during the early observation period, although growth gradually moderated over time. Malaysia also maintained relatively stable economic performance. Indonesia, Brazil, and Argentina experienced more volatile growth patterns, particularly during periods of global economic uncertainty.

The results further indicate that countries with stronger agricultural export performance tended to demonstrate better employment generation and economic growth. However, external shocks, exchange rate instability, and structural economic dependence affected the sustainability of labour market improvements. Overall, vegetable oil industries contributed positively to employment creation and macroeconomic performance, particularly in export-oriented economies.

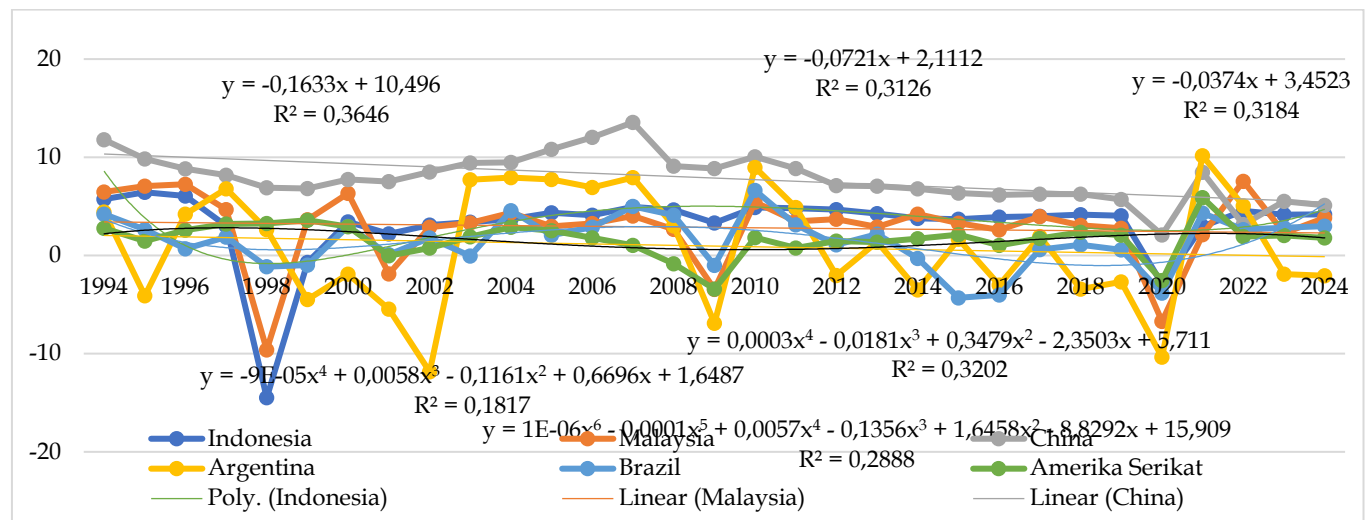


Figure 5. Development of Decent Work and Economic Growth in Major Producing Countries, 1995–2020

Equation Estimation Results

The simultaneous equation estimation produced relatively high coefficients of determination (R^2) for most equations, indicating that the model adequately explained the variation of endogenous variables within the system. Gross Domestic Product (GDP) equations in Indonesia, Malaysia, Brazil, China, Argentina, and the United States recorded R^2 values above 0.79, with several equations exceeding 0.95. This suggests strong explanatory power of the selected variables in describing economic performance in major vegetable oil-producing countries.

The estimation results show that vegetable oil production and export variables generally had positive effects on GDP and investment. In Indonesia, palm oil production positively influenced GDP, while investment was positively affected by GDP growth but negatively associated with exchange rates. Similar relationships were observed in Malaysia, Brazil, China, and Argentina, indicating that agricultural commodity expansion contributes to broader macroeconomic performance.

The decent work and economic growth equations also demonstrated positive relationships between investment and labour market performance. Investment variables significantly influenced decent work indicators in Indonesia, Malaysia, and the United States. These findings suggest that agricultural sector expansion stimulates employment opportunities and economic productivity.

