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Agricultural export concentration and market diversification in Azerbaijan: A human capital perspective

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Abstract: Economic diversification is a strategic priority for Azerbaijan, and agricultural and food exports are an important component of the non-oil economy. This study examines the geographical concentration and market diversification of Azerbaijan's agricultural and food exports during 2016–2024 using the Herfindahl–Hirschman Index (HHI). The analysis uses official trade statistics from the State Customs Committee and the State Statistical Committee of the Republic of Azerbaijan, complemented by International Trade Centre (ITC Trade Map) data. Government expenditure on education (% of total government expenditure) is used as a macro-level indicator of public investment in human capital. Because only nine annual observations are available, the correlation analysis is treated as exploratory rather than causal or confirmatory. Agricultural and food exports increased from USD 525.5 million in 2016 to USD 1.106 billion in 2024, while destination concentration remained substantial: the HHI rose from 0.394 in 2016 to 0.556 in 2019 and declined to 0.496 in 2024; Russia accounted for approximately 69.9% of exports in 2024. Education expenditure was positively correlated with agricultural and food exports in annual levels ($r = 0.766$, $p = 0.016$), but the relationship did not remain positive and significant after first-difference transformation, indicating sensitivity to common time trends. Education expenditure was not significantly correlated with geographical export concentration ($r = 0.337$, $p = 0.375$). The findings distinguish export growth from destination diversification and do not support causal claims about firm-level human-capital mechanisms. From a human-capital perspective, workforce skills, managerial expertise, certification, traceability, quality assurance, and foreign-market knowledge may facilitate market entry, but these mechanisms require direct firm-level investigation. Policy implications are therefore differentiated across public agencies, exporters, industry associations, training institutions, and logistics providers.

Keywords: Agricultural and food exports; export concentration; market diversification; human capital; Azerbaijan.

1. Introduction

Economic diversification has become a strategic priority for resource-dependent economies seeking to reduce vulnerability to external shocks. In Azerbaijan, expansion of competitive non-oil exports is a central policy objective [24], and agriculture is important for export earnings, rural employment, food security, and regional development. Agricultural and food exports have increased substantially, but their geographical distribution remains concentrated in a limited number of destination markets. Such dependence can amplify exposure to demand shocks, trade restrictions, geopolitical uncertainty, and logistics disruptions.

Export diversification is commonly explained by market access, infrastructure, trade policy, institutional quality, productivity, and the composition of exports [1,2,6,8,12,20]. For agricultural exporters, however, entry into new markets also requires the operational capacity to meet sanitary and phytosanitary rules, food-safety requirements, traceability systems, certification procedures, and buyer-specific quality standards [17–19,25]. These requirements create a clear human-resource dimension: exporters need employees able to implement quality-control procedures, managers able to interpret foreign-market requirements, and organizational routines that preserve and transfer market-specific knowledge. Human Capital Theory provides a useful perspective for considering how education and skills can support productive and adaptive capacity [5]. Nevertheless, the present study does not observe employee skills, HR practices, managerial competence, or firm-level organizational capabilities directly.

The empirical contribution is therefore deliberately narrower than a firm-level HR analysis. First, the study provides sector-specific evidence on destination concentration in Azerbaijan's agricultural and food exports (HS Chapters 01–24) through 2024, rather than treating non-oil exports as a single aggregate. Second, it separates export-value growth from geographical diversification by tracing the annual HHI and destination structure. Third, it explores whether a national indicator of public investment in human capital—government expenditure on education as a share of total government expenditure—co-moves with agricultural export outcomes. This macro-level indicator is not treated as a measure of exporter-level skills or organizational capabilities. The human-capital perspective is used to interpret possible policy channels and to identify questions for future firm-level research.

Accordingly, the study asks:

1. How did the geographical concentration of Azerbaijan's agricultural and food exports change during 2016–2024?
2. What exploratory associations are observed between the macro-level education-expenditure indicator, agricultural and food exports, and geographical export concentration?
3. What human-capital implications can cautiously be drawn for workforce development and export-market readiness, given that firm-level HR practices and organizational capabilities are not directly measured?

The study answers these questions using destination-market shares, the HHI, descriptive statistics, and exploratory correlation analysis. The remainder of the paper reviews the relevant trade and human-capital literature, explains the data and calculations, presents the empirical results and robustness checks, and then discusses the findings and policy implications. The distinction between measured macro-level evidence and unmeasured firm-level mechanisms is maintained throughout.

