

GLOBALIZATION OR GLOCALIZATION? A COMPARATIVE ANALYSIS OF AGRI-FOOD SYSTEMS IN NIGERIA AND DEMOCRATIC REPUBLIC OF CONGO AMID GLOBAL CRISES

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Abstract

The study analyses the impact of recent global crises on the agri-food systems from Nigeria and the Democratic Republic of Congo (DR Congo), exploring vulnerabilities generated by globalization, and to adopt glocalization principles as solution to increase resilience and sustainability. Through a comparative approach, the research identifies the main challenges, such as high dependence on imports, poor agricultural infrastructure, and significant post-harvest losses, and highlights the potential of traditional crops, such as cassava and sorghum, in reducing food insecurity. The study proposes measures for crop diversification, infrastructure investments, and the adoption of sustainable agricultural practices, adapted to local conditions, as well as the need for regional collaboration and international partnerships to reduce structural vulnerabilities, concluding that a balanced integration of globalization and glocalization, adapted to local specificities, is a solution to strengthen food security. This analysis contributes to understanding the interdependence between global and local factors, providing insights to develop more resilient agri-food systems.

Key words: DR Congo, Nigeria, food security, globalization, glocalization

INTRODUCTION

Nigeria, the most populous country in Africa, and DR Congo, a country with vast natural resources, are emblematic cases for analyze the impact of globalization and glocalization on food security. With rapidly growing populations – more than 220 million in Nigeria and more than 100 million in DR Congo – both countries face significant challenges in feeding their populations (Anyanwu & Jukes, 1991; Karume et al., 2022) [7, 17]. Globalized agri-food systems, while bringing economic benefits through efficiency and access to expanded markets, have proven vulnerable to recent global crises, such as the COVID-19 pandemic and the conflict between Russia and Ukraine (Andam et al., 2020; Manyong et al.,

2022) [6, 18].

Globalization - Opportunity and vulnerability

Globalization, defined as the process of worldwide economic, cultural and social interconnection, has been essential for the development of international trade and increased access to food resources (Folorunso et al., 2024; FAO, 2024) [12, 13]. In the context of agriculture, globalization has facilitated access to advanced technologies, fertilizers, and export markets for producers, transforming agriculture from a local activity into a complex global system. By creating extensive and interdependent supply chains, globalization has enabled the growth of large-scale food production and distribution, thereby reducing costs and giving consumers access to a diverse range of products.

However, over-reliance on these globalized systems has demonstrated major vulnerabilities to external disruptions (FAO, n.d.a; FAO, n.d.b) [14, 15]. In case of Nigeria, massive wheat imports from Russia and Ukraine – which account for around 30% of global wheat trade – have been severely affected by the conflict between the two countries (World Bank, 1. n.d.; World Bank, 2. n.d.) [30, 31]. This led to significant price increases on the domestic market and reduced food affordability for the poor people. In DR Congo, where the agricultural and logistics infrastructure is much less developed, the effects of the COVID-19 pandemic have been amplified by difficulties in transport and distribution, isolating many regions from the supply with basic food products (Chiarini, 2021; Manyong et al., 2022) [11, 18]. These crises have demonstrated that while globalization offers substantial benefits, exclusive reliance on global markets amplifies the risks associated with disruptive events.

Glocalization - Solution for sustainable future

In contrast to globalization, glocalization combines the advantages of global interconnectedness with adaptations at local level. The concept of glocalization involves customizing global products, services, and strategies to meet local needs and preferences (Folorunso et al., 2024) [12]. In agriculture, glocalization can mean promoting traditional crops, supporting small farmers, increasing farmers' income and their living standard, reducing dependence on imports and strengthening regional markets (Adebisi et al, 2021) [1].

In Nigeria, glocalization can play a critical role in reducing vulnerabilities and increasing resilience. By growing wheat locally or replacing it with alternatives better suited to the region's climate, such as cassava or sorghum or fish, the country could significantly reduce its dependence on foreign markets (Bradley et al., 2020; FAO, 2024; Akinkunmi et al., 2024) [8, 13, 3]. Also, the implementation of localized distribution networks and agricultural cooperatives could increase access to markets and better incomes for farmers, while supporting the rural economy.

In DR Congo, promoting subsistence agriculture by capitalizing on local crops such as cassava, yam and maize can ensure better food security. Although poor infrastructure limits access to international markets, glocalization could support local farmers by stimulating regional trade and reducing dependence on imports. Thus, DR Congo can turn current challenges into opportunities for a growth and sustainable adaptation.

