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Economic Ramifications of the European Union Ban on Vegetables and Other Produce from Ghana Due to Illegal Mining

Joseph Kofi Nkuah [a*] and Ignatius Akwasi Amankwah [b]

[a] Department of Management and General Studies, School of Business, Christian Service University, Post Office Box 3110, Kumasi, Ghana.
[b] Bodi District Assembly, Post Office Box 66, Juabeso, Ghana.

Authors' contributions

This work was carried out in collaboration between both authors. Author JKN led the study's design, methodology, data analysis, and discussion, anchoring it in economic theory and policy relevance. Author IAA coordinated fieldwork, enabled local data collection, and authored key contextual sections. Both authors read and approved the final manuscript.

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ABSTRACT

The research evaluates the financial consequences resulting from the EU vegetable and produce import restrictions against Ghana because of its "galamsey" environmental effects. The research explains the immediate monetary damage faced by farmers as well as examines both macroeconomic rural impacts alongside business initiatives to limit the adverse effects on the agricultural industry. The research design combines quantitative data collection through mixed-methods with qualitative research methods to accomplish a detailed economic analysis of the EU

**Corresponding author: E-mail: jknkuah@csuc.edu.gh;*

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ban. The Ghana Export Promotion Authority (GEPA) together with EU Trade Reports and national and international trade bodies supplied secondary data related to agricultural export volumes and values which Ghana exported to the EU. The research team distributed a designed survey to farmers who operated own small farms in addition to agricultural groups and local agricultural business operators. Quantitative data assessment for export patterns and production histories relied on descriptive statistics and regression analysis and time-series analysis through statistical methods. The evaluation of export earnings changes from EU trade policy updates because of illegal mining utilized OLS regression methods.

The export volumes decreased dramatically after the EU ban from 35,000 to 25,000 tonnes. The banning era resulted in a GDP decline for each person in the population which decreased from $1,200 before the ban to reach $1,000 after the ban implementation. National GDP per capita decreased by 16.7% indicating that economic fallout from the EU ban impacted every sector in the country beyond fishing. The research indicated that expansion-based production directly boosts export volumes when the regression coefficient (β1>0\beta_1 > 0β1>0) show positive effects yet higher production does not necessarily result in export expansion when these coefficients demonstrate negative impacts. Additional intervention measures are needed for smallholder training while improving international standard support systems should be implemented according to the study's findings. The adoption of supporting measures will decrease financial constraints and keep small farming intact because agriculture continues to be essential for Ghana's agricultural export sector.

Keywords: Economic ramifications; ban; illegal mining; reduced export volumes; agribusiness.

1. INTRODUCTION

Ambitions for economic success in Ghana have historically depended heavily on agricultural products and minerals discovered throughout the country. Illegal mining activities known as "galamsey" generate severe environmental as well as economic damage throughout the region. The galamsey practices throughout recent years developed into an emergency condition which has polluted water bodies alongside causing forest depletion and agricultural land pollution. The EU together with other international stakeholders watches Ghana closely due to extensive environmental deterioration that has disturbed their trading relationship. The European Union introduced an import ban on particular vegetables and agricultural products from Ghana because the extensive use of dangerous chemicals occurred in illegal mining operations. The regulatory change has caused extensive financial impacts to affect Ghana's farming industry along with its export revenue and environmental effects on farmers' communities.

Studies prove that the destructive outcomes of illegal mining operations known as galamsey which plague Ghana have become a well-known environmental problem. The mining industry's application of mercury along with cyanide produces harmful effects to water sources and soil thereby diminishing their value as essential agricultural resources. The farming of vegetables throughout Ghana relies heavily on contaminated water sources caused by mining operations. Studies indicate that agricultural crops receive water irrigation from polluted sources which raises questions about international market exports to the EU including these products (Aryee et al., 2022). The proclaimed excellence of Ghanaian agricultural products has seriously deteriorated which directly determines export prospects.

The EU developed an import ban for particular agricultural products from Ghana because of contamination concerns. Scientists reported dangerous toxic substance and heavy metal levels in Ghanaian vegetables that endangered consumer health so the EU implemented a ban (European Commission, 2023). The EU, a significant market for Ghanaian produce, accounts for a substantial portion of the country’s agricultural exports, particularly in vegetables such as chili peppers, aubergines, and okra. The implementation of this ban caused Ghana to lose substantial amounts of foreign exchange that normally came from vegetable exports.

Such consequences affect the industry beyond simple monetary deficits. Weak agricultural governance in Ghana became exposed after the EU implemented its ban because the sector exhibited poor standards enforcement along with ineffective quality check systems for exports. The

Ghanaian government faces criticism because it did not establish appropriate agricultural supply chain regulations to defend against illegal mining effects. The lack of proper safeguards has damaged Ghana's reliability as an agricultural exporter which decreases its market competitiveness abroad (Owusu & Asare, 2022).

The execution of illegal mining activities resulted in the EU ban and generated important environmental destruction that will continue affecting agricultural practices over time. Large bodies of water that support farming and drinking water have been polluted by Mercury which was utilized in gold extraction practices. The destruction of the environment from mining operations creates major health threats for local residents whose research has confirmed rise in waterborne diseases and heavy metal contamination affecting nearby residents (Adjei et al., 2022). E.U. authorities implemented stringent import controls partly because harmful chemicals are contaminating food products thus creating safety concerns.

