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Food Security in African Countries: A Multivariate Statistical Analysis of the 2022 Indices

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Abstract :
This study aims to analyze the food security of African countries for the year 2022. A descriptive analytical approach was employed, in addition to principal component analysis and clustering analysis, using data provided by the Economist Intelligence Unit (EIU) and processed with R-Studio software. The results revealed significant differences in food security across Africa in 2022. Countries such as South Africa, Morocco, and Algeria stood out for their strong performances, while countries like Sierra Leone and Madagascar faced significant challenges, particularly in terms of sustainability and access to food. The identified groups highlighted model countries, others facing difficulties, and some with average results but struggling with economic and climatic challenges.
Keywords: Food Security, Africa, Index, Clustering, Multivariate analysis.
Jel Classification Codes: Q18, O55, I32, C38

Introduction :

Ensuring food security is a crucial global challenge, as it guarantees every individual access to adequate nutrition. This issue, now at the forefront of international concerns, has become more complex due to challenges such as climate change and population growth, which have heightened the fragility of food systems over the past decade.

The issue of food security is multidimensional, requiring the analysis of multiple indicators and sub-indicators to fully understand its various aspects. In this context, the Economist Intelligence Unit (EIU) developed the Global Food Security Index, based on a set of indicators that provide a comprehensive overview of the state of food security worldwide.

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The challenges related to food security raise a critical question in many countries around the world, particularly in African countries. Within this framework, this study aims to address the following main question:
What is the state of food security in African countries?
To address this main question, it is essential to consider the following sub-questions:

- How do African countries compare to one another in terms of food security indices based on the identified dimensions?
- What are the clusters of African countries with similar characteristics regarding food security?

The primary objective of this study is to analyze food security in 31 African countries for the year 2022. It also aims to:

- Classify African countries into clusters based on their food security indices.
- Compare the state of food security among African countries in 2022.

This study holds particular significance as it first provides an accurate assessment of the state of food security in Africa for 2022. Secondly, it classifies African countries into homogeneous groups based on their food security characteristics, highlighting disparities and specific needs across the continent.
To achieve the objectives of this study and answer the research questions, a descriptive and analytical approach was adopted, analyzing the food security indices of African countries for 2022. Additional statistical methods, such as principal component analysis (PCA) and clustering using the k-means method, were also employed, with the aid of the statistical software RStudio.
To address the research problematic of this study, a theoretical section was first developed, presenting previous research on food security as well as an overview of food security indices. Subsequently, a practical section was introduced, aiming to answer the main question and sub-questions of this research through the analyses conducted.

1-Litterature Review :

Several studies have addressed the issue of food security, each contributing to a deeper understanding of this complex problem. Among these studies, we cite the following:
The study conducted by Gulton et al. (2024) aimed to identify the factors determining household food security in areas remote from food supply centers, specifically in the Kotawaringin Barat district of Central Kalimantan province. The results revealed that human, natural, financial, social, and physical assets along with food distribution, significantly influence household food security in this region. Additionally, government support plays a crucial role in strengthening the food security of local households[2].
The study conducted by Arafat (2024) aimed to examine concepts related to food security, the causes of food insecurity, the current state of food security, and the responses and strategies adopted in the MENA region. Based on a qualitative

[2] **Gultom, J., Hanani, N., Qurbani, I. D., & Asmara, R**. (2024), "Factors affecting household food security in non-food-center areas", Journal of Law and Sustainable Development, vol. 12, n°12, https://doi.org/10.55908/sdgs.v12i12.4134

analysis of key factors, the study proposed a strategy built on seven pillars, including increasing domestic production, supporting small-scale farming, and strengthening supply chains to enhance food security. However, the findings highlighted that despite these recommendations, the MENA region faces significant structural challenges, such as water scarcity, agricultural constraints, and rapid population growth, which limit its ability to ensure long-term food security[3].

The study by Aslan et al (2024) aimed to explore the concept of smart food security, which relies on the use of digital technologies and innovative approaches to develop a sustainable, efficient, and resilient food system. The results revealed that integrating digital technologies in this context helps optimize agricultural practices, reduce food losses, improve product quality, and ensure traceability and transparency within the supply chain[4].

The study by جناد مباركة (2023) focused on food security and self-sufficiency in Algeria, highlighting the strategic role of cereals in the Algerian diet. The results demonstrated that, despite internal and external challenges, Algeria managed to position itself as a leading African country in terms of food security in 2022[5].

