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SOCIO-ECONOMIC AND AGRONOMIC CHARACTERISATION AND PROSPECTS FOR WILD CASSAVA CULTIVATION IN HAUT-KATANGA, DEMOCRATIC REPUBLIC OF THE CONGO

CARACTÉRISATION SOCIO-ÉCONOMIQUE ET AGRONOMIQUE ET PERSPECTIVES DE LA CULTURE DU MANIOC SAUVAGE AU HAUT-KATANGA, EN RÉPUBLIQUE DÉMOCRATIQUE DU CONGO

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ABSTRACT

Research into the diversity and utilisation of cassava species (*Manihot* spp.) is of crucial importance in the context of food security, agricultural diversification and socio-economic development in rural areas of sub-Saharan. This study assessed the socio-economic and phytotechnical significance of wild cassava (*Manihot glaziovii*) cultivation in the Lubumbashi region of the Democratic Republic of Congo. The methodology combined surveys of 120 household heads, direct observations, focus group discussions and expert interviews, enabling a comprehensive analysis of producers' practices, motivations and constraints. The results reveal a male predominance in cultivation, with women heavily involved in the marketing of the leaves. Local propagation by cuttings remains the main method, although it is subject to risks related to limited genetic diversity and disease. Traditional cultivation practices, such as hoeing to a depth of 25 cm and flat field cultivation, predominate but could be optimised to improve productivity and sustainability. The average plant growth of 2.66 meters indicates high production potential, but pest and animal pressure still limits yields. The significant disparities in selling prices between Lubumbashi and Kipushi highlight the need to structure marketing channels. These results underscore the considerable potential of *Manihot glaziovii* as a food and economic resource, while emphasising the urgent need for investment in training, technical innovation and sectoral organisation to ensure sustainable and profitable exploitation.

Key Words: Agricultural diversification, food security, phytochemical resources, wild cassava

RÉSUMÉ

La recherche sur la diversité et l'utilisation des espèces de manioc (*Manihot* spp.) revêt une importance cruciale dans le contexte de la sécurité alimentaire, de la diversification agricole et du développement socio-économique dans les zones rurales d'Afrique subsaharienne. Cette étude a évalué l'importance socio-économique et phytotechnique de la culture du manioc sauvage (*Manihot glaziovii*) dans la région de Lubumbashi, en République démocratique du Congo. La méthodologie a combiné des enquêtes menées auprès de 120 chefs de ménages, des observations directes, des discussions de groupe et des entretiens avec des experts, ce qui a permis une analyse approfondie des pratiques, des motivations et des contraintes des producteurs. Les résultats montrent que la culture est principalement assurée par les hommes, tandis que les femmes jouent un rôle prépondérant dans la commercialisation des feuilles. La multiplication locale par bouturage reste la méthode principale, bien qu'elle comporte des risques liés à la diversité génétique limitée et aux maladies. Les pratiques culturales traditionnelles, telles que le sarclage à une profondeur de 25 cm et la culture en plein champ, prédominent, mais pourraient être optimisées afin d'améliorer la productivité et la durabilité. La croissance moyenne des plantes, qui s'élève à 2,66 mètres, témoigne d'un fort potentiel de production, mais la pression exercée par les ravageurs et les animaux continue de limiter les rendements. Les écarts importants entre les prix de vente pratiqués à Lubumbashi et à Kipushi soulignent la nécessité de structurer les circuits de commercialisation. Ces résultats soulignent le potentiel considérable de *Manihot glaziovii* en tant que ressource alimentaire et économique, tout en mettant en évidence la nécessité urgente d'investir dans la formation, l'innovation technique et l'organisation sectorielle afin d'assurer une exploitation durable et rentable.

Mots Clés : Manioc sauvage, diversification agricole, sécurité alimentaire, ressources phytochimiques

INTRODUCTION

Research into the diversity and utilisation of cassava species (*Manihot* spp.) is of crucial importance in the context of food security, agricultural diversification and socio-economic development in the rural areas of sub-Saharan Africa (Nweke *et al*., 2002). In the Democratic Republic of the Congo (DRC), cassava is a staple crop, both for food and for its economic potential, particularly in areas where food security remains fragile (Mutangase *et al*., 2018). Among the various cassava species, *Manihot glaziovii*, a wild species, offers significant potential for food, ornamental use and as a raw material for various industrial applications (Fouad *et al.*, 2019). Its ability to adapt to various soil types and climates, its rapid growth, and the high nutrient content of its leaves make it a potential resource for local farmers.

