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THE GEOGRAPHY OF FOOD INSECURITY. A TAXONOMICAL ANALYSIS

LA GEOGRAFÍA DE LA INSEGURIDAD ALIMENTARIA. UN ANÁLISIS TAXONÓMICO

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ABSTRACT

The problem of food insecurity is worsening in a multi-crisis world simultaneously affected by socio-economic, health, governance and environmental problems. This article characterizes the geography of food insecurity based on six influential theories that explain the emergence of the most dramatic manifestation of food insecurity: famines. We build a taxonomy of 98 developing countries using a clustering procedure and identify four groups of countries with different vulnerabilities. The multidimensional analysis depicts a complex map of the diversity of human vulnerabilities that trigger hunger and famines across the world.

Keywords: Hunger, famine, food insecurity, international classification, Sustainable Development Goals

RESUMEN

El problema de la inseguridad alimentaria empeora en un mundo afectado simultáneamente por diversas crisis (socioeconómica, de salud, de gobernanza y medioambiental). Este artículo caracteriza la geografía de la inseguridad alimentaria basándose en seis influyentes teorías explicativas de la manifestación más dramática de inseguridad alimentaria: las hambrunas. Construimos una taxonomía de 98 países en desarrollo mediante un procedimiento de análisis de conglomerados e identificamos cuatro grupos de países con diferentes vulnerabilidades. El análisis multidimensional muestra un mapa complejo de la diversidad de vulnerabilidades humanas que desencadenan el hambre y las hambrunas en todo el mundo.

Palabras clave: Hambre, hambruna, inseguridad alimentaria, clasificación internacional, Objetivos de Desarrollo Sostenible

JEL Classification/ Clasificación JEL: I12, J11, Q18, O10, Q01.

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1. INTRODUCTION

Extreme food insecurity is one of the harshest manifestations of the socio-economic, governance, health and environmental vulnerabilities that humanity faces in the 21st Century. The United Nations (UN) has been trying for decades to mobilize the support of the international community to put an end to this global problem. In particular, the second of the Sustainable Development Goals (SDG) is precisely to eradicate world hunger by 2030.

However, the current evolution of global food insecurity is alarming. Whereas the prevalence of undernourishment decreased at the beginning of the 21st Century, it began to increase in 2015. According to estimates provided by the UN Food and Agriculture Organization (FAO, 2024a), in 2022 there were 735 million undernourished people (9.2% of the world population and 146 million more than in 2015). Moreover, the *2023 Hunger Hotspots*, elaborated by the FAO and the World Food Programme (WFP), warned that acute food insecurity continues to escalate, impacting 175 million people in 22 countries who urgently require assistance (FAO and WFP, 2023). Consequently, humanity falls back on the “zero hunger goal” and the current trend leads us to a world with more than 800 million starving people in 2030.

With this aggravating context, the aim of this article is to characterize the current geography of food insecurity by means of an international classification. After this introduction, section two reviews the specialized literature on the causes of famine, identifying four main contributions: the classical economic theories, the Food Availability Decline approach, the entitlement approach, and the political theories. In section three we explain our analytical strategy for building an international classification that is theoretically-based on the main theories of famine and is built using a cluster analysis procedure. In section four we present the results of our taxonomical investigation. Section five concludes by summarizing the main findings and explaining the policy implications of the analysis.

2. LITERATURE REVIEW: THE CAUSES OF FAMINES

There are three relevant concepts that are often misunderstood and thus we need to previously define them: hunger, famine and food insecurity.

On the one hand, the FAO (2024b) defines “hunger” as:

“An uncomfortable or painful physical sensation caused by insufficient consumption of dietary energy. It becomes chronic when the person does not consume a sufficient amount of calories (dietary energy) on a regular basis to lead a normal, active and healthy life. For decades, FAO has used the Prevalence of Undernourishment indicator to estimate the extent of hunger in the world, thus “hunger” may also be referred to as undernourishment.”

On the other hand, the concept of “famine” is more controversial to define.¹ Rubin (2016: 11) explains that a famine is a “synergistic crisis” caused by multiple causes that results in “[...] a discrete event identifiable by an increase in mortality caused by mass starvation and diseases”. This definition has three important implications: first, that a famine has multiple (and reinforcing) causes. Second, that it is a “discrete” event (with an atypical occurrence) rather than a “normal” situation. And thirdly, that the rapid increase of deaths that accompanies famines is not only due to starvation but also due to the diseases caused by malnutrition.

Finally, the FAO (2024b) defines “food insecurity” in the following terms:

“A person is food insecure when they lack regular access to enough safe and nutritious food for normal growth and development and an active and healthy life. This may be due to unavailability of food and/or lack of resources to obtain food. Food insecurity can be experienced at different levels of severity”.

Therefore, food insecurity is a broader term that encompasses both hunger and famine: the lower levels of severity of food insecurity are characterised by low levels of undernourishment (hunger) and the highest level of food insecurity is reached when a famine (humanitarian crisis) is triggered.

Once these definitions have been clarified, we can now revise which are the main theories that explain the emergence of the most acute level of food insecurity: famines.² For the sake of simplicity, we classify this literature into four main theories: the classical economic theories, the FAD approach, the entitlement approach and the political theories.

2.1. CLASSICAL ECONOMIC EXPLANATIONS OF FAMINE

The causes of famines have been analysed since the inception of Economics as a Social Science. There are two main classical contributions to this analysis: the Smithian and the Malthusian approaches. Their common feature is that they carry out market-oriented analyses in order to identify the main “supply

1 For further detail, both Devereux (1993) and Rubin (2016) exhaustively review different contending definitions of famine.

2 Comprehensive revisions of this debate can be found in Devereux (1993), Rubin (2016) and Tezanos (2024).

cause” of a famine: either inadequate State interventions or excessive population growth.

The Smithian approach

Adam Smith asseverated in *The Wealth of Nations* that ‘[...] a famine has never arisen from any other cause but the violence of governments attempting, by improper means, to remedy the inconveniences of dearth’ (Smith, 1776: 526). Therefore, the main cause of famines are market interventions, such as regulating the price of food, controlling the exports of food and forcing suppliers to sell their stock of grain, to name a few examples. The policy recommendation for remedying these distortions is obvious: guarantee free functioning of the food market.

This theory was not empirically proven by Smith himself, and nowadays it is generally accepted that ‘full protection against famines appears well beyond the grasp of the market’ (Rubin, 2016: 28). The main problem is that Smith neglected the importance of “market failures”, such as the existence of imperfect information and the lack of sufficient infrastructure, which result in the creation of food monopolies and oligopolies that distort free competition.

Malthusian approach

The British reverend Thomas Malthus argued that famines are the consequence of food shortages due to excessive population growth. In his *Essay on the Principles of Population*, Malthus (1806) explains that the world population tends to grow ‘in geometric progression’, while the ‘means of subsistence’ (referring mainly to food) grow ‘in arithmetic progression’, thus irremissibly generating periodic famines, wars and epidemics that dramatically reduce the population in order to adapt it to the level of food supply. Malthus’ policy recommendation was similar to Smith’s: a *laissez faire* approach, letting the famine restore the population equilibrium.

However, this conception of hunger as a market problem associated with the scarcity of the food supply has been contested. It seems that “contemporary” famines have not significantly constrained the population growth, as Devereux (2000) proved with an historical analysis of various famines occurring during the 20th Century, thus refuting Malthus. All in all, the weakness of the Malthusian approach lies in its *ceteris paribus* assumption, especially in relation with technology, which has gradually improved over time, hence raising aggregate agricultural productivity.

