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Review Article

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Agrobiodiversity in Shifting Cultivation Systems and on Tropical Market Stalls

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ABSTRACT

In the current global context of agricultural intensification, a decline in the nutrient content of cultivated vegetables has been observed, contributing to widespread micronutrient deficiencies worldwide. This erosion of food nutritional quality results from multiple factors, including dietary simplification, the selection of high-yield but less nutritious crop varieties, soil-depleting agricultural practices, and the progressive abandonment of traditional cropping systems that historically ensured diversified and healthy diets. In response, agroecology emphasizes the role of agrobiodiversity in fields and food systems as a foundation for food security and human health.

This study investigates agrobiodiversity as expressed in the markets of French Guiana. We assessed the diversity of agricultural products sold, their geographical origins, and their links to the agricultural practices of different selling communities (Hmong, Bushi Konde Sama, Amerindians, Creoles, Haitians, among others) through surveys of stalls in eight markets. A high level of agrobiodiversity was recorded, with 156 products identified, though unevenly distributed among markets and communities. Rare products, often specific to particular cultural groups, played a key role in this diversity. The composition of market stalls reflected distinct livelihood strategies, notably self-consumption-oriented systems among Amerindian communities. Comparison with data from 2009 reveals temporal changes in both species composition and the representation of selling communities. Overall, markets emerge as valuable indicators of agricultural, social, and cultural dynamics, highlighting the importance of conserving agrobiodiversity for sustainable and healthy food systems.

Keywords: Agrobiodiversity, Agroecology, French Guiana, Market stalls diversity, Communities, Evolution

Introduction

Global agricultural systems are characterized by a wide diversity of practices shaped by socio-economic and environmental contexts. These farming practices range from intensive monoculture systems, which may achieve high short-term yields through the use of chemical inputs but lead to biodiversity loss and soil degradation, to agroecological systems that integrate biotic interactions and diversified practices, enhancing resilience to crises while maintaining high levels of biodiversity and improved soil health [1,2].

The sustainability of agricultural systems has become a major global concern, as agricultural intensification has led not only to biodiversity loss and soil degradation, but also to a decline in the nutritional quality of food. Indeed, agricultural production systems indirectly influence human health through the nutritional quality of food. The decline in nutrient content observed in vegetables cultivated during the 20th century reflects the effects of agricultural intensification, while changes in dietary composition and soil nutrient depletion contribute further to nutritional erosion [3,4]. Rising atmospheric CO_2 levels may further reduce protein and micronutrient concentrations in staple crops such as cereals [5]. As a result, more than two billion people worldwide currently suffer from deficiencies in essential micronutrients, including iron, zinc, and vitamin A, contributing to growth retardation, morbidity, and premature mortality [4].

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In this context, agroecology has emerged as a key framework to address food security, human health, and environmental sustainability. Agroecology relies in part on agrobiodiversity, which underpins resilient food systems and diversified diets. However, agrobiodiversity is unevenly distributed across regions and strongly shaped by local agricultural practices and cultural dynamics.

For these reasons, an increasing number of studies have focused on agroecology, which Wezel [9] defines as a scientific discipline, a set of agricultural practices, and a social or political movement. Agroecology relies heavily on agrobiodiversity. Qualset et al. define agrobiodiversity as the diversity of crops and livestock, their wild relatives, and the species that interact with and support them, including pollinators, symbionts, pests, parasites, predators, and competitors. Biotic interactions such as pollination, mycorrhization, and seed dispersal structure agroecosystems and are essential for agricultural productivity and soil regeneration [10,11]. Agrobiodiversity also constitutes a complex, interdependent resource system involving humans [12].

Agroecology is closely linked to traditional agricultural practices. For example, the Kuikuro people of Brazil maintain high biodiversity and soil fertility through the creation of terra preta enriched by organic residues and ashes [15]. In Central Africa, farming systems practiced by the Ntumu in Cameroon demonstrate how traditional agricultural dynamics shape forest landscapes and contribute to biodiversity conservation [16]. In intertropical and tropical regions, family farming remains widespread. In Oceania, agroforestry systems rely on shifting cultivation practices that help maintain soil fertility while ensuring diversified production [17]. Studies on Malo Island (Vanuatu) highlight trade-offs between agricultural productivity and ecosystem conservation, emphasizing the role of crop diversity and fallow management in long-term sustainability [18,19].