However, most research conducted to date focuses on domestic cassava, grown for food, while neglecting wild or underutilised species such as *Manihot glaziovii*, which are often marginalised or regarded primarily as ornamental plants (Gomes *et al*., 2014). Yet this wild species offers significant potential for the diversification of agricultural resources, particularly due to its agronomic qualities and its economic prospects, which remain largely unexplored in sub-Saharan Africa (Gomez *et al*., 2017; Fouad *et al*., 2019). A thorough characterisation of this species, particularly its cultivation methods, the socio-economic profile of the farmers involved, and the challenges associated with its sustainable development, is therefore, essential. Such an approach will enable the identification of appropriate strategies to promote its cultivation and local use, and to foster its regional commercial development.

Against this backdrop, the aim of this study is to assess the socio-economic and agronomic significance of *Manihot glaziovii* cultivation in Haut-Katanga, in the Democratic Republic

of the Congo. By providing a better understanding of its potential and constraints, this research aims to contribute to optimising the exploitation of this wild species, with a view to sustainable development and increased value creation within the local agricultural and economic context.

MATERIALS AND METHODS

The study area. This study was conducted in the Haut-Katanga Province, specifically in the city of Lubumbashi and the town of Kipushi, both in the DRC. Lubumbashi is located at latitude 11°41' S, longitude 27°29'E and altitude 1230 metres above sea level. The selection of these areas made it possible to cover different socioeconomic and agroecological contexts, promoting coverage of cassava producers (Mutangase *et a*l., 2018). Rapidly expanding metropolitan conditions in these area, is exerting considerable demand for this crop, beyond the present local supply capacity (Congo Data, 2022).

The survey. Respondent sampling was conducted using a stratified probabilistic approach. The target population included farmers involved in *M. glaziovii* cultivation in both localities. Stratification was carried out according to neighbourhoods (Kampemba, annexed commune, Lubumbashi center; Kipushi city). The sample size (n=120) was determined using Cochran's formula (Cochran, 1977), considering a 95%.

Data collection. Data were collected on local perception of culture significance issues using a mixture of approach and techniques, namely: face-to-face survey, direct observations, Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs).

Face-to-face survey. This component was conducted using semi-structured questionnaires, designed to collect socioeconomic information, cultivation techniques, motivations, constraints, and economic prospects of the cassava farmers (Kouadio *et al*., 2020). The questionnaires were administered by trained interviewers, taking into account the local linguistic and cultural contexts. Each session lasted about 1 hour maximum, and was characterised by respondent consent, verbally or in writing; a brief illustration to the background of the survey; and the confidentiality associated with the respondent's input. Respondents were fully informed of the study objectives and their voluntary participation was acknowledged, thus fostering trust and openness throughout the process. And interviewers were trained to use respectful and culturally sensitive communication approaches, adapting their language and tone to maintain respondent engagement and facilitate frank discussion. The semi-structured design of the interviews allowed respondents to freely express their views, while the interviewers encouraged clarifications and comments, thus improving the reliability and depth of the data collected.

Direct observations. This was conducted in the field to verify some responses provided during the face-to-face interview sessions; as well as document untold cultivation practices, e.g. tillage techniques, crop husbandry practices, and phytosanitary management, cultivated area, and crop condition. The referenced data being consistent with the data collected, which made it possible to validate the data collected during the surveys.

Focus groups. The Focus Group Discussion groups (FGDs) helped to deepen the validity of the respondents to the face-to-face sessions, and to illustrate more on some scenarios observed during the physical observations in the field. In other words, they were used to gather aggregate information and validate qualitative results (Nweke *et al*., 2002). They were a total of 32 in number each comprising of 8 members, representative of the different

cohorts of households selected from the face-to-face interviews.

To ensure equitable participation in the FGDs, a trained moderator actively encouraged more reserved participants by asking direct and open-ended questions, fostering an inclusive environment where all voices could be heard.

Gender representation was consciously balanced in the composition of the groups to reflect the demographic structure of cassava farmers and promote a diversity of perspectives.

Each session lasted approximately one and a half to two hours and was facilitated by a designated chairperson, appointed by group consensus or by the research team, to manage discussions, resolve lengthy debates through synthesis and consensus building, and maintain focus. In addition, a dedicated notes-taker recorded the discussions, supplemented by audio recordings to ensure the accuracy and reliability of the qualitative data collected.