2.2. FOOD AVAILABILITY DECLINE APPROACH

This second approach also focuses on the supply side of the problem. According to the Food Availability Decline (FAD) approach (as named by Sen in 1981), famines are determined by a temporal scarcity of food in particular areas. This scarcity is usually caused by natural disasters, such as floods and droughts.

In contrast with the pessimistic prediction of Malthus, the FAD approach offers an optimistic solution to famines, which consist of exponentially increasing the capacity to produce food, relying heavily on the technological progress of the agricultural sector (the so-called “green revolution”). Nevertheless, prospects for the future according to this approach are not so optimistic, given the aggravation of the climate change.

The FAD approach has relevant theoretical limitations that are related to its “implicit” assumptions. On the one hand, it assumes that famine-affected countries are totally closed economies, thus neglecting the existence of international food markets that can alleviate the episodes of food scarcity. As a consequence, this approach is unable to explain why some countries severely affected by droughts do not suffer famines (for example, Spain), while others do (such as the Sahel countries). On the other hand, the FAD approach assumes that everyone within a country is equally affected by a famine. Therefore, it is incapable of explaining why some social groups have better access to food than others. As Devereux (1993: 183) clearly said, ‘drought causes crop failure, but *vulnerability* to drought causes famine’. That is to say, the FAD causality link between a disruptive event (such as a drought) and famine seems theoretically incongruent as it neglects the fundamental aspect of human vulnerabilities, which is the actual transmission belt with famines.

2.3. ENTITLEMENTS APPROACH

The Indian economist Amartya Sen received the Nobel Prize in Economics in 1998 for his contributions in this field. In his influential book *Poverty and famines*, Sen (1981) viewed famines as “economic disasters” and not just as food crisis. He analysed four famines: Bengal (India, 1943), Ethiopia (1972-1974), the Sahel region (1970s) and Bangladesh (1974). His main finding was that these crises occurred without a “significant” reduction in food availability, from which he deduced and generalized that famines are not essentially a supply problem, but rather a demand problem associated with poverty and people’s lack of “entitlements” to access food markets.

Drèze and Sen (1989: 23) defined the “entitlement” of a person as ‘[...] the set of alternative commodity bundles that can be acquired through the use of the various legal channels of acquirement open to that person’. In particular, the entitlement of a person has two components: their “initial endowment” and their “entitlement mapping” (which consist of the set of alternative commodity bundles that can be obtained given the initial endowments). Furthermore, entitlement relations in a market economy are based on five different types of ownership: production, trade, labour, transfer and inheritance. Households combine these types of ownership in order to access food either producing it or buying it. Although the well-functioning of the market is crucial to facilitate the access to food, households that lack the appropriate entitlements can starve even when there is food available at the local markets. Famine is thus determined by a double failure: an “entitlement failure” that affects a

large proportion of the population, and the “State failure” to protect those entitlements.

Therefore, according to Sen the main cause of famine is not the lack of food but the disruption in the availability to access food. This approach allows a more precise study of famine than the previous theories, as it distinguishes across different socio-economic groups and identifies the victims of famine. As Sen (1981: 162) stated, ‘the entitlement approach provides a general framework for analysing famines rather than one particular hypothesis about their causation’ (as is the case in the classical economic and FAD approaches).³

2.4. POLITICAL EXPLANATIONS OF FAMINE

There are two political explanations of famine: on the one hand, the “political system approach” maintains that the lack of democracy causes famines. And, on the other hand, the “political accountability approach” considers that governments are responsible for famines.

Political system approach

Sen (1999 and 2009) also formulated the influential hypothesis that famines do not happen in countries with democratic regimes and free press because in democracy political leaders must be receptive to their citizens’ demands. This proposition emphasizes the importance of the instrumental role of democracy and political freedoms for the prevention of major economic, political and natural disasters.

Despite the influence of this hypothesis, Sen has never empirically verified it and, consequently, several studies have analysed the relation between democracy and famines. There are two possible interpretations of this relation:

On the one hand, a “deterministic interpretation” which conceives democracy as the definitive solution for famines (i.e. democratic systems always prevent famines). Some studies have carried out qualitative case-analysis which reject this interpretation by identifying counter-examples of famines that took place in democratic regimes, such as the famines in Ireland (1845-1849), Bangladesh (1974), Sudan (1986-1988), Malawi (2002), Niger (2005) and Madagascar (2021) (see, for example, de Waal, 1997; and Rubin, 2010).

On the other hand, there is a “probabilistic interpretation” which considers that democracy lowers the intensity and magnitude of famines. For example, Rubin (2009 and 2010), Plümper and Neumayer (2009), Burchi (2011) and Rossignoli and Balestri (2018) run quantitative regression analyses but did not offer conclusive results, as some studies supported Sen’s thesis while others rejected it (once other relevant factors are considered).

³ Constructive revisions and critiques of Sen’s entitlement approach can be found in de Waal (1990) and Gasper (1993), among others.

Political accountability approach

The political accountability approach assumes that famines are politically determined (they are the consequence of political decisions) and hence the analysis of famines should focus on identifying those political actors that — directly or indirectly— promote the emergence of famines.

Several empirical studies have applied inductive methodologies for capturing the political variables that cause famines. The first contributions (which were published immediately after the Cold War) recognised the role of conflict in famine causation, which was not adequately captured by the entitlement approach. As a result, the theory of “complex political emergencies” was elaborated, and numerous studies demonstrated the presence of certain social groups that gain advantages from famines. For example, the seminal study by Macrae and Zwi (1992) analysed six African famines (Angola, Ethiopia, Liberia, Mozambique, Somalia and Sudan) that took place in 1991 and 1992, and were caused by the use of food as a ‘weapon of war by omission, commission and provision’ (Macrae and Zwi, 1992: 299).

More recently, several studies have further verified the importance of the political triggers of famines. For example, Tyner and Rice (2016) argued that the famine that took place during the Cambodian genocide (1975-1979) was a “calculated policy”. Gooch (2017) and Kasahara and Li (2020) analysed the Great Chinese Famine (1959-1961), which coincided with the launch of the Great Leap Forward (the communist agricultural and industrial modernisation plan), and concluded that the famine was motivated by the negligence of the government. Furthermore, with an aggregated and long-term perspective, de Waal (2018) analysed the “structural causes” and the “proximate triggers” of famines over an extended period of 140 years (between 1870 and 2010), and concluded that almost all famines have multiple causes but that the most relevant ones were related to political decisions and military tactics.

All in all, the advantage of the political accountability approach is that it contributes both to revealing the main causes of famine, and to identifying which political actors carry the main responsibility.

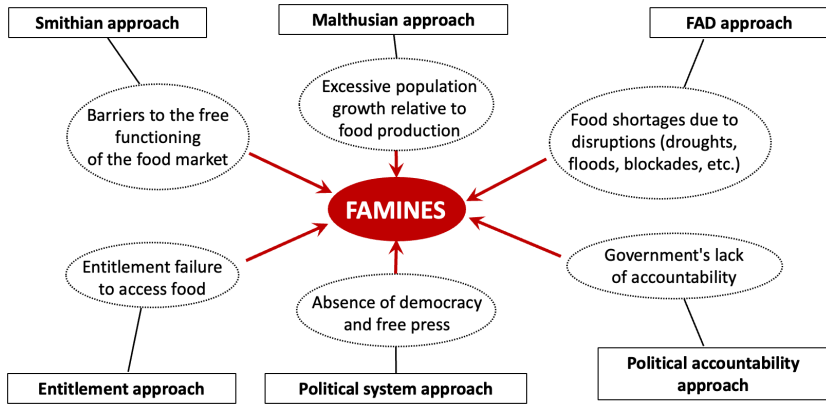
3. RESEARCH STRATEGY

3.1. ANALYTICAL MODEL

We have conceptualised famine as the final stage of a process of extreme human vulnerabilities that reveals a humanitarian crisis caused by a number of interrelated “triggers”. Therefore, the first step in building an international taxonomy of global hunger and famines is to decide which are the most relevant classificatory variables. This decision is based on our previous literature review. We assume that developing countries can be classified by the synergistic interaction among the following six complex explanatory variables (“triggers”) of famine:



FIGURE 1. INTERRELATIONS EXPLAINING HUNGER AND FAMINE



Source: authors.