Interdependence between globalization and glocalization

Although globalization and glocalization are often considered opposite approaches, they can be complementary. Glocalization does not imply the complete rejection of globalization, but the selective integration of global elements that can support local development. For example, Nigeria can use global agricultural technologies to improve the productivity of local farmers and increasing domestic production, while reducing the dependence on imports (Busari and Kehinde, 2021) [9].

Globalization has favored migration from the developing countries to the developed ones looking for jobs and a better life, and this has affected the local labour force and the economic growth (Iheke, 2016) [16], especially in Nigeria where agriculture has an important contribution to GDP (Okezie and Ihebuzoaju, 2017 [23].

Also, the alignment to UN SDGs in Nigeria is another form of glocalization connected to globalization for reducing poverty (Akpan et al, 2024) [4].

On the other hand, the adoption of glocalization requires well-thought-out public policies and significant investments in agricultural infrastructure, farmer education and access to finance. In addition, supporting local production must be accompanied by measures to reduce the impact of climate change, such as use of sustainable technologies and promotion of regenerative agriculture.

The paper analyzes the impact of recent global crises, such as the COVID-19 pandemic and the conflict between Russia and Ukraine, on the agri-food and agro-industrial sectors in Nigeria and DR Congo. The main objective is to assess how globalization and glocalization influence food security in these two countries,

highlighting both the vulnerabilities created by integration into global markets and the opportunities offered by harnessing local resources.

Through this approach, the study aims to:

- identify the key findings from the global crises in relation to the agri-food systems of Nigeria and DR Congo;
- explore the complementarity between globalization and glocalization to ensure food security;
- propose strategies adapted to local conditions to increase the resilience and sustainability of the agri-food systems in the two countries.

The comparative analysis between Nigeria and DR Congo provides a framework to understand how different policies and strategies can influence the response to global crises. Through this approach, our study contributes to the development of solutions applicable not only to Nigeria and DR Congo, but also to other African countries facing similar challenges. Not at least, our goal is to support the formulation of effective policies to ensure long-term food security in the context of an increasingly volatile global environment.

MATERIALS AND METHODS

This study uses a systematic documentary approach to analyze the influence of globalization and glocalization on food security in Nigeria and DR Congo, with a specific focus on the impact of recent global crises such as the COVID-19 pandemic and the conflict between Russia and Ukraine. The methodology adopted is based on literature review and use of relevant secondary data.

Data collection and selection criteria. For the comparative analysis, data sources from following categories were selected:

- International databases.* FAOSTAT, World Bank Data and United Nations Food and Agriculture Organization (FAO) reports;
- Scientific literature.* Peer-reviewed articles available in Scopus and Web of Science covering topics such as globalization, glocalization and food security;
- Government reports.* National strategies and documents published by the authorities of

Nigeria and DR Congo on agriculture and food security;

-*Regional case studies.* Empirical analyzes of local agriculture in the two countries, with focus on their responses to global crises.

Analyzed indicators. To highlight the differences and similarities between Nigeria and DR Congo, the analysis included following indicators:

-*Dependence on imports.* Share of food imports in total consumption;

-*Local production.* Yields for staple crops (wheat, cassava, rice, sorghum);

-*Impact of global crises.* Food price fluctuations and household accessibility to essential products;

-*Role of glocalization.* Local agricultural practices and the adoption of sustainable strategies,

-*Agricultural infrastructure.* Availability of storage, irrigation and transport.

Data analysis approach. The analysis followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (Moher, 2009) [21]. The guideline was followed to ensure a rigorous and replicable selection of sources.

Selection criteria. To ensure a systematic and transparent selection process, the study applied the PRISMA guidelines, with the following inclusion and exclusion criteria:

- *Inclusion criteria:*

- Studies published in peer-reviewed journals from 2010 to 2023;
- Reports and datasets from FAO, World Bank, UN focusing on Nigeria and DR Congo;
- Empirical studies, case studies, and systematic reviews relevant to agri-food systems.

- *Exclusion criteria:*

- Articles without full-text access or not written in English;
- Studies focused on food security outside Africa, unless they provide comparative insights;
- Opinion pieces, editorials, and articles lacking empirical data.

Keywords used were: "Globalization", "Glocalization", "Food security", "Nigeria", "DR Congo", "COVID-19", "Russia-Ukraine Conflict".

Period analyzed. 2010–2023.

Data synthesis. The information was organized into three main dimensions:

- *Impact of global crises.* Evaluation of how the COVID-19 pandemic and the Russia-Ukraine conflict disrupted food systems in Nigeria and DR Congo;

- *Opportunities of glocalization.* Assessment of local agricultural strategies that can enhance food security and reduce dependency on imports;

- *Diversification and resilience strategies.* Analysis of policy measures, infrastructure investments, and sustainable agricultural practices that can strengthen agri-food systems.