In Europe, two prospective scenarios are particularly relevant in this regard: Afterres2050 and TYFA [6,8]. Both promote models supporting an agroecological transition in response to current and future food and environmental challenges. Afterres2050 proposes a transformation of the French food system, while TYFA emphasizes a European agriculture less dependent on chemical inputs and more strongly oriented towards agrobiodiversity.

This study focuses on French Guiana, an overseas territory characterized by high biological and cultural diversity. Despite rapid population growth and increasing food demand, nearly 60% of food consumed in French Guiana still originates from local agriculture [7]. This relative food autonomy is closely linked to the diversity of agricultural practices developed by multiple communities, including Amerindian, Creole, Hmong, and Bushi Kondé Sama populations.

In French Guiana, agricultural systems reflect a long history of cultural diversity shaped by successive migrations from Africa, Europe, and Asia within an Amerindian territory [20-22]. This diversity has given rise to a wide range of production systems. Hmong communities practice intensive market gardening with high crop specialization [23]. Creole communities combine shifting cultivation (abattis) with permanent home gardens integrating food, medicinal, and ornamental plants [24]. Amerindian communities maintain itinerant agroecological systems based on long fallow periods and small cultivated plots, allowing soil regeneration and high crop diversity [25-[27]. Bushi Kondé Sama communities also practice shifting cultivation systems, often combining cassava, banana, watermelon, and rice, although some systems increasingly incorporate chemical inputs or are converted into pastures, compromising their sustainability [27,28].

The objective of this study is to assess agrobiodiversity on markets across French Guiana by documenting the diversity of agricultural products available on market stalls and linking this diversity to the cultivation practices of local communities. We also examine temporal changes by comparing current data with data collected in 2009, in order to evaluate shifts in agrobiodiversity and community representation over time. We hypothesize that shifting cultivation systems (abattis) promote higher levels of agrobiodiversity on markets, and that overall agrobiodiversity has declined between 2009 and 2025.

Together, these studies highlight the central role of traditional and community-based agricultural practices in maintaining agrobiodiversity, and underline the relevance of markets as indicators of agricultural, cultural, and social dynamics.

Materials and Methods

Historical Context

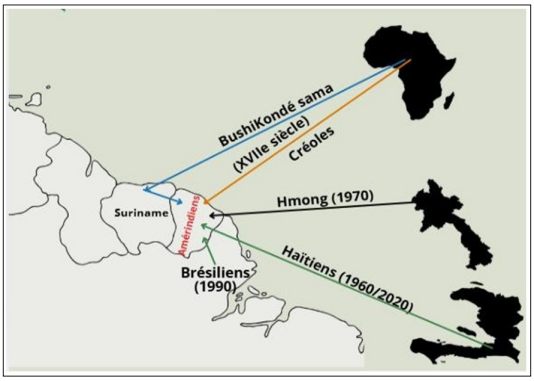


Figure 1: Schematic summary of the migratory history of French Guiana

The historical and cultural mosaic of French Guiana (fig.1) forms the framework of this study, allowing us to link the diversity observed in markets to the origin of the communities and their specific agricultural practices.

The current diversity of food products sold in Guyanese markets is closely linked to the region's historical context. Amerindians, the first inhabitants of French Guiana, developed traditional agriculture based on forest swiddens, cultivating mainly tubers (cassava), which are still widely represented on their stalls.

During the colonial period, the territory of French Guiana underwent significant changes. The arrival of enslaved Africans, followed by the abolition of slavery in 1848, gave rise to the Creole community, which remains a major part of contemporary Guyanese society. Creoles developed household

gardens ("jardins de case") rich in species and transmitted from generation to generation, alongside swidden cultivation.

The BushiKondé Sama are descendants of enslaved people who fled Surinamese plantations in the 18th century. They settled mainly along the Maroni River, practicing itinerant swidden cultivation and demonstrating detailed knowledge of forest ecosystems. Their settlement was reinforced in the 1980s due to political conflicts in Suriname.