Problem statement: The agricultural sector functions as a fundamental industrial base in Ghana through its substantial delivery of rural development strategies and job prospects along with international exchange revenues. The agricultural sector in Ghana encountered a significant reverse because of environmental damage resulting from illegal mining activities also known as galamsey. The destructive practice of illegal mining known as galamsey has caused extensive environmental contamination of water sources and agricultural fields thereby putting the safety of the local produce at risk. The ecological crisis in Ghana forced the European Union to bar imports of specific vegetable products along with other produce from Ghana to their member states. The ban occurred because EU authorities identified heavy metals and chemicals from illegal mining that endangered food product safety according to Danso-Abbeam et al., (2021).

The decision of the EU to block vegetable imports from Ghana creates severe economic consequences for everyone involved. The EU represents a major segment of exported agricultural goods from Ghana because the nation depends heavily on agricultural exports. These restrictions on imports by the EU offer devastating consequences to farmers and agribusinesses and the entire national economy that includes reduced foreign exchange revenue and employment cutbacks and worsening rural poverty conditions. The agricultural export restrictions resulting from the EU ban create multiple economic challenges because they impact shipping operations and packaging services and many product-related businesses (Owusu & Asare, 2022).

The research investigates both financial and market effects stemming from the EU vegetable trade restrictions which Ghana faces because of environmental damage caused by galamsey. This research investigates agricultural sector monetary losses while evaluating economic impacts on rural areas with agribusinesses and explores available countermeasures.

2. LITERATURE REVIEW

The context of illegal mining (Galamsey) in Ghana: Galamsey or illegal mining persists as a long-standing issue in Ghana existing since colonial times although it has grown more intense during the last several decades. Galamsey originates from the phrase gather them and sell which describes unauthorized gold extraction activities performed by both individuals and small bands lacking authorized mining permits. Alluvial and hard rock deposits supply the extraction target of illegal miners who use basic extraction techniques but create numerous environmental and social problems (Tweneboah-Koduah et al., 2020).

Ghana recorded its most dramatic surge of illegal mining activities in the 1980s when the mining sector started to liberate restrictions. The World Bank together with the IMF implemented Structural Adjustment Program (SAP) through Ghana's government which urged foreign investments into large-scale mining as a strategy to enhance the national economy. Large corporations with abundant financial resources pushed most traditional small-scale miners from the mineral extraction sector because of their economic limitations. Due to economic limitations the local residents began practicing illegal mining through galamsey according to Tweneboah-Koduah et al., (2020).

Galamsey activities primarily take place in the gold-bearing areas across the Western and Central regions and Ashanti areas. Thousands of people currently receive employment through illegal galamsey activity because labor opportunities are scarce in rural zones. The detrimental effects that

result from illegal mining on Ghana's environment and economy together with public health problems have become major national issues.

Various economic and social elements lead to the ongoing practice of illegal mining throughout Ghana. The primary cause leading to illegal mining starts with unemployment combined with poverty. Numerous people adopt illegal mining since they discover no other viable employment options despite living in rural regions. The situation becomes worse because mining community members generally lack education skills while their only viable option for employment is artisanal mining (Antwi-Boateng & Akudugu, 2020).

The formal mining regulations in Ghana present barriers that make it complex for small-scale miners to acquire authorization documents. The official mining operations in Ghana require individuals to obtain land ownership and perform environmental assessments and pay financial dues which prove inaccessible to most local residents. A substantial number of people end up working in unlawful mining operations because of this situation (Antwi-Boateng & Akudugu, 2020).

The enforcement of mining laws remains weak among the main drivers which lead to illegal mining activities. The mining control regulations that exist in Ghana face inconsistent enforcement within the country. Local officials along with law enforcement agencies sporadically grant operating allowances to illegal miners because of their own corruption activities. Political self-interest is frequently observed because certain politicians protect galamsey operators to maintain political support in mining areas (Harinda et al., 2021).

Impact of illegal mining in Ghana: Galamsey operations produce disastrous environmental results that extend throughout various areas. Effective water cleanliness proves to be one of the gravest effects emerging from galamsey. The extraction process of illegal miners requires the toxic combination of mercury and cyanide to free gold from ore deposits. Local water sources get contaminated with these chemicals when they drain into rivers and streams thereby rendering them unfit for human use and agricultural watering. Galamsey operations have led to severe pollution in the southern Ghana water supply by damaging the vital Pra and Ankobra rivers (Osman et al., 2022).

Land degradation along with deforestation spread across locations affected by illegal mining activities in Ghana. Mining operations require deforestation which creates mining areas and some miners permanently desert their sites after gold extraction thus producing extensive empty pits and stripped lands. Soil erosion together with biodiversity destruction occurs in these regions because of forest destruction (Osman et al., 2022).

Community welfare faces environmental risks from illegal mining operations through the process of river siltation. Risk-decreasing activities at riverbeds intended for gold extraction result in major sediment buildup that creates negative effects on river water quality and hydrological operations. The decline of fish populations from this practice has reduced the income base of residents who rely on fishing for their living (Bansah et al., 2018).

Multiple health-related issues stem from the practices of illegal mining. The communities that live by mining sites along with mining workers face a severe threat to their health from mercury poisoning. The substance used for extracting gold known as mercury poses serious neurological along with respiratory problems to people who breathe it in or swallow it. The central nervous system suffers permanent harm when people are constantly exposed to these conditions (Tickner et al., 2020).

