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Urban Trade of Non-Timber Forest Products (NTFPs) in Kolwezi, DR Congo: Diversity, Livelihoods, and Sustainability Changes

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Abstract

The urban trade in non-timber forest products (NTFPs) plays a crucial role in the resilience of populations in the Global South while exerting increasing pressure on ecosystems. This study analyses the dynamics of these resources in Kolwezi (DR Congo), a rapidly expanding mining city where data on these value chains remain fragmented. The methodological approach is based on interviews conducted with 35 vendors in two main urban markets and 384 users across different city neighbourhoods to characterize the diversity, socio-economic importance, and perceived factors responsible for the decline in NTFP availability. The results reveal a high level of biocultural diversity, with 65 species recorded (49 plant, 14 animal, and 2 fungal), closely linked to miombo ecosystems. Medicinal (59.3%) and food (29.4%) uses predominate, represented by multifunctional species such as *Bobgunnia madagascariensis*, *Canarium schweinfurthii*, *Terminalia mollis*, *Gardenia ternifolia*, and *Albizia antunesiana*. From a socio-economic perspective, the NTFP trade is a permanent activity and a key livelihood pillar, largely carried out by women (79.1%). Monthly gross incomes, ranging from USD 9 to 429.3, depend primarily on the volumes sold. However, the sector is weakened by logistical constraints and a decline in resource availability in urban markets. Respondents mainly attribute this scarcity to deforestation, mining expansion, overexploitation, and climate change. Ensuring the sector's sustainability requires integrated strategies, including the domestication of priority species, improved organization of stakeholders, and restoration of miombo landscapes, to reconcile the maintenance of socio-economic benefits with the conservation of natural ecosystems.

Keywords: urban markets; *miombo* woodland; supply chain; informal economy; food security; ecosystem services

1. Introduction

Non-timber forest products (NTFPs) constitute a major component of the ecosystem services provided by tropical and subtropical forests, contributing to biodiversity conservation, local well-

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being, and socio-ecological resilience [1,2]. Defined as all biological products other than timber derived from forests, woodlands, and trees outside forests, NTFPs encompass a wide range of plant, fungal, and animal resources used in food systems, traditional medicine, and livelihood activities across many regions of the Global South [3–5]. Beyond their subsistence role, these products are increasingly embedded in commercial dynamics that connect forest ecosystems to local and regional markets [6,7].

In rapidly expanding urban centers of developing countries, demand for NTFPs has increased sharply due to population growth and the diversification of dietary and therapeutic practices. Urban populations continue to rely on traditional food and medicinal products, fostering the emergence of dynamic, but largely informal, urban markets that connect cities to their forested hinterlands [8,9]. However, this urban demand places increasing pressure on source ecosystems, particularly when supply relies on wild harvesting in natural environments without effective regulatory mechanisms [10]. Urban markets thus become as drivers of spatially displaced ecological pressures, contributing to the overexploitation of certain species.

Miombo ecosystems, which dominate the southeastern part of the Democratic Republic of the Congo (DRC), represent one of the region's principal reservoirs of NTFPs [11–14]. These ecosystems are nevertheless subject to intense disturbances linked to deforestation, shifting cultivation, charcoal production, mining expansion, and climate change, resulting in progressive habitat degradation and reduced availability of NTFP source species [15,16]. Although the ecological and ethnobotanical importance of NTFPs in southeastern DRC has been documented [12,17–22], knowledge remains limited regarding their role in urban markets, particularly in rapidly growing mining cities such as Kolwezi. Information on product diversity, trade organization, traded volumes, income generation, and local perceptions of resource scarcity remain fragmented, thereby constraining the development of sustainable management strategies.

Against this background, the present study seeks to fill these gaps by analyzing the urban trade of NTFPs in Kolwezi to (i) document the diversity of marketed species, (ii) examine market structure and traded volumes, (iii) assess the economic importance of NTFPs for vendors, and (iv) analyse local perceptions of resource decline and sectoral constraints. The study tests the following hypotheses: (1) the diversity of traded NTFPs, dominated by medicinal and food species, reflects a strong urban dependence on *miombo* ecosystems, leading to increased pressure on the most versatile and sought-after species; (2) the NTFP trade in Kolwezi, largely dominated by women, constitutes a major socio-economic activity for involved households but faces structural and logistical constraints; and (3) deforestation, mining expansion, and overexploitation are perceived as the main factors responsible for the decline in availability of NTFP in urban markets.

2. Materials and Methods

2.1. Study Area

The present study was conducted in the city of Kolwezi, located in Lualaba Province in the southeastern part of the DRC (Figure 1). Located at 10°43′ S and 25°28′ E, at an altitude of approximately 1,500 m on the Manika Plateau, the city lies within the Katangea Copperbelt, which hosts the country's largest copper–cobalt deposits [23]. This mining context subjects the region to strong ecological and demographic pressures, mainly driven by the intensification of extractive activities.