Comparative methodology. To emphasize the main insights of this study, a comparative method was applied, analyzing the following aspects:

-the different levels of global integration of Nigeria and DR Congo;

-the local strategies used to deal with agri-food vulnerabilities;

-the potential to adopt glocalization as a sustainable solution for both countries.

This methodological framework provides a solid basis to analyze the impact of globalization and glocalization, as well as to identify solutions adapted to local conditions.

RESULTS AND DISCUSSIONS

Impact of global crises on supply chains in Nigeria and DR Congo

Agri-food supply chains in Nigeria and DR Congo have been deeply affected by two recent global events: the COVID-19 pandemic and the conflict between Russia and Ukraine. These two crises have exposed significant vulnerabilities of the food systems on these two countries, which rely heavily on global markets for the supply of staples. Analysing the impact of these crises in Nigeria and DR Congo highlights both country-specific challenges and common vulnerabilities.

The COVID-19 pandemic and the effects on imports and prices

The COVID-19 pandemic has significantly disrupted global supply chains, with severe consequences on access to food in Nigeria and DR Congo. Transport restrictions, logistical

bottlenecks and labor cuts have limited the flow of essential imports. In Nigeria, imports of wheat, widely used to make bread, fell by 25% from 2020 to 2022, caused by international transport restrictions and rise of global wheat prices (FAO, 2024; World Bank b, n.d.) [13, 31]. As a result, prices of bakery products have increased by over 40%, disproportionately affecting vulnerable urban households.

In DR Congo, the pandemic has exacerbated already existing infrastructure and logistics problems (FAO, 2024; World Bank a, n.d.) [13, 30]. Isolated regions, which depend on imports to supply their food needs, faced acute shortages of corn and vegetable oils. Due to transportation restrictions and poor infrastructure, many rural communities were completely cut off from food supply (Chiarini, 2021; Manyong et al., 2022) [11, 18]. In addition, transport costs have risen significantly, contributing to rise of food prices by up to 35%.

The conflict between Russia and Ukraine, a catalyst for food insecurity

The conflict between Russia and Ukraine, which erupted in 2022, amplified already existing vulnerabilities, having a profound impact on grain and fertilizer global markets (Amare et al., 2024; FAO, 2024) [5, 13]. Russia and Ukraine are responsible for about 30% of global wheat exports, and the disruption of this flow has led to a massive increase in prices at global level. In Nigeria, this dependence on wheat imports from the Black Sea region has led to an acute food crisis (Wuepper et al. 2024) [29]. Rise of wheat prices had a domino effect on other staple foods, further limiting households' access to adequate nutrition (Matemilola, 2017; Onilogbo, 2024) [19, 25].

In DR Congo, the effects of the conflict were mainly felt through increased prices of fertilizers and other agricultural inputs. Congolese farmers, who already faced financial difficulties, could no longer afford to purchase fertilizers, leading to lower yields for essential crops such as cassava and maize (Chiarini, 2021; Rossi et al. 2006) [11, 27]. This decline in domestic production has exacerbated food insecurity in rural areas,

where subsistence agriculture is the main source of food.

Common issues: infrastructure and access to markets

Although the pandemic and conflict have affected Nigeria and DR Congo differently, there are common challenges that have amplified the effects of these crises. Poor infrastructure is one of the main barriers in both countries. In DR Congo, the lack of roads and efficient transport networks makes food distribution a challenge, especially in isolated regions. In Nigeria, although infrastructure is better developed, congested ports and inadequate storage infrastructure have exacerbated post-harvest delays and losses (Table 1).

Table 1. Impact of global crises on supply chains (2019–2022)

Indicator	Nigeria	DR Congo
Decrease in imports (%)	-25% (wheat)	-30% (maize)
Price increase (%)	+40% (bread)	+35% (vegetable oil)
Food accessibility	Reduced in urban areas	Severely affected in rural areas

Source: Our World in Data, 2023 [26].

Key findings from global crises

Recent crises have highlighted the need for strategic changes in agri-food systems in Nigeria and DR Congo to reduce vulnerabilities and increase resilience. On the base the key findings, three main directions of action were identified.

Diversification of supply sources. A key lesson derived from the COVID-19 pandemic and the conflict between Russia and Ukraine is the need to reduce dependence on grain imports. Nigeria and DR Congo, like many other African states, are significantly dependent on global markets for products such as wheat, maize and rice. This dependence makes them highly vulnerable to disruptions in global supply chains.