- i. Existence of obstacles to the free functioning of the food market (Smithian approach).
- ii. Excessive population growth in relation to each country's capacity to produce food (Malthusian approach).
- iii. Emergence of disruptive events (droughts, floods, blockades, etc.) that sharply reduce the amount of food available to the population (FAD approach).
- iv. Failure of entitlements to access food (entitlement approach).
- v. Absence of democracy and free press (political system approach).
- vi. Lack of accountability of the government in the prevention of famines (political accountability approach).

Figure 1 depicts these various relations and constitutes the framework for building our international classification.

3.2. SELECTION OF VARIABLES AND PERIOD OF ANALYSIS

The second task for building our taxonomy is to decide which are the most appropriate proxies to measure the six afore-mentioned theories of famine. Table 1 summarises this information. As is always the case in Social Sciences, the selected proxies are far from perfect, as they oversimplify the complexity of each of the analysed theories. Nevertheless, we take this selection very seriously in order to guarantee meaningful results and a wide geographical coverage.

TABLE 1 . DIMENSIONS, VARIABLES, PERIODS AND SOURCES

#	Famine approach	Main cause	Proxy	Variable code	Source	Period
1	Smithian approach	Barriers to the free functioning of the food market	Index of Economic Freedom	Economic_freedom	Kim (2023)	2023
2	Malthusian approach	Excessive population growth relative to food production	Gross <i>per capita</i> food production index	<i>Food_production</i>	FAO (2024a)	2020
3	FAD approach	Food shortages due to disruptions	Multidimensional Poverty Index	Poverty	UNDP and OPHI (2023)	2010-2021 (last available year)
4	Entitlement approach	Entitlement failure to access food	Polity score	Democracy	Center for Systemic Peace (2023)	2018
5	Political system approach	Absence of democracy and free press	Voice and Accountability	Accountability	Kaufmann et al. (2023)	2021
6	Political accountability approach	Government's lack of accountability	Internally displaced persons by conflict and violence (%)	War	World Bank (2023a)	2021
	Classificatory variable	Hunger	Prevalence of undernourishment (%)	Hunger	FAO (2024a)	2020

Source: authors.



- Smithian approach: we use the Index of Economic Freedom, which is co-published by *The Wall Street Journal* and the Heritage Foundation. The index covers 184 countries and measures 12 economic freedoms, grouped into the following four broad categories (Kim, 2023):
 - i. Rule of Law: property rights, government integrity and judicial effectiveness.
 - ii. Government size: government spending, tax burden and fiscal health.
 - iii. Regulatory efficiency: business freedom, labour freedom and monetary freedom.
 - iv. Open markets: trade freedom, investment freedom and financial freedom.

Each of these 12 economic freedoms is graded on a scale of 0 to 100. We use each country's overall score, which is the equally weighted average of the 12 variables.

- Malthusian and FAD approaches: we proxy both theories with the same variable in order to measure the final implication of the existence of a relative scarcity of food, which is the decline in the amount of food relative to each country's population⁴. In particular, we use the gross *per capita* food production index elaborated by FAO (2024a). The index shows the agricultural production for each year in comparison with the base period 2014-2016; it is based on the sum of price-weighted quantities of different agricultural commodities after deductions of quantities used as seed and feed.
- Entitlement approach: we use the Multidimensional Poverty Index (MPI), elaborated by the UN Development Programme and the Oxford Poverty and Human Development Initiative (UNDP and OPHI, 2022). The MPI measures 10 deprivations at the household level in health, education and standard of living. It uses micro data from household surveys to assign a deprivation score to each person. The three dimensions are equally weighted and the maximum deprivation score is 100 percent. In particular, we use the MPI value, which measures the proportion of the population that is multidimensionally poor adjusted by the intensity of the deprivations⁵.
- Political system approach: we use the indicators elaborated by the Center for Systemic Peace (Marshall and Elzinga-Marshall, 2017). The "Polity" examines the quality of democratic and autocratic regimes, rather than discreet and mutually exclusive forms of governance. The Polity score captures the regime authority spectrum on a 21-point

4 The alternative of using two different proxies for measuring the Malthusian and the FAD approaches results in a high bi-variate correlation that is problematic for cluster analysis, as we will explain in section 3.3.

5 The MPI value is the product of the incidence of multidimensional poverty and the intensity of poverty.

scale ranging from -10 (fully institutionalized autocracies) to +10 (fully institutionalized democracies).

- Political accountability approach: as this approach is especially broad in pointing out possible triggers for famine, we try two different proxies. On the one hand, we use an overall measure of the governments' levels of accountability. The voice and accountability indicator, elaborated by Kaufmann *et al.* (2010) as part of their Worldwide Governance Indicators, measures the level of citizens participation in selecting their government, and the level of freedoms of expression, freedom of association and free media. It is constructed by averaging and rescaling the data to run from 0 to 1. On the other hand, we try to measure the single most determinant trigger of modern famines, this being the existence of wars and violent conflicts. We proxy the intensity of war with the percentage of internally displaced persons by conflict and violence. Internally displaced persons have been forced to leave their homes, but they have not crossed an international border, due to armed conflicts, situations of generalized violence and violations of human rights. Displaced people are alienated from their previous sources of income (which implies the loss of their assets and, hence, the loss of their entitlements to food) and quite often become dependent on aid. As Devereux (1993: 156) pointed out, 'the problems are more acute when those affected are farmers. Displaced from their land, they are producing nothing for themselves nor for the market'.

Apart from these proxies, we add a classificatory variable that will help us to interpret the cluster results: the prevalence of undernourishment (as a percentage of total population), which is the indicator 2.1.1. of the SDG and constitutes the "departing point" of a country's vulnerability process that may lead to famine.

Regarding the population of study, we focus on "developing countries", where problems of hunger and famine are more intense. In particular, we aim at the 136 low and middle income countries according to the World Bank's income classification (World Bank, 2023b).

In relation to the period of analysis, we try to build the most contemporary taxonomy, so we use the last available year for each of the proxies, as it is specified in the last column of Table 1.

Finally, we try to keep a reasonable sample size in relation to the number of clustering variables. Formann (1984) proposed a simple rule: the number of countries must be equal or larger than 2^k , where k represents the number of clustering variables.⁶ With our sample of 98 countries, we limit the cluster analysis to a maximum of six variables (table 2).

6 Nevertheless, according to Mooi and Sarstedt (2011), very few studies comply with Formann's criterion, as it is very restrictive.

TABLE 2. DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean	Std. Deviation
Economic_freedom	110	29.5	71.8	55.29	7.78
Food_production	113	73.32	159.06	100.97	13.04
Poverty	113	0.0004	0.6013	0.13	0.15
Democracy	102	-9	10	3.37	5.60
Accountability	113	-1.92	1.16	-0.41	0.78
War	109	0	31.24	1.56	4.30
Hunger	104	2.4	53.1	15.67	13.15
Valid N (listwise)	98				

Source: authors.