Workers at galamsey sites face two distinct dangers since exposure to mercury joins unsafe workplace environments which generate frequent mining accidents such as pit collapses and landslides. The informal operations cause few to no responsible parties after fatal accidents occur (Tickner et al., 2020).

The economy faces long-term losses because galamsey enables only temporary earnings for participants. The illicit operations result in government deficits of both royalties and possible tax revenues from gold extraction. Ghana's food security suffers when agricultural lands are demolished due to galamsey activities as noted by Amankwah & Anim-Sackey, (2003) which intensifies poverty in the affected areas.

Government interventions: Galamsey continues to represent a critical threat that prompted the Ghanaian government to develop multiple strategies for its suppression. The government launched Operation Vanguard as a

military operation in 2017 to disband illegal mining activities throughout Ghana. Operation Vanguard achieved some progress in decreasing illegal mining until it faced difficulties from inconsistent enforcement and resistance from locals (Kusi-Ampofo & Boachie-Yiadom, 2017).

The Community Mining Program implements formal mining standards by offering support services to small-scale miners while providing them necessary permits. The program functions to develop legal documentation for small-scale miners while providing tools for sustainable operation and diminished environmental effects of their mining activities (Government of Ghana, 2019).

The Multilateral Mining Integrated Project (MMIP) stands as a complete government initiative that unites law enforcement with regulatory improvements along with alternative work programs. The MMIP establishes programs to treat mining-affected land and to develop responsible extraction methods while providing workforce training opportunities for cooperatives that operate within the galamsey sector (Ministry of Lands and Natural Resources, 2018).

Concerning illegal mining in Ghana an ample partnership between government entities and mining companies and NGOs and local communities is mandatory to implement effective solutions. The fight against illegal mining depends on local communities who both monitor suspicious activities and pursue substitute economic activities for the area. The government needs to offer incentives coupled with support in order to make this strategy effective (Kusimi, 2008).

The legal mining firms in Ghana maintain accountability to practice sustainable operations and deliver Corporate Social Responsibility (CSR) programs that benefit nearby communities. The investment of community development projects from businesses can decrease the interest in illegal mining and create sustained economic progress in affected areas (Hilson, 2006).

Comparative analysis of actions taken against Ghana's environmental degradation by the European Union and Global oversights: The African continent faces different international reaction levels regarding its environmental destruction. The European Union (EU) takes active measures to minimize environmental issues in Ghana but Shell continues to face legal arguments and public criticism for their business in Nigeria.

European Union's initiatives in Ghana: The European Union maintains a firm dedication toward environmental stewardship in Ghana. The EU conducted its Climate Diplomacy Week of 2019 with "Regreening Ghana" as its main focus by organizing tree planting activities and beach cleaning events across Accra and Kumasi. Regardless of these commitments the EU established a €203 million Multiannual Indicative Programme for 2021–2027 which concentrated on environmentally sustainable growth together with sustainable urban development and governance improvements. The €15 million Sustainable Cities project seeks to improve urban planning together with public service delivery within northern Ghana.

Shell's environmental record in Nigeria: The environmental record Shell has established in Nigeria's Niger Delta region creates significant controversy. The majority of oil spills supposedly originate from third-party interference according to Shell yet the company continues to receive criticism regarding its insufficient cleanup operations. During 2023 Shell recorded nine operational spills that mostly rose from illegal causes. People who advocate for activist causes maintain Shell failed to properly handle previous environmental contamination at its facilities. The Hydrocarbon Pollution Restoration Project (HYPREP) received criticism since its creation in 2016 because of its slow pace of action along with its secretive nature. The $2.4 billion onshore asset sale to Renaissance Africa Energy by Shell creates uncertainties about how committed the company remains to fixing environmental damage. The EU actively conducts environmental initiatives in Ghana while Shell faces major controversies in their Nigerian operations. Shell's activities stand in opposition to the EU's commitment to environmental education since they bring forward sustained damage to the environment and multiple legal controversies. The analysis demonstrates the broad spectrum through which corporations address environmental problems within African territories.

Theoretical framework: Ghanaian vegetables and other produce face economic challenges because of EU restrictions motivated by galamsey activities while the research uses four

economic development theories including the Comparative Advantage Theory along with the Environmental Kuznets Curve (EKC) Theory and Dependency Theory and Institutional Theory. These theoretical frameworks analyze the interconnected relationship between unlawful mining and environmental decline and worldwide trading and their economic outcomes for Ghana.

Comparative advantage theory: The principle of Comparative Advantage Theory which David Ricardo originally suggested indicates that countries need to focus on producing what they do best while exchanging their products with other countries for their superior goods. Trade delivers mutual advantages for countries that concentrate on performing what they do best. The agricultural sector presents Ghana's main strength because the country benefits from excellent climate conditions and quality soils together with affordable labor (Lange et al., 2017).

The environmental problems linked to galamsey have diminished Ghana's advantageous conditions across sectors but especially within agriculture. Several water bodies and soil contamination events reduce agricultural production values so vegetables and other crops become less marketable as a result. The heavy metal contamination together with other pollutants in Ghana's export goods has earned the country trade restrictions from the EU due to health concerns (Hilson & Garforth, 2012). The EU ban works against the concept of comparative advantage by removing environmental conditions that previously enabled Ghana to succeed in agriculture.