2. Literature review

Export diversification is associated with structural transformation, resilience, and reduced exposure to destination-specific shocks [1,2,6,8,12,14,15,20]. In agriculture and agricultural value chains [3], geographical diversification is particularly relevant because trade is affected by perishability, sanitary and phytosanitary requirements, logistics constraints, and geopolitical uncertainty [17–19]. Diversification is therefore not equivalent to export growth: a country may increase export value while remaining dependent on a small number of destination markets.

The HHI provides a transparent way to summarize the distribution of export shares across destinations [9,10]. Higher values indicate that a larger proportion

of exports is concentrated in fewer markets. For Azerbaijan, this distinction is important because research on non-oil development has often emphasized aggregate export expansion, product structure, or trade policy. The present study instead focuses specifically on geographical destination concentration within agricultural and food exports and extends the observation period through 2024. The contribution is thus sectoral and structural, not merely an update of the final year.

Human Capital Theory argues that education, skills, and knowledge can raise productivity and adaptive capacity [5]. Strategic HR research similarly links workforce quality and HR practices to organizational performance and export activity [7,11,16,26]. These insights are relevant to agricultural exporters because access to more demanding markets requires personnel who can manage certification, traceability, quality assurance, documentation, and changing buyer requirements. Workforce planning and employee development may therefore matter for export-market readiness. Industry associations and training institutions can also reduce knowledge gaps by disseminating information about standards and market-entry procedures.

The Resource-Based View emphasizes firm-specific resources and capabilities [4], but the present study does not empirically test RBV constructs. Organizational learning, managerial competence, and knowledge-management routines are discussed only as plausible firm-level mechanisms that may connect workforce development to export competitiveness. They are not measured variables and are not used to explain the HHI statistically. This distinction avoids attributing macro-level trade outcomes directly to unobserved organizational characteristics.

The empirical gap addressed here is therefore specific. Existing Azerbaijan-focused work has examined non-oil export development and broader diversification issues, whereas less attention has been given to the annual geographical concentration of agricultural and food exports and to the distinction between export growth and destination diversification. By combining an HHI-based destination analysis with a cautiously interpreted macro-level education-expenditure indicator, the study provides updated sector-specific evidence while explicitly identifying the limits of inference about firm-level human capital.

3. Materials and methods

3.1. Data sources

The overall research design is summarized in **Figure 1**. The empirical analysis uses annual data for 2016–2024. Agricultural and food exports are defined as products in HS Chapters 01–24 of the Harmonized Commodity Description and Coding System. Export values and destination data were compiled from the State Customs Committee and the State Statistical Committee of the Republic of Azerbaijan [21,22] and cross-checked against ITC Trade Map [13]. The national official sources were used as the primary basis for aggregate export totals; ITC Trade Map was used to complement and cross-check destination-level information. Where presentation tables group small destinations as “Other countries,” that grouping is for display only and was not treated as a single destination in the HHI calculation.

All export values are reported in current USD because the principal objective is to describe the observed trade structure and destination shares. Current-price export values are not interpreted as real export growth in the correlation analysis without qualification. To address the possibility that the level correlation with education expenditure reflects a common time trend, the revised analysis includes transformed-data robustness checks and treats the correlation evidence

as exploratory. Government expenditure on education, total (% of government expenditure), World Development Indicators code SE.XPD.TOTL.GB.ZS [23], is used as a national indicator of the priority given to education spending. It is not a direct measure of employee skills, managerial competence, HR practices, or organizational capabilities. As an additional reproducibility check, the destination-level calculations for 2016–2023 were independently reconstructed from World Integrated Trade Solution (WITS) reported trade data [27] by aggregating Animal (HS 01–05), Vegetable (HS 06–15), and Food Products (HS 16–24). The resulting annual destination shares and recalculated HHI values are provided in Supplementary Appendix Tables A1–A2. This independent reconstruction closely reproduces the HHI series used in the manuscript; all absolute differences are below 0.001. WITS data for 2024 were not used for this validation because the corresponding partner-level series was not available in the same extract, so the 2024 results remain based on the original national/ITC source compilation described above.

