

Short review on current status of cassava processing in Africa: Innovations and challenges in the Republic of Guinea

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Abstract

Cassava transformation in Guinea has recently experienced notable progress but continues to face structural challenges. Key achievements include the diversification of derived products such as chips, biscuits, enriched flours, and packaged attiéké, alongside the emergence of agro-industrial initiatives and the integration of traditional know-how into modernized processes. These innovations have contributed to reducing post-harvest losses, improving food security, and creating new economic and social opportunities.

Nevertheless, persistent limitations hinder the sector's competitiveness: limited valorization of by-products, inadequate storage and transport infrastructure, lack of harmonized quality standards and certification aligned with regional benchmarks, and insufficient inclusion of women and rural cooperatives in entrepreneurial dynamics.

Looking forward, the adoption of energy-efficient processes, ecological packaging, and locally adapted solutions is essential to reduce environmental impact while strengthening regional competitiveness. Establishing harmonized standards within ECOWAS and the African Union, coupled with credible certification mechanisms, would facilitate access to regional and international markets. Investment in semi-industrial units, inclusive training programs, and tailored financing mechanisms could further structure the cassava value chain and generate local employment. Additionally, valorizing by-products into compost, animal feed, or bioenergy would enhance sustainability and territorial anchorage.

Thus, cassava transformation in Guinea, if driven by an integrated strategy combining technological innovation, standardization, social inclusion, and environmental sustainability, can become a major lever for food sovereignty, regional competitiveness, and socio-economic development.

Keywords: Cassava transformation; Product diversification; Agro-industry; Environmental sustainability; Social inclusion; Regional competitiveness.

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1. Introduction

Cassava (*Manihot esculenta* Crantz), a starchy root crop native to South America [1], has emerged as one of the world's leading starch crops [2]. Its ability to be integrated into mixed-cropping systems, to withstand drought, and to thrive in poor soils [3] makes it a strategic resource for tropical regions.

According to the FAO, Africa produces approximately 205 million metric tons of fresh cassava per year, accounting for more than 65% of global production. Based on an estimated global population of 8.28 billion in 2026 [4], this amounts to nearly 25 kg of fresh cassava per person per year. In Guinea, production has remained relatively stable over the past two decades: approximately 3.1 million metric tons in 2004 compared to 3.5 million metric tons in 2024 [4]. Although modest compared to African giants such as Nigeria (~62 Mt in 2024) and Ghana (~28 Mt in 2024), this production confirms cassava's role as an essential food crop for the country.

In West Africa, cassava is processed into a variety of products for human and animal consumption. Among the most common cassava products are gari, attiéké, cassava chips, starch, tapioca, fufu, and coarse flour [5,6,7,8]. In Guinea, surveys conducted in the Nimba Mountains Biosphere Reserve reveal that Managuele (cassava tapioca) is the most widely consumed product (45%), followed by Thoo (30%), Attiéké (15%, mainly for children), and Couti (10%) [5].

Beyond its role as a food source, cassava is a strategic crop that links food security, agri-food processing, and rural industrialization. It serves both as a subsistence crop and as a raw material for modern products, offering considerable potential for West Africa and Guinea.

This article aims to provide an overview of the current state of cassava processing in Africa, highlight technological and organizational innovations, and analyze the specific challenges faced in Guinea. The objective is to provide guidance for strengthening the sustainability and value added of the cassava sector, in support of research and public policy.

2. General Background

Cassava is experiencing rapid growth worldwide, and its production is expected to increase due to rising demand, both as a food crop and as an industrial cash crop, particularly for starch production [9,10]. This potential has led some researchers to describe cassava as the “food crop of the 21st century” [11]. Between 2019 and 2023, global cassava production grew steadily by about 9% [10]. Africa has remained the leading producer of cassava, followed by Asia and South America [10], the continent of origin for this crop [12]. Today, cassava production in Africa stands at approximately 223 million metric tons per year (representing nearly 70% of the global total), concentrated mainly in West and Central Africa. Its uses are still dominated by human consumption in the form of traditional products such as gari, attiéké, fufu, and tapioca, but industrial processing (starch, flour, bioethanol) is gaining momentum. According to the work of Dankwa *et al.* [10], although Africa accounts for approximately 63% of global cassava production close to the 70% figure mentioned earlier it uses 80% of the total cultivated area for this purpose. In contrast, Asia demonstrates greater efficiency, accounting for approximately 30% of global production while using only 13% of the cultivated area [10]. Africa's dominance in global cassava production appears to stem primarily from its vast harvested area rather than from higher yields, which is not a very sustainable path for the future. Collectively, the three other major cassava-producing regions Asia, South America, and Oceania account for only about 19% of the global harvested area.