Poverty equations consistently showed negative relationships between GDP and poverty indicators across countries, indicating that higher economic growth contributes to poverty reduction. However, the

magnitude and significance differed among countries, reflecting variations in institutional quality, labour market conditions, and social policies. Inequality variables generally exhibited positive relationships with poverty, suggesting that unequal income distribution weakens the effectiveness of economic growth in reducing poverty.

The hunger equations indicated that GDP growth tended to reduce undernourishment levels, although the statistical significance varied across countries. Poverty variables positively affected hunger indicators, implying that food insecurity remains closely associated with low income and limited economic access to food resources.

Global vegetable oil prices also played an important role within the system. Crude palm oil (CPO) prices positively influenced export performance and production levels in several producing countries. Likewise, soybean oil prices contributed positively to soybean export dynamics. These findings confirm the strategic role of international commodity markets in shaping domestic economic and sustainability outcomes.

Overall, the empirical results demonstrate that vegetable oil systems are closely linked with SDG indicators through multiple transmission channels, including economic growth, investment, employment, poverty reduction, and food security. Nevertheless, the impacts differed across countries depending on production structure, export dependence, and macroeconomic stability. The findings highlight the importance of sustainable agricultural governance and inclusive development policies to maximise the contribution of vegetable oil industries toward SDG achievement.

Table 1. Comparison of Estimation Results

Variabel Endogen	R-Square	Variabel Eksogen	Parameter Estimate	Signifikansi
PDBI	0.95783	APOI	0.007213	0.0986
		XPOI	0.205508	0.4416
		LPDBI	0.770966	<.0001
INVI	0.74079	PDBI	20.75568	0.0010
		EXCRI	-0.00286	0.0038
		IRI	-0.30418	0.2563
PDBM	0.97566	LINVI	0.25271	0.3263
		APOM	0.181846	0.0647
		XPOM	0.177999	0.4239
INVM	0.65321	LPDBM	0.805477	<.0001
		PDBM	1.058055	0.0008
		EXCRM	-0.28766	0.2348
PDBB	0.91553	IRM	-0.05463	0.1328
		LINVM	0.07856	0.7126
		ASBB	0.013541	0.9333
INVB	0.90574	XSBB	0.252694	0.1616
		LPDBB	0.964902	<.0001
		PDBB	0.557204	0.0016
		EXCRB	-0.06223	0.2765
		IRB	-0.00225	0.1756

Variabel Endogen	R-Square	Variabel Eksogen	Parameter Estimate	Signifikansi
PDBC	0.99763	LINVB	0.624927	<.0001
		ASBC	0.019999	0.8613
		XSBC	0.034408	0.1649
INVC	0.89614	LPDBC	0.961538	<.0001
		PDBC	0.470550	0.0010
		EXCRC	-0.40831	0.1065
PDBA	0.79274	IRC	-0.05968	0.0319
		LINVC	1.139389	<.0001
		ASBA	0.256425	0.5792
INVA	0.76957	XSBA	0.134655	0.1748
		LPDBA	0.834322	<.0001
		PDBA	1.003307	0.0027
PDBU	0.97378	EXCRA	-0.00186	0.0160
		IRA	-0.03707	0.0148
		LINVA	0.024625	0.9013
INVU	0.7544	QSBU	0.039499	0.1816
		XSBU	0.018725	0.1428
		LPDBU	0.965331	<.0001
DWEI	0.79813	PDBU	0.912591	0.1002
		IRU	-0.02707	0.1731
		LINVU	0.374530	0.0998
POVI	0.94413	INVI	0.255836	0.0405
		QPOI	2.100644	0.1444
		HUNI	-0.39225	0.1898
IEQI	0.89461	LDWEI	0.042756	0.8505
		PDBI	-3.95914	0.1748
		DWEI	-0.00307	0.1994
HUNI	0.99617	IEQI	0.017025	0.1989
		LPOVI	0.820197	0.0103
		DWEI	-0.00253	0.1965
DWEM	0.78189	PDBI	-0.73122	0.1060
		LIEQI	0.758548	<.0001
		PDBI	-0.41118	0.1253
POVM	0.86762	POVI	0.01253	0.1907
		LHUNI	0.997548	<.0001
		INVM	3.130149	0.0228
IEQM	0.95416	QPOM	5.753091	0.0800
		HUNM	-1.48453	0.4606
		LDWEM	0.075483	0.6952
HUNM	0.78564	PDBM	-2.44203	0.0382
		DWEM	-0.03067	0.1543
		IEQM	0.137265	0.1308
DWEB	0.74400	LPOVM	0.344029	0.1130
		DWEM	-0.07135	0.1272
		PDBM	-4.88527	0.0078
POVB	0.98281	LIEQM	0.305842	0.1941
		PDBM	-0.01269	0.1933
		POVM	0.02694	0.1662
IEQB	0.85972	LHUNM	0.938026	<.0001
		INVB	0.392715	0.1756
		QSBB	3.990884	0.1249
PDBB	0.98281	HUNB	-0.40872	0.1347
		LDWEB	0.178242	0.1856
		PDBB	-1.76722	0.0543
LIEQB	0.85972	DWEB	-0.01727	0.1256
		IEQB	1.258452	<.0001
		LPOVB	0.204960	0.0862
PDBB	0.98281	DWEB	-0.14674	0.1937
		PDBB	-1.16425	0.1758
		LIEQB	0.729008	0.0003