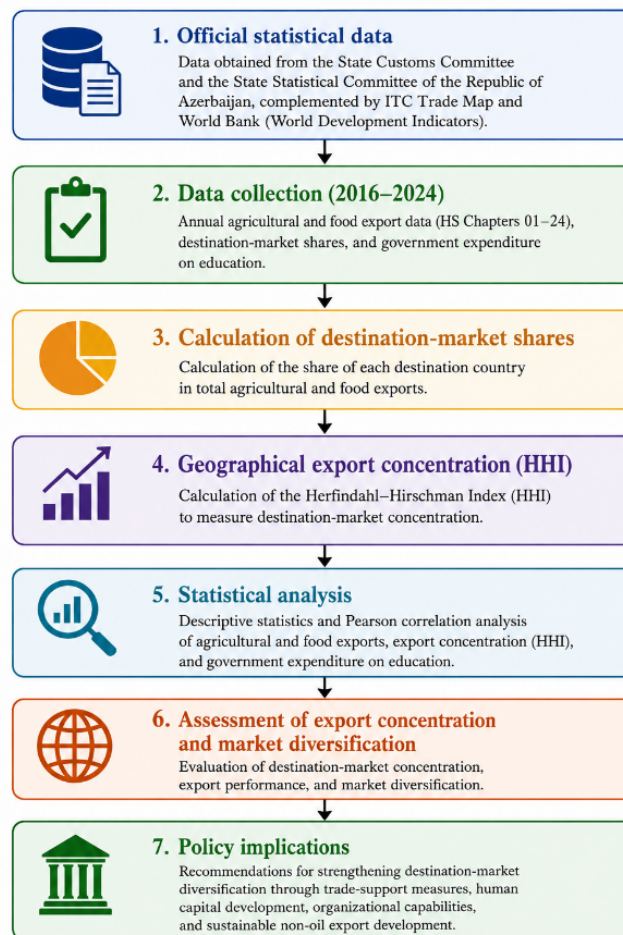


Figure 1. Conceptual Framework and Proposed Hypotheses

Source: Author's illustration.

3.2. Data analysis

The Herfindahl–Hirschman Index (HHI) was used to measure geographical export concentration. For each year, the share of every individual destination country in total agricultural and food exports (HS Chapters 01–24) was calculated and squared; the squared shares were then summed. The “Other countries” category shown in the 2024 presentation table is an ex-post aggregation for readability and was not entered into the HHI as one combined market. This distinction is important because treating all residual destinations as one market

would upwardly bias measured concentration. The share of agricultural and food exports in total non-oil exports and cumulative nominal export growth were also calculated to describe the sector's changing role. For the supplementary WITS validation, regional aggregate rows were excluded, individual country partners were retained, and the WITS 'World' total was used only as the annual denominator.

$$HHI = \sum s_i^2$$

where s_i denotes the share of destination country i in Azerbaijan's total agricultural and food exports classified under HS Chapters 01–24.

The HHI ranges from values approaching 0 for highly dispersed destination structures to 1 for complete concentration in a single destination [9,10]. Because concentration benchmarks developed for competition analysis do not map mechanically onto country export portfolios, the index is interpreted comparatively over time and alongside the observed destination shares rather than as a stand-alone regulatory threshold. In this study, values close to 0.5 together with a dominant destination share near 70% are interpreted as evidence of substantial geographical dependence.

$$\text{Share (\%)} = (\text{Agricultural and Food Exports} / \text{Non-Oil Exports}) \times 100$$

In addition, export growth dynamics were assessed using the following expression:

$$\text{Growth Rate (\%)} = [(X_t - X_0) / X_0] \times 100$$

where X_t represents the value of agricultural and food exports in the final year (2024), and X_0 denotes the corresponding value in the base year (2016).

Descriptive statistics summarize agricultural and food exports, non-oil exports, their share, the HHI, and government expenditure on education. Government expenditure on education (% of total government expenditure; WDI indicator SE.XPD.TOTL.GB.ZS) is used only as a macro-level indicator of public investment priority in education. It does not directly measure the human capital employed by agricultural exporters.

Pearson correlations are reported for transparency, but with $N = 9$ they are treated as exploratory descriptive associations. The revised analysis also reports a log-level specification, a rank-based Spearman correlation, and a first-difference robustness check using annual changes in education expenditure and log changes in export values. The log-difference transformation focuses on year-to-year proportional changes in exports and substantially reduces the influence of common deterministic trends in the levels. Formal unit-root testing is not emphasized because nine annual observations provide insufficient power for reliable time-series diagnostics. If an association is not stable after transformation, the manuscript does not treat the level correlation as robust inferential evidence. Statistical p-values are reported as descriptive diagnostics rather than as proof of causality.