Diversification can be achieved by stronger domestic production, promotion of traditional crops adapted to local climates, such as cassava and sorghum, and support for small farmers to accessible technologies and local resources. Also, increasing rice production in Nigeria through national programs such as the "Rice Revolution", is a positive example that could

be replicated and expanded to other sectors and regions.

Infrastructure improvement

Agricultural infrastructure plays a critical role in supply chains, and its lack has amplified the impact of crises in both countries. The development of transport networks, including more efficient rural roads and ports, is essential to ensure faster and more reliable food distribution.

In Nigeria, overburdened ports and inadequate storage infrastructure have caused significant delays in processing imports and considerable post-harvest losses. In DR Congo, the lack of adequate roads has isolated entire communities, preventing access to domestic and regional markets. Developing modern warehouses and cold storage facilities can reduce food losses, thereby increasing the efficiency of supply systems and reducing pressures on local farmers.

Creation of regional trade networks

Intra-continental cooperation and the stimulation of regional trade represent another essential direction to reduce vulnerabilities. Economic integration among African countries can provide viable alternatives to dependence on foreign markets. Developing regional trade networks such as the African Continental Free Trade Area (AfCFTA) [2], countries can harness local resources and boost regional production.

In the context of DR Congo, this could mean expanding trade with neighboring countries to facilitate distribution of agricultural products, while in Nigeria, expanding access to regional markets could strengthen incomes of small and medium farmers. These initiatives not only reduce exposure to global risks but also provide a platform for sustainable economic development.

By implementing these measures, Nigeria and DR Congo can reduce the risks associated with global shocks, ensure a more sustainable agri-food system and increase the population's resilience to future crises. The key findings emphasize the need for a balance between food autonomy and integration into global markets, a strategic approach that can transform current vulnerabilities into opportunities for development.

Opportunities offered by glocalization

Glocalization offers a strategic and sustainable alternative to reduce agri-food vulnerabilities in Nigeria and DR Congo (Folorunso et al., 2024; Omotoso & Omotayo, 2024) [12, 24]. This concept involves the adaptation of global resources to local needs and conditions, emphasizing the use of traditional cultures and the development of the local economy. Facing recent global crises, such as COVID-19 pandemic and conflict between Russia and Ukraine, glocalization has emerged as a viable solution to strengthen food security and increase resilience.

Capitalizing on traditional cultures

A central aspect of glocalization is the promotion of traditional cultures (Bradley et al., 2020; FAO, 2024) [8, 13]. These are better adapted to local conditions and more resistant to climate change (Table 2).

Table 2. Yield, Drought resistance, and Costs of local vs. Imported crops in Nigeria and DR Congo

Culture	Local yield (tons/ha)	Drought resistance	Production cost (\$/ha)	Main use
Cassava	15 (Nigeria)	High	350	Staple foods (fufu, gari)
	14 (DR Congo)	High	300	Staple foods (kwanga, chikwangue)
Imported wheat	3 (Nigeria)	Low	800	Bakery products
	2.5 (DR Congo)	Low	850	Bakery products
Sorghum	10 (Nigeria)	High	400	Animal feed, beer and traditional food
	7 (DR Congo)	High	380	Animal feed and traditional food

Source: Our World in Data, 2023 [26].

In Nigeria, cassava, sorghum and yam are staple crops used for both human and animal food (Figure 1).

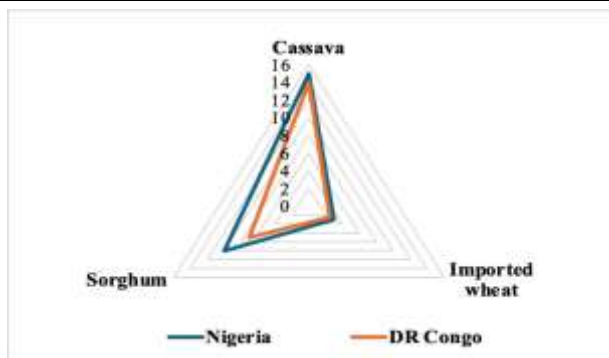


Fig. 1. Local yield (tons/ha)

Source: by authors based on the data from Our World in Data, 2023 [26].

Initiatives such as the "Rice Revolution" have demonstrated the effectiveness of strategies to promote domestic production. During 2017–2021, Nigeria managed to reduce rice imports by 30%, partially replacing them with domestic production (Figure 2).

