

Multidimensional Analysis Of Economic Inequality And Its Relationship To Development And Food Security

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Summary

Economic inequality continues to be one of the main challenges for sustainable development and food security at the global level. This article proposes a multidimensional analysis approach to understand how different economic, social, and structural factors interact with and affect the food security of populations. Through the use of multivariate statistical methods and the cross-referencing of socioeconomic indicators, the relationship between income distribution, access to basic services, structural poverty and food availability is examined. The results reveal a significant correlation between high levels of inequality and low levels of food security, evidencing the need for comprehensive public policies that address these dimensions simultaneously.

Keywords: *Economic inequality, sustainable development, food security, multidimensional analysis, structural poverty.*

INTRODUCTION

Economic inequality represents one of the greatest contemporary challenges on the road to sustainable development, especially in low- and middle-income countries. Despite the economic growth experienced in different regions of the world, social and economic gaps have tended to widen, generating deep asymmetries in access to basic resources such as education, health, employment and, critically, adequate food (FAO, 2023). This situation has been exacerbated by multiple crises in recent years, including the COVID-19 pandemic, rising international food prices, and the effects of climate change, factors that have disproportionately affected the most vulnerable populations (World Bank, 2022; IPCC, 2023). In this context, food security has become a central axis of the debate on equity and well-being. According to the FAO (2022), more than 735 million people suffered from hunger in the world in 2021, and a significant proportion was concentrated in countries with high inequality rates. This suggests a direct correlation between structural socioeconomic conditions and households' ability to access sufficient, safe and nutritious food in a sustainable manner. Empirical evidence supports this connection: lower-income households not only consume less food, but also have less access to nutritious diets and public services that guarantee basic health and sanitation conditions (UNDP, 2023; UNICEF, 2022). Traditional analysis of inequality tends to focus on one-dimensional measures, such as per capita income or the Gini coefficient. However, this approach is insufficient to understand the root causes

and consequences of inequality, especially in its relation to complex phenomena such as food security. Therefore, it is necessary to adopt a multidimensional analytical approach that integrates structural variables such as access to basic services, educational level, housing conditions, and labor participation, as well as territorial and governance factors (Alkire et al., 2021). This article proposes an analysis of this type, addressing inequality from multiple dimensions and establishing its link with food security in the context of sustainable human development. It is hypothesized that high levels of multidimensional inequality reduce the resilience of communities to economic and food shocks, which directly compromises their long-term development possibilities. Thus, it seeks to contribute to the design of more comprehensive and effective public policies, based on empirical evidence and aimed at promoting inclusive and equitable development.

Theoretical Framework

2.1. Economic Inequality: Dimensions and Measurement

Economic inequality is a multidimensional phenomenon that manifests itself in the unequal distribution of income, assets, access to public services, and job opportunities (UNDP, 2023). Traditionally, it has been measured using the **Gini coefficient**, which reflects income concentration; however, this indicator does not capture other dimensions of structural exclusion, such as gender, ethnic, or territorial inequality (World Bank, 2022).

According to the World Bank (2021), the causes of inequality are associated with factors such as:

- Differences in human capital (education and health)
- Unequal access to markets and financial services
- Concentration of productive assets
- Structural discrimination and social exclusion

These inequalities directly affect households' ability to generate income, access quality jobs, and actively participate in the formal economy.

Table 1. Common indicators of economic inequality

<i>Indicator</i>	<i>Description</i>	<i>Fountain</i>
<i>Gini coefficient</i>	Measures income inequality between 0 (equality) and 1 (maximum)	World Bank, 2021
<i>Palma Index</i>	Ratio of the income of the richest 10% to the poorest 40%	UNDP, 2023
<i>MPI (Multidimensional Poverty Index)</i>	It measures deficiencies in health, education and standard of living	Alkire et al., 2021
<i>Intergenerational inequality</i>	Opportunity gaps inherited from parents to children	OECD, 2020

2.2. Food Security: Approaches and Dimensions

Food security, according to the FAO (2023), implies that all people, at all times, have physical and economic access to sufficient safe and nutritious food. This definition encompasses **four key dimensions**:

1. **Food availability** (production, stockpiles, imports)
2. **Economic and physical access** (income, markets, infrastructure)
3. **Biological use** (nutrition, health, drinking water)
4. **Stability** (resilience to economic or environmental shocks)

Failures in any of these dimensions have an unequal impact on the poorest social groups, who devote a greater proportion of their income to food purchases (FAO, 2022).

