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## Part 1: Introduction

Agricultural raw materials refer to unprocessed agricultural goods that are commonly shipped in their original or basic state. These products are essential components used in subsequent processing and manufacture, or for immediate consumption (Burdzik 2009)

The exports of agricultural raw resources play a crucial role in global trade and economic expansion. According to the FAO, these exports consist of a wide range of items, including agricultural, livestock, forestry goods, and fisheries. The agricultural sectors have a vital role in fostering economic growth, especially in nations with a strong agricultural industry (FAO 2020). According to the experts at the FAO, the export of agricultural raw resources is beneficial since it helps generate foreign exchange earnings, create employment opportunities, and increase income generation (FAO 2020). Exports have a crucial role in the development and expansion of economies, particularly in developing countries. This is because agriculture significantly affects rural communities and efforts to alleviate poverty.

Global monitoring of agricultural raw material exports is essential for ensuring sustained socio-economic development due to a variety of reasons.

Exports of agricultural raw commodities are essential for countries as they provide foreign exchange revenues, which subsequently contribute to their economic growth and stability (Ali et al. 2020). The generated revenue can be utilized to finance various development initiatives, such as infrastructure projects, education, healthcare, and poverty alleviation efforts. Policymakers and stakeholders can assess the economic implications and maximize the benefits by examining the exportation of agricultural raw materials.

Moreover, the sustainable expansion of the agricultural sector relies heavily on the effective management of agricultural raw material exports. The long-term sustainability of agriculture depends on the adoption of sustainable practices, including responsible land utilization, effective resource allocation, and environmental preservation (FAO 2020). The monitoring of exports allows for the detection of any environmental risks associated with intensive agricultural production and ensures the implementation of appropriate measures to mitigate them (FAO 2020). Countries can achieve a balanced state of economic growth, environmental preservation, and human well-being by promoting sustainable policies.

Additionally, there is a notable link between the export of agricultural raw materials and the GNI per capita. GNI per capita is an essential measure that offers valuable information on the economic development and standard of living in a specific country. The export of agricultural raw materials enhances GNI by generating revenue and boosting economic activity (Okwori & Sule 2016). Countries that rely largely on exporting agricultural raw materials may see fluctuations in their GNI per capita due to changes in global market conditions, commodity prices, and demand.

Through the surveillance of this correlation, policymakers can assess the impact of agricultural exports on GNI per capita and develop strategies to diversify their economies and reduce dependence on a specific sector. This will promote long-term and fair development.

In order to achieve sustainable socio-economic advancement, it is essential to closely monitor the export of agricultural raw materials. Countries can optimize the advantages of exporting agricultural raw materials and achieve sustainable and inclusive growth by understanding the economic consequences, advocating for sustainable practices, and assessing the correlation between exports and GNI per capita.

## Part 2: Descriptive Statistics and Probability

Contingency Table

| | **Low-Income countries (LG)** | **Middle- Income countries (MG)** | **High-Income countries (HG)** | **Total** |
|---|---|---|---|---|
| **Low agricultural raw materials exports (L) <1.18** | 2 | 6 | 6 | 14 |
| **High agricultural raw materials exports (H) >=1.18** | 6 | 5 | 4 | 15 |
| **Total** | 8 | 11 | 10 | **29** |

**a. Interdependent events of Agricultural raw materials exports and GNI per capita**

To determine whether GNI and agriculture raw materials exports are independent events, we will compare the probabilities of low agricultural raw material exports that have low GNI (P(L|LG)) and low GNI countries (P(LG)) to discover if they are related.

- $P(L|LG) = \frac{□(□ \cap □□)}{□(□□)} = \frac{2}{8} = 0.25$

- $P(LG) = \frac{8}{29} = 0.28$

$\Rightarrow 0.25 \neq 0.28 \Rightarrow P(L|LG) \neq P(LG)$

It can be seen that $0.25 \neq 0.28$, hence, the probability of low agriculture raw materials exports in low-income nations (P(L|LG)) and the probability of low-income countries (P(LG)) are not equivalent. In other words, the low income can affect the country's low agricultural raw materials exports and vice versa. Therefore, we can conclude that agricultural raw materials exports and GNI are not independent events and they can impact each other's performance.