In DR Congo, cassava plays a crucial role, being widely consumed in traditional forms such as kwanga and chikwangue. Yams and maize are also grown on a small scale in households and agricultural cooperatives (Figure 1). These crops have the potential to replace imported products, thereby reducing costs and dependence on foreign markets. However, high post-harvest losses caused by poor infrastructure limit the efficiency of these crops (Figure 2).

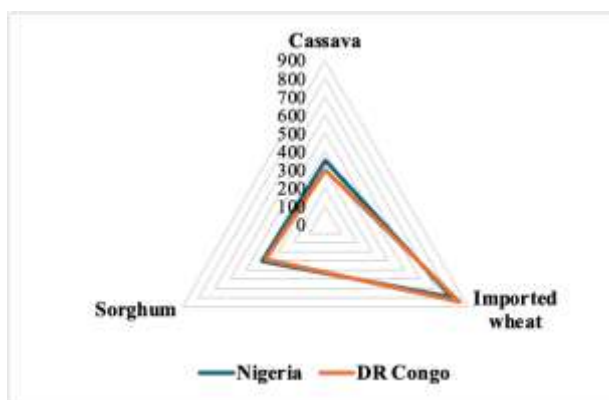


Fig. 2. Production cost for cassava, sorghum, and imported wheat (USD/ha)

Source: by authors based on the data from Our World in Data, 2023 [26].

Supporting small farmers

In both countries, small farmers are the backbone of agriculture. In Nigeria, financial support programs and access to inputs such as

fertilizers and seeds have helped increase productivity. Examples include the subsidized distribution of agricultural inputs through government programs. In addition, creation of agricultural cooperatives and local markets facilitated the sale of surplus production, boosting farmers' incomes.

In DR Congo, small farmers are responsible for about 80% of agricultural production. However, limited access to agricultural technologies and financial resources represent significant obstacles. Glocalization can contribute to the creation of local support networks and promotion of agricultural cooperatives. They can reduce production costs, facilitate access to markets and ensure more efficient distribution of agricultural products.

Development of regional markets

Another element of glocalization is the creation and expansion of regional markets to reduce dependence on global imports. In Nigeria, the promotion of trade between West African states has enabled the development of better integrated local and regional markets. This helped increase exports of products such as sorghum and rice.

In DR Congo, the lack of road infrastructure and organized markets limits regional trade. However, the potential to expand local markets through regional cooperation networks is significant. By developing infrastructure and connecting farmers to larger markets, DR Congo could reduce post-harvest losses and increase farmers' incomes.

Key findings from applying glocalization

The experiences of Nigeria and DR Congo highlight the importance of glocalization as a strategy to reduce vulnerabilities associated with global supply chains and enhance food security. Recent crises have demonstrated that the integration of local solutions adapted to the specific needs of each country can bring significant benefits. Analysis key findings from the application of glocalization principles reveal three essential directions of action: promoting traditional cultures, supporting small farmers and developing regional markets.

Promotion of traditional cultures

One of the most important key findings from

the application of glocalization is the relevance of traditional cultures in strengthening food security. Local plants such as cassava, sorghum and yam in Nigeria and cassava, maize and bananas in DR Congo are adapted to the climate and soils specific to each region. These crops offer significant advantages compared to wheat or other imported crops, which require expensive inputs and are more vulnerable to climate change.

For example, in Nigeria, cassava is widely used in staple food preparations such as gari and fufu, being an essential source of calories for the rural and urban population (Sambo & Sule, 2024) [28]. Similarly, in DR Congo, cassava is processed into products such as kwanga and chikwangue, which are staple foods for rural households. These crops not only reduce dependence on imports, but also contribute to food diversification, increasing communities' resilience to global crises.

In addition, the use of traditional crops has a positive economic impact on local farmers, reducing production costs by using local inputs and limiting the risks associated with global price fluctuations. Promoting traditional crops, along with introduction of modern agricultural practices adapted to them, can become a long-term solution to increase the resilience of agri-food systems.

Supporting small farmers

Another crucial lesson is the need to support small farmers, who are the backbone of agriculture in Nigeria and DR Congo. Despite their critical contribution to food security, smallholder farmers face numerous challenges, including limited access to inputs, modern technologies and markets. Investments in agricultural cooperatives and infrastructure can change this dynamic, increasing production efficiency and farmers' incomes.

In Nigeria, programs such as subsidized distribution of seeds and fertilizers have had a positive impact on agricultural productivity. However, limited access to finance remains a barrier for many small farmers. By creating well-organized agricultural cooperatives, farmers can benefit from shared resources, including storage facilities, agricultural technologies and logistical support. This model not only reduces individual costs, but also

facilitates access to local and regional markets. In DR Congo, where small farmers produce more than 80% of the food consumed locally, support for agricultural cooperatives is extremely important. Through them, farmers can access cheaper agricultural inputs, share transport costs and get better prices for their products. Developing the infrastructure such as rural roads and collection centers is essential to integrate these farmers into local and regional supply chains.