Table 2. Structural factors affecting food security

DIMENSION	VULNERABILITY FACTORS	EXAMPLE	FOUNTAIN
AVAILABILITY	Climate, agricultural production, armed conflicts	Drought in the Horn of Africa	IPCC, 2023
ACCESS	Poverty, unemployment, food inflation	Post-COVID-19 price increase	FAO, 2023
UTILIZATION	Malnutrition, inadequate health services	High prevalence of childhood anemia	UNICEF, 2022
STABILITY	Economic shocks, pandemics, political instability	War in Ukraine	WFP, 2022

2.3. Multidimensional Approaches to Development Analysis

The concept of human development states that well-being cannot be understood only through economic income, but through the **expansion of human freedoms and capacities** (Sen, 1999/2020). In this line, the UNDP Human Development Index (HDI) and the Multidimensional Poverty Index (MPI) provide frameworks for assessing simultaneous deprivations. According to Alkire and Santos (2021), the multidimensional approach makes it possible to identify *poverty traps* that arise when multiple deprivations (education, health, housing) are combined. In addition, it facilitates the design of more focused public policies, recognizing the heterogeneity of the affected populations. Current analytical frameworks also incorporate **territorial** and **environmental** dimensions, recognizing that local contexts and ecological sustainability directly influence inequality and food security (UNDP, 2023; IPCC, 2023).

2.4. Intersection between Inequality and Food Security

Recent studies show a **significant correlation between levels of economic inequality and food insecurity**. A joint report by WFP and FAO (2023) concludes that in countries with high levels of

inequality ($Gini > 0.45$), the prevalence of undernourishment exceeds 25%, while in more egalitarian countries (< 0.30), the prevalence is less than 10%. In addition, territorial inequality means that rural and indigenous populations face higher levels of food insecurity, even in countries with acceptable average levels (FAO, 2023; UNDP, 2023).

Table 3. Empirical relationship between inequality and undernourishment (global sample)

<i>Country group (according to Gini)</i>	<i>Gini Average</i>	<i>Undernourishment (%)</i>	<i>Level of development</i>
High inequality	> 0.45	27.3 %	Low
Average inequality	0.35–0.45	15.2 %	Middle
Low inequality	< 0.35	9.1 %	High

Source: Authors' elaboration with data from FAO (2023) and World Bank (2022).

METHODOLOGY

3.1. Research design

The present research adopts a **quantitative, correlational and explanatory** approach, with the aim of exploring the relationship between multiple dimensions of economic inequality and levels of food security at the national level. A **cross-sectional and non-experimental** strategy was used, based on the analysis of international public secondary databases (Creswell & Creswell, 2023). This approach is suitable for identifying patterns, associations, and potential causal relationships in large, heterogeneous datasets (Hair et al., 2021). The integration of economic, social and human development variables allows us to build a holistic perspective of the phenomenon.

3.2. Population and sample

The unit of analysis corresponds to **countries in Latin America, Sub-Saharan Africa and South Asia**, due to their high vulnerability to food insecurity and structural inequality. A sample of **42 countries** was selected with available and consistent data between 2019 and 2023, from the following sources:

- World Bank DataBank
- United Nations Development Programme (UNDP Human Development Reports)
- Food and Agriculture Organization of the United Nations (FAO)
- Índice de Pobreza Multidimensional de OPHI (Oxford Poverty and Human Development Initiative)

3.3. Study variables

We worked with a combination of **independent variables (multidimensional inequality)** and a **dependent variable (food security)**.

Table 4. Variables considered in the analysis

Category	Variable	Fountain	Year
Economic inequality	Gini coefficient	World Bank	2023
Structural inequality	MPI (Multidimensional Poverty Index)	UNDP / OPHI	2022
Income	Gross national income per capita	World Bank	2023
Access to services	% of population with access to drinking water	FAO / WHO	2022
Education	Secondary school enrolment rate	UNESCO	2022
Health and nutrition	Prevalence of child malnutrition	UNICEF	2023
Food safety	Global Food Security Index (GFSI)	The Economist Intelligence Unit	2023

3.4. Analysis techniques

Various methods of multivariate statistical analysis were applied, with the support of SPSS 27 and Stata 17 software, to perform the following operations:

- **Pearson correlation analysis:** To measure the strength and direction of bivariate relationships between key variables (Field, 2021).
- **Principal Component Analysis (PCA):** To reduce the dimensionality of the data and detect underlying patterns, grouping variables into interpretable axes or factors (Hair et al., 2021).
- **Hierarchical cluster analysis:** To classify countries into homogeneous groups according to their levels of inequality and food security.
- **Multiple linear regression:** To estimate the joint effect of independent variables on food security.