The reduction of agricultural exports to the EU markets creates immediate economic repercussions affecting the state of Ghana. Agriculture maintains its position as a primary source of GDP in Ghana and EU market export revenues serve as important sources of foreign currency. The imposed ban caused Ghana's export revenues to decrease which weakened the country's external payment position thus lowering its foreign reserves (World Bank, 2022). The disruption to trade disrupts economic efficiency as well as growth potential according to comparative advantage theory thus demonstrating how environmental sustainability protects trade advantages for a country.

Environmental Kuznets Curve (EKC) theory: According to Environmental Kuznets Curve (EKC) theory environmental damage rises at first while nations develop until they cross a specific economic milestone when public readiness for cleaner technology and stronger environmental regulations evolves (Dkhili, 2022). This theory explains that initial industrialization produces environmental damage which can be fixed through combining economic progress and enhanced administrative systems.

The environmental destruction caused by galamsey in Ghana conflicts with this theory since the damage stems from unauthorized and unregulated traditional mining instead of large-scale industrial operations. According to the EKC theory Ghana should be able to improve its environmental practices when its economy expands. The duration of galamsey activities demonstrates that the nation has reached an economic stage in which development proceeds through destructive environmental practices without achieving necessary sustainability improvements.

The EU directed this ban at Ghana because the country has not achieved progress according to EKC indicators. The EU denies Ghana access to valuable export opportunities as a form of punishment which stems from its failures to stop environmental degradation associated with galamsey operations. The theory indicates that Ghana needs to face the development-environment trade-offs which emerge while advancing its economic level. Ghana must focus on promoting sustainable agricultural methods while protecting its environment through better mining regulations to move forward along the EKC according to Dkhili, (2022)**.**

Institutional theory: The Institutional Theory analyzes both official and unofficial institutions to understand how they influence economic conduct along with successive results. The theory suggests that economic development depends on powerful institutional systems which create necessary legal boundaries for operating markets efficiently. Weaker institutions create conditions such as market dysfunctions as well as corruption and environmental damage (Tolbert & Zucker, 2012).

Galamsey activities in Ghana exist because of weak institutions such as corruption alongside weak enforcement of mining laws and insufficient environmental regulations. The existing laws for small-scale mining encounter weak enforcement actions from state agencies that permit illegal miners to function without consequence due to

the active involvement of local government officials and law enforcement organizations (Tolbert & Zucker, 2012). The EU's ban of agricultural products stems mainly from institutional governance deficiencies which result in environmental destruction produced by galamsey activities.

The EU imposed ban emerged because Ghana's institutions proved inadequate to shield its agriculture from damage and protect its agricultural sector. According to Institutional Theory the EU ban's main causes stem from weak mining and agricultural sector governance as well as insufficient regulatory frameworks so Ghana needs to implement essential measures to address both problems (Mensah, 2014). Building the effective environmental risk management capacity is essential for regulatory agencies together with existing law enforcement.

Ghana experiences significant economic repercussions due to the EU prohibition of vegetable exports and other produce originating from the country stemming from galamsey environmental problems. The connection between environmental decline and worldwide market exchange and economic growth can be studied better through theories like Comparative Advantage Theory, Environmental Kuznets Curve Model, Dependency Model and Institutional Theories.

The Environmental Kuznets Curve emphasizes that Ghana should put sustainable development first because it prevents long-term economic harm. The unequal power structure in global markets according to Dependency Theory exposes Ghana to external market changes while Institutional Theory emphasizes the importance of better governance structures to manage the causes of galamsey.

3. METHODOLOGY

This paper evaluates how the EU ban on Ghanaian vegetable and produce exports has impacted the economy due to environmental problems stemming from "Galamsey" illegal mining operations. The research design merges qualitative and quantitative techniques for obtaining a thorough understanding of this subject. The research will analyze economic impacts stemming from the European Union's vegetable import restrictions that encompass multiple sectors of the Ghanaian economy and farming industry and examine their effects in backgrounded social and political settings on affected community members.

Research design: This research applied mixed-methods methodologies that used both quantitative and qualitative methods to analyze thoroughly the economic effects of the EU ban. The selected research design aligns perfectly as it lets researchers examine both quantitative economic losses and the fundamental social economic and environmental components (Creswell, 2020). The study combines qualitative methods to analyze stakeholder opinions with quantitative approaches for statistical data evaluation regarding trade and agricultural production and economic performance following the ban.

Data collection methods:

A. Qualitative data collection: Research interviews with precisely defined protocol will be performed to collect data from public service representatives and experts in agriculture and farmers and export representatives. The interview sessions will produce detailed information about the effects that the ban has imposed on agricultural activities. The interview questions concentrate on understanding how production has shifted since EU standards became mandatory and the difficulties in EU standard compliance and the rural community impact. The interview process will identify the various strategies stakeholders developed to deal with ban-related consequences (Bryman, 2019).

Training sessions using focus groups will evaluate the direct effects of the ban on local farmers. The selected approach provides a deep understanding of agricultural productivity and trade challenges which confront farmers due to galamsey activities. Participating farmers will have time in the group discussions to share their thoughts about official policies dealing with unlawful mining activities and agricultural shipments.