Variabel Endogen	R-Square	Variabel Eksogen	Parameter Estimate	Signifikansi
HUNB	0.97494	PDBB	-0.13278	0.1914
		POVB	0.02842	0.1133
DWEK	0.72761	LHUNB	0.976760	<.0001
		INVC	0.111247	0.1843
		QSBC	1.900815	0.1547
		HUNC	-0.35976	0.1762
POVC	0.98820	LDWEC	0.669105	0.0142
		PDBC	-11.4047	0.0250
		DWEC	-0.26281	0.4818
		IEQC	0.38779	0.1961
IEQC	0.79619	LPOVC	0.489393	0.0296
		DWEC	-0.145358	0.2968
		PDBC	-0.45280	0.0835
HUNC	0.99874	LIEQC	0.788848	<.0001
		PDBC	-0.370330	0.1234
		POVC	0.01664	0.1789
DWEA	0.3142	LHUNC	1.098036	<.0001
		INVA	0.033248	0.9871
		QPOA	1.823986	0.5820
		HUNA	-4.989430	0.1707
POVA	0.91233	LDWEA	0.198692	0.4317
		PDBA	-1.93700	0.1319
		DWEA	-0.19904	0.0004
		IEQA	0.450234	0.0019
IEQA	0.92534	LPOVA	0.212435	0.1641
		DWEA	-0.11219	0.0178
		PDBA	-0.879403	0.4828
HUNA	0.53156	LIEQA	1.041235	<.0001
		PDBA	-0.37791	0.1326
		POVA	0.01000	0.7372
DWEU	0.36632	LHUNA	0.359122	0.0767
		INVU	1.460470	0.0406
		QPOU	4.49546	0.0611
		HUNU	-2.261179	0.7458
POVU	0.75941	LDWEU	0.40132	0.1108
		PDBU	-0.18442	0.1768
		DWEU	-0.009132	0.6367
		IEQU	0.175864	0.0073
IEQU	0.49467	LPOVU	0.499016	0.0520
		DWEU	-0.112066	0.1976
		PDBU	-0.40495	0.5689
HUNU	0.60156	LIEQU	0.883195	0.0039
		PDBU	-0.37791	0.1326
		POVU	0.045000	0.1926
PwCPO	0.67621	LHUNU	0.359122	0.0837
		XwCPO	-0.004912	0.1655
		MwCPO	0.096017	0.1696
		PwSBO	0.062808	0.3077
PwSBO	0.33439	LPwCPO	0.495156	0.0096
		XwSBO	-0.00047	0.6261
		MwSBO	0.30343	0.2012
		PwCPO	1.191869	0.1359
XPOI	0.98488	LPwSBO	0.17590	0.1564
		PwCPO	0.11637	0.2085
		APOI	0.149932	0.5447
XPOM	0.96881	LXPOI	0.833575	0.0001
		PwCPO	0.07462	0.1129
		APOM	0.194117	0.2025
XSBC	0.43867	LXPOM	0.768742	<.0001
		PwSBO	0.146718	0.1144