4. Results

4.1. Geographical export concentration

Azerbaijan's agricultural and food exports remained geographically concentrated throughout 2016–2024. The HHI increased from 0.394 in 2016 to 0.556 in 2019 and subsequently declined to 0.496 in 2024. The decline of 0.060 points from the 2019 peak indicates some moderation, but the 2024 value remained above the 2016 level. It therefore should not be interpreted as a transition to a broadly diversified export structure. This interpretation is reinforced by the 2024 destination distribution, in which Russia alone accounted for approximately 69.9% of agricultural and food exports.

4.2. Structure of export destinations

Table 1. Distribution of Azerbaijan’s Agricultural and Food Exports by Destination Countries (2024)

Country	Share (%)	Value (million USD)
Russia	69.90	772.801
Georgia	6.35	70.187
Türkiye	2.44	26.927
Turkmenistan	2.17	23.966
Germany	2.10	23.239
Ukraine	2.04	22.600
Other countries	15.00	165.806

Source: Author’s calculations based on foreign trade data from the State Customs Committee and the State Statistical Committee of the Republic of Azerbaijan, complemented by ITC Trade Map data.

The 2024 destination structure was highly asymmetric. Russia accounted for approximately 69.9% of agricultural and food exports, compared with 6.35% for Georgia; no other listed major destination exceeded 2.5%. The residual 15.0% shown as “Other countries” in **Table 1** is an aggregated presentation category only. For HHI computation, the underlying individual destination-country shares were used separately. The large gap between the first and second destinations provides an economically intuitive complement to the HHI and indicates substantial dependence on the Russian market.

4.3. Growth and structural imbalance

Table 2 shows that agricultural and food exports increased from approximately USD 525.5 million in 2016 to USD 1.106 billion in 2024, a nominal cumulative increase of approximately 110.4%. Because these values are expressed in current USD, this percentage describes nominal export-value expansion and is not interpreted as real growth. Over the same period, the HHI ranged from 0.394 to 0.556. The coexistence of higher nominal export values and persistent concentration shows why export expansion and destination diversification should be evaluated separately.

4.4. Role of agricultural and food exports in non-oil exports

Table 2. Share of Agricultural and Food Exports in Azerbaijan’s Non-Oil Exports (2016–2024)

Year	Agricultural and food exports (million USD)	Non-oil exports(million USD)	Share %
2016	525.520	1,237.1	42.48
2017	658.912	1,538.4	42.83
2018	704.368	1,689.2	41.70
2019	772.198	1,954.4	39.51
2020	759.877	1,851.3	41.05
2021	816.225	2,713.4	30.08
2022	912.381	3,047.7	29.94
2023	969.250	3,348.0	28.95
2024	1,105.526	3,356.5	32.94

Source: Author’s calculations based on data from the State Customs Committee, the State Statistical Committee of the Republic of Azerbaijan, and ITC Trade Map.

The share of agricultural and food exports in total non-oil exports fluctuated during 2016–2024. It remained above 39% during 2016–2020, reaching its highest level of approximately 42.83% in 2017. The share subsequently declined to 28.95% in 2023 before recovering to approximately 32.94% in 2024. These results indicate that agricultural and food exports remained an important component of Azerbaijan’s non-oil export sector, although their relative contribution varied considerably over the study period.

4.5. Dynamics of export growth and concentration

Figure 2 illustrates the joint evolution of agricultural and food export value and geographical concentration during 2016–2024. Export value followed a generally upward trajectory, increasing markedly over the period, whereas the HHI exhibited a non-linear pattern. Concentration rose during the earlier years, peaked in 2019, and subsequently moderated. The contrasting trajectories suggest that changes in export value and geographical concentration did not move proportionately over time.