The study by Masih et al. (2017) aimed to analyze food security and its indicators in underdeveloped, developing, and developed countries, as well as to develop a trend forecasting model considering food security, climate change, meta-analytic agriculture, and nutrition. The results highlighted that climate change negatively affects agricultural production, particularly in developed countries, and is the main factor impacting all four dimensions of food security across all country categories. In contrast, elements such as microcredit and agricultural techniques were found to be positive, as they represent recently explored levers to strengthen food security[6].

Our study aligns with these questions regarding the analysis of food security, but its uniqueness compared to these studies lies in its focus on African countries. It covers a sample of 31 countries for the year 2022 and aims to classify these countries based on their similarity in terms of food security.

2- Basic Concepts:

This section introduces key definitions and indices used to assess food security across different contexts.

2.1. Definition of Food Security:

Food security, as defined at the World Food Summit in 1996, refers to the guarantee that all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their needs and preferences for an active and healthy

[3] **Arafat, A. A.-D.** (2024), "Food Security in the MENA Region", In A. A.-D, Arafat, "Human Security in the Middle East and North Africa" , Springer Nature Switzerland, (p. 85-109), https://doi.org/10.1007/978-3-031-70196-2_3

[4] **Aslan, I., Barbara, S., Aslan, H., Skiba, D., & Said, M. M. T.** (2024), "Sustainable Smart Food Security", In A. N. Abougreen, S. Mehta, & C. Costa (Éds.), "Interdisciplinary Technological Advancements in Smart Cities". Springer Nature Switzerland, (p. 153-182), https://doi.org/10.1007/978-3-031-69441-7_7

[5] **جناد, م.** (2023)، «اشكالية الأمن الغذائي و تحقيق الاكتفاء الذاتي في الجزائر»، مجلة الاقتصاد الجديد، *14*، 01، ص 428-447.

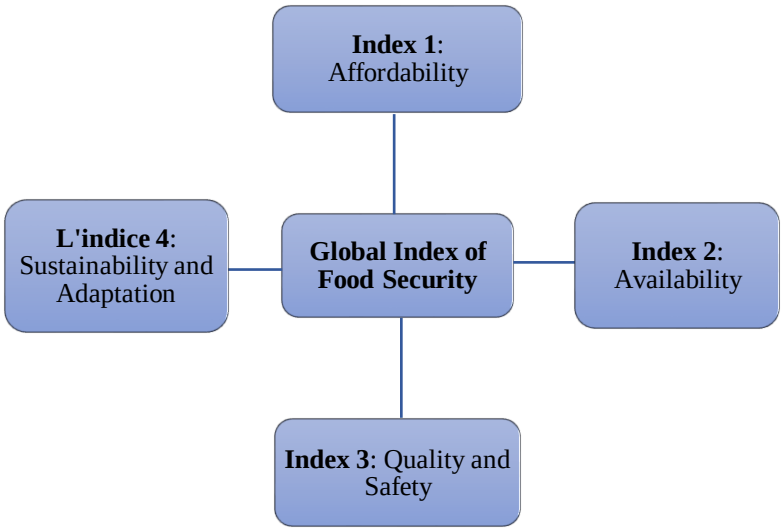
[6] **Masih, J., Sharma, A., Patel, L., & Gade, S.** (2017), "Indicators of Food Security in Various Economies of World", Journal of Agricultural Science, vol.9, n°3,https://doi.org/10.5539/jas.v9n3p254

life. It also allows for the assessment of the number of people facing food insecurity in a country or region, based on its key pillars: accessibility, availability, quality and safety of food, as well as sustainability and stability[7].

2.2. Food Security Indices:

Food security indices are statistical tools used to assess and quantify various aspects of food security at the regional, national, or global level, based on four main dimensions. The global food security index, in particular, serves as a dynamic assessment model that integrates both quantitative and qualitative data. It is developed from 58 specific indicators and sub-indicators, such as access to agricultural inputs, agricultural development, supply chain infrastructure, as well as political and social commitments to food security. These elements reflect the food situation in a given region or globally[8]. These indices are presented by the Economist Intelligence Unit (EIU) through its monthly reports and are evaluated on a scale of 0 to 100.

Figure 1. The four main pillars of food security



Source : Created by the author based on: Economist Impact. (2021), "Global Food Security Index 2021", CORTEVA agriscience. P.34

2.2.1. Affordability Index:

This index evaluates consumers' ability to acquire food, their vulnerability to price fluctuations, as well as the existence of programs and policies designed to support them in times of shocks. The score for this index is determined from several indicators, including the variation in the average cost of food, the proportion of the population living below the global poverty line, the income inequality-adjusted index, agricultural trade, and food safety net programs. The latter is a composite

[7] **Caraher, M., & Coveney, J.** (2015), Food poverty and insecurity : International food inequalities, Springer. P. 11
[8] **Economist Impact.** (2021), "Global Food Security Index 2021", CORTEVA agriscience. P.34

indicator that measures the quality of these programs based on their funding, coverage, and operational effectiveness.