Variabel Endogen	R-Square	Variabel Eksogen	Parameter Estimate	Signifikansi
XSBB	0.40007	ASBC	0.90644	0.3735
		LXSBC	0.609748	0.0019
		PwSBO	0.018979	0.1649
XSBA	0.91666	ASBB	0.03812	0.1317
		LXSBB	0.618442	0.0020
		PwSBO	0.053655	0.0938
XSBU	0.32426	ASBA	0.612599	0.0032
		LXSBA	0.347563	0.0397
		PwSBO	0.04929	0.1091
QPOI	0.99712	ASBU	0.227266	0.1674
		LXSBU	0.357345	0.0321
		APOI	0.344264	0.0248
QPOM	0.95817	YPOI	0.088877	0.0124
		PwCPO	0.001941	0.9604
		LQPOI	0.628659	<.0001
		APOM	0.091301	0.1687
		YPOM	0.79015	0.1993
QSBB	0.99948	PwCPO	0.022022	0.1978
		LQPOM	0.789611	0.0003
		ASBB	1.006696	<.0001
		YSBB	3.367870	<.0001
QSBC	0.98824	PwSBO	0.00050	0.8349
		LQSBB	0.03173	0.1808
		ASBC	0.098574	0.7671
		YSBC	0.037991	0.7976
QSBA	0.99975	PwSBO	0.021495	0.1090
		LQSBC	0.921930	<.0001
		ASBA	1.031365	<.0001
		YSBA	2.483374	<.0001
QSBU	0.99948	PwSBO	0.002923	0.2356
		LQSBA	0.01360	0.1218
		ASBU	1.049703	<.0001
		YSBU	3.178925	<.0001
		PwSBO	0.001589	0.1783
		LQSBU	0.03304	0.1252

The estimation results presented in Table 1 indicate that the simultaneous equation model successfully captured the interrelationship between vegetable oil systems and Sustainable Development Goals (SDGs) indicators in major producing countries. Most structural equations generated relatively high coefficients of determination (R^2), particularly GDP, production, export, and poverty equations, suggesting that the selected explanatory variables were capable of explaining a substantial proportion of variation in endogenous variables. Several GDP equations, including Indonesia, Malaysia, China, and the United States, recorded R^2 values above 0.95, indicating strong model performance and consistency with macroeconomic linkage theory (Greene, 2018; Wooldridge, 2016).

The results further demonstrate that vegetable oil production and export activities positively contributed to economic growth across producing countries. Palm oil and soybean production variables generally showed positive parameter estimates in GDP equations,

implying that expansion of agricultural commodity sectors supports national output and investment performance. These findings are consistent with previous studies explaining that agricultural commodity development contributes significantly to rural economic transformation, export earnings, and labour absorption in developing economies (Astari, 2025; Chong & Loh, 2023; Enders, 2015). In Indonesia and Malaysia, palm oil exports positively influenced GDP performance, reflecting the strategic role of export-oriented agricultural sectors in supporting macroeconomic stability and foreign exchange earnings.

Investment equations also revealed that GDP growth positively affected investment levels in nearly all observed countries. Conversely, exchange rate variables and interest rates generally showed negative relationships with investment, indicating that macroeconomic instability may discourage capital formation and productive expansion. Similar findings were reported by (FAO, 2024; United Nations, 2023a), which emphasised that agricultural investment

performance is highly sensitive to financial conditions, exchange rate volatility, and international market uncertainty.

The decent work and economic growth equations showed that investment variables positively affected labour market performance, particularly in Indonesia, Malaysia, and the United States. This suggests that expansion of vegetable oil industries contributes to employment creation and productivity improvement. However, the relatively moderate significance levels in several countries indicate that employment dynamics are also influenced by structural factors such as labour market efficiency, technological change, and institutional quality (Indexmundi, 2025; Li, 2024; Ngan et al., 2022). Countries with stronger industrial integration and downstream processing capacity tended to demonstrate better decent work performance.