**b. Country categories are more likely to have higher Agricultural raw materials**

**exports**

The probability of high agricultural raw materials in each country category exports is as below:

- Low-Income country (LG) = P(H|LG) = 75%
- Middle-Income country (MG)= P(H|MG) = 45%
- High-Income country (HG) = P(H|HG) = 40%

Based on the statistics, it can be concluded that the country category with lowest GNI has the highest likelihood to export agricultural raw materials in large quantities, in comparison to other country classifications.

### c. Compare the different country GNI per capita categories

**Central Tendency**

| | **Low-Income countries (LG)** | **Middle- Income countries (MG)** | **High-Income countries (HG)** |
|---|---|---|---|
| Mean | 16.91 | 1.52 | 0.83 |
| **Median** | **13.26** | **1.00** | **0.38** |
| Mode | - | - | - |

Table 1: Measure of tendency of 3 country categories

| **Low-Income countries (LG)** | | | **Middle- Income countries (MG)** | | | **High- Income countries (MG)** | | |
|---|---|---|---|---|---|---|---|---|
| **Lower fence** | | **Minimum** | **Lower fence** | | **Minimum** | **Lower fence** | | **Minimum** |
| -29.46 | < | 0.05 | -2.01 | < | 0.08 | -2.12 | < | 0.01 |
| **Upper fence** | | **Max** | **Upper fence** | | **Max** | **Upper fence** | | **Max** |
| 53.75 | < | 56.45 | 4.53 | < | 5.43 | 3.70 | < | 4.49 |
| Have outlier | | | Have outlier | | | Have outlier | | |

Table 2: Measure of outliers of 3 country categories

There is an appearance of outliers in the dataset. Therefore, we should use Median as a suitable method to analyze the data since this measurement can reflect the central point more accurately without extreme effect from outliers.

From the result in table 1, it can be seen that LG, with a value of 13.26%, received the highest median number among 3 country categories. This implies that LG countries usually have high agricultural raw materials (>1.18%) and agricultural raw materials also plays an important role in its export economic sectors, compared to MG and HG countries, as their median value is much lower with 1% and 0.38% respectively.

**Variation**

| | Low-Income countries (LG) | Middle-Income countries (MG) | High-Income countries (HG) |
|---|---|---|---|
| Range | 56.39 | 5.35 | 4.48 |
| **Interquartile Range (IQR)** | **20.80** | **1.63** | **1.46** |
| Sample Variance | 365.08 | 0.79 | 1.09 |
| Sample standard deviation (SD) | 19.11 | 0.89 | 1.05 |
| Coefficient of variance (CV%) | 113.01% | 58.20% | 126.33% |

Table 3: Measure of variation of 3 categories

Variation measures how individual data points deviate from the central value, providing insights into the overall distribution and variability of the dataset. When a dataset contains outliers, extreme values that deviate significantly from the majority of the data, using the IQR can be beneficial because it focuses on the central portion of the data, where the majority of the values lie and neglect the outlier value.

Table 3 shows that LG's IQR of 20.80, is much higher than two other country categories, at 1.63 and 1.46 respectively. Thus, we can conclude that agricultural raw material export data in low-income nations is more variable, indicating a greater range of values. On the contrary, MG and HG suggest more stable agricultural raw material export figures.

## Part 3: Confidence Intervals

### a. Confidence intervals calculation

As a common level, the significance level 5% would be applied. With the sample size is smaller than 30 (n=29 <30), when the population SD is unknown, t-distribution would be the way to find the t-critical value.

| | | |
|---|---|---|
| **Population SD** | σ | unknown |
| **Sample SD** | S | 11.965 |
| **Sample mean** | $\overline{X}$ | 5.702 |
| **Sample size** | n | 29 |
| **Confidence level** | 1-α | 95% |

**- Degree of Freedom (df):** n - 1 = 28

**- Significance level:** 0.05

⇒t-critical value: ± 2.0484

**Confidence interval:**

- Lower point: 5.702 - 2.0484 x $\frac{11.965}{\sqrt{29}}$ = 1.151

- Upper point: 5.702 + 2.0484 x $\frac{11.965}{\sqrt{29}}$ = 10.253

⇒$1.151 \leq \mu \leq 10.253$

**Interpretation:** The world agriculture raw material export (% total merchandise exports) is in the range of 1.1551% to 10.253% with 95% confidence level.

### b. Assumption

Typically, if the sample size is sufficiently big ($n \geq 30$), it is unnecessary to make any assumptions in order to apply the Central Limit Theorem (CLT) and conclude that the data follows a normal distribution.