2.2.2. Availability Index:

The Food Availability Index evaluates a country's ability to produce agricultural goods, prevent supply disruptions, ensure national food distribution, and promote research to increase agricultural production. The score for this index is calculated from several indicators, including access to agricultural inputs, research and development in the agricultural sector, agricultural infrastructure, supply chain infrastructure, the adequacy of supply, political and social barriers to access, political commitments to food security, agricultural production volatility, and food losses.

2.2.3. Quality and Safety Index:

The Food Quality and Safety Index assesses the diversity and nutritional quality of average diets, as well as food safety. The score for this index is determined from several indicators, including food diversity, measured by the share of non-starchy foods and sugar consumption, as well as nutritional standards, based on national dietary guidelines and national nutrition plans or strategies. It also takes into account the availability of micronutrients, protein quality, and food safety, assessed through food safety mechanisms, access to potable water, and food storage capacity.

2.2.4. Sustainability and Adaptation:

This Index measures a country's exposure to the impacts of climate change, its vulnerability to risks related to natural resources, and its capacity to adapt to these challenges. The score for this index is based on criteria such as political commitment to adoption, disaster risk management, the quality of drinking water, land management, and other essential factors.

3- Research Methodology:

The methodology of this study can be summarized in these two aspects:

3.1. Data Presentation:

The data used in this study mainly consists of the scores of the indices that form the Global Food Security Index, published by Economist Impact in its 2022 report. These indices, which constitute the variables of our study, are four in total. The data also includes observations represented by African countries, our area of interest. We selected 31 countries after excluding some due to the lack of data on food security indices during the studied period.

3.2. Analysis Methods:

To achieve our research objectives, we used a descriptive analytical approach, with the statistical software RStudio:

- **Descriptive analysis of the Global Food Security Index**: This method provides a crucial overview of the Global Food Security Index in African countries.
- **Principal Component Analysis (PCA)**: PCA, a multivariate analysis method, will be used to visualize the countries in our study in a two- or three-dimensional space. This will help facilitate the interpretation of the relationships between countries concerning food security.
- **Clustering analysis**: Clustering, an unsupervised learning method, will be used to group African countries into homogeneous clusters in terms of food security. This approach will help identify groups of countries with similar characteristics,

allowing for a deeper analysis of the differences and similarities in their food security.

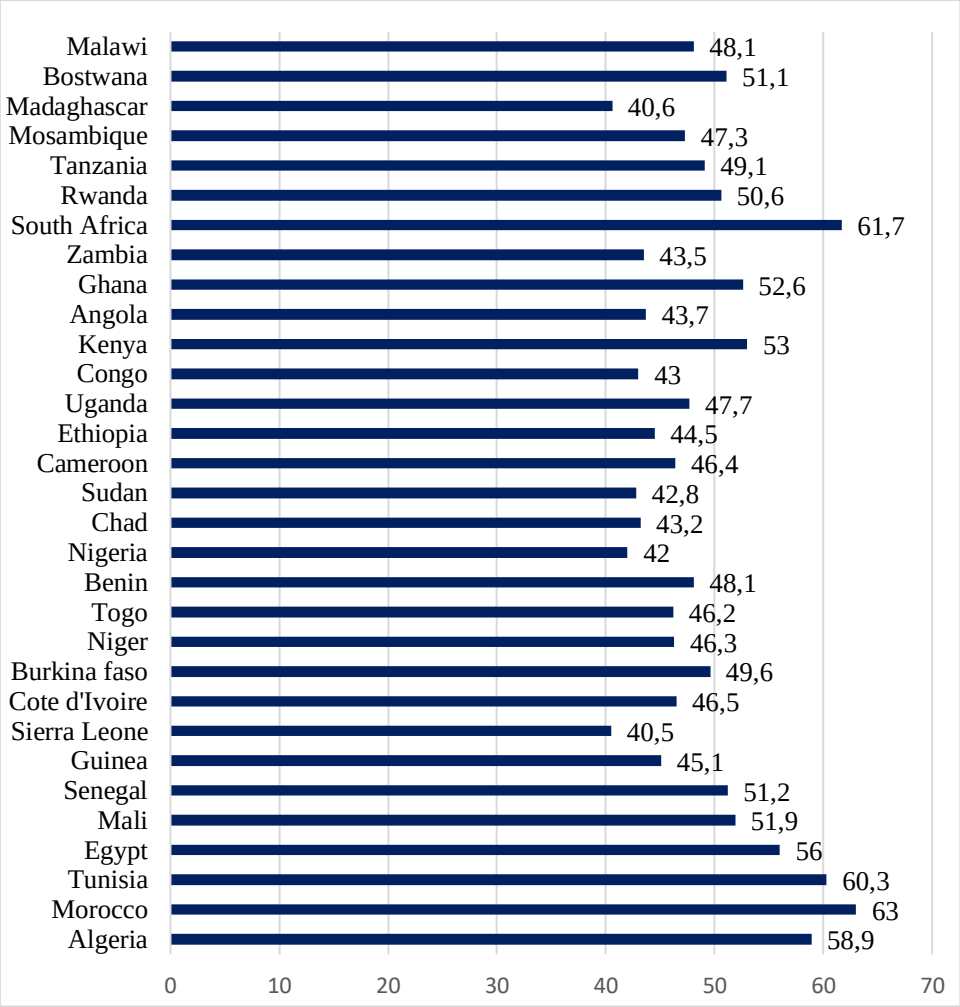
4- Presentation and Analysis of the Study Results:

In this section we will first analyze the global food security index in African countries, then proceed to principal component analysis and clustering analysis.

4.1. Overview of the Global Food Security Index in Africa:

The figure below provides an overview of the ranking of African countries according to the global food security index:

Figure 2. Global Index of Food Security of African Countries - 2022



Source : Created by the author using Excel 2019 software

It can be observed from the bar chart presented above that the global food security index scores measured for African countries in 2022 range between 40.5% and 63%. This result reflects a significant disparity in the ability of countries on the continent to ensure food security for their populations. The countries with the highest scores

are Morocco (63%), South Africa (61.7%), Tunisia (60.3%), Algeria (58.9%), and Egypt (56%). These high scores are mainly explained by several structural factors. Firstly, these countries benefit from relative political and economic stability compared to other African nations. This stability enables them to implement coherent agricultural policies and effective food security strategies. For example, Algeria, Egypt, and Morocco have developed national programs focused on improving local agricultural production, reducing dependence on imports, and modernizing agricultural infrastructure. Furthermore, these countries have relatively better access to food, facilitated by more developed logistical systems and transportation infrastructure, which help reduce post-harvest losses and ensure better distribution of food products. On the other hand, the countries with the lowest scores in Africa are Sierra Leone (40.5%), Madagascar (40.6%), Nigeria (42%), Sudan (42.8%), and Congo (43%). These low scores reflect a critical situation marked by various complex challenges. The context of armed conflicts, such as in Sudan and Congo, severely disrupts food supply chains, destroys agricultural infrastructure, and leads to mass population displacements, further exacerbating food insecurity. In the case of Nigeria, the low score is largely attributed to an excessive dependence on food imports, making the country vulnerable to price fluctuations in global markets and disruptions in international supply chains. Generally, these low-scoring countries share common challenges such as low agricultural productivity, often linked to limited access to agricultural inputs (seeds, fertilizers), and the lack of effective public policies to support the agricultural sector. For example, in Madagascar, climate vulnerability (cyclones, droughts) also plays a major role, regularly compromising harvests and exacerbating the difficulties faced by local farming communities.

4.2. Principal Component Analysis:

Principal Component Analysis (PCA) is a statistical technique used to analyze data tables of the type observations (individuals) - variables when the latter are quantitative. Its goal is to extract the essential information from a data table and provide a graphical representation that facilitates its interpretation.

4.2.1. Bertlett's Sphericity Test:

To test the homogeneity of variances of the analysis variables, we use this test under the following hypotheses:

H0: The variances of the variables are identical.

H1: At least one of variances is different from the others.

Table 1. The bartlett's sphericity test results

K-Squared	Degree of freedom	P-value
16.919	3	0.0007

Source: Created by the author based on the study results extracted from R-studio software

Since the 'p-value' is lower than the significance threshold of 0.05, we reject the null hypothesis H0 and accept the alternative hypothesis H1. Therefore, it is possible to apply principal component analysis.

4.2.2. Eigenvalues:

According to the eigenvalue table presented below, the analysis focuses on the first two components, as the inertia percentage is 66.34%. This means that the main plane explains 66.34% of the total information, making the first two axes sufficient.