The Hmong arrived more recently, in the 1970s, as refugees from Laos. Settled in Cacao and later Javouhey, they introduced intensive agricultural practices, notably market-garden polyculture. Today, they play a major role in local agricultural production, particularly in fruit and vegetable supply.

Finally, Haitians, whose migration intensified in the early 2000s due to political conflicts and natural disasters, occupy mainly reseller positions in markets. Often without access to land, they purchase products from local producers or shops, which is reflected in the highly varied composition of their stalls.

Data were collected during a field campaign in February 2025. Eight markets representative of the geographical and cultural diversity of French Guiana were selected: Saint-Laurent-du-Maroni, Iracoubo, Sinnamary, Cayenne, Javouhey (between Mana and Saint-Laurent-du-Maroni), Cacao, Régina, and Saint-Georges-de-l'Oyapock (Figure 2).

Figure 2: Map of French Guiana with eight markets (red triangles) (© pomogayev – stock.adobe.com), and Bushikondé Sama stall from the St Laurent du Maroni market (left) and Hmong stall from the Cacao village market (right). Photographs by L. Pascal.

Photographic surveys were conducted systematically, and for each image, several qualitative nominal variables were recorded: products for sale, botanical type, food type, vendor community, market location, and stall number. The survey date (ordinal qualitative variable) and an estimate of percentage cover for each product (continuous quantitative variable) were also noted. Coverage was not always 100%, as some stalls included non-food products. Data were compiled into an Excel table for comparative agrobiodiversity analyses, including comparison with a 2009 campaign. Additional observations were made in Hmong, BushiKondé Sama, and Amerindian swiddens to compare cultivated diversity with market diversity. A literature review was conducted to identify the geographic origin of marketed species.

Statistical Analyses

All statistical analyses were performed in R (version recorded at the time of analysis: April–May 2025). Data were filtered to retain complete and standardized observations. Species were aggregated at multiple scales (market, community, market × community, and geographic origin) according to the objectives of diversity, structure, and floristic composition analyses.

Sampling effort was assessed with species accumulation curves per market (Régina excluded due to a single stall). Rarefaction curves based on percentage cover allowed comparison of species richness among markets and communities independently of sampling effort. Community structure was examined with rank- abundance curves for markets, communities, and market × community combinations. Food-type distribution was visualized using pie charts at the global scale and by community, with categories <3% grouped.

Diversity indices were calculated from percentage cover at the community, market, and market × community scales. Indices included Shannon (H'), Simpson (D), Heip's evenness, species richness (S), and S/stall ratio. For Shannon, the theoretical maximum (H'max) was calculated to obtain the H'/H'max ratio. Diversity was further decomposed into alpha, beta, and gamma components at two scales : (i) intra-market (alpha = mean diversity per stall, gamma = total market diversity) and (ii) inter-market (alpha = mean diversity per market, gamma = total diversity across all markets).

Table 1: Number of stalls sampled by market

Market	Saint-Georges	Régina	Sinnamary	Iracoubo	Cacao	Javouhey	Saint-Laurent	Cayenne	Total
Stalls	12	1	8	5	17	31	53	72	199

Vendor community distributions were analyzed at global and market scales. Chi-square goodness-of-fit tests were used for evenness, and Fisher's exact tests were applied when counts were low or contingency tables contained zeros. Standardized residuals were calculated for significant results to identify over- or under- represented categories.

Marketed species were analyzed at multiple scales (global, by community, by market, and market × community) using presence-frequency matrices. Species occurring on only one stall were considered rare. Proportions of rare species were computed at all scales and compared using chi-square or Fisher's exact tests, depending on counts. Some markets and communities were excluded when their structure prevented meaningful comparisons. Floristic similarity between markets and communities was assessed using the Jaccard index (presence/absence matrices). This method was also used to compare swiddens and corresponding market stalls for each community, as well as to compare 2009 and 2025 datasets.