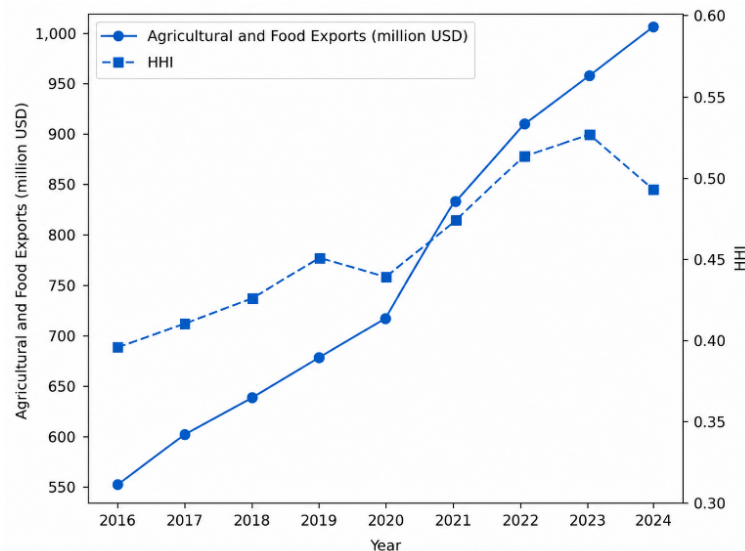


Figure 2. Dynamics of Agricultural and Food Exports and Export Concentration in Azerbaijan (2016–2024)

Source: Author's calculations based on data from the State Statistical Committee and the State Customs Committee of the Republic of Azerbaijan, complemented by ITC Trade Map data.

The visual evidence therefore suggests that quantitative export expansion and geographical diversification followed distinct trajectories. This observation provides the basis for the correlation analysis presented in the following section.

Table 3. Descriptive statistics of the variables (2016–2024)

Variable	Mean	Std. Dev.	Min	Max
Agricultural and food exports (USD million)	802.70	173.78	525.52	1105.53
Non-oil exports (USD million)	2304.00	817.61	1237.10	3356.50
Share of agricultural and food exports in non-oil exports (%)	36.61	5.98	28.95	42.83
Herfindahl–Hirschman Index (HHI)	0.509	0.052	0.394	0.556
Government expenditure on education (% of total government expenditure)	9.88	1.88	6.95	11.64

Source: Author's calculations based on the State Customs Committee of the Republic of Azerbaijan, the State Statistical Committee of the Republic of Azerbaijan, and the World Bank (2025).

Table 3 summarizes the main variables. During 2016–2024, agricultural and food exports averaged USD 802.70 million and non-oil exports averaged USD 2.30 billion. Agricultural and food exports accounted for an average 36.61% of non-oil exports, while the mean HHI was 0.509. Based on the year-by-year WDI observations reported in **Table 4**, government expenditure on education averaged approximately 9.88% of total government expenditure. The complete annual series is reported to improve transparency and reproducibility.

Table 4. Complete annual analytical dataset (2016–2024)

Year	Agricultural and food exports (USD million)	HHI	Government expenditure on education (% of total government expenditure)
2016	525.520	0.394	8.1958
2017	658.912	0.470	6.9546
2018	704.368	0.552	7.3997
2019	772.198	0.556	9.7676
2020	759.877	0.551	10.79
2021	816.225	0.516	11.51
2022	912.381	0.510	11.64
2023	969.250	0.537	11.18
2024	1,105.526	0.496	11.45

Source: Author's calculations based on State Customs Committee and State Statistical Committee trade data; HHI from destination-country shares; education expenditure from World Bank WDI indicator SE.XPD.TOTL.GB.ZS.

4.6. Correlation analysis between government expenditure on education, agricultural and food exports, and export concentration

To examine the macro-level relationship between education expenditure and export outcomes, Pearson correlations were first calculated using annual levels. Given the short series and the visible upward movement in both education expenditure and nominal exports, these coefficients are not treated as confirmatory evidence. Robustness checks using log export values, Spearman ranks, and first differences are reported below in **Table 5**.

Table 5. Exploratory correlation analysis

Variable	Agricultural and food exports	Herfindahl–Hirschman Index (HHI)
Government expenditure on education (% of total government expenditure)	0.766*	0.337

Notes: Pearson correlation coefficients for annual levels. * $p < 0.05$. $N = 9$. The p -values are descriptive diagnostics and do not establish causality.

Source: Author's calculations based on World Bank, World Development Indicators (2025), the State Customs Committee of the Republic of Azerbaijan, and the State Statistical Committee of the Republic of Azerbaijan.