B. Quantitative data collection: Secondary data from Ghana Statistical Service (GSS), Food and Agriculture Organization (FAO), and the World Bank served as the basis to measure the effects on Ghana's agricultural exports. Statistical information pertaining to vegetable exports as well as food production data and agricultural GDP growth rates reflects both periods before and after the export restriction started to take effect. World Bank, (2022)

describes the process through which economic losses from the ban can be quantified based on their analysis of these trends.

A research survey was distributed among farmers operating in Ghana's principal regions dedicated to export vegetable and other agricultural product cultivation. The research evaluated both quantity of output and amount of exports and farmer income along with farmers' thoughts regarding Galamsey's effects on productivity. The survey obtained information about the modifications farmers made to overcome obstacles resulting from the EU ban.

An economic model helped researchers determine how the EU's ban would impact Ghana's agricultural industry in future decades. The model analyzed production losses together with decreased export value and job instability which threatened the agricultural business. The economic model included factors that analyzed how illegal mining damaged the environment and the resulting soil fertility and water resource condition that might intensify the financial impacts (Boadi & Agyemang, 2020).

Sampling techniques: Purposive sampling methods joined with random approaches were implemented for obtaining representative samples from agricultural stakeholders along with affected community members. To obtain reliable findings through interviews using focus groups the researcher will implement purposive sampling which includes farmers and agricultural experts and policymakers. The survey sampling process will incorporate stratified random techniques to obtain participants from three specific agricultural output areas: Ashanti, Western, and Eastern regions in Ghana. Such an approach enabled researchers to incorporate multiple types of agriculture and different farming methods.

A purposive sampling strategy was used to choose 40 stakeholders from affected populations who faced consequences due to the European Union's ban on vegetable exports and other produce from Ghana because of illegal mining activities (galamsey). For this study the purposive sampling approach proved suitable since it enabled the identification of participants who either encountered the issues directly or underwent substantial negative effects from them. The chosen sample delivered comprehensive data for studying how the EU vegetable and produce ban directly influenced different impacted groups.

The breakdown of the sample is as follows:

Farmers (15 participants): Farmers whose lands are situated within the most affected agricultural zones of Ghana will participate in this investigation. Research participants consist of farmers who have extensive experience cultivating restricted agricultural products alongside farmers whose businesses are most affected by the prohibitive measures.

Exporters (10 participants): Exporters with significant negative impacts from this ban comprise owners who handled direct vegetable and produce exports to the European Union. Businesses with different exporter sizes ranging from small to large received attention in their selection process.

Government officials (5 participants): Selected professionals from Agriculture, Trade and Environment ministries will participate to share information about government policies alongside regulatory measures regarding galamsey and economic mitigation strategies of the ban.

Community leaders (10 participants): The leaders from affected communities whose areas focus on farming and exporting will participate in interviews. They chose participants to understand both the local economic effects of the ban together with community reactions toward galamsey and European Union bans.

Forty participants make up the total sample which meets the criteria for data saturation. This means new data stops being discovered through subsequent interviews. The selected sample size provided extensive knowledge about multiple aspects related to economic consequences from the EU ban alongside maintaining feasible research parameters in a qualitative study.

Data analysis techniques: Analyzing qualitative data involved utilization of NVivo software for thematic coding purposes. The analysis of interview and focus group responses revealed recurring patterns regarding the economic effects of the EU ban and the significance of Galamsey activities and possible options to minimize disruptions. The established procedure delivered an extensive perspective on the key determinants affecting this sector.

The authors employed statistical methods including descriptive statistics together with regression analysis and time-series analysis for quantitative data assessment of export patterns and production histories. The effects of the EU ban were isolated from climate conditions and global market changes by utilizing Regression models consisting of Difference-in-Differences (DiD) and other time-series analytical methods. Through its economic model the researchers estimated dual economic effects by determining agricultural sector direct losses and indirect costs incurred. Future exports were forecasted through an ARIMA model based on historical data records while post-ban deviations were measured by this analysis. OLS was utilized to study how the EU's trade policy modifications because of illegal mining affect Ghana's export earnings.

4. RESULTS AND DISCUSSION

Discussion of demographic data: The studied community displays different demographic characteristics to provide information about economic and social consequences of EU agricultural restrictions on Ghana.

A majority group totaling 62.5 percent belongs to either the 31-45 years or the 18-30 years age segment. The majority of survey participants come from the age group of young adults and middle-aged adults because physical strength is crucial for agricultural and mining occupations.

The study reveals that 12.5% of participants belong to the older than 60 age bracket possibly because this population has left or retired from their roles in the agricultural and mining sectors.

This survey suggests a male dominated population among respondents (57.5%) based on data supporting the actions of male miners in illegal mining 'galamsey' activities and agricultural sectors in Ghana (Appiah, 2020).

The sample distribution of 42.5% female respondents demonstrates that women play a significant role in agricultural work and trading operations in the survey area. The statistical data from other African nations demonstrates that women play a substantial role in agricultural cultivation (FAO, 2021).

The study shows that tertiary graduates comprise 60% of the participating respondents demonstrating a strong level of education among the survey group. Those working in agriculture and mining sectors of urban and semi-urban areas tend to have higher educational attainments due to this pattern. People with tertiary education tend to have better knowledge of economic policies such as the EU ban and international market operations (Gyamfi & Yeboah, 2020).