Cassava is the staple food for more than 800 million people in tropical regions, including 500 million in Africa, and its production is steadily increasing at a faster rate than that of cereals [13,14]. It represents a significant source of income for stakeholders in this sector and provides producers with revenues far exceeding those from rice and corn [15]. Because cassava deteriorates rapidly after harvest resulting in abnormal discoloration of the vascular tissue within a few days the roots quickly become unfit for consumption and further processing. Guinean farmers therefore prefer to leave cassava roots in the ground until they are processed into dried products. Another technique involves burying the roots in pits or trenches after harvest. Freshly harvested roots can also be stored for a short period by stacking them and watering them daily. In Upper Guinea, where dried cassava is widely consumed in the form of “too,” there are very practical preservation methods. Fresh cassava is peeled and soaked in water for one day if it is sweet cassava, or for three days if it is bitter cassava. It is then washed and sun-dried for several days. Thanks to this soaking in water, cassava can be stored for nearly a year without spoiling. In Maritime Guinea and other areas, freshly harvested cassava is peeled and washed before being sun-dried either as is or after soaking in hot water. According to the research by Lamah *et al.* [5], cassava is considered the most widely consumed food, although rice is regarded as the staple food of the communities living near the UNESCO World Heritage site. However, it is consumed in various forms: Managuele, also known as beauguelely or cassava tapioca, is the most widely consumed in the area (45%) because it is energy-dense

and economical; Thoo (30%) serves as a supplementary food; followed by Attiéké (15%), which is consumed primarily by children; and Couti (10%). Despite cassava's significant contribution to human nutrition and household income, it is important to note that the lack of cassava processing facilities, the absence of specialized groups involved in the cassava value chain, and the isolation of production areas are problems faced by producers [5]. Nigeria, the world's leading producer with a diversified industrial sector (gari, flour, starch, biofuels), is followed by Côte d'Ivoire, which specializes in the production of attiéké now a flagship product exported throughout the subregion. However, the DRC, with chikwangu and bobolo, stands out for its massive consumption in Central Africa.

Cassava in Guinea is at once a staple food, an economic resource, and a cultural element. Its widespread consumption and diverse culinary uses attest to its vital role in Guinean society. However, for Guinea to rank among Africa's major producers, it is necessary to strengthen processing facilities and specialized cooperatives; improve transportation infrastructure to open up production areas; and promote value-added products (flour, starch, tapioca) for regional export. In this way, cassava can become not only a pillar of national food security but also a driver of economic and cultural development for Guinea.

3. Traditional cassava processing methods

Traditional cassava processing methods play a central role in the diet and rural economy of Africa, particularly in Guinea. These artisanal methods, passed down from generation to generation, are used to produce a variety of cassava products such as gari, attiéké, tapioca, cassava flour, and dried cassava chips. Each product requires specific skills, often adapted to local conditions and the dietary preferences of communities [16,17]. Gari, for example, is produced by grating, fermenting, and roasting cassava, while attiéké involves a longer fermentation period and steaming, which give it a texture similar to couscous. These processes, though rudimentary, ensure the value-added use of cassava and the diversification of diets.

In Guinea, traditional cassava processing practices are widespread in rural areas, where women play a central role in the production of dried cassava chips, cassava flour, and gari. These products are essential for food security and serve as a source of income for households. However, the processes remain physically demanding and pose hygiene challenges, which limit the quality and competitiveness of the products in urban markets [18].

In other African countries, the diversity of cassava-based products illustrates the importance of this traditional knowledge. In the Congo, various processing methods yield a range of finished products such as chikwangu, fofou, and cooked cassava roots, which take on different forms depending on the techniques used [19]. In Benin, a survey of traditional food technologies revealed the existence of about twenty cassava-based foods, with gari as the predominant product [20]. More recently, studies have shown that gari remains one of the most widely consumed products in Nigeria, with standardization efforts aimed at improving its quality and reducing health risks [21]. In Côte d'Ivoire, attiéké has been the subject of in-depth studies on its sensory and physicochemical properties, with the aim of adapting cassava varieties to consumer expectations and urban markets [22]. In Cameroon, recent research has highlighted endogenous innovations in the production of fermented cassava sticks and flour, while also pointing out challenges related to hygiene and preservation [23].

Another key aspect is the role of women and rural communities in these processes. In Guinea, as in many African countries, it is primarily women who carry out cassava processing, from harvest to the marketing of cassava-based products. They possess valuable empirical know-how and play a key role in household food security [24]. Artisanal cassava processing is also an important source of income for rural families, strengthening women's economic autonomy and their position within community dynamics [25]. This social and economic role gives traditional processes a dimension that goes beyond mere technique: they are at the heart of cultural practices and the resilience of rural communities [26].