Key informant interviews. The KIIs were conducted with persons privileged with deep but relevant information, and/or specialised in the specific topic (in this case 40 agricultural experts, 40 representatives of agricultural associations, and 40 rural sector technicians) to gather expert opinions on the sector and development prospects.

Socioeconomic variables included demographic characteristics such as gender, age, education level, occupation, and place of residence. The economic factors included agricultural motivation, harvested quantities, sales prices, and local market dynamics. In contrast, phytotechnical parameters encompassed crop-related aspects, including the origin of planting material, tillage depth, planting methods, crop cycle length, pest and disease control techniques, soil management practices, and cultivated area. This clear classification facilitated a targeted analysis of the influence of social factors on adoption and commercialisation, while agronomic factors were presumed to have affected the productivity and sustainability of *Manihot glaziovii* cultivation.

Variables studied. The main variables analysed include socio-economic and phytotechnical variables, whose details follow:

The main socio-economic variables included gender, age, education level, occupation, and place of residence; while the key phytotechnical variables included origin of plant material, tillage depth, planting methods, crop cycle length, pest and disease control techniques, soil management techniques, and land area under wild cassava cultivation. The main economic variables included farming motivation, harvested products, quantities, selling prices, and constraints encountered. Data collection for this study was conducted using a combination of semi-structured questionnaires, direct observations, focus group discussions, and key informant interviews, supplemented by audio recordings to ensure data accuracy. The participation of highly qualified participants, including agricultural experts, association representatives, and rural technicians, was justified by their in-depth understanding of the local context and sectoral dynamics, which enriched the data quality and provided expert insights.

Each session lasted approximately one and a half to two hours; challenges, such as managing divergent opinions and lengthy discussions, were mitigated by a skilled moderator who facilitated consensus building and maintained a respectful and inclusive climate throughout the discussions.

Data analysis. The qualitative data from the surveys, observations and focus groups were analysed using a thematic approach (Braun and Clarke, 2006), allowing for the identification of practices, motivations and constraints. The quantitative data were processed using the the Statistical Package for Socio-scientists (SPSS) software (Version 2.5).

The data analysis was conducted by addressing distinctly the socio-economic and phytotechnical significance of *Manihot glaziovii* cultivation. Regarding the socio-economic aspect, qualitative data from interviews and focus groups were analysed thematically (Braun and Clarke, 2006) to identify the motivations, constraints and economic behaviours of farmers. Quantitative variables such as demographic data, harvested quantities and selling prices were statistically synthesized using descriptive statistics (percentages, means, standard deviations) in SPSS (Version 2.5).

Phytotechnical importance was assessed by analysing agronomic variables such as sowing methods, ploughing depth, crop cycle duration, and pest control techniques, using descriptive statistics and inferential tests (ANOVA or Chi-square tests), examining their effects on productivity indicators such as the amount of leaves harvested and plant growth. This dual approach provided a better understanding of the influence of social factors on adoption and commercialisation, as well as the impact of technical practices on crop performance and sustainability.

Descriptive: frequencies. This included percentages, means, standard deviations, allowing us to characterise the socio-economic profile of farmers, their farming practices, and their perceptions.

Hypothesis testing. This was purposely to assess the influence of qualitative variables (e.g. planting method, plowing depth) on quantitative variables (e.g. quantity of leaves harvested, plant height), using the ANOVA or chi-square test, depending on the nature of the variables (Fisher, 1925). Significant means were separated using Tukey's method (or other appropriate post-hoc test) at $P<0.05$ level of significance.

Although classical null hypothesis significance testing (NHST) methods, as described by Fisher (1925), were initially used, recent methodological advances have been considered to improve the robustness of statistical inferences. In this study, NHST were complemented with effect size measures and confidence intervals to better understand the practical significance of the results (Wasserstein *et al*., 2019). This approach is consistent with contemporary statistical best practices by not relying solely on p-values but by incorporating broader indicators of the strength of evidence to interpret the influence of socioeconomic and phytotechnical variables on *Manihot glaziovii* cultivation outcomes.

Validation and reliability. All data collection instruments (questionnaires, observation guides, interview guides) were pre-tested in pilot areas, to ensure their consistency and adaptation to the local context. Preliminary testing of the data capture tools identified and corrected ambiguous or culturally inappropriate questions, ensuring clarity and improving respondent understanding. Feedback from the pilot phase also helped adjust the flow and length of the questionnaire, optimising data quality and minimising respondent fatigue during data collection. Interviewer training ensured the reliability of the collected data (Kouadio *et al*., 2020). Triangulation of methods (questionnaires, observations, focus groups) strengthened the validity of the results. To ensure effective communication, all data collection tools and interviews were translated and conducted in Swahili, the locally predominant language among respondents, with the assistance of trained bilingual moderators fluent in both scientific terminology and local dialects. Complex scientific concepts were carefully simplified and explained using culturally relevant analogies, thus ensuring the comprehension and accuracy of respondents' responses.