Table 5. Applied statistical techniques and their objectives

<i>Statistical technique</i>	<i>Main objective</i>
Pearson correlation	Establishing a linear relationship between inequality and food insecurity
Principal Component Analysis (PCA)	Group correlated variables into explanatory factors
Cluster analysis	Classify countries according to similar characteristics
Multiple regression	Determine the influence of predictor variables

3.5. Validation and reliability

To ensure the reliability of the model, internal data consistency tests were performed (Cronbach's alpha for composite indicators > 0.70) and cross-validation of the regression model. Variables with high levels of collinearity ($FIV > 5$) were discarded to avoid distortions in the estimates (Tabachnick & Fidell, 2020).

3.6. Methodological limitations

Among the main limitations are:

- Uneven availability of up-to-date data across countries.
- Risk of omission of qualitative contextual variables (conflicts, governance).
- Temporal bias for using a transverse (not longitudinal) structure.

However, geographic diversity and statistical robustness allow findings to be generalized in similar contexts and relevant recommendations to be formulated.

RESULTS

4.1. Relationship between economic inequality and food security

Pearson's correlation analysis showed a **significant negative relationship** ($r = -0.71$; $p < 0.01$) between the Gini coefficient and the Global Food Security Index (GFSI), indicating that **the higher the economic inequality, the lower the level of food security**. This trend was consistent across all regions assessed, especially in Latin America and sub-Saharan Africa.

Table 6. Correlations between main variables

<i>Independent variable</i>	<i>GFSI (Pearson's r)</i>	<i>Significance (p)</i>
Gini coefficient	-0.71	0.000
MPI (Multidimensional Poverty)	-0.67	0.000
Gross national income per capita	+0.63	0.001
Access to safe drinking water (%)	+0.59	0.002
Secondary schooling (%)	+0.55	0.005

Source: Authors' elaboration with data from the World Bank, FAO, UNDP (2023).

These results confirm the findings of recent studies linking deteriorating equity to increased exposure to food insecurity, both at the household and entire community levels (FAO, 2023; UNDP, 2023).

4.2. Grouping of countries according to levels of inequality and food security

The cluster analysis revealed the existence of **three distinct groups of countries** according to their levels of multidimensional inequality and food security:

Table 7. Ranking of countries according to cluster analysis

<i>Group</i>	<i>Key features</i>	<i>Country Examples</i>
Group 1	High inequality, low food security	Haiti, Sudan, Yemen
Group 2	Medium inequality, medium food security	Bolivia, India, Philippines
Group 3	Low inequality, high food security	Uruguay, Vietnam, Portugal

Source: Own analysis based on FAO (2023) and UNDP (2023).

Group 1 countries simultaneously have **Gini coefficients above 0.45** and **undernourishment above 20%**, while Group 3 countries have **Gini indices below 0.35** and **undernourishment levels below 10%**.

4.3. Principal Component Analysis (PCA) Results

The PCA allowed the variables to be reduced to **three main factors**, which explain **82.5% of the total variance** of the model:

Table 8. Extracted Major Components (PCAs)

COMPONENT	EXPLAINED VARIANCE (%)	VARIABLES INCLUDED
COMPONENT 1: STRUCTURAL INEQUALITY	41.3 %	IPM, Gini, schooling, access to drinking water
COMPONENT 2: ECONOMIC CAPACITY	25.8 %	Per capita income, formal employment
COMPONENT 3: FOOD RESILIENCE	15.4 %	GFSI, malnutrition, social protection spending

Source: Prepared by the authors using SPSS 27 software.

This shows that **structural inequality**, defined by the combination of multidimensional poverty and lack of services, is the main explanatory factor for low performance in food security, beyond absolute income (Alkire et al., 2021).

4.4. Multiple regression model

The multiple linear regression model identified **three significant predictors** of food security level (as measured by the GFSI):

- Gini coefficient ($\beta = -0.52$; $p < 0.01$)
- IPM ($\beta = -0.46$; $p < 0.01$)
- Per capita income ($\beta = +0.38$; $p < 0.05$)

Table 9. Multiple Linear Regression Model (Dependent Variable: GFSI)

<i>Independent variable</i>	<i>β-coefficient</i>	<i>Significance (p)</i>
Gini coefficient	-0.52	0.001
IPM	-0.46	0.003
Per capita income	+0.38	0.020
R ² Adjusted	0.68	—

Source: Own model calculated in Stata 17.

The model explains **68% of the GFSI variability**, confirming that countries with lower levels of structural inequality tend to offer better food security conditions.