3.3. CLUSTER PROCEDURE

The third step in this research strategy is to select an appropriate methodology for building an international taxonomy. We utilize SPSS to run a hierarchical cluster analysis using the Ward agglomeration method. As the variables have different scales, we standardise them with the range -1 to 1 method, and we compute the squared Euclidean distances between countries.⁷ The sample includes 98 of the 136 developing countries (accounting for more than 95% of the aggregate developing countries' population).⁸

A relevant preliminary analysis is to verify if there is substantial collinearity across the six variables used to proxy different theoretical causes of famine.⁹ The bivariate correlation matrix (table 3) shows that two variables (*Democracy* and *Accountability*) have a statistically significant and relatively high correlation coefficient (close to 0.8), indicating possible collinearity. As we have considered two proxies for the political accountability approach, we choose the variable related to armed conflicts (*War*) instead of the more general variable of voice and accountability, as the former is not highly correlated with any other classificatory variable (thus avoiding the unwanted information redundancy).¹⁰

The subsequent step involves determining the desired number of country groups for our classification. We take this decision using two statistical tools: the dendrogram and the variance ratio criterion (see appendixes 1 and 2). Both methods recommend a four-cluster solution which results in limited

7 See Tezanos and Sumner (2013) for a detailed methodological explanation on the use of cluster analysis for building an international development taxonomy.

8 There are two types of missing countries: those with limited statistical information (Cuba, Eritrea, Kosovo, Lebanon, Libya, North Korea, Uzbekistan and Palestine), and insular nations with populations below one million.

9 When highly correlated variables are used, they tend to be overrepresented in the cluster analysis. That is why Mooi and Sarstedt (2011) and Everitt *et al.* (2011) do not recommend to use pairs of variables with correlations above 0.9.

10 We further assume that the *Polity* score is a useful proxy for both democracy and accountability, as democracy is a political system designed for making governments accountable for their citizens.

TABLE 3. CORRELATION MATRIX

		<i>Economic_ freedom</i>	<i>Food_ production</i>	<i>Poverty</i>	<i>Democracy</i>	<i>Accountability</i>	<i>War</i>	<i>Hunger</i>
<i>Economic_ freedom</i>	Pearson Correlation	1	0.125	-0.302**	0.356**	0.536**	-0.051	-0.429**
	Sig. (2-tailed)		0.192	0.001	0	0	0.601	0
	N	110	110	110	102	110	106	103
<i>Food_ production</i>	Pearson Correlation	0.125	1	-0.012	0.182	-0.008	0.082	-0.196*
	Sig. (2-tailed)	0.192		0.904	0.068	0.936	0.396	0.046
	N	110	113	113	102	113	109	104
<i>Poverty</i>	Pearson Correlation	-0.302**	-0.012	1	-0.123	-0.347**	0.277**	0.672**
	Sig. (2-tailed)	0.001	0.904		0.217	0	0.004	0
	N	110	113	113	102	113	109	104
<i>Democracy</i>	Pearson Correlation	0.356**	0.182	-0.123	1	0.789**	-0.261**	-0.18
	Sig. (2-tailed)	0	0.068	0.217		0	0.008	0.074
	N	102	102	102	102	102	101	99
<i>Accountability</i>	Pearson Correlation	0.536**	-0.008	-0.347**	0.789**	1	-0.381**	-0.390**
	Sig. (2-tailed)	0	0.936	0	0		0	0
	N	110	113	113	102	113	109	104
<i>War</i>	Pearson Correlation	-0.051	0.082	0.277**	-0.261**	-0.381**	1	0.445**
	Sig. (2-tailed)	0.601	0.396	0.004	0.008	0		0
	N	106	109	109	101	109	109	102
<i>Hunger</i>	Pearson Correlation	-0.429**	-0.196*	0.672**	-0.18	-0.390**	0.445**	1
	Sig. (2-tailed)	0	0.046	0	0.074	0	0	
	N	103	104	104	99	104	102	104

* Significant correlation at the 0.05 level (2-tailed).

** Significant correlation at the 0.01 level (2-tailed).

Source: authors.



TABLE 4. ONE-WAY ANOVA ANALYSIS

		Sum of Squares	df	Mean Square	F	Sig.
<i>Economic_freedom</i>	Between Groups	854.42	3	284.81	6.2420	0.001
	Within Groups	4,289.28	94	45.63		
	Total	5,143.70	97			
<i>Food_production</i>	Between Groups	3,022.73	3	1007.58	6.8160	0.000
	Within Groups	13,895.14	94	147.82		
	Total	16,917.86	97			
<i>Poverty</i>	Between Groups	1.54	3	0.51	52.7030	0.000
	Within Groups	0.91	94	0.01		
	Total	2.45	97			
<i>Democracy</i>	Between Groups	2,304.32	3	768.11	116.0780	0.000
	Within Groups	622.02	94	6.62		
	Total	2,926.34	97			
<i>War</i>	Between Groups	757.42	3	252.47	19.5940	0.000
	Within Groups	1,211.22	94	12.89		
	Total	1,968.64	97			
<i>Hunger</i>	Between Groups	9,834.62	3	3278.21	41.6140	0.000
	Within Groups	7,404.92	94	78.78		
	Total	17,239.54	97			

Source: authors.

dissimilarities within each group. In particular, the most dissimilar country in the sample is Syria, being the last country to be grouped.

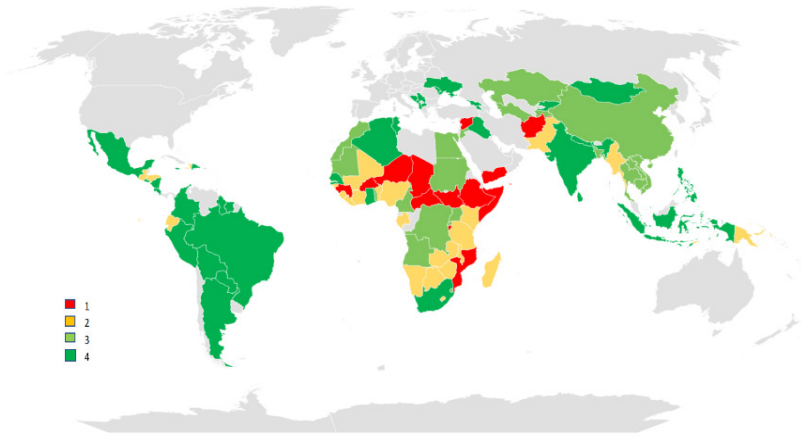
A final methodological step involves investigating which variables have a greater influence on distinguishing between country groups. The one-way ANOVA analysis verifies if there are significant differences across clusters. In our case, the six variables are statistically significant (table 4) and the most relevant variable for discerning groups (i.e. the one with the largest *F* statistic) is *Democracy*, followed by *Poverty*, *Hunger* and *War*. By contrast, the least influential variables are *Economic freedom* and *Food production per capita*. This last result coincides with our previous literature review, as both classical economic theories (Smith's and Malthus') and the FAD approach have been empirically refuted as reasonable explanations for the emergence of famines.

4. DISCUSSION OF RESULTS

The cluster analysis classifies 98 developing countries into four groups, with each group comprising countries from diverse geographical regions (map 1).