Ethical considerations. Participants were informed of the purpose of the study, and their informed consent was obtained verbally or in writing, depending on participants' preferences and literacy levels, to ensure their full

understanding and voluntary consent to participate. In addition, all focus group sessions and key informant interviews were recorded with prior permission to maintain an accurate record of the discussions while maintaining participant confidentiality. Data confidentiality was respected in accordance with ethical principles of research (Kayudi and Henrotte (2023)

RESULTS AND DISCUSSION

Socio-economic profile of farmers

Gender issues. Analysis of the socio-demographic profile of farmers revealed a predominance of men in agricultural activities, with a notable proportion of women involved in marketing (39%) (Fig. 1), which highlights the active participation of women in the sector, particularly in the sale of leaves.

Education level. The majority of farmers (44 and 37%) had a secondary or university level of education, especially in the city of Lubumbashi (Fig. 2) , which could positively influence their ability to adopt modern or innovative wild cassava cultivation practices. *Age and experience.* The age distribution (16 to 69 years) indicates a relatively mature workforce, with an average of around 42 years and an average experience of nearly 4 years in cultivation of wild cassava (Table 1), suggesting relative stability but also potential for development; if specific training is reinforced.

Nature of occupation. The diversity of occupations such as agricultural trade and civil service, trade in no-agricultural products, students, and other civil service; which reflected a multifaceted exploitation activity, which can promote the dissemination of practices and the economic valorisation of *M. glaziovii* in different socio-professional contexts.

The results reveal a male preponderance in *M. glaziovii* cultivation, accompanied by significant female participation in leaf marketing (Fig. 1). This distribution is consistent with previous observations in sub-Saharan Africa, where women play a crucial role in the agricultural value chain, particularly in product sales and processing (Nweke *et al*., 2002).

The majority of secondary or university education levels (44 and 37%) in Lubumbashi, as shown in Figure 2, demonstrate greater adoption of modern and innovative agricultural practices (Kouadio *et al*., 2020). The diversity of farmers' economic activities (commerce, civil service, students) indicates socioeconomic integration that could facilitate the dissemination of agricultural practices for the development of wild cassava (Mutangase *et al*., 2018).

Phytotechnical significance

Source of materials. Most of wild cassava plant materials were sourced from neighbouring households (95.33%) (Fig. 3); indicating a heavy reliance on local plant

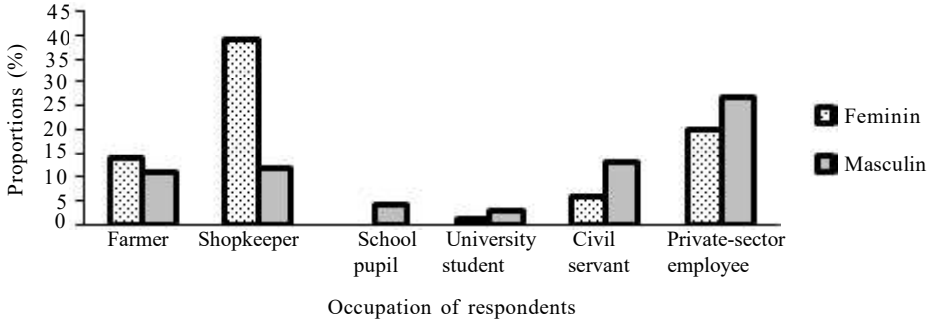

Figure 1. Distribution of *M. glaziovii* farmers by gender and occupation in the study area.