Correspondence analyses (CA) were performed on community × food type, market × food type, and community × market datasets. Results were visualized as biplots to identify proximities or divergences in composition. CA results were complemented by hierarchical clustering analyses (HCA) using Euclidean distances; multiple linkage methods were tested. Classification quality was evaluated using cophenetic correlation and mean squared deviation.

Floristic composition in 2025 was compared with 2009 using the Jaccard index to identify shared and unique species. Community distributions between years were compared globally and by market using Fisher's exact tests, excluding markets absent from one of the campaigns.

Finally, stall composition was analyzed according to the geographic origin of marketed species, defined by biogeographic categories from the literature. Distributions were examined globally, by community, by market, and market × community using frequency matrices. Chi-square or Fisher's exact tests were applied depending on counts. Results were visualized using distribution diagrams

Results

Richness and diversity of stalls

A total of 156 food products were recorded across all markets in French Guiana. Analysis of market stalls revealed marked differences in product richness among communities and markets. Some stalls stood out for their particularly diverse offerings: Creole stalls in Sinnamary averaged 7.2 products, Haitian stalls in Saint-Laurent 7.3, and Brazilian stalls in Cayenne 6.3 products per stall. In contrast, Amerindian stalls remained highly specialized, with fewer than one product per stall on average (0.89). This pronounced variation indicates that commercial diversity is concentrated among specific seller groups and certain markets. Comparing markets, Cayenne and Saint-Laurent exhibited the highest total product diversity, with 103 and 95 products, respectively. Hmong markets in Javouhey and Cacao also showed substantial diversity (65 and 58 products), whereas smaller markets, such as Sinnamary (5 stalls) and Régina (1 stall), offered fewer products overall but high richness per stall.

All communities exhibited high diversity relative to the theoretical maximum (H'/H'max = 0.71–0.88). Creole sellers had the highest diversity (H' = 3.98; D = 0.97), followed by BushiKondé sama (3.81; 0.97) and Hmong (3.75; 0.96). Amerindians had the lowest diversity (1.48; 0.66). Evenness (Heip) was highest among Brazilians (0.62) and lower for Hmong (0.44), with other communities around 0.5. Market-level diversity showed similar trends: Saint-Laurent was the most diverse (H' = 3.99; D = 0.97), followed by Cayenne (3.87; 0.97) and Cacao (3.64; 0.96), while Régina (1 stall) had low diversity (2.09; 0.85) but high evenness (0.71).

Intra-market diversity (α) was highest at Sinnamary (2.18) and lowest at Saint-Georges (1.1), while β-diversity indicated strong heterogeneity between stalls in Saint-Georges (2.37), Cayenne (2.09), and Saint-Laurent (1.97), with lower heterogeneity in Iracoubo and Sinnamary (1.59). Across markets, mean α (3.21) and γ (4.08) indicated high overall diversity, with moderate β-diversity (1.27) reflecting some product turnover between markets.

Community Distribution Across Markets

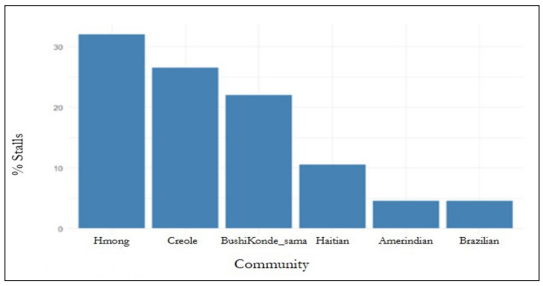


Figure 3: Barplot showing the distribution of communities across all market stalls

Hmong and Creole vendors dominated the overall composition of stalls (30 % and 25 %, respectively), whereas Brazilians and Amerindians were minority groups, each representing approximately 5 % of stalls (figure 3). Haitians and BushiKondé sama occupied intermediate positions (10 % and 20 %). A chi-squared test indicated that this distribution was significantly uneven ($p < 0.001$), reflecting local migration history and commercial specialization.