In order to characterize the four groups of countries we compute the cluster "centroids" (which are the average values of the variables for the countries included in each cluster). We focus our description of the country groups on those variables that have low variability within each cluster in order

MAP 1. WORLD DISTRIBUTION OF CLUSTERS



Source: authors.

to avoid spurious interpretations (as centroids with high dispersion are not representative of that cluster) (Table 5).¹¹

- Cluster 1 (C1): poor and conflicted countries facing severe risk of famine

14 countries, 11 of which are located in Sub-Saharan Africa, two in the Middle-East region (Syria and Yemen) and the remaining one in Central Asia (Afghanistan). They have the highest poverty and hunger rates and most of them are severely damaged by conflicts. Among them, seven are autocratic regimes and the remaining seven are weak democracies. Although they have a high prevalence of undernourishment, this outcome is not clearly related with the levels of *per capita* food production; a result that provides evidence for refuting the “food scarcity” theories (the Malthusian and the FAD approaches).¹²

11 See appendix 3 for detailed information on cluster memberships and the values of each variable for each developing country.

12 The relation between food scarcity and hunger is incongruent. There are countries with both a high prevalence of undernourishment and low levels of food production (the clearest example is Somalia, the C1 country with both the lowest *per capita* food production and the largest proportion of hungry people). Whereas other countries have high rates of undernourishment but relatively high levels of *per capita* food production (such as Burundi and Mozambique).

TABLE 5. CLUSTER CENTROIDS

		Economic_freedom	Food_production	Poverty	Democracy	War	Hunger
C1	Mean	51.06	104.52	0.4023	0.14	8.51	35.31
	N	14	14	14	14	14	14
	Std. Deviation	5.21	12.03	0.1543	5.25	8.66	10.55
	Minimum	39.40	86.38	0.0210	-9	0	18
	Maximum	59.00	126.85	0.6013	6	31.24	53.1
C2	Mean	53.72	96.37	0.2077	6.12	0.39	22.44
	N	26	26	26	26	26	26
	Std. Deviation	6.84	9.10	0.1022	1.66	0.67	11.65
	Minimum	33.10	73.32	0.0079	3	0	3.1
	Maximum	64.80	116.32	0.3840	9	2.40	48.5
C3	Mean	53.23	97.45	0.1216	-4.36	0.53	12.72
	N	22	22	22	22	22	22
	Std. Deviation	6.97	7.46	0.1121	2.17	1.61	9.76
	Minimum	32	89.11	0.0008	-9	0	2.4
	Maximum	64.40	120.24	0.3270	-1	6.95	35.8
C4	Mean	58.83	108.80	0.0273	7.61	0.74	6.43
	N	36	36	36	36	36	36
	Std. Deviation	7.06	15.83	0.0476	1.66	2.21	4.02
	Minimum	43	82.56	0.0004	2	0	2.4
	Maximum	71.80	159.06	0.2629	10	10.16	18.6
Total	Mean	55.11	102.34	0.1499	3.46	1.71	16.21
	N	98	98	98	98	98	98
	Std. Deviation	7.28	13.21	0.1589	5.49	4.51	13.33
	Minimum	32	73.32	0.0004	-9	0	2.4
	Maximum	71.80	159.06	0.6013	10	31.24	53.1

Source: authors.

Syria requires further explanation. As we said before, it is the most dissimilar country in the whole data set. The cluster procedure locates Syria in C1 because of the similarities with the other 13 countries in this group in all variables except on the MPI. The problem is that there is no updated information on the MPI, so we needed to include the last available year (2009), before the Syrian war started in 2011. However, according to a recent report by the UN Office for the Coordination of Humanitarian Affairs (OCHA, 2022), extreme poverty has risen drastically since the beginning of the conflict, which presumably means that the MPI value is also much higher than it was in 2009, clearly locating Syria close to the average of this group (implying that this country is not actually an outlier).

- Cluster 2 (C2): democratic regimes with chronic problems of hunger

These are 26 countries from different continents that have, on average, the second highest prevalence of undernourishment. Some of these countries

produce very low levels of food in *per capita* terms (in particular, Haiti has the lowest production of the whole sample), although there is an important variability in this indicator. Similarly, poverty rates vary significantly across countries; whereas Benin, Guinea-Bissau, Madagascar and Mali have very high MPI values, Ecuador and Honduras have much lower values. A remarkable feature is that C2 countries have relatively high standards of democracy and, in general terms, are not affected by war and conflicts.¹³

- Cluster 3 (C3): autocratic regimes with chronic problems of hunger

22 countries with autocratic regimes and a relatively high prevalence of undernourishment (only two countries within this cluster, China and Kazakhstan, have rates below 2.5%). They share the important feature of a relatively low incidence of conflicts. The notable exceptions are Sudan and Cameroon, which have the largest proportion of internally displaced population in this cluster (they are the only countries with more than 1% of their population internally displaced).

It is worth mentioning that the information on Sudan is prior to the recent break out of the civil war. In its current violent situation, Sudan is closer to C1 countries and it is already facing a severe risk of famine.

- Cluster 4 (C4): democratic regimes with moderate poverty and hunger

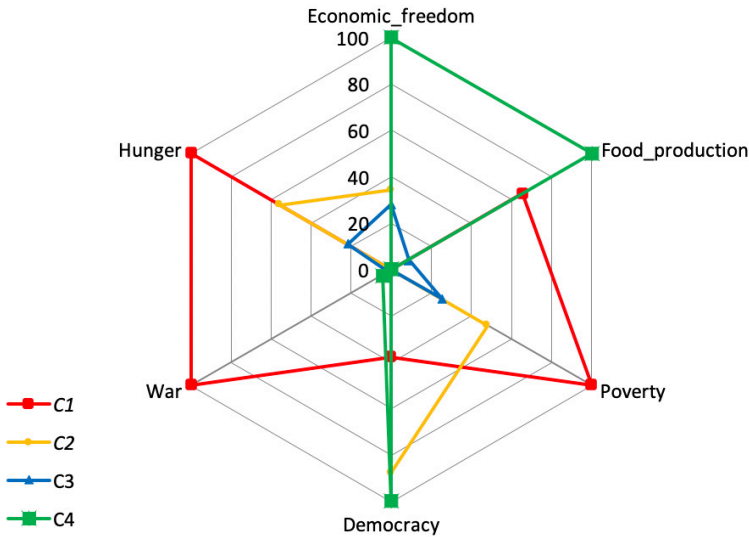
This is the largest cluster, with 36 countries scattered across all the developing regions. They are all democratic regimes (Algeria being the country with the weakest democracy). Poverty rates are comparatively low (in fact, much lower than the rest of the clusters, with the sole exception of Senegal) and the prevalence of undernourishment is also lower than in the other three groups, although India, Iraq and Nicaragua have considerably higher rates than the rest of the C4 countries (above 15%).

We explore the dissimilarities across clusters by means of a “web graph”. In order to facilitate the interpretation, figure 2 rescales the magnitudes of the six variables to a range of 0 to 100. The graph shows that C1 has the highest indicators of poverty, hunger and war. The main characteristics in C2 are the lowest incidence of wars and *per capita* food production. C3 does not have either a minimum value, or a maximum one. And C4 has the highest scores in terms of democracy, food production and economic freedom (although this last variable is highly dispersed within the cluster), as well as the lowest ratios of poverty and hunger.

Figure 3 summarises the cluster results organizing them into four quadrants in terms of the four classificatory variables which, according to the ANOVA analysis (see previous section), have the greatest discriminating power (these

¹³ A notable exception is Honduras, with almost 2.5% of its population internally displaced due to conflicts.

FIGURE 2. COMPARISON OF CLUSTERS' AVERAGES



Source: authors.

Note: the centroids have been rescaled to a range of 0 to 100.