Recent studies show that in isolated areas such as Lélouma, the processing of cassava into attiéké has become a symbol of local resilience and financial independence, despite the lack of modern tools [27]. Similarly, in Fotoba, an agri-food training program launched in 2025 by the National Office for Vocational Training and Development (ONFPP) enabled women to strengthen their cassava processing skills, reducing post-harvest losses and opening up new economic opportunities [28]. In the N'Zérékoré region, cassava vendors attest to the importance of this tuber in the local diet and trade, while highlighting the difficulties associated with price fluctuations and competition, which illustrate the economic fragility of these activities [29].

These recent findings confirm that artisanal cassava processing in Guinea remains an activity of high social and economic value, driven by women, but one that requires technical and institutional support to improve product quality, reduce losses, and enhance competitiveness in the markets [30].

This research shows that, despite the continued use of traditional methods, a wave of innovation is underway in several African countries that produce and consume cassava. It aims to improve product quality, enhance food safety, and meet the expectations of local and international markets, while promoting community know-how and the central role of women in the sector.

4. Technological and Organizational Innovations

In Guinea, the introduction of new machinery and equipment designed for cassava processing represents a major step forward in modernizing the sector. The prototypes of multifunctional grinders and hydraulic presses presented at the Guinean Student Forum in 2023 demonstrated the value of tools adapted to local conditions, capable of reducing the physical strain of the work and increasing the efficiency of the processes [31]. In Kindia Prefecture, the Guinea Commercial Agriculture Development Project (PDACG), funded by the World Bank and implemented by the Ministry of Agriculture and Livestock, illustrates the emergence of infrastructure investments in the agri-food sector. This project, which focuses in particular on the fonio, fruit and cassava value chains, provides for the establishment of processing facilities and regional quality control laboratories in Kindia, with a view to enhancing the competitiveness and added value of local agricultural products [32, 33]. Furthermore, the import of Chinese machinery by Henan Jinrui between 2023 and 2024 including motorised stainless-steel graters, mechanical peelers and hydraulic dehydrators helped to improve product hygiene standards and increase yield, notably by reducing the residual moisture content of the pulp to around 38 per cent [34]. These technological innovations are accompanied by significant organizational changes, such as the formation of women's groups, the implementation of technical training by the ONFPP, and the strengthening of public-private partnerships, which promote the widespread adoption of equipment and improve the competitiveness of cassava-based products [28].

In the field of preservation and value-adding in Guinea, progress is reflected in the introduction of new packaging methods and greater diversification of value-added products. Improvements in packaging techniques, particularly through the use of airtight plastic bags and biodegradable films, help to extend the shelf life of dried cassava chips and cassava flour, whilst minimising the risk of microbiological contamination [35, 36, 37]. In 2024, local initiatives supported by the National Office for Vocational Training and Development (ONFPP) enabled women's groups to be trained in the use of improved dryers and hygienic packaging, thereby enhancing the food safety standards and competitiveness of their products in urban markets [38]. The added value of cassava has also led to the diversification of cassava-based products attiéké packaged in trays, cassava crisps, biscuits and fortified flours meeting growing demand from urban consumers and supermarkets [27, 38].

Finally, entrepreneurial and cooperative initiatives are experiencing remarkable growth. In the Kindia and N'Zérékoré regions, rural cooperatives have been set up to share the use of processing equipment notably motorised graters and hydraulic presses thereby reducing costs and improving product quality. These cooperative initiatives also facilitate access to finance and training, drawing on institutional support programmes that assist women's groups in adopting modern hygiene and packaging practices. At the same time, young Guinean entrepreneurs have set up micro-enterprises specialising in the production of cassava crisps and fortified flours, aimed at urban markets and supermarkets, thereby contributing to product diversification and the creation of local jobs. These initiatives reflect a growing entrepreneurial dynamic, where cooperation and innovation combine to strengthen the economic and social resilience of rural communities.