However, in this scenario, if the sample size is smaller than 30 (n=29 <30) and we do not assume that the data follows a normal distribution, the sample mean would be affected by bias. As a result, the final analysis of the data would be affected. Also, the assumption aids in gauging the degree to which the CLT to the provided sample size when the sample size is insufficient.

## Part 4: Hypothesis Testing

### a. Hypothesis test

According to the published report, average agricultural raw materials exports (% total exported merchandise) is recorded at 1.21% in 2017, while the data set in 2018 show the agriculture raw exports contributes from 1.551% to 10.253%. Therefore, it can be assumed that the contribution in total exported merchandise of agriculture raw material shows the increase trend.

**Step 1: Check CTL**

The CLT cannot be used when the sample size is smaller than 30 (n=29). It is necessary to make the assumption that the data set follows a normal distribution.

**Step 2: Set up null & alternative hypothesis**

**Null hypothesis** $H_0$**:** $\mu \leq 1.21\%$

⇒World average agricultural raw materials remain constant and decrease.

**Alternative hypothesis** $H_1$: $\mu > 1.21\%$

⇒World average agricultural raw materials increase

**Step 3: Determine values & test type**

| | | |
|---|---|---|
| **Sample SD** | S | 11.965 |
| **Sample mean** | $\overline{X}$ | 5.702 |
| **Sample size** | n | 29 |
| **Level of significance** | α | 0.05 |

⇒**Upper-tailed test** under assumption that there is a rise in the world average of agricultural raw material exports.

**Step 4: Identify data distribution**

When the standard deviation of the population is unknown, we make the assumption that the data follows a normal distribution. In this case, we use the **student t-table for conducting tests**.

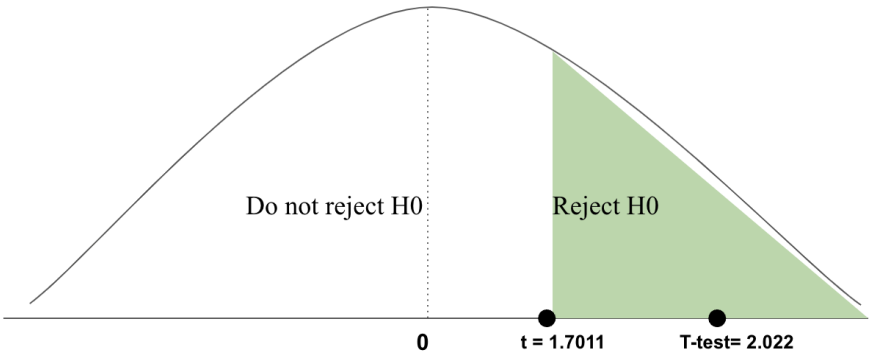
**Step 5: Identify T-critical value**

- Degree of Freedom (df): 28
- Significant level: 0.05
- Upper-tailed test

⇒t-value = 1.7011 (right-tall)

**Step 6: Test statistic value**

T-test statistic = $\frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{5.702 - 1.21}{\frac{11.965}{\sqrt{29}}} = 2.022$




Since the T-test statistic of 2.022 is greater than the critical value of t=1.7011, it may be concluded that the T-test statistic falls within the region where the null hypothesis - $H_0$ area (which states that the world average agricultural raw materials remain stable or decline) can be rejected.

**Step 8: Determine the decision**

The null hypothesis is rejected, hence, the alternative hypothesis is adopted. With a 95% confidence level, the global average agricultural raw material exports in 2018 showed an increase compared to the previous year's growth rate of 1.21%.

**Step 9: Type of error**

Given that the null hypothesis ($H_0$) has been rejected, there is a possibility of committing a type I mistake. The mistake has a probability of 5%.

**In this context, the error has the meaning that:**

In the framework of hypothesis testing, it may be inferred that the world average exports of agricultural raw materials are rising by a margin of 1.21%. However, the world average of agricultural raw material exports has not experienced any growth in reality due to some reasons. The published studies wrongly concluded that the world average agriculture raw material exports will grow, indicating that economic professionals committed a Type I Error.