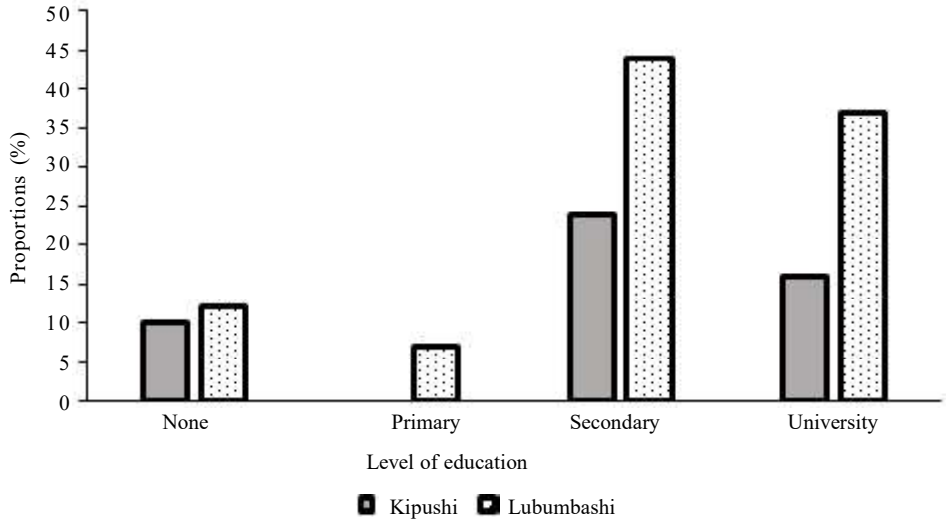

Figure 2. Distribution of wild cassava farmers by education level in the study area.

TABLE 1. Shows the variation in age and experience in the cultivation of *M. glaziovii*

Quantitative variables	Minimum	Average	Maximum
Age (years)	16	41,66±12,25	69
Length of service (years)	1	3,97±2,26	10

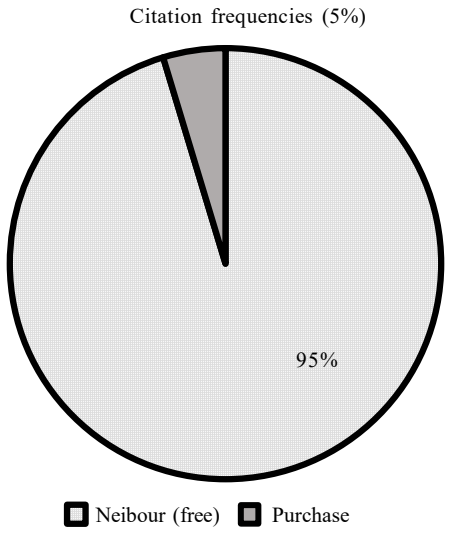

Figure 3. Source of *M. glaziovii* planting materials used in the study area.

propagation, which is inexpensive but potentially risky in terms of genetic diversity and cutting disease transmission.

Soil tilth. The majority of farmers used hand-hoes (100%) for ploughing, preferring a depth of 25 cm (83%) (Fig. 4); which demonstrates an adaptation to traditional practices, without systematic recourses to switch to more sophisticated soil preparation techniques.

Mode of field cultivation. The majority preferred flat field cultivation (73.3%) (Fig. 5); suggesting simplicity of implements, but also a possible limitation in terms of soil management or erosion control. These

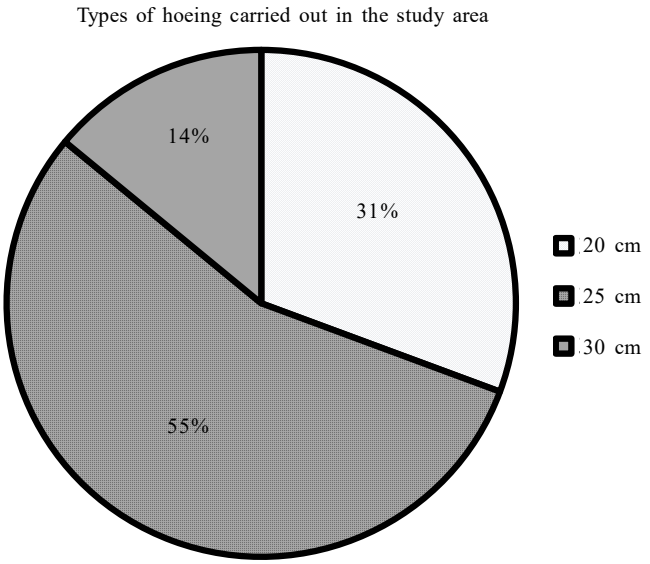

Figure 4. Types of ploughing and equipment used in the study area.