5. Challenges and Constraints

In Guinea, the cassava sector continues to face a series of multifaceted challenges that hinder its competitiveness and sustainability. From a technical standpoint, the issue of product quality remains central: cassava-based products such as attiéké, gari, and cassava flour exhibit significant variations in texture, hygiene, and nutritional value due to non-standardized artisanal production processes. The lack of national and regional standards limits Guinean products' access to urban and international markets and underscores the need for an appropriate regulatory framework [27]. Processing and storage infrastructure also appears inadequate: in several rural areas, production facilities lack modern dryers, motorized presses, and appropriate storage systems, leading to significant post-harvest losses. In Baranama, in the Kankan region, local agricultural federations face major structural constraints, such as the absence of protective fencing, a lack of boreholes for access to water, and limited technical support, which undermine the sustainability of

their initiatives. Added to these barriers are organisational and financial constraints: cooperatives and women's groups, despite being at the heart of the cassava processing sector, have very limited access to seasonal loans and modern equipment. Analyses of pilot projects, such as the initiatives run by the Société Coopérative Ouvrière de Développement Agroalimentaire et Artisanale (SCODAA GIE) in partnership with TIAST Guinea, thus demonstrate that without a secure supply of raw materials and basic infrastructure, industrial processing units cannot operate profitably and efficiently [39].

Economic challenges exacerbate these vulnerabilities. Access to finance remains one of the main obstacles: producers and cooperatives, particularly women's groups, face significant difficulties in obtaining suitable seasonal loans, which hinders the acquisition of modern equipment and the establishment of semi-industrial units. Local financial institutions generally remain reluctant to invest in agricultural sectors, which are perceived as high-risk and low-return, despite their strategic role in food security and job creation. Furthermore, the competitiveness of processed products is undermined by high production costs and a lack of standardisation; Guinean processors therefore struggle to compete with the sectors in Côte d'Ivoire or Ghana, where industrial processes are better structured and certification standards are more strictly enforced. Added to this is limited distribution, attributable to inadequate transport and storage infrastructure, which complicates the delivery of goods to urban centres. Finally, institutional support reports highlight that the lack of marketing strategies and attractive packaging significantly restricts local products' access to modern supermarkets and export markets. Inadequate transportation and storage infrastructure complicate delivery to urban centers, while the lack of marketing strategies and attractive packaging limits access to supermarkets and export markets [38]. Private initiatives, such as the industrial facility inaugurated in Samaya in 2024, show, however, that there is potential for economic development, provided that public-private partnerships are strengthened and the institutional environment is improved.

Social challenges are another obstacle to the modernization of the sector. Training for stakeholders appears essential: while the majority of women producers and processors possess empirical know-how passed down from generation to generation, they lack the formal technical skills needed to meet the quality and hygiene standards of modern markets. Training programs implemented by the ONFPP in 2024 have helped build the capacity of several women's groups, particularly in the use of improved dryers and hygienic packaging techniques [38]. However, these initiatives remain limited and need to be expanded nationwide. Producer organization also remains inadequate: while some rural cooperatives have been structured to pool equipment and reduce costs, many groups remain poorly organized and struggle to access financing and urban markets. Finally, although women play a central role in cassava processing, their position remains vulnerable due to social and economic constraints. They carry out the majority of harvesting, processing, and marketing activities, but their access to modern equipment, financing, and training remains limited. Several recent studies highlight that, despite their essential contribution to food security and household economic autonomy, rural women continue to face institutional marginalization and limited recognition of their strategic role.

Finally, environmental challenges affect the sector's sustainability. Reliance on artisanal processes which are often energy-intensive and poorly optimized leads to excessive consumption of firewood and contributes to local deforestation [36, 37]. Managing waste from processing is another major challenge: pulp residues and press water, often discharged without treatment, can cause soil and water pollution, affecting biodiversity and the health of rural communities. Although some local initiatives have experimented with using byproducts as animal feed or compost, these practices remain limited and require technical support to be widely adopted. The overall ecological impact is exacerbated by the lack of adequate infrastructure for storage and transport: post-harvest losses, linked to inadequate storage conditions, contribute to significant food waste and increased pressure on natural resources. Pilot projects led by NGOs and research institutes, aimed at introducing solar dryers and biodegradable packaging, show that it is possible to reduce the environmental footprint while improving the sanitary quality of the products [38].

6. Outlook and Recommendations

6.1. Opportunities for Guinea: product diversification, exports, agribusiness

The cassava sector in Guinea, deeply rooted in traditional practices and driven by rural women, holds considerable potential for diversification, industrialization, and expansion into regional and international markets. Technological and organizational innovations introduced in recent years are opening up promising prospects, despite the technical, economic, social, and environmental constraints that continue to hinder its competitiveness. The following priorities are essential for transforming these challenges into drivers of development.

6.1.1. Product Diversification

Traditional know-how (gari, attiéké, flour, dried flakes) provides a solid foundation for developing value-added products. Experience from other African countries demonstrates the feasibility of expanding the product range to include chips, cookies, enriched flours, and fermented sticks [16,17,23,27].