Poverty equations consistently showed negative relationships between GDP and poverty indicators, indicating that economic growth generated through agricultural commodity expansion contributes to poverty reduction. China and Indonesia demonstrated stronger poverty reduction trajectories compared with several other countries, reflecting the role of rapid economic transformation and agricultural productivity improvement. These findings support previous empirical studies suggesting that agricultural growth remains an important mechanism for reducing rural poverty and improving household welfare (Shahimi et al., 2023; Sukiyono et al., 2024). Nevertheless, inequality variables exhibited positive relationships with poverty indicators, implying that unequal income distribution may weaken the poverty-reducing effects of economic growth.

The inequality equations produced mixed results across countries. GDP variables generally showed negative coefficients, suggesting that higher economic growth may contribute to improved income distribution under supportive institutional conditions. However, several countries still experienced persistent inequality despite economic expansion, indicating that growth alone is insufficient to ensure equitable welfare distribution. Similar conclusions were highlighted by (Fosch & al., 2023; Vijay et al., 2021), who argued that sustainability outcomes in commodity-based economies depend heavily on governance quality, social inclusion, and redistribution mechanisms.

The hunger equations demonstrated that GDP growth tended to reduce undernourishment levels, while poverty variables positively influenced hunger indicators. These results confirm the close relationship between economic access, food security, and agricultural development. Countries with more stable agricultural production systems and stronger economic growth generally experienced lower hunger prevalence.

According to (FAO, 2024; Jelsma et al., 2022), improvements in agricultural productivity and food trade integration contribute substantially to reducing undernourishment and strengthening food system resilience.

The global price equations further reveal the interconnectedness between palm oil and soybean oil markets. Crude palm oil (CPO) prices positively influenced export and production variables, while soybean oil prices also contributed positively to soybean trade dynamics. This finding confirms the high degree of integration within global vegetable oil markets, where price movements in one commodity affect production and trade decisions in other commodities. Previous studies noted that global vegetable oil markets are increasingly interconnected due to substitution effects, international trade integration, and changing consumption patterns (World Bank, 2025).

Overall, the estimation results indicate that vegetable oil systems have multidimensional impacts on SDGs indicators through economic growth, investment, employment generation, poverty reduction, and food security channels. However, the magnitude and consistency of these impacts differed among countries depending on economic structure, export dependency, institutional conditions, and macroeconomic stability. These findings highlight the importance of sustainable agricultural governance and inclusive development policies in maximising the contribution of vegetable oil industries toward SDG achievement.

Conclusion

This study demonstrates that vegetable oil systems, particularly palm oil and soybean oil, have significant relationships with Sustainable Development Goals (SDGs) indicators in major producing countries. The results indicate that the development of vegetable oil production and trade contributes positively to economic growth, investment, employment generation, poverty reduction, and food availability. Countries with stronger export performance and more stable agricultural systems generally experienced more consistent improvements in SDG indicators.

The empirical findings also reveal that the impacts of vegetable oil industries differ across countries depending on economic structure, institutional conditions, and macroeconomic stability. While several countries achieved substantial reductions in poverty and hunger, inequality dynamics remained heterogeneous. The results suggest that economic growth generated by agricultural commodity expansion does not automatically ensure equitable welfare distribution.

Overall, sustainable governance of vegetable oil systems is essential to balance economic development,

social welfare, and sustainability objectives. Strengthening inclusive agricultural policies, improving productivity, and maintaining sustainable trade systems are important strategies to enhance the contribution of vegetable oil sectors toward SDG achievement in major producing countries.

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Author Contributions

N.H., Z.A.: Conceptualization; N.H., D.N.: methodology; N.H., Z.A., D.N.: software; Z.A., D.N., A.R., M.Y., K.R.: validation; N.H.: formal analysis; investigation, writing original, draft preparation, writing, review and editing, visualization; Z.A.: resources; A.R., M.Y., K.R.: data curation; Z.A., D.N.: supervision; Z.A.: project administration, funding acquisition.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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