Regional integration

Another essential element of glocalization is regional integration, which can help to reduce the dependence on global markets and create sustainable economic opportunities. Currently, many African states, including Nigeria and DR Congo, depend on imports for a wide range of food products, exposing them to risks associated with global price fluctuations and supply chain disruptions. Developing regional markets can provide a viable alternative, creating a more resilient intra-continental trade network (Folorunso et al., 2024; Omotoso & Omotayo, 2024) [12, 24].

In Nigeria, regional trade within the Economic Community of West African States (ECOWAS) has facilitated the expansion of local markets for agricultural products such as sorghum and rice. This integration has helped increase farmers' incomes and reduce post-harvest losses. Similarly, DR Congo could benefit from expanding regional trade by facilitating agricultural exports to neighboring countries. However, this requires significant investment in transport infrastructure and market organization.

Regional integration also provides opportunities to promote traditional crops on a larger scale, boosting production and increasing farmers' incomes. In addition, cooperation between African states can facilitate the transfer of technology and resources, thereby supporting development of a more resilient and sustainable agri-food system.

By capitalizing on traditional crops, supporting small farmers, and regional integration, glocalization can transform the current vulnerabilities of agri-food systems in Nigeria and DR Congo into sustainable opportunities.

These key findings highlight the importance of a balance between adapting to local needs and using global resources, offering a promising path to strengthen food security in the long term.

Strategies for diversification and resilience of agri-food systems

Transforming agri-food systems to make them more diverse and resilient is a next important priority for both Nigeria and DR Congo, two countries that face common challenges but also offer valuable key findings through their responses to recent global crises. Diversifying agricultural crops, improving infrastructure and adopting sustainable practices are essential elements to strengthen agri-food resilience facing climate change, global market fluctuations and other disruptive factors (Morgan & Fanzo, 2020; Mekonnen et al., 2021) [22, 20].

Diversification of agricultural crops

Diversification is one of the most important pillars of resilience. In Nigeria, crop diversification has begun to be promoted through government programs that encourage farmers to adopt traditional plants adapted to local conditions, such as cassava, sorghum and yam (Bradley et al., 2020; FAO, 2024) [8, 13]. These crops are not only more drought resistant, but also reduce dependence on imported crops such as wheat. For example, the "Rice Revolution" managed to increase domestic rice production by 20% between 2017 and 2021, while reducing imports by over 30%.

In DR Congo, crop diversification is mainly based on use of indigenous plants such as cassava, maize and bananas. However, productivity is limited by lack of access to quality seeds, agricultural inputs and irrigation infrastructure. A promising program is the promotion of vegetable crops in small households, which has improved the diversification of diet and income in certain rural regions. However, these initiatives must be supported by better-structured public policies and substantial funding.

Improving infrastructure and logistics

Agricultural infrastructure plays a key role to reduce post-harvest losses and improve access to markets. In Nigeria, the government has

invested in upgrading silos and creating collection centers for farmers. For example, upgrading storage infrastructure reduced post-harvest losses for cassava by about 10% in the southeastern regions. However, the lack of adequate rural roads remains a major challenge, limiting farmers' access to regional markets.

In DR Congo, the infrastructure deficit is much more severe. Lack of roads and storage centers causes post-harvest losses of up to 30% for crops such as cassava and maize (Table 3).

Table 3. Impact of infrastructure improvements on post-harvest losses in Nigeria and DR Congo

Measure implemented	Losses without infrastructure (%)	Losses with infrastructure (%)
Modern Silos (Nigeria)	25	15
Modernized rural roads	20	10
Collection Centers (DR Congo)	30	20

Source: Our World in Data, 2023 [26].

Investments in rural roads and storage facilities could greatly increase the efficiency of supply chains and farmers' incomes.