The introduction of hydraulic presses, motorized graters, and improved dryers [31] now makes it possible to produce a wider range of cassava-based products. Strong urban and regional demand for these products paves the way for further diversification, helping to reduce post-harvest losses and improve food security.

6.1.2. Standardization and Regional Integration

The implementation of quality standards and hygiene protocols is essential to enhancing the competitiveness of Guinean products. Efforts to standardize gari in Nigeria [21] and attiéké in Côte d'Ivoire [22] demonstrate that alignment with sensory and physicochemical standards paves the way for exports.

Guinea could develop a national and regional regulatory framework, in partnership with the ONFPP and the IRAG, to facilitate access to subregional and international markets.

6.1.3. Development of the Agribusiness Sector

The introduction of modern equipment is a first step toward semi-industrialization. To build on this momentum, it is recommended to support the creation of integrated agro-industrial facilities capable of processing cassava on a large scale while utilizing byproducts (animal feed, compost, bioenergy).

The emergence of industrial facilities, such as the one inaugurated in Samaya in 2024 by the TOPAZ Group, illustrates the potential of the agro-industry. These initiatives, backed by women's cooperatives and public-private partnerships, would contribute to the development of the sector and the creation of local jobs.

6.1.4. Empowering Women and Rural Communities

Women, as key drivers of this transformation, must be granted greater access to financing, training, and modern equipment [25, 28]. Their strategic role in food security and household economic autonomy warrants targeted support policies, including the establishment of groups and institutional recognition of their contribution.

6.1.5. Environmental Opportunities and Sustainability

The challenges associated with wood consumption and waste management can be turned into opportunities through the adoption of energy-efficient technologies (solar dryers, biodegradable packaging) and the recovery of processing residues [38]. These innovations would help reduce the sector's ecological footprint and position Guinea as a responsible player in sustainable development.

6.1.6. Exports and Regional Competitiveness

Efforts to modernize and standardize processes—particularly through technical training provided by the ONFPP [28, 38], are enhancing the food safety standards of these products. By drawing on the experiences of neighboring countries such as Côte d'Ivoire for attiéké or Nigeria for gari Guinea can develop national and regional standards that would facilitate access to subregional and international markets. The export of cassava-based products would thus represent a strategic opportunity to increase revenues and position Guinea as a competitive player in West Africa.

6.1.7. Entrepreneurial and Cooperative Dynamics

Initiatives led by rural cooperatives and young entrepreneurs demonstrate a growing momentum of cooperation and innovation across the country. By providing long-term support to these stakeholders through tailored financing mechanisms and continuing professional development programmes, Guinea has a key lever for strengthening the economic and social resilience of rural communities, whilst fostering the emergence of a robust and competitive entrepreneurial ecosystem in the agri-food sector.

6.2. Research and Development Needs for Guinea.

Cassava processing in Guinea, which relies heavily on artisanal methods and the expertise of rural women, requires sustained research and development efforts to improve product quality, reduce post-harvest losses, and enhance the sector's competitiveness. The technological and organizational advances introduced in recent years open up new

opportunities, but they also highlight areas that need to be strengthened and made sustainable. The following priority areas have emerged.

6.2.1. Improvements to Traditional Processes

Traditional methods for producing gari, attiéké, flour, and dried flakes [16,17] should be studied and optimized to reduce physical strain and improve hygiene. Research should focus on standardizing the fermentation, drying, and packaging stages to ensure consistent quality that meets health standards [18].

6.2.2. Development of Adapted Technologies

It is necessary to design and distribute simple, durable, and accessible equipment, such as motorized graters, hydraulic presses, and solar dryers. These innovations must be designed to reduce women's workload, improve productivity, and remain economically accessible [27, 28].

6.2.3. Development of the Agribusiness Sector

Processing and preservation infrastructure remains inadequate [40], but industrial initiatives such as Samaya's demonstrate potential that needs to be built upon [41]. Research must explore models for semi-industrial and industrial units adapted to local conditions, incorporating energy-efficient technologies and processes for valorizing byproducts like compost, animal feed, and bioenergy [42]. Organizational and financial studies are also needed to identify best practices for structuring cooperatives and public-private partnerships.

6.2.4. Diversification and Value Addition of Byproducts

Research should explore new avenues for value addition inspired by regional experiences: fermented sticks in Cameroon [23], standardized attiéké in Côte d'Ivoire [22], and enriched gari in Nigeria [21]. In Guinea, diversification could include potato chips, cookies, enriched flours, and products packaged in trays, meeting the expectations of urban markets and supermarkets.