4.5. Notable regional observations

- **Latin America:** Despite having upper-middle incomes, countries such as Colombia and Brazil maintain high levels of inequality and have pockets of rural food insecurity (FAO, 2023).
- **Sub-Saharan Africa:** The combination of inequality, institutional fragility and climate change generates the worst indicators in all the components analysed (WFP, 2023).
- **Southeast Asia:** Some countries such as Vietnam have managed to improve food security by reducing territorial inequality through inclusive agricultural policies (UNDP, 2023).

CONCLUSIONS

The results of this study empirically confirm that economic inequality, approached from a multidimensional approach, has a **direct and significant influence on the food security** of countries. This link is manifested not only in income distribution (measured by the Gini coefficient), but also in structural deficiencies in education, health, access to basic services, and decent employment. The simultaneous presence of multiple deprivations drastically reduces the ability of households and communities to access adequate food, both in quantity and quality (FAO, 2023; UNDP, 2023). Statistical evidence obtained—especially through principal component analysis and linear regression—demonstrates that **multidimensional poverty and structural inequality** explain a substantial part of the variability in food security levels across countries. This coincides with recent studies that warn that the approach based exclusively on per capita income growth is insufficient to ensure sustainable food well-being, particularly in contexts where social gaps persist or deepen (Alkire et al., 2021; World Bank, 2022). One of the most relevant findings is that **inequality acts as a systemic obstacle to food resilience**, affecting vulnerable groups such as rural women, indigenous communities, and people in extreme poverty more acutely. These groups are often excluded from effective public policies, perpetuating a cycle of intergenerational marginalization and malnutrition (UNICEF, 2022; WFP, 2023).

In addition, countries classified as having low levels of inequality and high human development indices – such as Vietnam or Uruguay – have better food security indicators, suggesting that a **policy of social inclusion and equitable redistribution of resources** can have concrete positive effects on food access and stability. These policies must be accompanied by sustained investment in social infrastructure, inclusive agricultural technologies, and adaptive social protection (FAO, 2022; UNDP, 2023).

In summary, it is concluded that:

1. Economic inequality, particularly in its structural dimension, is a key factor that weakens food security.
2. Multidimensional poverty is a robust explanatory variable of food insecurity, beyond monetary income.
3. Policies that address only economic growth without equity can exacerbate levels of food insecurity.
4. An intersectoral, territorial and evidence-based approach is necessary to design effective and sustainable responses.

Finally, it is recommended that governments, multilateral organizations, and civil society **incorporate multidimensional analysis tools** in the design, implementation, and evaluation of public policies, especially those aimed at achieving the Sustainable Development Goals (SDGs), in particular **SDG 2 (Zero Hunger)** and **SDG 10 (Reduced inequalities)** (United Nations, 2023).

REFERENCES

- Alkire, S., Kanagaratnam, U., & Suppa, N. (2021). *The Global Multidimensional Poverty Index (MPI) 2021*. Oxford Poverty and Human Development Initiative (OPHI), University of Oxford. <https://ophi.org.uk>
- Creswell, J. W., & Creswell, J. D. (2023). *Research design: Qualitative, quantitative, and mixed methods approaches* (6th ed.). SAGE Publications.
- FAO. (2022). *The State of Food Security and Nutrition in the World 2022: Repurposing food and agricultural policies to make healthy diets more affordable*. Food and Agriculture Organization of the United Nations. <https://doi.org/10.4060/cc0639en>
- FAO. (2023). *Overview of food and nutrition security in Latin America and the Caribbean 2023*. FAO, PAHO, WFP, UNICEF. <https://www.fao.org/americas>
- Field, A. (2021). *Discovering statistics using IBM SPSS Statistics* (5th ed.). SAGE Publications.
- Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLSSEM)* (3rd ed.). SAGE Publications.
- IPCC. (2023). *Sixth Assessment Report: Climate Change 2023*. Intergovernmental Panel on Climate Change. <https://www.ipcc.ch/report/ar6>
- United Nations. (2023). *2030 Agenda for Sustainable Development: Sustainable Development Goals Report 2023*. <https://sdgs.un.org/goals>
- OECD. (2020). *A Broken Social Elevator? How to Promote Social Mobility*. OECD Publishing. <https://doi.org/10.1787/9789264301085-en>
- Sen, A. (2020). *Development as Freedom* (2nd ed.). Oxford University Press. (Original work published in 1999)
- Tabachnick, B. G., & Fidell, L. S. (2020). *Using multivariate statistics* (7th ed.). Pearson Education.
- The Economist Intelligence Unit. (2023). *Global Food Security Index 2023*. <https://impact.economist.com/sustainability/project/food-security-index>
- UNDP. (2023). *Human Development Report 2023/24: Breaking the Gridlock*. United Nations Development Programme. <https://hdr.undp.org>