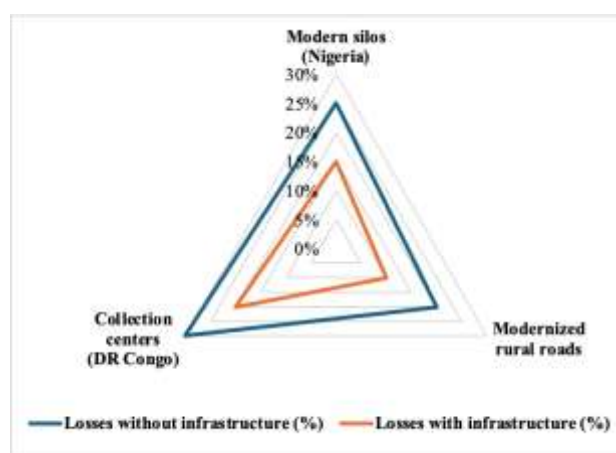


Fig. 3. Comparison of post-harvest losses with and without infrastructure implementation

Source: by authors by authors based on the data from Our World in Data, 2023 [26].

In addition, the development of river transport infrastructure, which is an essential resource in DR Congo, could improve market access for isolated regions (Figure 3).

Adoption of sustainable agricultural practices
Sustainable agricultural practices are fundamental to increase resilience to climate change and protect natural resources. In Nigeria, crop rotation and the use of organic compost have started to be adopted on a large

scale, thanks to the support provided through training programs for farmers. Also, the introduction of cover crops, which reduce soil erosion, has helped improve long-term yields. In DR Congo, organic farming is starting to be promoted in rural areas, where farmers use natural inputs and traditional methods for soil conservation. These practices, although effective in the long term, are still limited by a lack of resources and limited access to modern technologies.

Implementing agricultural education programs that promote regenerative practices could significantly contribute to increasing productivity and reducing dependence on imported chemical fertilizers.

Key findings from the diversification and resilience of agri-food systems

The experiences of Nigeria and DR Congo offer valuable key findings for understanding and applying the principles of glocalization in response to vulnerabilities in agri-food systems. These *key findings* highlights the importance of integrated public policies, infrastructure investments and the promotion of sustainability for the creation of a more resilient and diversified agri-food system.

Integrated public policies

A fundamental pillar of the development of agri-food systems is represented by integrated public policies, which respond to the needs of farmers and support the transition to modern and sustainable agricultural practices. In Nigeria, seed and fertilizer subsidies have supported farmers to increase productivity and diversify crops grown. However, the distribution of subsidies remains uneven, and small farmers' access to these benefits is sometimes limited by complex administrative procedures.

In DR Congo, the lack of a coherent policy framework limits farmers' access to necessary resources, amplifying vulnerabilities. Public policies must include programs that support small farmers by reducing production costs, access to finance and technical training. These measures will not only boost agricultural production, but will also contribute to increasing incomes in rural communities, where agriculture is the main source of livelihood.

Investments in infrastructure

Another important lesson is related to the need for significant investment in agricultural infrastructure. The lack of adequate roads, modern warehouses and efficient transport networks limits farmers' ability to capitalize on their production and contributes to significant post-harvest losses. In Nigeria, infrastructure investments such as modern silos and collection centers have reduced post-harvest losses for cassava and sorghum by up to 10% in some regions. However, these advances are uneven, and an expansion of the infrastructure is also needed in the less accessible areas.

In DR Congo, the impact of the lack of infrastructure is much more severe. Post-harvest losses for cassava and maize can reach up to 30%, due to lack of warehouses and roads to facilitate transport to markets. Infrastructure development, including the use of river transport, represents a unique opportunity for DR Congo, a country characterized by a vast network of navigable rivers. This type of infrastructure could connect isolated regions to larger markets, reducing losses and improving farmers' access to resources.

Promoting sustainability

Adopting sustainable agricultural practices is an essential lesson for reducing the impact of climate change and protecting natural resources. In Nigeria, crop rotation, use of organic compost and planting of cover crops are promoted through educational programs for farmers, with positive results on soil fertility and agricultural yields. However, these practices are mainly adopted by larger farms, with small farmers needing more support to implement them.

In DR Congo, organic farming is often the only viable option for farmers due to limited access to chemical fertilizers and industrial inputs. Traditional methods such as the use of mulch and agroforestry are widely used to conserve soil and reduce moisture loss. However, the effectiveness of these practices can be improved by the introduction of modern technologies adapted to local needs, as well as by access to additional training and resources. These key findings emphasize the importance of local adaptation of agricultural policies, infrastructure and practices, using the

principles of glocalization to address the structural vulnerabilities of agri-food systems in Nigeria and DR Congo. Implementation of these measures requires strong commitment at the national level, as well as international support, to ensure long-term sustainability and resilience.

Policy Recommendations and Strategic Priorities for Agri-Food Resilience

Based on the analysis presented in this study, a set of strategic recommendations emerges as crucial for enhancing the resilience and sustainability of agri-food systems in Nigeria and the Democratic Republic of Congo.