Applied research should focus on nutritional fortification (proteins, micronutrients), the study of consumer preferences, and the sensory and nutritional standardization of products [27].

6.2.5. Socioeconomic and Organizational Studies

The development of cooperatives and the growth of microenterprises call for research into the most effective organizational models for pooling equipment, facilitating access to financing, and strengthening local governance. Particular attention must be paid to the role of women, who are key drivers of this transformation, in order to develop inclusive and equitable strategies [24,25,26].

6.2.6. Sustainability and Environmental Impact

Applied research should focus on managing processing waste (press water, pulp residues) and reducing the ecological footprint of artisanal processes. The introduction of solar dryers, biodegradable packaging, and residue recovery processes represents a promising path toward a sustainable industry [35, 36, 37].

6.2.7. Optimization of processing methods

Prototypes of multifunctional shredders and hydraulic presses [31], as well as equipment imported from China, have improved productivity and sanitation standards. However, further research is needed to adapt these technologies to rural conditions: reducing costs, simplifying maintenance, and improving energy efficiency.

6.2.8. Development of Local and Sustainable Solutions

Research should focus on designing local, robust, and accessible machines in order to reduce dependence on imports and promote community ownership. The integration of solar dryers and environmentally friendly processes is a promising avenue for a sustainable industry.

6.2.9. Innovation in Preservation and Packaging

The progress made in packaging (airtight bags, biodegradable films) [35, 36] must be further advanced through research on local, recyclable materials that are suited to Guinea's climatic conditions. The goal is to extend shelf life, reduce post-harvest losses, and ensure food safety.

6.2.10. Byproduct Utilization and Waste Management

Research should explore ways to transform pulp residues and press water into value-added products (compost, animal feed, bioenergy). This approach would help reduce the environmental impact and create new economic opportunities for rural communities.

6.2.11. Exports and Regional Competitiveness

The lack of standards constitutes a major barrier to exports. Research must contribute to the development of quality and food safety protocols that are aligned with regional and international standards. Market research is also needed to identify consumer preferences in the subregion and adapt Guinean products accordingly [38].

6.2.12. Social inclusion and capacity building

Research must document and promote the role of women in the sector, proposing inclusive strategies to improve their access to financing, modern equipment, and training. Socio-economic studies will enable the design of programs adapted to the realities of rural communities and strengthen their resilience to market fluctuations.

6.3. Public policies and support strategies needed for Guinea.

Cassava processing in Guinea, deeply rooted in traditional practices and driven by rural women, requires a strengthened political and institutional framework to modernize the sector, improve product quality, and increase its competitiveness. The technological and organizational innovations introduced in recent years represent significant progress, but their sustainability and widespread adoption require robust and inclusive public policies. The following areas appear to be priorities.

6.3.1. Standardization and regulation of the sector

The establishment of national quality and hygiene standards is essential to guarantee the competitiveness of cassava-derived products. Inspired by regional experiences (Nigeria for gari, Côte d'Ivoire for attiéké), a standardization policy would ensure sanitary compliance and facilitate access to urban, regional, and international markets [22, 31].

6.3.2. Support for modern infrastructure and equipment

Traditional methods, while valuing local expertise, remain characterized by significant labor and hygiene constraints. Public authorities should promote access to modern equipment (motorized graters, hydraulic presses, solar dryers) and storage and transport infrastructure. Subsidy mechanisms, agricultural loans, and public-private partnerships would help reduce post-harvest losses and improve competitiveness [18].

6.3.3. Product diversification and enhancement

Public policies should encourage the diversification of derived products (crisps, biscuits, enriched flours, attiéké packaged in trays), by supporting applied research and agri-food innovation. The valorization of by-products (compost, animal feed, bioenergy) must also be integrated into national strategies to reduce losses and strengthen sustainability [23,27].

6.3.4. Capacity building and inclusive training

The central role of women in cassava processing justifies targeted training programs, such as those initiated by the ONFPP [28, 38]. Public policies should expand these initiatives on a national scale, by integrating modules on hygiene, conservation, cooperative management and the valorization of by-products. An inclusive public policy would strengthen the economic autonomy of women and their contribution to food security.

6.3.5. Support for cooperatives and financial inclusion

The structuring of producers and women's groups must be encouraged through appropriate financing mechanisms. The creation of guarantee funds and specific microcredit schemes would facilitate access to financing and strengthen the entrepreneurial dynamics of rural cooperatives and micro-enterprises.

6.3.6. Development of the agri-food industry

Guinea could draw inspiration from the experiences of Benin and Cameroon to diversify its derived products and develop integrated agro-industrial units. Public and private investments should be encouraged to create semi-industrial

and industrial units, like the Samaya factory inaugurated in 2024. These units would make it possible to process cassava on a large scale, add value to by-products and create local jobs.