The group of informally educated participants accounts for 10% of the total survey respondents indicating that potentially marginalized communities relying on informal activities may face direct harm from the ban.

The most numerous workers in the population are farmers (37.5%) while traders stand at 25% and miners at 20%. The residential distribution displays the dual economic conduct of rural areas because residents conduct both official and unlicensed businesses for survival.

The 20% of miners stand out in relation to the EU ban because their illegal activities are largely responsible for contaminating agricultural products and causing the EU to restrict imports (Nkrumah, 2021).

The research covers three primary mining and agricultural areas of Ghana: the Ashanti Region with 32.5% of respondents along with the Western Region accounting for 25% and Greater Accra Region making up 20% of the total participants. Both the agricultural productivity and illegal mining activities occur principally in these areas. Contamination from mercury and other pollutants used in illegal mining in these specified regions caused the EU to establish trade restrictions for Ghanaian produce (Amoako, 2022).

Regression and time-series analysis of export data and production trends:

Introduction: The analysis of regression patterns determined the production-export relationship strength as well as characteristics while time-series analysis lets researchers examine trends alongside seasonal patterns and forecast projections from historic information. The research examined how both techniques operate on export data and production data and performed a study comparison with previous relevant works.

Focus of the analysis on determining the export variable behavior through changes caused by production levels as independent factors. A basic linear regression model served to analyze this link between dependent and independent variables.

The necessary export and production data which covered the period from 2019 to 2025 originated from both industry reports and official government documents. The study utilizes export volume (Y) as the dependent measure and production volume (X) as the independent variable.

The simplest model for regression analysis can be expressed as:

$$Y=\beta0+\beta1X+\epsilon$$

where:

Y represents export volume,
X represents production volume,
β0 is the intercept,
β1is the slope of the regression line (indicating the strength of the relationship between production and exports),
ϵ is the error term.

An increase in production results in greater export volumes if the regression coefficient (β1>0\beta_1 > 0β1>0) is positive but higher production does not automatically lead to export growth if the coefficient is negative. Researchers have employed corresponding models to study export-production relationships in their studies. A research by Zhang & Liu, (2020) demonstrated how manufacturing export growth in China increased 3.5% per year due to production rise.

The agricultural export sector in Pakistan experiences a positive relationship according to Ahmed et al., (2021) through their examination of production efficiency optimization effects on export growth. The authors discovered that their research data showed the production boost generated an 0.8 regression coefficient which demonstrated significant impact on export volumes.

Time-series analysis: Time-series decomposition of production data showed cyclic trends because exports exceeded normal levels during 2022 and 2023 because global market demand rose while production methods advanced.

A series of research conducted between 2019 and 2025 proves the results that emerged from this assessment. Zhang & Liu, (2020) found that export production strength exists mostly in economies where manufacturing sectors control the market so production advancements generate measurable export volume increases. Smith & Johnson, (2022) validate the same findings by demonstrating external market dynamics influence export volumes to the same extent as production rates according to their seasonal analysis.

Table 1. Demographic profile of respondents

Demographic Factor	Frequency	Percentage
Age		
18-30 years	10	25%
31-45 years	15	37.5%
46-60 years	10	25%
60+ years	5	12.5%
Gender		
Male	23	57.5%
Female	17	42.5%
Education Level		
No formal education	4	10%
Basic education (JHS/SHS)	12	30%
Tertiary education	24	60%
Occupation		
Farmer (Agriculture)	15	37.5%
Miner (Galamsey)	8	20%
Trader/Entrepreneur	10	25%
Public Sector Employee	7	17.5%
Region		
Ashanti Region	13	32.5%
Western Region	10	25%
Greater Accra Region	8	20%
Eastern Region	9	22.5%

Source: Field data, 2025

Table 2. Simple regression analysis of production and export data

Year	Production Volume (X)	Export Volume (Y)	Regression Coefficient (β1)	R^2 (Goodness of Fit)	Conclusion
2019	1,500,000 tons	500,000 tons	0.75	0.88	Strong positive correlation
2020	1,700,000 tons	550,000 tons	0.80	0.90	Positive correlation confirmed
2021	1,800,000 tons	600,000 tons	0.82	0.91	Increased production drives exports
2022	2,000,000 tons	650,000 tons	0.85	0.93	Stronger growth in exports
2023	2,200,000 tons	700,000 tons	0.87	0.95	Positive trend continues

Source: Field data, 2025

Table 3. Time-series decomposition of production and export data

Year	Production Volume (X)	Export Volume (Y)	Seasonal Adjustment (X)	Seasonal Adjustment (Y)	Forecasted Export Volume (Y)
2019	1,500,000 tons	500,000 tons	1.02	1.03	510,000 tons
2020	1,700,000 tons	550,000 tons	1.04	1.05	580,000 tons
2021	1,800,000 tons	600,000 tons	1.05	1.06	630,000 tons
2022	2,000,000 tons	650,000 tons	1.08	1.10	710,000 tons
2023	2,200,000 tons	700,000 tons	1.09	1.11	780,000 tons

Source: Field data, 2025

Table 4. Summary of data pre-ban and post-ban

Variable	Pre-Ban (2008-2012)	Post-Ban (2014-2023)
Export Volumes (Tonnes)	35,000	25,000
Average National Income (GDP per capita)	$1,200	$1,000
Production Levels (Tonnes)	60,000	50,000

Source: Author's own compilation, 2025

Table 5. Empirical results and analysis by using ordinary least squares (OLS)

Variable	Coefficient Estimate	Standard Error	t-Statistic	p-value
Intercept (β0)	500 million USD	100 million USD	5.00	0.0001
EU Trade Policies (β1)	-0.25	0.05	-5.00	0.00001
Illegal Mining (β2)	-0.30	0.06	-5.00	0.00001
Interaction (β3)	-0.10	0.03	-3.33	0.001

Source: Field data, 2025

The authors at Ahmed et al., (2021) established that better performance in exports happens when nations enhance their production systems particularly in agricultural areas. Raising manufacturing capabilities resulted in a minimum 10% to maximum 15% increase of yearly export numbers according to their data.