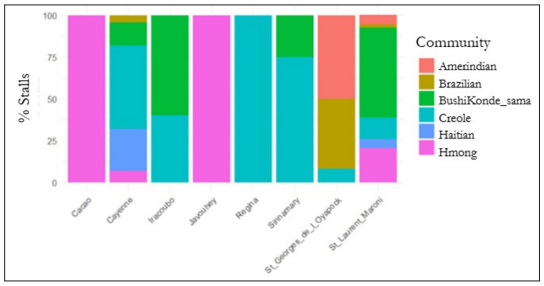


Figure 4: Stacked bar chart showing the distribution of communities within each market

Community composition also varied across markets (Fisher's exact test, $p < 0.001$): Hmong were overrepresented in Cacao and Javouhey, Creoles and Haitians in Cayenne, and BushiKondé sama in Saint- Laurent (fig.4). This distribution highlights market specialization, where certain communities concentrate the diversity of products. Jaccard indices measuring similarity between market–community pairs showed that Hmong from Cacao, Javouhey, and Saint-Laurent were relatively similar (0.57–0.60), whereas Creoles from more isolated markets exhibited very specific compositions, distinct from other groups.

Correspondence and Cluster Analyses

Correspondence analysis (CA) and hierarchical clustering (HC) were used to characterize the relationships between communities, markets, and food types.

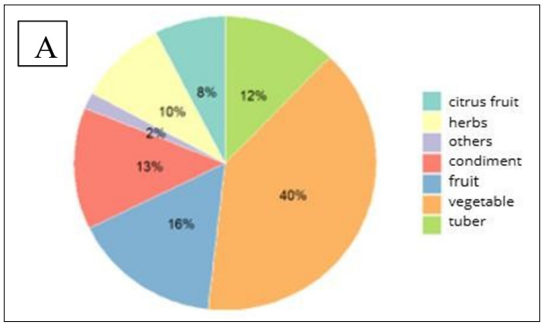
Community × Food Type: The CA explained 89 % of inertia. Creoles and BushiKondé sama clustered together, primarily associated with vegetables, tubers, and condiments. Haitians were distinguished by seeds and dry fruits, while Brazilians remained near the origin, reflecting a diverse product range. Hmong were linked to herbs and citrus, and Amerindians specialized in fruits and tubers. HC confirmed these groupings with an mSD of 0.016.

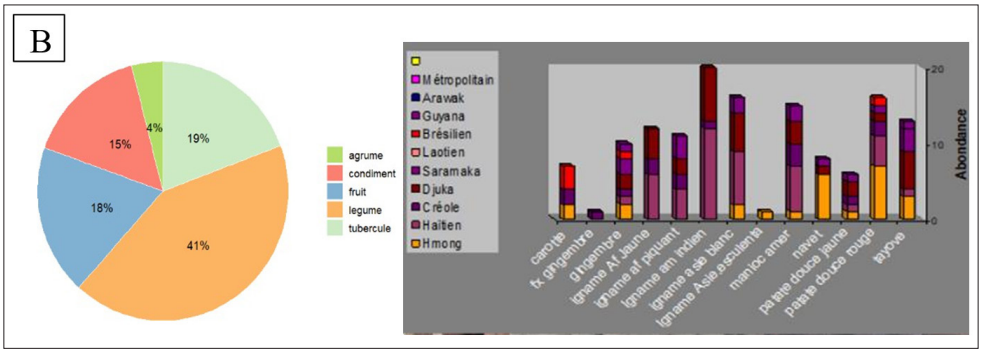
Market × Food Type: The CA explained 86 % of inertia. Central markets (Saint-Laurent, Cayenne, Sinnamary, Saint-Georges) offered a wide range of products. Cayenne was characterized by a strong presence of condiments and seeds/arils, Saint-Laurent by dry fruits and beverages, Iracoubo by tubers, Cacao and Javouhey by herbs and citrus, and Régina, with a single stall, by condiments. HC grouped the Hmong markets together, central markets into subgroups, and Régina separately (mSD = 0.017).