In annual levels, government expenditure on education was positively correlated with agricultural and food exports ($r = 0.766$, $p = 0.016$), while its correlation with the HHI was positive but not statistically significant ($r = 0.337$, $p = 0.375$). The first result should not be interpreted as evidence that education spending caused export growth. Both series vary over time, and the small sample makes conventional inference fragile. The robustness analysis therefore examines whether the association persists under alternative transformations. The results are shown in **Table 6**.

Table 6. Robustness checks for the education-expenditure/export association

Specification	Coefficient	p-value	Interpretation
Pearson, annual levels	0.766	0.016	Positive level association; trend-sensitive
Pearson, log(exports) levels	0.773	0.015	Similar positive level association
Spearman rank correlation	0.800	0.010	Positive monotonic level association
Pearson, Δ education expenditure vs. Δ ln(exports)	-0.541	0.167	No significant positive association in annual changes

Notes: $N = 9$ for level and rank specifications; $N = 8$ for the first-difference specification. Δ ln(exports) is the annual log change in agricultural and food export values. Because of the short series, these checks are descriptive. The disappearance of the positive association after first-differencing indicates that the level result is not robust to trend removal.

5. Discussion

The results show a clear distinction between export-value expansion and destination diversification. Agricultural and food exports more than doubled in nominal current-USD terms between 2016 and 2024, yet the HHI remained high and Russia accounted for about 69.9% of exports in 2024. The fall in the HHI from 0.556 in 2019 to 0.496 in 2024 is economically relevant as a partial moderation of concentration, but it is not sufficient to characterize the export structure as broadly diversified. The 2024 HHI also remained above its 2016 value of 0.394.

This sector-specific destination evidence is the study's main empirical contribution relative to broader discussions of Azerbaijan's non-oil exports. Aggregate non-oil export growth can conceal dependence within individual sectors. Focusing on HS Chapters 01–24 shows that agricultural export expansion has largely coexisted with strong dependence on a dominant destination market. This distinction matters for resilience because destination-specific shocks can affect a concentrated sector even when aggregate non-oil exports are growing.

Several context-specific factors help explain the persistence of concentration. Russia combines geographical proximity, established commercial relationships, relatively low transport costs, and logistics networks suited to Azerbaijan's fresh and perishable products. Entry into more distant markets can require longer cold-chain routes, additional certification, packaging changes, market intelligence, distributor relationships, and higher working-capital commitments. These fixed and variable costs are particularly burdensome for small exporters and producers of perishable goods [17–19]. Diversification policy should therefore recognize that concentration can partly reflect rational cost and risk considerations rather than simply a lack of market ambition.

The human-capital perspective is relevant at this point, but the evidence must be separated from the conceptual mechanism. Exporters seeking new markets may need staff capable of managing certification, traceability, quality assurance, customs documentation, buyer communication, and market research. Managers also need knowledge to evaluate the costs and risks of alternative destinations. These workforce and managerial requirements provide a plausible link between market diversification and HR development [5,7,11,16,26]. However, the present dataset does not measure employee skills, HR practices, managerial competence, or organizational capabilities. These mechanisms therefore remain hypotheses for future firm-level research rather than empirical findings of this study.

The exploratory education-expenditure analysis reinforces the need for caution. The positive level correlation with nominal agricultural and food exports is statistically significant, but the association does not remain positive and significant when year-to-year changes are examined. This sensitivity indicates that common trends may contribute materially to the level relationship. Accordingly, the revised manuscript does not claim that higher public education expenditure causes or robustly predicts agricultural export growth. The absence of a significant level relationship with the HHI likewise provides no evidence that national education spending alone reduces destination concentration. Human capital may still matter through firm-level skills and managerial capabilities, but those channels require direct micro-level measurement.

The findings are consistent with the broader literature in one central respect: diversification is a structural process rather than an automatic consequence of higher export values [1,2,6,20]. The distinctive insight here is that this separation is visible within Azerbaijan's agricultural and food sector through 2024. The analysis also clarifies the limits of macro-level human-capital proxies. National education expenditure can indicate the public priority assigned to education, but it cannot substitute for measures of exporter-specific skills, training, HR systems, or

managerial capability. Future research should therefore link firm-level workforce indicators to exporter destinations and market-entry outcomes.

Policy implications should be allocated across actors. Government agencies can reduce market-entry costs through trade information, mutual recognition and certification support, export-promotion services, and improvements in border and transport infrastructure. Agricultural exporters should invest in quality-control personnel, traceability, certification readiness, foreign-market intelligence, and managerial skills. Industry associations can pool information and coordinate training for smaller firms. Universities and vocational or training institutions can develop targeted programmes in food safety, export documentation, quality management, logistics, and international marketing. Logistics providers can expand cold-chain reliability and route options. These measures do not guarantee diversification, but they address concrete constraints that are especially important for smaller exporters and perishable products.