Table 2. Eigenvalues

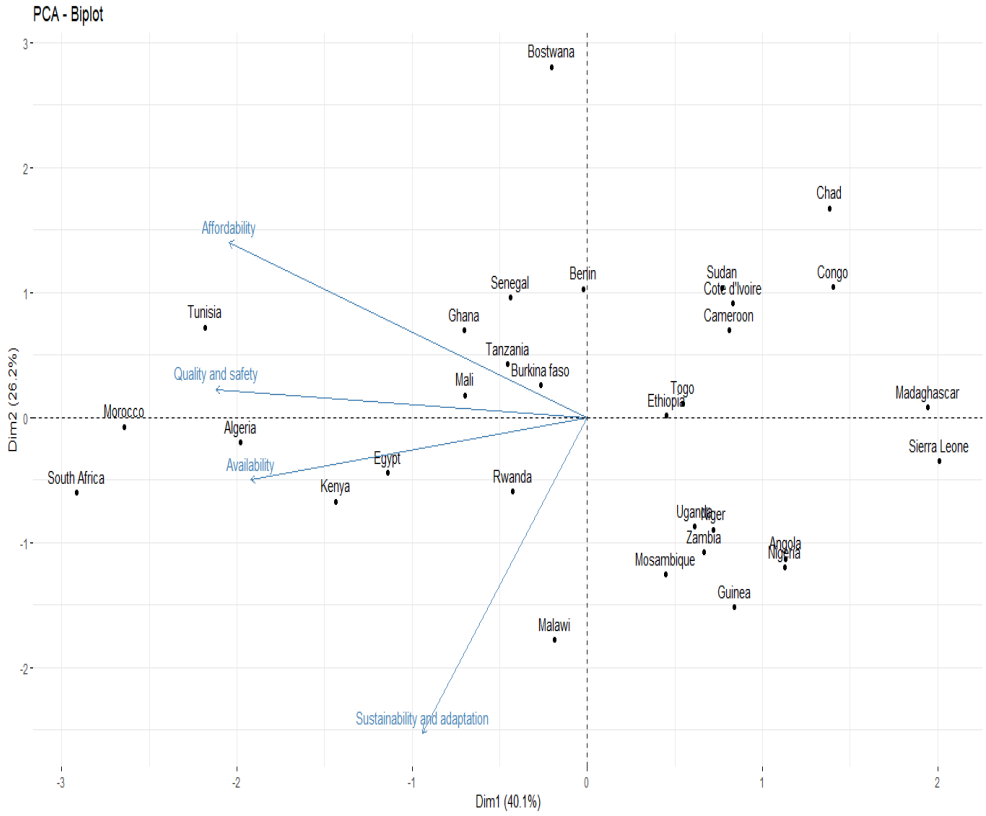
Principal components	PCA 1	PCA 2	PCA 3	PCA 4
Eigenvalues	1.2672	1.0236	0.8872	0.7479
Variability	0.4015	0.2620	0.1968	0.1398
Cumulative %	0.4015	0.6634	0.8602	1

Source: Created by the author based on the study results extracted from R-studio software

4.2.3. Representation of the Study Variables and Observations on the First Factorial Plan (Axis 1 and Axis 2):

The representation of the study data on the same factorial plane is one of the objectives of Principal Component Analysis, as this representation allows for better visualization of all the variables and observations of the study on a two-dimensional map.

Figure 3. Graphical representation of countries and indices



Source : Created by the author using R-studio software

According to the graphical representation above, the first axis explains 40.1% of the total inertia, indicating that it captures a significant portion of the overall information. All the variables contribute in the same direction to the formation of this axis, as they are located on the same side of axis 1. Among them, the variables with the highest contributions are: 'Quality and Safety,' 'Affordability,' and 'Availability.' On the country side, those contributing positively to this axis include Sierra Leone, Madagascar, Congo, and Chad. These countries are distinguished by notable weaknesses in the 'Quality and Safety,' 'Affordability,' and 'Availability' dimensions, reflecting major challenges in food security. On the opposite side, countries like South Africa, Morocco, Tunisia, Kenya, and Algeria strongly contribute to the negative side of this axis. This indicates relatively better performances in the same dimensions, showing greater resilience to food security challenges. These results highlight a regional or economic divide. The countries located on the negative side of the axis (South Africa, Morocco, Tunisia, Algeria, Kenya) generally enjoy more advanced socio-economic development than those on the positive side (Sierra Leone, Madagascar, Congo, Chad). This disparity could be explained by better-structured food policies, more developed agricultural and logistical infrastructures, or a lower vulnerability to climate change.