Community × Market: The CA explained 82 % of inertia. Hmong were associated with Cacao and Javouhey, Brazilians and Amerindians with Saint-Georges, while Creoles, BushiKondé sama, and Haitians remained near the center, linked to their dominant markets. HC revealed three groups:

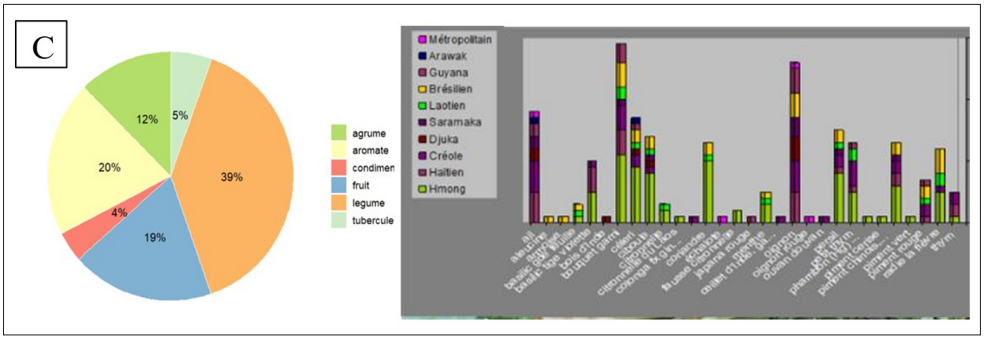
(i) Brazilians and Amerindians,
(ii) Hmong and Creoles with Haitians as a subgroup, and
(iii) BushiKondé sama (mSD = 0.07).

These results indicate that communities and markets exhibit distinct selling profiles, strongly influenced by the types of food offered and the specificity of individual stalls.





Distribution of food types on Bushi stalls Distribution of Roots and tubers specific to Bushi and Creole stalls (purple) originating from Africa



Distribution of food types on Hmong stalls Distribution of Aromatic herbs specific to Hmong (green) stalls originating from Asia

Figure 5: Distribution of food types A- on a global scale, B - on specifics African stalls (Creole and Bushikondé sama) C- on Hmong Asian stalls

The types of products sold varied among communities. Vegetables represented 40 % of all products, followed by fruits (16 %) and condiments (13 %) (figure 5). Creoles and BushiKondé sama shared similar food profiles, dominated by vegetables, **tubers,** and condiments. Hmong stalls were distinguished by a large proportion of **aromatic plants** and citrus fruits, while Amerindians focused on fruits (50 %) and tubers (45 %). Haitians and Brazilians offered more dried products and condiments, consistent with their role as resellers.

At the regional scale, lime, cucumber, bacove banana, purple eggplant, and plantain banana were the most frequent products. Approximately 22 % of products (34 species) were rare, appearing on only a single stall. Rarity varied by market–community combination: some groups, such as Creoles in Saint-Georges or BushiKondé sama in Sinnamary, offered **more than 70 % rare products,** while other groups were more homogeneous. Fisher's exact test confirmed a significantly heterogeneous distribution of rarity ($p = 0.02$). Product rarity was particularly high in isolated markets, such as Iracoubo (≈55 %), Cacao (≈50 %), and Saint-Georges (≈45 %), compared with Cayenne and Saint-Laurent, where it was lower (≈25 %).

Geographic Origin of Products

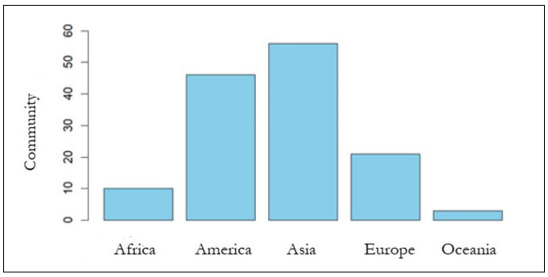


Figure 6: Barplot showing the geographical origin of plants sold at market stalls

Most species sold were of Asian (60 species) or American from amazonie (45) origin, whereas European, African, and Oceanian species were less represented (fig.6). A chi-squared test confirmed that this distribution was highly uneven ($p < 0.001$), with overrepresentation of Asian and American species. This pattern reflects both local production choices and commercial networks and indicates that French Guiana markets introduce products from diverse regions, contributing to overall stall diversity.