6. Conclusion

This study examined the geographical concentration and market diversification of Azerbaijan's agricultural and food exports during 2016–2024. Nominal export value increased from USD 525.5 million to USD 1.106 billion, while the HHI rose from 0.394 in 2016 to 0.556 in 2019 and then declined to 0.496 in 2024. Russia remained the dominant destination with approximately 69.9% of exports in 2024. The evidence therefore indicates substantial export expansion without a comparable transition to a broadly diversified destination structure.

The macro-level education-expenditure analysis is exploratory. Although the level correlation with agricultural and food exports is positive, robustness checks show that the relationship is sensitive to transformation and does not persist as a positive significant association when annual changes in education expenditure are compared with log changes in exports. No significant relationship is found between education expenditure and the HHI. These results do not support causal claims about human capital and export performance. Instead, they identify a question that should be tested with longer series and direct firm-level measures of skills, training, managerial competence, and export-market outcomes.

Policy should therefore focus on the concrete constraints that shape destination choice. Public agencies can facilitate certification, market information, trade promotion, and infrastructure; exporters can strengthen workforce skills and quality-management capacity; industry associations and training institutions can coordinate specialized training; and logistics providers can improve cold-chain connectivity. For smaller exporters and producers of perishable goods, diversification initiatives should explicitly account for the higher fixed costs, transport risks, certification requirements, and working-capital needs associated with distant markets.

The study has several limitations. First, it uses aggregated national annual data and cannot capture product- or firm-level heterogeneity. Second, government expenditure on education is a macro-level budget indicator, not a direct measure of the human capital employed by agricultural exporters. Third, $N = 9$ is too small for strong time-series inference or reliable unit-root testing. The level correlation is sensitive to transformation, so it is presented only as exploratory descriptive evidence. Fourth, current-USD export values are affected by price and exchange-rate movements; the robustness checks reduce but do not eliminate this limitation. Future research should use longer real-value series and matched firm-level data on employee skills, training, managerial capabilities, certification, and destination entry. The supplementary destination matrix provides a reproducibility check for 2016–2023 but does not replace the study's original national/ITC trade series.

The principal contribution is therefore the updated, sector-specific evidence

on geographical destination concentration and the explicit separation of export expansion from market diversification. The human-capital discussion is retained as a carefully bounded policy perspective rather than as a claim that firm-level HR mechanisms have been empirically demonstrated.

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Informed consent statement: Not applicable.

Data availability statement: The trade data supporting the study are available from the State Customs Committee of the Republic of Azerbaijan, the State Statistical Committee of the Republic of Azerbaijan, and ITC Trade Map. Government expenditure on education is from the World Bank World Development Indicators, indicator SE. XPD. TOTL. GB. ZS. The complete annual analytical series used in the revised correlation analysis is reported in **Table 4**. For reproducibility, the 2016–2023 destination-level validation dataset was reconstructed from the World Integrated Trade Solution (WITS) reported trade data [27]; the resulting annual HHI validation and destination-country shares are reported in Supplementary Appendix **Tables A1–A2**.

Conflict of interest: The author declares no conflict of interest.

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Appendix

Annual Destination Shares and HHI Validation for Azerbaijan's Agricultural and Food Exports (HS 01–24), 2016–2023

Data and calculation note. The appendix aggregates WITS partner-level export data for Animal (HS 01–05), Vegetable (HS 06–15), and Food Products (HS 16–24). These three groups jointly cover HS Chapters 01–24. Regional aggregate rows are excluded from the destination matrix. “World” is used only as the annual export denominator. The Herfindahl–Hirschman Index (HHI) is calculated as the sum of squared individual destination-country export shares. The WITS pages state that the trade statistics are based on reported data and are not gap-filled.