6.3.7. Export and regional competitiveness

The lack of standards constitutes a major barrier to exports. Public policies must contribute to the development of quality and food safety protocols aligned with regional standards (ECOWAS). The creation of a certification body dedicated to cassava-derived products would strengthen confidence in foreign markets. Attractive marketing and packaging strategies would allow Guinean cassava to be positioned in urban and international markets [38].

6.3.8. Integration of environmental sustainability

Waste management and reduction of the ecological footprint must be integrated into national strategies. The promotion of solar dryers, biodegradable packaging and energy-efficient processes would help place the cassava sector in a logic of sustainability and resilience in the face of environmental challenges [35, 37].

6.4. Importance of regional integration and international partnerships

Cassava processing in Guinea, still largely dominated by artisanal methods, would benefit from being integrated into a dynamic of regional integration and international cooperation. This approach would not only enhance local expertise but also strengthen the sector's competitiveness at the African and global levels. The ongoing modernization introduction of new machinery, structuring of women's groups, and emergence of entrepreneurial initiatives cannot reach its full potential without opening up to regional integration and international partnerships.

6.4.1. Harmonisation of standards and access to regional markets

The lack of quality and hygiene standards is a major limitation to the competitiveness of Guinean products [18]. Regional integration, through ECOWAS or the African Union, would offer an opportunity to harmonize processing and packaging standards, similar to the standardization efforts for gari in Nigeria [21] or the studies on attiéké in Côte d'Ivoire [22]. Such harmonization would facilitate exports and access to regional and international markets.

6.4.2. Product diversification through regional trade

Successful experiences in neighboring countries, such as Côte d'Ivoire with attiéké and Nigeria with gari, offer models from which Guinea can draw inspiration. Regional integration would allow for the sharing of expertise, the adaptation of technological innovations, and the development of new derivative products (chips, biscuits, fortified flours) that meet the demands of urban and regional markets.

6.4.3. Sharing of experiences and transfer of technologies

Endogenous innovations observed in Cameroon [23], Benin [20], and Congo [19] demonstrate the richness of African practices. Guinea could benefit from technical and scientific partnerships to adapt these innovations to its local realities, particularly in the areas of controlled fermentation, preservation, and diversification of by-products. International partnerships would also facilitate the transfer of appropriate technologies and strengthen the competitiveness of Guinean products in global markets.

6.4.4. Cooperation for capacity building

The central role of women in cassava processing [24,25] justifies regional training and support programs. Local initiatives, such as those led by the ONFPP [28, 38], would benefit from being expanded through partnerships with African research institutes and international NGOs, in order to strengthen the technical and entrepreneurial skills of women producers and disseminate best practices.

6.4.5. Development of the agri-food industry and integration into global value chains

The Samaya industrial unit, financed by TOPAZ, illustrates the potential of agribusiness in Guinea. International partnerships could support the creation of other semi-industrial and industrial units, backed by cooperatives and young entrepreneurs, in order to integrate Guinea into global cassava value chains. These initiatives would contribute to structuring the sector, creating jobs, and adding value to by-products (compost, animal feed, bioenergy).

6.4.6. Promotion of sustainability and green innovations

The environmental challenges associated with artisanal processing (wood consumption, waste management) require concerted solutions. International partnerships can facilitate the introduction of energy-efficient technologies (solar dryers, biodegradable packaging) and practices for valorizing residues. These innovations would reduce the ecological footprint and position Guinea as a responsible actor in the cassava value chain.

The cassava value chain in Guinea is at a strategic turning point where technological innovation, social inclusion, and environmental sustainability must converge. Table summarizes the main areas of action, their expected impacts, and key partnerships, offering an integrated vision to strengthen competitiveness, diversify products, and ensure the sustainable transformation of the value chain.