Correspondence Between Agricultural Production and Markets

Similarity between abattis (fallow fields) and market stalls was moderate for Hmong and BushiKondé sama (Jaccard index ≈ 0.34) but low for Amerindians (0.13). Among Hmong, 38 species were common to both abattis and markets, 16 were exclusive to abattis, and 58 were exclusive to stalls, demonstrating that commercialization substantially expands the available diversity. For BushiKondé sama, a complementary relationship between production and market was also evident, whereas for Amerindians, few cultivated products appeared on markets, indicating limited commercial integration.

Temporal dynamics 2009–2025

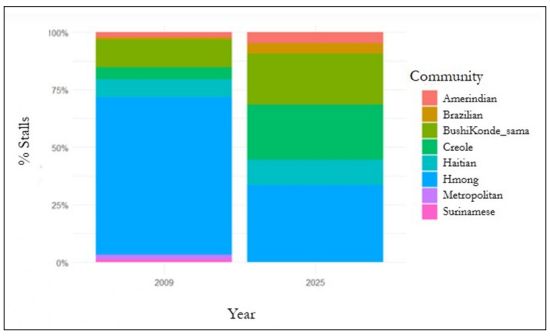


Figure 7: Stacked bar chart showing the evolution over time of the distribution of communities in Guyanese markets between 2009 and 2025

Between 2009 and 2025, French Guiana markets underwent substantial reorganization. The proportion of Hmong stalls decreased from 60 % to 30 %, while Creole stalls increased from 5 % to 25 %. Metropolitan French and Surinamese vendors disappeared (figure.7).

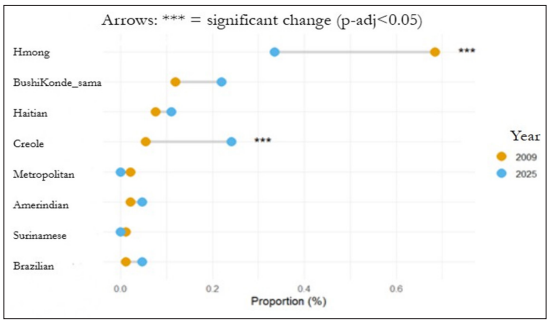


Figure 8: Scatter plot with transition arrows showing the variation in the proportion of communities present in Guyanese markets between 2009 and 2025, with indication of significant changes (Fisher's test, adj p-value < 0.05)

Fisher's exact test confirmed that these changes were significant at the global scale ($p < 0.001$) and in several key markets: Cayenne ($p < 0.001$), Saint-Georges ($p = 0.004$), and Saint-Laurent ($p = 0.03$) (figure 8).

Floral composition also changed: of the 137 products recorded in 2009 and 156 in 2025, only 68 were shared, 69 were exclusive to 2009, and 88 were exclusive to 2025, yielding a Jaccard index of 0.30. These results indicate substantial turnover in marketed species, with the emergence of new products and the disappearance of older ones, while maintaining a high overall level of agrobiodiversity across markets.

Discussion

Markets in French Guiana provide a relevant observatory of the territory's agricultural, social, and economic dynamics. Analysis of the food offer revealed a high level of agrobiodiversity, with 156 recorded products (137 species) and substantial diversity indices at the market scale (H' up to 3.99; $D \approx 0.97$). These results confirm the central role of markets in agrobiodiversity valorization, as previously reported in other tropical contexts, while also showing that this diversity is structured by historical, social, and economic factors [29,30].

Observed diversity was neither homogeneous nor random. Significant differences between markets (mean β-diversity = 1.27) indicate a contrasting organization of commercial offer. Large urban markets (Cayenne, Saint-Laurent) concentrated high total richness (up to 103 products) but exhibited substantial heterogeneity among stalls (intra-market $\beta \approx 2$), suggesting vendor specialization. In contrast, smaller markets presented lower total richness but higher richness per stall, reflecting greater vendor versatility adapted to less segmented local contexts. These patterns differ from observations in other tropical regions, where smaller markets tend to be more specialized, highlighting the importance of local socio-geographical context [31].

Market composition was also strongly influenced by community structure. The distribution of vendor communities was significantly non-random (Fisher's exact test, $p < 0.001$), reflecting migratory histories and spatial organization. Creole, Hmong, and BushiKondé sama communities exhibited high total richness ($H' = 3.75–3.98$) but low diversity per stall, suggesting specialization on targeted products. Conversely, Haitian and Brazilian stalls had higher average richness per stall (up to 7.3 products per stall), relying more on resale and diversification strategies, consistent with limited access to agricultural land [7,32].