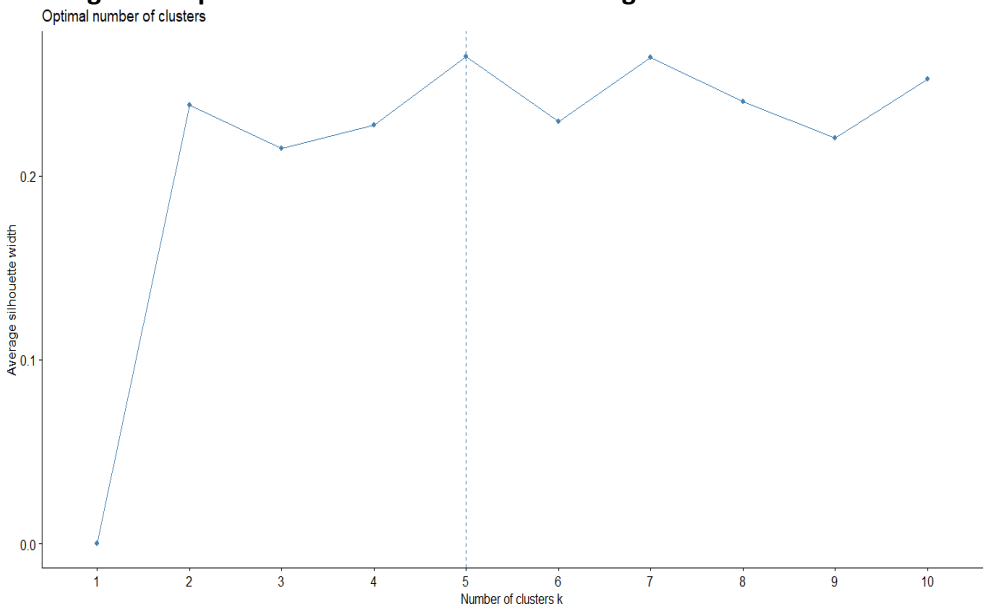
The second axis represents 26.2% of the total inertia, making it a significant component of the analysis. On the negative side, the dimension 'Sustainability and Adaptation' contributes strongly. Countries associated with this side of the axis include Malawi, Guinea, Mozambique, Angola, and Zambia. These countries appear less influenced by this dimension, which may reflect a high dependence on agricultural or economic practices that are particularly sensitive to climate shocks. On the positive side, we observe a strong contribution from the following countries: Botswana, Chad, Congo, Sudan, and Benin. These countries show relatively neutral performances or are less impacted by this dimension. However, they share common characteristics, such as persistent vulnerability to climate shocks, despite efforts or conditions that somewhat mitigate this influence.

4.3. Clustering Analysis:

In order to identify groups of countries that share similar characteristics in terms of food security, it is important to classify these countries using the K-means clustering method.

To choose the optimal number of clusters, the silhouette index was used, and the results of this index for our data are presented in the graphic below:

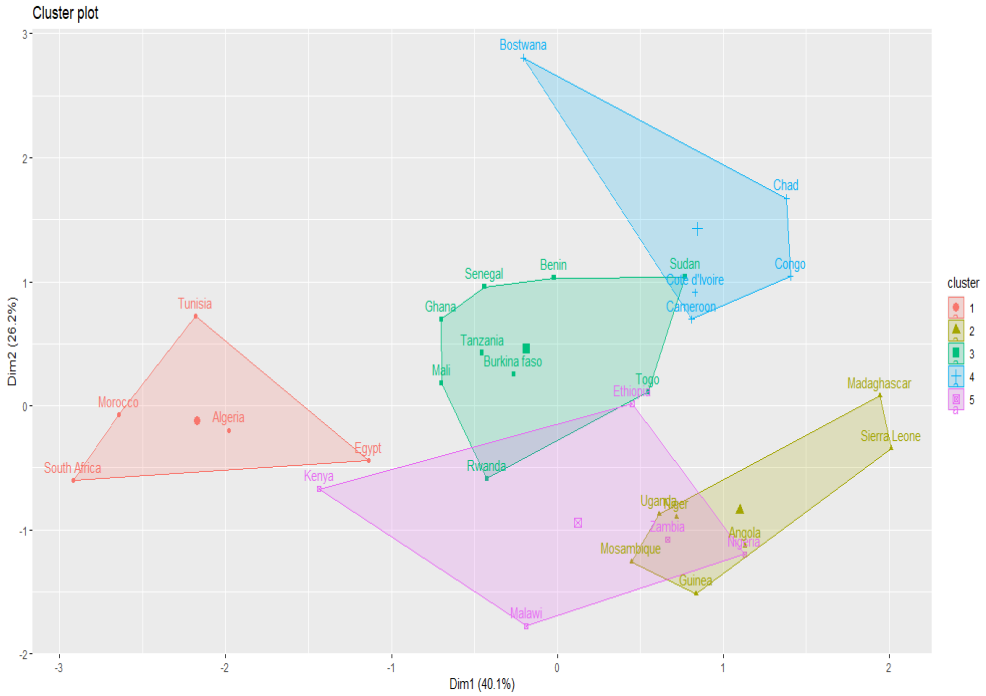
Figure 4. Optimal number of clusters according to the silhouette index