Table 1 Main areas of action

Strategic focus	Recommended action	Expected impact	Potential partners
Product diversification and enhancement	Develop new derivatives (chips, biscuits, fortified flours, packaged attiéké); finance applied research and agri-food innovation; share regional know-how (attiéké in Ivory Coast, gari in Nigeria).	Reduced post-harvest losses, diversified income, increased competitiveness, and responsiveness to urban and regional expectations.	IRAG, ONFPP, universities, agri-food entrepreneurs, supermarkets, ECOWAS.
Export and regional competitiveness	Harmonize quality and hygiene standards; create a national certification body; develop food safety protocols; support attractive marketing and packaging; align processes with neighboring countries.	Easier access to regional and international markets; increased credibility of Guinean products; diversification of revenues.	ECOWAS, African Union, Codex, ISO, ONFPP, Ministries of Trade, regional partners (Côte d'Ivoire, Nigeria, Ghana).
Agribusiness and infrastructure	Create integrated semi-industrial and industrial units; develop storage and transport centers; valorize by-products (compost, animal feed, bioenergy).	Structuring the sector, large-scale processing, creation of local jobs, integration into modern value chains.	Public-private partnerships, TOPAZ, TIAST, women's cooperatives, international donors (FAO, BAD).
Innovation in preservation and packaging	Develop local, recyclable and climate-friendly packaging; promote energy-efficient technologies (solar dryers, biodegradable packaging).	Extended shelf life, reduced losses, food safety, responsible positioning.	ONFPP, packaging entrepreneurs, environmental NGOs, climate projects (UNDP, GEF).
Environmental sustainability and ecological impact	Promote solar dryers, biodegradable packaging and waste recovery; introduce energy-saving processes.	Reducing the ecological footprint, better management of natural resources, a sustainable and resilient sector.	IRAG, ONFPP, environmental NGOs, Ministry of the Environment, international cooperation projects.
Capacity building and social inclusion	Expand technical and entrepreneurial training; target women's groups; document and promote the role of women; develop inclusive strategies.	Improved skills, economic empowerment of households, enhanced social inclusion.	ONFPP, local and international NGOs, training institutes, microfinance institutions, social ministries.
Support for cooperatives and financial inclusion	Create guarantee funds and microcredit mechanisms tailored to cooperatives and rural women; support young entrepreneurs	Easier access to financing, structuring of producers, consolidation of	Local cooperatives, microfinance institutions, Ministry of

	through financing and ongoing training.	entrepreneurial momentum.	Finance, development NGOs.
Standardization and regulation	Develop national quality and hygiene standards aligned with regional standards; harmonize standards within ECOWAS and the African Union.	Health compliance, increased competitiveness, export facilitation, credibility of Guinean products.	ONFPP, IRAG, ECOWAS, African Union, Ministry of Trade and Agriculture.
Improvement of traditional processes and adapted technologies	To study and optimize traditional methods (fermentation, drying, packaging); to design simple, robust and accessible equipment (motorized graters, hydraulic presses, solar dryers).	Reduced physical strain, improved hygiene, consistent quality, increased productivity.	IRAG, ONFPP, technological research centers, universities, local workshops, rural NGOs.
Sharing experiences and transferring technologies	Establishing technical and scientific partnerships with African countries (Cameroon, Benin, Congo).	Adaptation of local innovations, improvement of fermentation and packaging processes.	African research institutes, international NGOs, technical centers.
Socio-economic and organizational studies	Analyze the structure of cooperatives and micro-enterprises; document the role of women.	Strengthening local governance, social inclusion, women's empowerment.	ONFPP, local NGOs, microfinance institutions.

7. Conclusion

The analysis of innovations and challenges linked to cassava processing in Guinea highlights significant achievements but also persistent limitations. The achievements mainly concern the progressive diversification of derived products (chips, biscuits, enriched flours, packaged attiéké), the emergence of agro-industrial initiatives, and the growing integration of traditional know-how into modernized processes. These advances contribute to reducing post-harvest losses, improving food security and opening up new economic and social opportunities. However, the limitations remain notable: low valorization of by-products, insufficient storage and transport infrastructure, lack of standardization and certification to regional standards, as well as poor inclusion of women and rural cooperatives in entrepreneurial dynamics.

From a prospective perspective, technological and organizational innovations offer potential for sustainable transformation of the cassava sector in Guinea. L'adoption de procédés sobres en énergie, de conditionnements écologiques et de solutions locales adaptées peut réduire l'empreinte environnementale tout en renforçant la compétitivité régionale. The establishment of harmonized standards within ECOWAS and the African Union, associated with credible certification mechanisms, would facilitate access to sub-regional and international markets. Furthermore, investment in integrated semi-industrial and industrial units, coupled with inclusive training programs and adapted financing mechanisms, would make it possible to structure the sector, create local jobs and ensure better governance of cooperatives. Finally, the valorization of by-products into compost, animal feed or bioenergy would strengthen the sustainability and territorial anchoring of the sector.

Thus, cassava processing in Guinea, if it is based on an integrated strategy combining technological innovation, standardization, social inclusion and environmental sustainability, can become a major lever for food sovereignty, regional competitiveness and socio-economic development. The cassava sector, long perceived as traditional, is now positioned as a strategic sector capable of contributing to the achievement of national and regional sustainable development objectives.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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