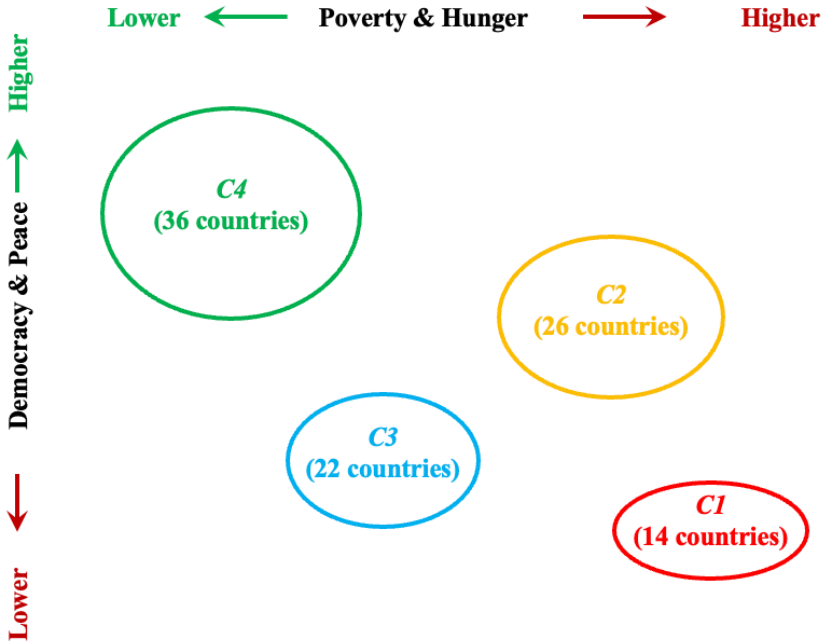
are democracy, poverty, hunger and war). The cluster results show positive associations between poverty and hunger on the one hand, and between democracy and absence of conflicts, on the other hand. A remarkable feature is that each cluster of countries has specific characteristics and vulnerabilities, and, therefore, the multidimensional world map of hunger and famines cannot be easily represented in a “linear” way.

5. CONCLUSIONS AND IMPLICATIONS

Despite the efforts made by the UN to mobilize international support towards the *2030 Agenda for Sustainable Development*, humanity falls back on the SDG-2 of “zero hunger” as the current trend leads us to a world with more undernourished people in 2030 than we had in 2015. This terrible trend is a consequence of a multi-crisis world, simultaneously affected by socio-economic, health, governance and environmental problems.

Hunger and famine are different phases of a multivariate and synergistic process of aggravation of human vulnerabilities and deprivations. On the one hand, hunger means undernourishment, and this problem becomes chronic in some societies. On the other hand, famine is a humanitarian crisis characterized by extreme levels of mass starvation that result in a sharp increase in mortality and morbidity. Hunger and famine are thus different concepts but intimately

FIGURE 3. SPATIAL REPRESENTATION OF CLUSTERS' CHARACTERISTICS



Source: authors.

connected in the continuum of human food insecurity, as chronic and severe hunger can be the prelude for the emergence of famine.

In order to shed light on the complexity of the current geography of food insecurity, we build an international classification of developing countries in relation to the main determinants of famine. The following five results are derived from this research effort:

1. There is a vast literature that analyses the determinants of famines which can be classified into four main theories. Each of these theories identifies “triggers” of famine, some of which are related to the supply side of the food market, others to the demand side, while more recent explanations highlight the importance of several political factors. No single theory offers a comprehensive and universal explanation of the causes of famines, applicable to every food security crisis (irrespective of where and when it took place). On the contrary, some of these theories offer complementary explanations which, brought together, help us to understand the complexity of the process of human vulnerabilities that leads to famine. In this sense, a “systemic approach” for understanding famines seems necessary for



overcoming the single-factor explanations and for better understanding the synergetic formation and evolution of these crises.

2. In order to build an international taxonomy, we assume that the complex process of vulnerabilities that generate food insecurity stems from the synergetic interaction of six possible causal explanations of famine derived from the specialized literature: i) the existence of obstacles to the free functioning of the food market (Smithian approach); ii) the excessive population growth in relation to each country's capacity to produce food (Malthusian approach); iii) the emergence of disruptive events (like droughts and floods) that sharply reduce the amount of food available to the population (FAD approach); iv) the failure of the entitlements to access food (entitlement approach); v) the absence of democracy and free press (political system approach); and vi) the lack of accountability of the government (political accountability approach).
3. We run a hierarchical cluster analysis in order to classify 98 countries (accounting for more than 95% of the population in the developing world) into four country groups with distinguishable features.
4. Although the six variables used in the classification are statistically significant, only four of them are relevant in discriminating groups (*Democracy, Poverty, Hunger and War*). By contrast, the variables related to the supply side of the food market (Smith's, Malthus' and FAD approaches) do not significantly contribute to explaining the cross-country differences in terms of vulnerabilities to hunger and famine.
5. This multidimensional world map of food insecurity cannot be represented in a linear way and, hence, our taxonomy depicts a complex map of the variety of human vulnerabilities that trigger hunger across the world.

Apart from these research results, it is also worth reflecting on five policy implications that are derived from our taxonomical analysis:

1. International classifications on global food insecurity serve a purpose for identifying groups of countries with similar vulnerabilities and, in this sense, are useful for guiding international development policies by highlighting a set of geographical priorities. But our classification should not be confused with an "early warning system" to prevent famines, as the later requires detailed information at subnational levels and is based on current and prospective conditions —not on past conditions, as it is the case in our classification. For the purpose of alerting on famine risk, the Integrated Food Security Phase Classification (IPC), elaborated by the FAO and other 14 organizations, is currently the most advanced available mechanism.
2. The greatest challenges for meeting the SDG-2 are located in the 40 countries grouped in clusters 1 and 2. These countries have chronic problems of hunger and are affected by severe human vulnerabilities. Therefore, the international community needs to strengthen the cooperation efforts (both

- Nort-South and South-South initiatives) in these most vulnerable countries, not only focusing on alleviating food security crises, but specially on solving the multiple causes that generate these crises (such as building peace and strengthening governments' accountability).
3. In this international context, C4 countries have the potentiality to act as donors from the Global South, as they have the best scores in terms of democracy, food production, poverty and hunger. Therefore, they can share with other developing countries their own experiences on fighting against food insecurity, thus enriching the South-South cooperation system.
 4. Despite the acute situation of clusters 1 and 2, "only" 42% of the world's starving people live in these countries, basically because India (located in cluster 4) still accounts for 31,7% of the global undernourished population (almost 230 million people). This figure sharply contrasts with the fact that India has experienced a considerable reduction in the reception of Official Development Assistance since it started being classified as a middle income country. Beyond this simple income classification, it is obvious that meeting the SDG-2 requires India to solve the vulnerabilities that generate hunger with the collaboration of the international community.
 5. Although we need more regional and international cooperation to improve global food security, we are currently moving away from this ambition due to the aggravation of the geopolitical rivalries in an increasingly multipolar world. In particular, it is worth mentioning that solving the global food crisis requires reintegrating both Ukraine and Russia into the world food markets, which makes it even more urgent to put an end to the war.

We think that the taxonomic procedure that we propose in this article has four main advantages:

Firstly, it is "innovative" because the multivariate statistical technique of cluster analysis has not been previously used (to the best of our knowledge) to analyse the geography of food insecurity.

Secondly, it is "objective" in the sense that we build the classification using a meticulous statistical procedure. The only arbitrary decision that we have taken is the selection criteria of the analysed countries. We included the so-called "developing countries", as these are the countries, in the 21st Century, with a higher incidence of hunger and famine.

Thirdly, it is "multidimensional" and "synergetic", as our taxonomy is based on six different approaches that offer interrelated explanations of hunger and famines.

And fourthly, our statistical procedure allows a "fine discrimination" of reasonably homogenous groups of countries that share vulnerabilities to food insecurity.