Source: Created by the author using R-studio software

The silhouette index scores indicate that the optimal number of clusters is five. The grouping of countries within each cluster is illustrated below:

Figure 5. Visualization of clusters from the K -means method



Source : Created by the author using R-studio software

Table 3: The means of the variables (food security indices) for each cluster

	Index 1	Index 2	Index 3	Index 4
Cluster 1	68.9	53.72	59.72	55.32
Cluster 2	40.33	43.3	42.04	53.6
Cluster 3	49.59	51.33	50.97	44.24
Cluster 4	54.12	39.02	49.22	39.82
Cluster 5	32	47.26	57.98	52.2

Source: Created by the author based on the study results extracted from R-studio software

The five clusters of African countries defined by the K-means method are:

Cluster 1: It includes the following countries: Morocco, Tunisia, Algeria, South Africa, and Egypt. This cluster includes the countries that have obtained the highest average scores across all food security indices compared to other clusters. These high performances can be attributed to several factors such as economic and political stability, as these countries benefit from relatively stable governance, which promotes the implementation of effective food security policies. Improved access to food through subsidy systems, higher income levels, and better management of natural resources allow these countries to ensure more affordable improvements for their populations. This cluster can be considered a model for other African countries in terms of food security, although challenges remain to be addressed.

Cluster 2: This cluster includes Madagascar, Sierra Leone, Uganda, Angola, Guinea, Mozambique, and Niger. The countries in this cluster have experienced a high average for index 3, 'Quality and Safety,' indicating a certain quality in the available food, especially for Madagascar and Uganda. However, weaknesses were observed in index 4, 'Sustainability & Adaptation,' as the average for this index is the lowest among all clusters. This reflects a lack of preparedness for climate challenges and insufficient investments in sustainable food systems.

Cluster 3: This cluster includes the following countries: Senegal, Benin, Ghana, Mali, Tanzania, Burkina Faso, Rwanda, Togo, and Sudan. The countries in this cluster are characterized by a high average on index 2, 'Availability,' but still well below that of cluster 1, reflecting relatively satisfactory food availability for countries like Tanzania, Benin, and Ghana, which benefit from diversified agricultural production and local initiatives to improve access to food. On the other hand, poor performance on index 1, 'Affordability,' was recorded, notably in the case of Sudan, which experienced very low scores on this index, highlighting issues with the economic accessibility of food, exacerbated by conflicts and political instability. This cluster illustrates a certain capacity to produce food locally, but highlights challenges related to accessibility in countries with low purchasing power.

Cluster 4: This cluster includes Botswana, Chad, Congo, Côte d'Ivoire, and Cameroon. The countries in this cluster have shown relatively good performance on index 1, 'Affordability,' where the average of this index is the second highest after that of cluster 1. However, weaknesses have been marked in countries like Cameroon and Chad, which reflects issues with agricultural infrastructure, logistics, and distribution.

Cluster 5: This cluster includes the following countries: Kenya, Malawi, Ethiopia, Zambia, and Nigeria. The countries in this cluster displayed good performance on index 3, 'Quality and Safety,' with a high average for this index, particularly for Kenya, Ethiopia, and Nigeria, reflecting a certain quality and safety of available food

products. However, it recorded the lowest average for this index, with particularly low scores for Nigeria and Zambia. This reflects major economic challenges, high poverty levels, and an increased dependency on food imports, making food products unaffordable for a large portion of the population. This cluster highlights the importance of bridging the gap between food quality and financial accessibility by investing in inclusive and resilient agricultural systems.

Conclusion:

At the end of this study on food security analysis in 31 African countries, the following conclusions can be drawn:

Firstly, the principal component analysis showed that some African countries are characterized by difficulties on both axes, such as Sierra Leone, Madagascar, Congo, and Chad, which accumulate weaknesses in the dimensions of the axis (Quality, accessibility, and availability) and are also vulnerable in terms of sustainability. Others, like Botswana or Benin, show neutral or slightly better performance on certain axes but remain exposed to climate vulnerabilities. There are also countries that can be considered high performers, such as South Africa, Morocco, Algeria, Tunisia, and Egypt, which stand out for their more resilient food systems and better capacity to respond to food security challenges.