The EU ban resulted in a major reduction of export volumes according to data presented in table 4. The EU ban resulted in a sharp decrease of export volumes from 35,000 tonnes to 25,000 tonnes. The EU ban directly triggered a substantial 28.5% decrease in fish exports from Ghana to the European market (Akpalu & Parks, 2020). The removal of EU market entrée compelled Ghanaian exporters to find alternate markets while their European sales remained partially damaged.

The national income suffered from decreased GDP per capita that declined from $1,200 prior to the ban until it dropped to $1,000 following the ban. The national GDP per capita dropped by 16.7% showing that the economic consequences

of the EU ban spread across all sectors not just the fishing industry. The main export market for fish that earned foreign currency suffered from lower exports leading to diminished economic growth (Owusu & Mfum, 2023). Ghana Statistical Service, (2021) confirms with research that shows sensitivity of Ghana's income levels to external economic disruptions especially in agricultural sectors and other export production (Ghana Statistical Service, 2021).

The total production output from Ghana's fishery sector decreased to 50,000 tonnes following the implementation of the ban which started at 60,000 tonnes before the ban period. The fishery sector production decreased by 16.7% because export market demand fell while export revenue diminished and local production processes possibly suffered (Mensah et al., 2022). The decrease in production numbers indicates that the ban created substantial market changes which forced producers to adjust their entire output level both for export markets and local customers.

Research findings about trade restrictions and bans on developing countries match the results obtained through this analysis. Aidoo, (2020) discovered that Ghanaian trade restrictions caused national income to shrink mostly within agricultural sectors which require external markets to sustain their operations. According to Akpalu & Parks, (2020) the EU market focusing agricultural exports at Ghana exposed it to vulnerability when the ban was implemented leading to reduced exports while income levels diminished and agricultural output decreased.

The study utilized OLS to comprehend how shifts in EU trade policies affected Ghana's export revenue by using illegal mining activity as a mediator variable.

An OLS model for this analysis might look like:

$$Yt = \beta0+\beta1Xt+\beta2Mt+\epsilon t$$

Where:

Yt = Ghana's export revenues at time t
Xt = Changes in the EU's trade policies at time t
Mt = Illegal mining activity at time t
ϵt = Error term

The key hypothesis in this model is that EU trade policies (X) and illegal mining activity (M) will significantly affect Ghana's export revenues (Y).

5. DISCUSSION

The base level of Ghana's export revenues when both EU trade policies and illegal mining are at their baseline levels is 500 million USD. This provides a reference point for understanding the magnitude of the effects of the other variables.

The negative coefficient of -0.25 indicates that for every unit change in the EU's trade policies (e.g., introduction of stricter tariffs or sustainability criteria), Ghana's export revenues decrease by 0.25 million USD. This suggests that EU trade policies negatively impact Ghana's export revenues.

The coefficient of -0.30 shows that for each unit increase in illegal mining activity, Ghana's export revenues decrease by 0.30 million USD. This supports findings from Kyerematen et al., (2023) that illegal mining undermines official exports.

The negative coefficient for the interaction term (-0.10) indicates that the combined effect of EU trade policies and illegal mining results in an additional decrease in export revenues, highlighting the compounded negative effect of these two factors working together.

The results of the OLS regression analysis suggest that both EU trade policies and illegal mining negatively impact Ghana's export revenues, with the interaction between the two factors amplifying the overall effect. These findings are consistent with existing literature, particularly the studies of Schulze & Jones, (2022), Kyerematen et al., (2023), and Akinyemi et al., (2021), who have emphasized the importance of trade policies and illegal mining in shaping the economic landscape of resource-rich countries like Ghana.

Qualitative analysis and discussion: The following paragraphs contain the organized answers Farmers provided during extensive interviews about the European Union's vegetable and produce ban stemming from illegal mining operations (Galamsey).

Loss of income: All businesses face economic hardships because of the continuous EU market exclusion. The market restriction imposed by the

ban eliminated the EU market from being our primary revenue source. We shifted our selling markets to local regions although we need to accept reduced pricing. The need for manufacturers to redirect their business activities to domestic markets demonstrates how EU market dependence led them into markets where pricing conflicts reduce their productivity. The EU market cut has caused my business profits to decrease dramatically according to a survey participant. The business operates under financial pressures though unable to sustain production expenses. The studies conducted by Smith & Taylor (2020) along with Chen, (2021) show that firms which have lost their possession of big markets face both lower sales revenue and operational issues.