Nevertheless, our analysis also has four limitations that must be considered:

Firstly, there is the difficulty of measuring six complex theoretical explanations of famine with a reduced set of "simple" proxies. We have carefully

selected and justified the indicators but, as always the case in Social Sciences, the selected proxies are far from perfect and they over simplify the complexity of each of the theories.

Secondly, cluster analysis has some margin of error, as happens in any other multivariate statistical technique, and, in particular, it relies heavily on the researchers' selection of the similarity measure and the agglomeration method. We have guided these decisions both on statistical theory and on the coherence and interpretability of the results, and we have offered all the necessary information to understand the statistical procedure.

Thirdly, international classifications have the intrinsic weakness of "generalization", which implies that this type of analysis should be understood as complementary to other, more detailed, qualitative case-studies.

And fourthly, our analysis does not seek to test the validity of the six causative approaches to famine. Instead, we depart from these theoretical explanations of famine to build a theoretically-based taxonomy. Our future line of research is thus moving to a causality analysis.

Ultimately, the main motivation for studying extreme food insecurity is to contribute to its ending. With this modest piece of research we try to raise awareness on this (aggravating) global problem and to improve our knowledge on the formidable and necessary challenge of advancing towards the "zero hunger" goal.

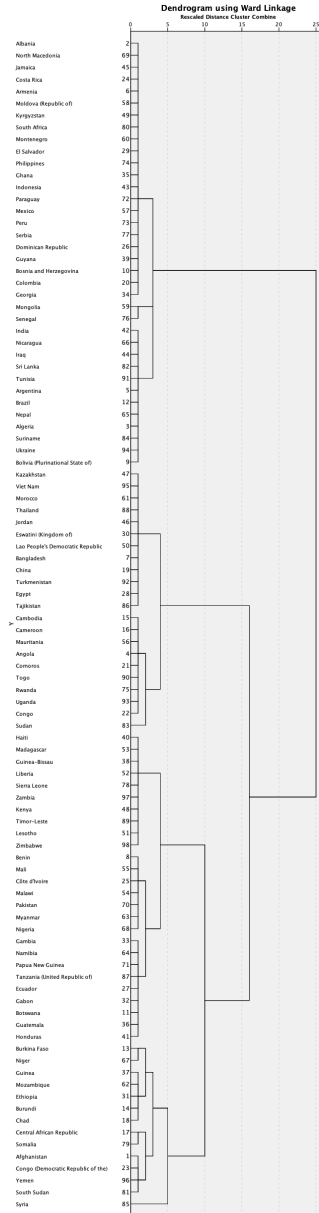
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APPENDIX 1. DENDROGRAM OF COUNTRIES



Source: authors.



APPENDIX 2. VARIANCE RATIO CRITERION (VRC)

# clusters	VRC _k	w _k
2	179.92	..
3	209.37	4.22
4	243.05	-31.09
5	245.63	-30.51
6	217.70	..

Source: authors.

APPENDIX 3. Cluster membership of developing countries

Country	Cluster membership	For reference			Variables considered for the classification						
		Population	GNI per capita, Atlas method (current US\$)	Economic freedom	Food production	Poverty	Democracy	Accountability	War	Hunger	
Afghanistan	1	40,099,462	390	48	104.22	0.2717	-1	-1.5709	10.7582	29.8	
Burkina Faso	1	22,100,683	830	58.3	93.64	0.5234	6	-0.1093	7.1491	18	
Burundi	1	12,551,213	220	39.4	122.65	0.4089	-1	-1.4052	0.1514	40	
Central African Republic	1	5,457,154	480	45.7	98.04	0.4613	6	-1.1956	12.6806	52.2	
Chad	1	17,179,740	640	49.8	103.71	0.5170	-2	-1.4201	2.2818	32.7	
Congo (Democratic Rep.)	1	95,894,118	550	47.6	94.01	0.3312	-3	-1.1982	5.5676	39.8	
Ethiopia	1	120,283,026	940	49.6	104.57	0.3666	1	-1.0691	2.9838	24.9	
Guinea	1	13,531,906	1,020	54.2	118.34	0.3732	4	-0.9876	0.0000	30	
Mozambique	1	32,077,072	480	51.3	113.18	0.4170	5	-0.6125	2.2914	32.7	
Niger	1	25,252,722	590	54.9	106.87	0.6013	5	-0.3871	0.8870	19.8	
Somalia	1	17,065,581	430	49	86.38	0.5140	5	-1.7492	17.3917	53.1	
South Sudan	1	10,748,272	1040	53	98.01	0.5802	-7	-1.7265	12.7369	40	
Syria	1	21,324,367	760	59	126.85	0.021	-9	-1.9167	31.2413	40	
Yemen	1	32,981,641	840	55	92.77	0.2452	-7	-1.6845	13.0042	41.4	
Benin	2	12,996,895	1,350	61	100.91	0.3677	7	-0.2375	0.0208	7.4	
Botswana	2	2,588,423	6,430	64.8	92.44	0.0726	8	0.4576	0.0000	21.9	
Côte d'Ivoire	2	27,478,249	2,420	61.6	104.3	0.2359	4	-0.4711	1.0991	4.4	
Ecuador	2	17,797,737	5,960	54.3	88.98	0.0079	5	0.1061	0.0000	15.4	
Gabon	2	2,341,179	6,440	55.8	90.24	0.0697	3	-0.8942	0.0000	17.2	
Gambia	2	2,639,916	740	58	87.43	0.1980	4	-0.1029	0.0000	21.6	
Guatemala	2	17,109,746	4,940	63.2	96.74	0.1335	8	-0.4619	1.4202	16	
Guinea-Bissau	2	2,060,721	760	46	92.77	0.3407	6	-0.2363	0.0000	31.7	
Haiti	2	11,447,569	1,430	50	73.32	0.1996	5	-0.9521	0.1485	47.2	
Honduras	2	10,278,345	2,490	59.5	95.34	0.0512	7	-0.5871	2.4031	15.3	

/ ... /

Country	Cluster membership	For reference		Variables considered for the classification						
		Population	GNI per capita, Atlas method (current US\$)	Economic_ freedom	Food_ production	Poverty	Democracy	Accountability	War	Hunger
Kenya	2	55,005,614	2,080	52.6	96.92	0.1708	9	-0.3663	0.3585	26.9
Lesotho	2	2,281,454	1,210	48.1	94.71	0.0844	8	-0.0198	0.0000	34.7
Liberia	2	5,193,416	630	47.9	89.09	0.2593	7	-0.0211	0.0000	38.3
Madagascar	2	28,915,653	490	58.9	89.6	0.3840	6	-0.2701	0.0097	48.5
Malawi	2	19,889,742	620	53	116.32	0.2311	6	0.0846	0.0000	17.8
Mali	2	21,904,983	820	55.9	116.14	0.3761	5	-0.7775	1.4882	9.8
Myanmar	2	53,798,084	1,170	49.6	99.73	0.1758	8	-1.6614	1.2064	3.1
Namibia	2	2,530,151	4,650	59.2	94	0.1847	6	0.5723	0.0000	18
Nigeria	2	213,401,323	2,080	54.4	93.46	0.2544	7	-0.6566	1.5126	12.7
Pakistan	2	231,402,117	1,470	48.8	106.98	0.1982	7	-0.8405	0.0449	16.9
Papua New Guinea	2	9,949,437	2,460	54.6	92.15	0.2633	5	0.0230	0.2412	21.6
Sierra Leone	2	8,420,641	500	52	97.34	0.2929	7	-0.0636	0.0653	27.4
Tanzania	2	63,588,334	1,100	59.5	100.13	0.2842	3	-0.7116	0.0000	22.6
Timor-Leste	2	1,320,942	1,140	46.3	88.3	0.2215	8	0.4591	0.0000	26.2
Zambia	2	19,473,125	1,030	48.7	105.65	0.2317	6	-0.3670	0.0000	30.9
Zimbabwe	2	15,993,524	1,530	33.1	102.7	0.1099	4	-1.1369	0.0000	30
Angola	3	34,503,774	1,710	52.6	91.69	0.2824	-2	-0.8409	0.0000	20.8
Bangladesh	3	169,356,251	2,570	52.7	106.44	0.1041	-6	-0.7696	0.2521	11.4
Cambodia	3	16,589,023	1,580	57.1	99.59	0.1703	-4	-1.4359	0.0000	6.3
Cameroon	3	27,198,628	1,590	52.9	90.54	0.2321	-4	-1.1602	3.3421	6.7
China	3	1,412,360,000	11,880	48	100.64	0.0161	-7	-1.6366	0.0000	2.4
Comoros	3	821,625	1,580	50.4	93.51	0.1808	-3	-0.7404	0.0000	20.4
Congo	3	5,835,806	1,970	48.5	89.3	0.1117	-4	-1.2381	0.9767	31.6
Egypt	3	109,262,178	3,350	49.1	89.92	0.0197	-4	-1.5098	0.0000	5.1
Eswatini	3	1,192,271	3,650	51.4	97.91	0.0813	-9	-1.2973	0.0000	11
Jordan	3	11,148,278	4,170	60.1	89.83	0.0015	-3	-0.7992	0.0000	16.9
Kazakhstan	3	19,000,988	8,880	64.4	109.31	0.0016	-6	-1.1355	0.0000	2.4