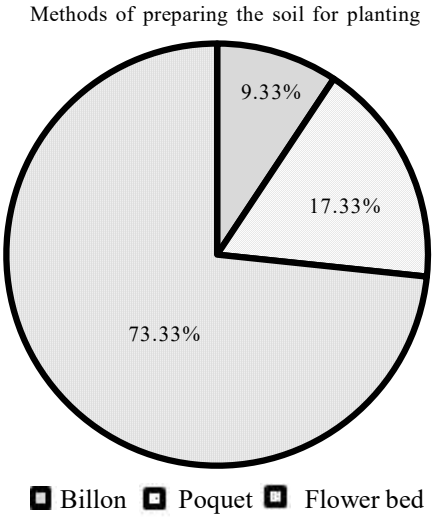

Figure 5. Methods of preparing the soil for planting.

cultivation practices, although ancestral, must be evaluated to optimise productivity while ensuring ecological sustainability.

The overwhelming reliance on local propagation through cuttings from neighbouring households (95.33%) highlights the importance of traditional knowledge in the expansion of *Manihot glaziovii*, but also raises concerns about low genetic diversity and the potential risks of disease transmission present in plant material (Gomes *et al*., 2014). Limited genetic diversity can affect the resilience of plantations to biotic and abiotic stresses, making it necessary to implement varietal improvement and appropriate health management programmes (Fouad *et al*., 2019).

The exclusive use of manual hoeing, with a clear preference for a depth of 25 cm (83% of farmers), illustrates a strong adaptation to ancestral practices, but also a lack of access to or reluctance towards more modern and mechanised techniques. Although these practices facilitate work that is affordable to local farmers, they can limit the optimisation of root development, soil aeration and erosion control, which are essential factors for long-term productivity and the ecological sustainability of crops (Kabeya *et al*., 2018; Mutangase *et al*., 2018).

The predominance of flat field cultivation (73.3%) suggests simplicity of implementation, but raises the question of managing the risks of water erosion and leaching, especially in the context of the environmental conditions in the Lubumbashi region. More innovative agroecological practices, such as ridge or contour farming, could be encouraged to improve soil fertility and ensure sustainable use of natural resources (Nweke *et al*., 2002; Gomez *et al*., 2017). It is therefore crucial to evaluate these traditional methods in terms of their agronomic effectiveness while preserving local biodiversity and soil health.

Overall, these results confirm the need to support farmers with targeted training on the integration of innovative and ecologically appropriate technical practices, while promoting traditional local knowledge. This dual objective would help to maximise yields and preserve ecosystems, thereby promoting the sustainable development of the wild cassava sector in the region (Fisher, 1925; Kouadio *et al*., 2020).

Evaluation of the price of cassava leaves in the two areas studied. The difference in cassava leaf sales prices between Kipushi (1.25 USD kg^{-1}) and Lubumbashi (0.9 USD kg^{-1}) is statistically significant, highlighting economic disparities related to location, demand, and marketing methods. This variation highlights the potential benefits of developing more structured marketing channels and promoting the value of cassava leaves as a high-value product, particularly in the Kipushi region. Differentiated pricing may also reflect perceptions of quality or local competition, factors that should be analysed to strengthen the sector. By integrating these results, appropriate strategies can be developed to improve the profitability and economic sustainability of the crop.

The marked differences in the selling prices of leaves between Kipushi and Lubumbashi (Table 2) reflect economic disparities linked to demand, marketing methods and perceptions

TABLE 2. Unit sales price of cassava leaves by location

Retail outlets	Average unit price in CDF	
Kipushi	1.25[a]	
Lubumbashi	0.9[a]	
t = 7.9382,	df = 26,	P-value = 2.045e-08

of quality (Nweke *et al*., 2002). The development of better structured commercial circuits in these areas could strengthen the sector, in particular by further promoting these leaves as a high value-added product (Kouadio *et al*., 2020).

CONCLUSION

This study highlights the potential of wild cassava *Manihot glaziovii* for food security, agricultural diversification and local economic development, despite its still small-scale exploitation. The demographic and economic diversity of farmers promotes the dissemination of good practices (Nweke *et al*., 2002). Phytotechnical results demonstrate the positive impact of optimised cultivation techniques on leaf productivity, reinforcing the contribution of wild cassava to agroecological sustainability (Fisher, 1925). The commercial disparities identified highlight the importance of institutional support to structure the sector and promote this resource (Kouadio *et al*., 2020).

To better support this dynamic, research on the domestication and genetic improvement of *Manihot glaziovii* should be strengthened, as should technical training for farmers. These measures, combined with better market organisation and an integrated approach combining technical innovations and ancestral practices, could amplify the socio-economic and ecological benefits observed (Fouad *et al*., 2019).

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