Globalization has played a key role in facilitating technological progress in agriculture, access to international markets, and economic growth (Folorunso et al., 2024; FAO, 2024). In Nigeria, for example, farmers have benefited from imported fertilizers, modern technologies, and foreign investment, which have contributed to increased agricultural productivity (FAO, 2024) [13]. However, these benefits have come at a high cost. Dependence on imports of wheat, maize, and rice has made the country highly vulnerable to global price fluctuations, trade restrictions, and geopolitical crises. In the DR Congo, where infrastructure is poorly developed, globalization has failed to generate significant improvements in food security because local farmers have no access to either global or regional markets (FAO, n.d.a.) [14].

In contrast, glocalization offers a more sustainable solution by capitalizing on local resources and strengthening domestic agricultural production. Promoting traditional crops such as cassava, sorghum, and yams is a viable strategy for reducing import dependence and improving food security at the community level. These crops, already adapted to the local climate, require fewer imported inputs and provide a more stable food supply. In addition, supporting local agricultural cooperatives and creating regional markets can reduce post-harvest losses and increase economic stability. An important lesson from this analysis is that glocalization does not imply a rejection of globalization, but rather the selective integration of global elements that support local development while avoiding the

vulnerabilities associated with excessive dependence on international markets. For example, Nigeria can adopt modern agricultural technologies, but at the same time it must prioritize domestic food production so that it is not solely dependent on imports. Similarly, the DR Congo needs to invest in infrastructure – roads, warehouses, distribution centers – to reduce post-harvest losses and improve access to local and regional markets. From an agricultural policy perspective, governments should adopt proactive strategies to support farmer resilience and reduce supply chain vulnerabilities. Key measures can include:

Expanding financing programs and microcredit for small farmers, so that they can invest in production, agricultural equipment, and irrigation. In Nigeria, programmes such as the Anchor Borrowers' Programme have demonstrated that access to finance can increase agricultural productivity (Central Bank of Nigeria, 2024) [10].

Supporting local agricultural cooperatives and regional markets, to facilitate access to more stable commercial opportunities for small farmers.

Investments in agricultural and logistics infrastructure, such as upgrading rural roads, building storage depots and developing agricultural production collection centres.

Promoting sustainable and climate-adapted agriculture, through innovative technologies and training for farmers.

Stimulating intra-regional trade, through integration into the African Continental Free Trade Area (AfCFTA) (African Union, n.d.) [2].

International organizations and NGOs can play a crucial role in implementing these measures. FAO, the World Bank and regional development agencies should support local initiatives through infrastructure projects, farmer financing and knowledge transfer programs.

For a better understanding of the long-term impact of glocalization strategies, further research on the effects of these policies on food security is needed, particularly comparative studies of various government interventions and regional initiatives, providing valuable

insights into the most effective solutions for integrating global and local markets.

CONCLUSIONS

The comparative analysis of Nigeria and the DR Congo reveals the scale of the challenges facing agri-food systems in fragile economies in the context of global crises. The COVID-19 pandemic and the conflict between Russia and Ukraine have demonstrated how external shocks can have a severe impact on food supply chains, especially in countries with high import dependence, weak infrastructure and limited institutional capacity. In this context, the choice between globalization and glocalization becomes not a dichotomy but an opportunity for strategic integration.

The study showed that while globalization brings undeniable benefits, such as technological innovation, access to international markets and economic growth, it also creates critical vulnerabilities when local systems are not resilient. Glocalization, on the other hand, offers a more adaptive framework by encouraging the use of traditional crops, strengthening local production systems and promoting regional trade alliances. These elements are not mutually exclusive but must be combined in a way that supports long-term sustainability.

For Nigeria and the DR Congo, the way forward must include a mix of targeted infrastructure investments, support for smallholder farmers, crop diversification, and the creation of robust intra-regional trade networks. Improving food security in both countries requires not only technical solutions, but also inclusive public policies that empower rural communities and reduce structural inequalities.

Moreover, the comparative perspective adopted in this research offers valuable lessons for other African countries with similar socioeconomic and agroecological conditions. The findings emphasize that resilience must be rooted locally, even as countries engage in the global food economy. This means prioritizing policies that adapt international best practices to specific realities on the ground, while

drawing on indigenous knowledge and resources.

The future of food security in Nigeria, the DR Congo, and beyond, therefore, depends on finding the right balance between global integration and local empowerment. Glocalization does not emerge as an alternative to globalization, but as a complement to it - a strategy that turns vulnerabilities into strengths and builds food systems that are not only efficient, but also equitable, inclusive, and prepared for future disruptions.

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