Table A1. Recalculated annual export totals and HHI validation

Year	WITS HS 01–24 exports (USD million)	Recalculated HHI	HHI reported in manuscript	Difference
2016	525.543	0.3947	0.394	+0.0007
2017	658.910	0.4704	0.470	+0.0004
2018	704.417	0.5524	0.552	+0.0004
2019	772.334	0.5563	0.556	+0.0003
2020	759.915	0.5517	0.551	+0.0007
2021	816.437	0.5157	0.516	–0.0003
2022	912.612	0.5101	0.510	+0.0001
2023	969.665	0.5369	0.537	–0.0001

For concise presentation, **Table A2** reports destinations that accounted for at least 0.20% of Azerbaijan's HS 01–24 exports in at least one year during 2016–2023. The table is abbreviated for presentation purposes only. The HHI calculations use the complete set of individual partner-level destination shares available in the underlying WITS data. Destinations omitted from **Table A2** were therefore retained in the HHI calculation and were not combined into a residual “Other countries” category.

Table A2. Selected Destination-Country Shares of HS 01–24 Exports, 2016–2023

Partner	2016	2017	2018	2019	2020	2021	2022	2023
Russian Federation	61.532	67.600	73.928	74.138	73.928	71.325	70.894	72.900
Italy	7.638	7.814	2.903	4.303	3.812	4.287	2.937	1.671
Turkmenistan	6.333	5.885	2.995	2.559	2.170	3.368	1.653	1.875
Georgia	3.642	3.935	4.265	4.552	3.372	3.607	4.901	4.652
Germany	4.778	2.985	2.283	2.789	2.102	2.187	2.299	2.447
Kazakhstan	2.001	0.776	0.514	0.470	1.047	0.985	3.322	1.874
Iraq	3.190	2.195	1.792	1.404	1.221	2.565	2.663	1.449
Belarus	1.398	1.746	1.672	1.510	1.623	1.977	3.001	1.434
Ukraine	1.029	1.374	2.156	2.352	2.288	2.432	1.190	2.401
Tajikistan	2.250	0.236	0.749	0.349	0.604	0.588	0.336	0.391
Iran, Islamic Rep.	1.690	1.521	2.200	1.130	0.428	0.665	0.274	0.306
Turkey	0.379	0.306	0.661	1.049	1.412	1.578	2.157	1.993
Czech Republic	0.194	0.175	0.039	0.019	1.216	0.149	0.077	0.093
Uzbekistan	0.058	0.073	0.404	0.155	1.208	0.420	0.673	0.861
Poland	0.525	0.709	0.366	0.353	0.322	0.199	0.300	0.488
Kyrgyz Republic	0.666	0.065	0.230	0.106	0.124	0.585	0.394	0.306
Switzerland	0.000	0.019	0.199	0.119	0.170	0.159	0.220	0.626
United Arab Emirates	0.196	0.156	0.289	0.301	0.215	0.157	0.302	0.613
Afghanistan	0.388	0.245	0.233	0.249	0.561	0.102	0.029	0.013
Spain	0.112	0.056	0.077	0.080	0.105	0.527	0.168	0.496
Qatar	0.007	0.468	0.063	0.036	0.045	0.035	0.064	0.106
China	0.200	0.173	0.127	0.204	0.353	0.307	0.159	0.238
Luxembourg	0.000	0.000	0.000	0.000	0.313	0.172	0.082	0.000
United States	0.183	0.149	0.138	0.169	0.150	0.188	0.273	0.157

Continued table:

Partner	2016	2017	2018	2019	2020	2021	2022	2023
France	0.269	0.136	0.241	0.158	0.050	0.096	0.063	0.176
Lithuania	0.134	0.186	0.161	0.237	0.172	0.079	0.057	0.095
Latvia	0.115	0.066	0.129	0.044	0.008	0.024	0.027	0.210
Japan	0.204	0.117	0.042	0.054	0.042	0.026	0.019	0.146

Source: Author's calculations from World Integrated Trade Solution (WITS) [27], based on reported trade data. Product groups: Animal (HS 01–05), Vegetable (HS 06–15), and Food Products (HS 16–24).

Interpretation. The independently reconstructed WITS series closely reproduces the manuscript HHI values for 2016–2023. The largest absolute difference is below 0.001. This validation supports the reproducibility of the destination-concentration calculations while leaving the manuscript's original official-source series unchanged. **Table A2** is abbreviated solely to improve readability; all individual destination partners available in the underlying WITS dataset were retained when recalculating the HHI. The independent WITS validation is limited to 2016–2023 because comparable partner-level WITS data for 2024 were not available in the same extract; the manuscript's 2024 estimates therefore remain based on the original national and ITC source compilation.