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Country	Cluster membership	For reference		Variables considered for the classification						
		Population	GNI per capita, Atlas method (current US\$)	Economic_ freedom	Food_ production	Poverty	Democracy	Accountability	War	Hunger
Laos	3	7,425,057	2,500	49.2	96.3	0.1083	-7	-1.6817	0.0000	5.1
Mauritania	3	4,614,974	1,950	55.3	96.14	0.3270	-2	-0.7652	0.0000	10.1
Morocco	3	37,076,584	3,620	59.2	94.43	0.0267	-4	-0.6073	0.0000	5.6
Rwanda	3	13,461,888	840	57.1	98.17	0.2310	-3	-0.9554	0.0000	35.8
Sudan	3	45,657,202	650	32	101.86	0.2794	-4	-1.4682	6.9540	12.8
Tajikistan	3	9,750,064	1,150	49.7	120.24	0.0290	-3	-1.7052	0.0000	8.6
Thailand	3	71,601,103	7,090	63.2	92.77	0.0021	-3	-0.7906	0.0573	8.8
Togo	3	8,644,829	960	57.2	98.16	0.1796	-2	-0.7944	0.0000	18.8
Turkmenistan	3	6,341,855	6970	46.2	89.11	0.0008	-8	-1.9147	0.0000	3.5
Uganda	3	45,853,778	760	54.2	97.02	0.2810	-1	-0.8218	0.0037	30
Viet Nam	3	97,468,029	3,590	60.6	100.96	0.0077	-7	-1.3042	0.0000	5.7
Albania	4	2,811,666	6,110	66.6	106.14	0.0027	9	0.0912	0.0000	3.9
Algeria	4	44,177,969	3,660	45.8	101.95	0.0054	2	-1.0095	0.0000	2.70
Argentina	4	45,808,747	9,960	50.1	104.68	0.0015	9	0.6196	0.0000	3.7
Armenia	4	2,790,974	4,850	65.3	84.66	0.0007	7	0.0592	0.0501	3.5
Bolivia	4	12,079,472	3,290	43	102.11	0.0378	7	-0.1099	0.0000	13.9
Bosnia and Herzegovina	4	3,270,943	6,810	63.4	120	0.0083	7	-0.3133	2.8126	2.4
Brazil	4	214,326,223	7,740	53.3	107.59	0.0163	8	0.2782	0.0098	4.1
Colombia	4	51,516,562	6,190	65.1	96.3	0.0197	7	0.0997	10.1618	8.2
Costa Rica	4	5,153,957	12,310	65.4	93.57	0.0020	10	1.0914	0.0000	3.4
Dominican Republic	4	11,117,873	8,100	63	111.21	0.0088	7	0.3018	0.0000	6.7
El Salvador	4	6,314,167	4,260	59.6	101.86	0.0325	8	-0.0552	0.0000	7.7
Georgia	4	3,708,610	4,700	71.8	116.97	0.0012	7	0.0153	8.2241	7.6
Ghana	4	32,833,031	2,280	59.8	103.63	0.1112	8	0.4673	0.0000	4.1
Guyana	4	804,567	9,410	59.5	110.99	0.0066	7	0.2467	0.0000	4.9
India	4	1,407,563,842	2,150	53.9	110.49	0.0688	9	0.1127	0.0359	16.3
Indonesia	4	273,753,191	4,180	64.4	108.15	0.0140	9	0.1552	0.0267	6.5

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Country	Cluster membership	For reference		Variables considered for the classification						
		Population	GNI per capita, Atlas method (current US\$)	Economic freedom	Food production	Poverty	Democracy	Accountability	War	Hunger
Iraq	4	43,533,592	4,760	46	131.1	0.0327	6	-0.9630	2.7266	15.9
Jamaica	4	2,827,695	5,190	67.4	98.43	0.0108	9	0.6280	0.0000	6.9
Kyrgyzstan	4	6,691,800	1,180	55.8	100.71	0.0014	8	-0.6055	0.0000	5.3
Mexico	4	126,705,138	9,590	63.7	106.65	0.0281	8	-0.0742	0.2991	6.1
Moldova	4	2,615,199	5,370	61.3	82.56	0.0035	9	0.0476	0.0000	6.7
Mongolia	4	3,347,782	3,730	63.9	159.06	0.0281	10	0.3189	0.0000	3.6
Montenegro	4	619,211	9,340	57.8	102.4	0.0049	9	0.1745	0.0000	2.4
Nepal	4	30,034,989	1,220	49.7	106.51	0.0744	7	-0.0891	0.0000	5.5
Nicaragua	4	6,850,540	1,950	54.8	123.57	0.0745	6	-1.2870	0.0000	18.6
North Macedonia	4	2,065,092	6,190	65.7	101.97	0.0014	9	0.1415	0.0053	3.3
Paraguay	4	6,703,799	5,740	62.9	109.53	0.0188	9	0.0091	0.0000	8.7
Peru	4	33,715,471	6,460	66.5	109.64	0.0292	9	0.1816	0.1780	8.3
Philippines	4	113,880,328	3,550	61.1	93.76	0.0242	8	-0.1505	0.0948	5.2
Senegal	4	16,876,720	1,570	60	158.24	0.2629	7	0.1926	0.0498	7.5
Serbia	4	6,834,326	8,460	65.2	112.65	0.0004	8	-0.1236	0.0000	3.3
South Africa	4	59,392,255	6,530	56.2	103.59	0.0249	9	0.7885	0.0000	6.9
Sri Lanka	4	22,156,000	4,030	53.3	123.23	0.0112	6	-0.0696	0.0542	3.4
Suriname	4	612,985	4,410	48.1	95.09	0.0112	5	0.3769	0.0000	8.2
Tunisia	4	12,262,946	3,540	54.2	115.9	0.0029	7	0.1871	0.0000	3.1
Ukraine	4	43,792,855	4,120	54.1	102.03	0.0008	4	0.0763	1.9501	2.8

Source: authors. See Table 1 for detailed information on each variable.