Amerindian stalls were characterized by low commercial diversity (0.89 products per stall; $H' = 1.48$) despite higher cultivated diversity in fallow fields. This decoupling reflects a production strategy primarily oriented toward self-consumption, consistent with specific lifestyles and food systems, rather than integration into commercial circuits [7,32].

The geographic origin of marketed species further highlighted the structuring of agrobiodiversity. Asian- origin plants (60 species) and American-origin plants (45 species) were significantly overrepresented (χ^2, $p < 0.001$). This distribution partially reflects French Guiana's migratory history and associated cultural heritage. American-origin plants, historically cultivated by Amerindian populations, form the basis of local food systems [27]. Furthermore, as noted by Kassabian, some immigrant populations maintain traditional dietary habits, while others gradually integrate into local culture and modify their practices [33]. These cultural adjustment processes help explain the coexistence of products tied to specific food traditions alongside products widely shared between communities.

Multivariate analyses (CA and HC) confirmed this structuring. CA explained 82–89% of the inertia, highlighting strong associations between communities, markets, and food types. Despite a global dominance of vegetables (≈ 40% of products), each community displayed distinct food profiles, reflecting cultural preferences and specific agricultural know-how, consistent with observations in other tropical contexts [31,34].

The diversity of food types is also a matter of human health. Agricultural intensification and varietal selection tend to reduce the nutritional quality of foods [6]. In contrast, the diversity observed in markets across French Guiana aligns with FAO recommendations, which promote agroecology and diversified food systems while preserving local knowledge [35].

The high proportion of rare species (≈ 22% of products), whose distribution was significantly heterogeneous ($p = 0.02$), contributed substantially to regional β-diversity and market identity. These species, often specific to a community or a market, play a key role in conserving food resources and associated knowledge, thus supporting local food system resilience [36].

Low overlap between fallow fields and stalls (Jaccard index = 0.34 for Hmong and BushiKondé sama; 0.13 for Amerindians) indicates that markets represent only a fraction of cultivated agrobiodiversity. This decoupling emphasizes the importance of non-commercial circuits (self-consumption, gift exchange, informal trade) in the circulation of plant biodiversity, as observed in other tropical regions (Heindorf et al., 2021).

Finally, diachronic analysis highlighted significant changes between 2009 and 2025, both in community composition (Fisher, $p < 0.001$) and floristic composition (Jaccard = 0.30). Despite substantial turnover in marketed species, the maintenance of high diversity suggests an adaptive capacity of Guianese markets. Nonetheless, these dynamics raise critical issues regarding the conservation of local varieties and biocultural knowledge in the face of land pressure, food homogenization, and increasing dependence on imports.

Limitations, Conclusions, and Recommendations

The limitations of the study, including sample size and methodological constraints, are acknowledged after summarizing the overall survey. The study was based on a limited number of markets and stalls, which may not capture the full spatial and temporal variability of agrobiodiversity in French Guiana. Seasonal effects and accessibility constraints in certain fallow fields could also have influenced species detection.

Despite these limitations, the study provides a comprehensive overview of market-based agrobiodiversity and its relationship with community composition, historical trajectories, and food practices. The findings highlight the central role of markets in maintaining both biological and cultural diversity, as well as the importance of rare species and local production systems in sustaining resilient food networks.

Future research should consider:

1. Expanded spatial and temporal sampling to cover additional markets, seasons, and agricultural cycles.
2. Integration of non-market data, such as household production, gift exchange, and informal trade, to better assess the total agrobiodiversity available to local communities.
3. Longitudinal monitoring to evaluate trends in species composition, market specialization, and community adaptation over time.
4. Ethnographic and socio-economic analyses to understand the decision-making processes underlying product selection, cultivation, and marketing strategies across different communities.

These recommendations aim to provide a more detailed understanding of agrobiodiversity dynamics in tropical contexts and to support evidence-based conservation and food system policies.

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