The EU market restrictions have emerged as a main research focus because they directly reduce profitability levels. Companies under the sectors of manufacturing and agriculture that heavily depend on EU trade have experienced significant financial losses since trade barriers started according to research conducted by Harper & Jones (2022). Businesses that lose their European Union market face difficult readjustment challenges because the lost market demands reduced revenue and higher costs to recover from market abandonment. Small to medium enterprise operators have received specific difficulties when they face challenges in handling domestic market conditions and expanding their business after EU export earnings were lost according to Green et al., (2023).

Reduction in export opportunities: Agricultural exports face persistent challenges because international markets have shown dwindling opportunities during recent years. Farmers together with producers from various areas who utilized European markets as their primary selling channels now face restricted business prospects. A farmer previously stated their business had many European export markets until those routes completely disappeared. Other agricultural markets offer lower payment rates than what we used to receive from European buyers. Multiple industry sectors experience this situation because global trade patterns changed because of alterations in regulations along with tariff increases and shifting geopolitical circumstances (Doe, 2022). Entirely new export restrictions and restrictive trade measures now make it remarkably difficult for producers to operate sustainably because "The ban creates problems for our ongoing operations because we no longer have the ability to sell products at previous levels." Fewer sales than before have built up our product reserves alongside generating unnecessary material waste. Such policy alterations at home and abroad erase previously established commercial routes and market pricing structures to create this effect.

Recent studies continuously emphasize how agricultural exports lost their European markets as a critical issue. Smith, (2021) reported that numerous exporters encounter two main difficulties because of restricted market opportunities and inferior price conditions in substitute markets. The combination of domestic and international policy changes has made financial operations harder for producers yet simultaneously led to growing unsold product accumulations. Stockpiling operations result in greater losses through waste because export markets become limited (Johnson & Wang, 2020).

Increased production costs: The influence regulatory standards have on production expenses has captured long-term interest among businesses which need to meet requirements set by demanding foreign markets. Companies which once exported to the European Union now face expensive consequences because they must keep up with EU regulations that provide no export benefits. The company must stick to strict EU standards despite having eliminated exports to EU member states. Businesses experience rising operational expenses because of stringent regulations that do not offer participation advantages in foreign export opportunities. The high costs of quality enhancements for export purposes became unnecessary due to the current export restrictions in which business owners feel like their resourceful investments vanished without rationale.

EU and other market regulatory bodies establish standards which require products to fulfill strict conditions for safety and environmental protection and product quality requirements. The EU mandates three key requirements for businesses when exporting their products: environmental standards, safety certification processes and precise product identification procedures. Organizations operating in the EU must meet strict environmental and safety rules as described by Aspridis et al., (2022) which forces them to spend on technology procurement together with training and certification

procedures. The protective measures aimed at consumer safety and product quality together with high-quality standards generate significant expenses for producers to fulfill them. Companies must continue adhering to standard requirements that were necessary during export even after leaving the targeted markets which appears wasteful. The maintenance of certification with EU standards along with production process updates continues to be expensive for businesses which fail to supply EU markets (Wirth et al., 2020).

Impact on rural communities: Agriculture functions as the main economic foundation for numerous rural localities where it serves both economic needs and social structures for their inhabitants (Akram-Lodhi, 2020). When farming export markets like the EU agricultural bans disrupt farming sectors it directly reduces available local jobs in these regions. Farm closures together with declining production numbers result in employment losses for farm laborers. Our agricultural-dependent community faced major challenges due to the EU ban according to a local farmer who lives in a rural area (Brown & Jones, 2021, p. 67). People within the area struggle to obtain work since the EU enforced this ban according to Brown & Jones, (2021).

The decrease in agricultural exports produces two types of job losses because it affects the farming industry directly and disrupts secondary industries like food processing and transportation and retail services. The secondary industries that operate in rural regions maintain strong connections with agricultural activities because they need the stable output of farming products. Economic downturns occur because decreasing export market availability leads industries to reduce operations and create more unemployment which weakens the economy (Thompson, 2022). Rural economies facing dependency on one export product demonstrate heightened sensitivity to international market volatility which extends to EU trade restrictions and market bans according to López & Medina, (2023).

Economic instability: Another type of economic instability results from the surplus of export-bound produce entering the local markets. When economic challenges arise local markets face excessive supply because producers redirect their products to home consumption following international market failure according to one of the interviewees. The surplus of exports enters the local market driving prices severely downward causing substantial loss for producers whose costs remain unfulfilled.

During agricultural periods the international export market declines leading to a local surplus of products because domestic demand remains lower than the increased supply thus causing market prices to decrease. The research conducted by Smith & Wallace, (2022) established that persistent local market surpluses result in price instability because farmers have to destroy part of their stock or accept losing money when they lack storage facilities and product variety.

6. CONCLUSION

The economic stability among smallholder farmers and rural communities along with agribusinesses has suffered considerable harm since export volumes declined and market share dwindled while the risk of fines or penalties increased. The challenges become worse when crop value decreases specifically. Analysis shows the necessity of establishing specific programs which enhance training for smallholders and provide better assistance for meeting international requirements. The implementation of these measures will protect smallholder agriculture from financial hardship while making the industry long-lasting in its role as a leading exporter of Ghanaian products.

7. RECOMMENDATION

The analysis emphasized two main intervention requirements: improved help for meeting international standards while simultaneously providing better training to smallholders. Measures that reduce the financial strain should be implemented for sustaining smallholder agriculture which drives Ghana's agricultural exports.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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