Secondly, the clustering analysis identified five distinct clusters for the year 2022. Cluster 1 includes the model countries (South Africa, Morocco, Algeria, Tunisia, and Egypt), with high performances due to their economic and political stability, while cluster 2, which includes Sierra Leone, Madagascar, Angola, and others, as well as cluster 5 (which includes Ethiopia, Zambia, Malawi, Nigeria, and Kenya), highlight challenges related to sustainability, food quality, and economic accessibility. Clusters 3 (which includes Senegal, Benin, Ghana, and others) and 4 (which includes Botswana, Chad, Ivory Coast, and others) stand out for notable efforts in food availability, but deficiencies remain in terms of infrastructure and resilience. These results demonstrate the need for targeted solutions to address the specific needs of each group of countries.

References :

Algérie ECO. (2022, novembre 8), « Agriculture : Hausse de la production dans les principales filières en 2022 », https://www.algerie-eco.com/2022/11/08/agriculture-hausse-de-la-production-dans-les-principales-filieres-en-2022/ (consulted on 02/02/2025)

Arafat, A. A.-D. (2024), "Food Security in the MENA Region". In A. A.-D. Arafat, "Human Security in the Middle East and North Africa", Springer Nature Switzerland, (p. 85-109), https://doi.org/10.1007/978-3-031-70196-2_3

Aslan, I., Barbara, S., Aslan, H., Skiba, D., & Said, M. M. T. (2024), "Sustainable Smart Food Security", In A. N. Abougreen, S. Mehta, & C. Costa (Éds.), "Interdisciplinary Technological Advancements in Smart Cities", Springer Nature Switzerland, (p. 153-182), https://doi.org/10.1007/978-3-031-69441-7_7

Caraher, M., & Coveney, J. (Éds.). (2015), Food poverty and insecurity : International food inequalities, Springer.

Cherrou, K. (2023), « La sécurité alimentaire en Algérie : Enjeux et défis », Revue Etudes Economiques, vol. 17, n°01, P. 970-982.

Daoudi, A., & Bouzid, A. (2020), « La sécurité alimentaire de l'Algérie à l'épreuve de la pandémie de la covid 19 », Les cahiers de Cread, vol. *36, n°* 03, P. 185-207.

De Pee, S. (2013), "Food Security". In "Encyclopedia of Human Nutrition", Elsevier, (p. 353-360), https://doi.org/10.1016/B978-0-12-375083-9.00127-6

Economist Impact. (2021), Global Food Security Index 2021, CORTEVA agriscience, (p. 1-49).
Economist Impact. (2022), Global Food Security Index 2022, CORTEVA agriscience, (p. 1-48). https://my.corteva.com/GFSI?file=GFSI_2022_Global_Report_Sep_2022
Food and Agriculture Organization of the United Nations. (2023), Statistical Yearbook- World food and agriculture 2023, United Nations, (p. 1-384).
Gultom, J., Hanani, N., Qurbani, I. D., & Asmara, R. (2024), "Factors affecting household food security in non-food-center areas", Journal of Law and Sustainable Development, Vol. 12, n°12, https://doi.org/10.55908/sdgs.v12i12.4134
Harrag, M., & Boulfred, Y. (2019), « La sécurité alimentaire en Algérie : Une étude analytique sur les céréales », Revue de l'économie financière et des affaires, vol. 03, n°02, P. 162-188.
L'organisation des nations unies pour l'alimentation et l'agriculture. (s. d.), « L'état de la sécurité alimentaire et de la nutrition dans le monde 2023 », https://www.fao.org/3/CC3017FR/online/state-food-security-and-nutrition-2023/food-security-nutrition-indicators.html (consulted on 04/01/2025)
Masih, J., Sharma, A., Patel, L., & Gade, S. (2017), "Indicators of Food Security in Various Economies of World", Journal of Agricultural Science, vol.9, n°3, https://doi.org/10.5539/jas.v9n3p254
Office National des Statistiques. (2023), La production agricole, n°990, Office National des Statistiques, https://www.ons.dz/IMG/pdf/ProdAgricol2020_2021.pdf
Rahmani, M. (2020), "Food Security in Algeria : Concept Review and Measurement Indicators", Economic and Management Research Jounal, vol. 14, n°03, P. 235-248.
جناد، م. (2023)، «اشكالية الأمن الغذائي و تحقيق الاكتفاء الذاتي في الجزائر»، مجلة الاقتصاد الجديد ، 14، 01، ص 428-447.
ربيعي، ح.، و سمر، م. (2022)، «واقع الأمن الغذائي في الجزائر في ظل الاستراتيجيات و الاليات القانونية المستحدثة»، مجلة جامعة الأمير عبد القادر للعلوم الإسلامية، 36، 03، ص 2061-2275.
عياد، ف.، & مكيد، ع. (2018)، «واقع الأمن الغذائي الجزائري في ظل مؤشرات الأمن الغذائي العالمي»، مجلة البحوث و الدراسات العلمية، 12، 01، ص 108-128.