**Indeed, Type I Error can result in substantial consequences.** Specifically, if there is a projected increase in the proportion of agricultural raw materials being exported compared to the overall exports, policymakers can allocate an excessive amount of resources to the agriculture sector, disregarding other industries. This might potentially lead to economic disparities. Moreover, if there is a projected rise in the export of unprocessed resources, it also results in the over allocation of resources towards agricultural production. Consequently, this may lead to an over supply of

agricultural goods, market inefficiencies, and decreased profitability for farmers.

**In order to minimize the impact of Type I error,** it is crucial to carefully select the significance level and take into account the replication of results, conducting larger sample sizes, and conducting additional studies to authenticate the findings prior to reaching definitive conclusions or making significant decisions solely based on the results of a single study.

**b. Discuss possible impact if data is reduced by half**

If we reduce the data by 50%, which means the sample size is smaller, there is a possibility that the statistical choice we previously examined may shift from rejecting the null hypothesis (H0) to accept it. Bonett (2020) found that when the **sample size decreases, the confidence interval becomes wider**. This widening indicates a higher level of uncertainty in the estimate process, which might result in more inadequate and biased outcomes. In section 4a, **we did not reject the alternative hypothesis because the test-value was within the range of acceptance**. However, if we decrease the sample size by half, **the increased width of the confidence interval will lead to less accurate outcomes, resulting in a larger acceptance range and a narrower rejection range**. In addition, the t-test statistic, which is 2.022, is in close proximity to the boundary of the confidence interval. Expanding the wideness of the confidence interval increases the chance that the t-test outcome will be within the acceptance range. **This might result in accepting the null hypothesis and changing the statistical conclusion**. This modification would diminish the precision of the outcome and raise the error probability.

## Part 5: Overall Conclusion and Recommendations For Policymakers

In conclusion, the export of agricultural raw materials is crucial for promoting economic growth. The prior investigation reveals four key findings about the situation and importance of agricultural raw material exports compared to merchandise exports globally.

Firstly, based on secondary research, it has been determined that the export of agricultural raw resources plays a crucial role in promoting sustainable socio-economic growth in countries. Exports have a crucial role in alleviating poverty in emerging nations, particularly those with a strong dependence on agriculture for their economy.

Furthermore, we can investigate the correlation between the exports of agricultural raw materials and the GNI per capita. Research has shown a strong association between the exports of agricultural raw materials and GNI, suggesting that these two variables have a mutual effect on each other's results. In particular, when countries possess a comparative advantage in the production and exportation of agricultural commodities, an increase in exports might result in more income from trade, hence favorably affecting GNI (Bakari 2019). Given the crucial role of agricultural raw materials in driving the country's economic development, governments should

give priority to implementing strategies that can boost agricultural output. Moreover, promoting sustainable agriculture is important to boost resilience and mitigate environmental consequences of this export's sector.

The importance of exporting agricultural raw materials for each country's income categories is further highlighted using descriptive measures and probability. Specifically, low-income nations exhibit the greatest probability of having high exports in agricultural raw materials, indicating their heavy dependence on agriculture as a key means for economic development. In contrast, countries with high incomes typically exhibit a greater degree of economic diversification and a higher level of industrialization (IMF 2020). Consequently, their GNI is not primarily influenced by exports of agricultural raw materials, resulting in their having the smallest share of agricultural raw materials exports. As a policy maker in low-income countries, besides agriculture, the government should put more effort in diversifying the economy into other categories such as manufacturing or services. From that, reducing the dependence on external factors such as weather may impact the agriculture performance.

The latest findings are derived from the results of the confidence interval, which **indicates that the global average agricultural raw material exports would fall within the range of 1.551% to 10.253%** of the overall merchandise export. Furthermore, according to hypothesis testing, it is anticipated that the average raw material exports would exhibit a 1.21% rise compared to the figure recorded in 2017, with a 95% level of confidence. By adopting an optimistic perspective, **policymakers may leverage the benefits of the agriculture sector to secure advantageous conditions for these goods in international trade agreement**s, thus promoting long-term economic growth. In addition, t**he allocation of resources such as logistics, infrastructure, and investment** is dependent on the calculation of the percentage of farm exports. This contributes to the growth of the sector's outcome and overall economic development.

In conclusion, the paper provides a comprehensive perspective on the correlation between the percentage of agricultural raw material exports and GNI of a nation. The current limit of the report remains adequate, and the little data set presents an opportunity for further investigation into this matter. Therefore, it is necessary to assess a bigger and more up-to-date sample, as well as consider other factors that influence the two variables.

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