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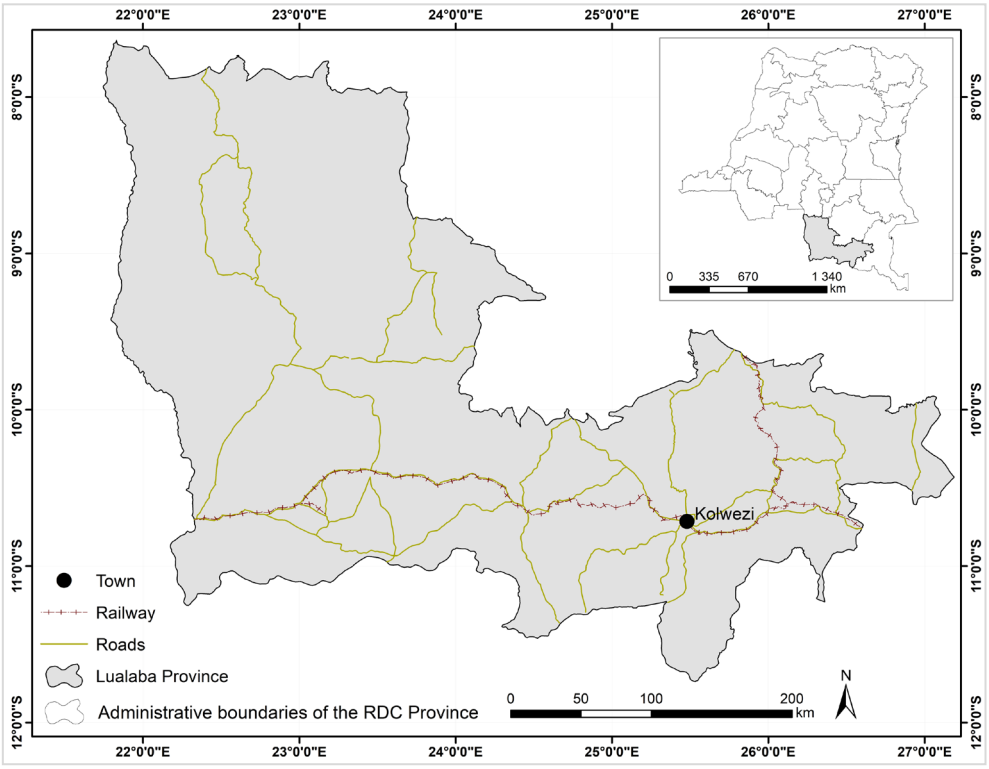

Figure 1. Location of the city of Kolwezi in Lualaba Province, southeastern Democratic Republic of Congo.

The climate of Kolwezi is classified as type "Cw" according to the Köppen system, characterized by a rainy season from November to April and a dry season during the remainder of the year [24]. However, ref. [25] reported the existence of a cool dry season (May–July), a hot dry season (August–September), an early rainy season (October–November), a peak rainy season (December–February), and a late rainy season (March–April) based on phenological observations of vegetation. Total annual rainfall ranges between 1,200 and 1,600 mm, while average annual temperatures vary from 17 to 25 °C [12].

The soils are predominantly Ferralsols, highly weathered, nutrient-poor, and prone to erosion in the absence of vegetation cover [26]. These edapho-climatic conditions determine the structure of *miombo* woodland, the dominant vegetation formation, alongside dry forests (*Muhulu*), gallery forests (*Mushitu*), savannas, and marshy grasslands [12]. Around the city, however, this natural vegetation has undergone marked regression due to increasing anthropogenic pressures [27,28]. With a population of approximately 800,000 inhabitants, the local economy is primarily based on mining, agriculture, and a dynamic (largely informal) commercial sector [29,30], which includes the trade in NTFPs.

2.2. Methods

2.2.1. Market Selection and Population Sampling

Two central markets in Kolwezi, Kasulo and Manika, were selected for this study. Identified during preliminary surveys as the main trading hubs, these markets concentrate the majority of NTFP commercial flows on the urban scale. In the absence of reliable statistical data on the total number of NTFP sellers and given their strong spatial dispersion within the markets, a non-probabilistic sampling approach was adopted. The sample was constructed using a combination of itinerant approach and snowball sampling to progressively locate active sellers and ensure spatial and functional coverage of sales points [31]. This methodological combination aims to minimize omissions rather than achieving strict statistical representativeness. A total of 35 NTFP sellers were surveyed, including 15 in Kasulo and 20 in Manika, representing nearly all regular sellers present

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during the study period. The sample size was validated using the principle of information saturation, reached when additional interviews no longer provided qualitatively new insights [32].

To assess use value and user perceptions regarding the availability of NTFPs in urban markets, a stratified systematic sampling approach was implemented. Given the lack of an exhaustive sampling frame and the dispersed nature of NTFP users in urban areas, the city was divided into two geographical strata to account for socio-spatial heterogeneity [33]. Stratification was based on urban planning characteristics and access to basic services: a stratum of relatively well-serviced neighbourhoods (Moïse Tshombé and Mutoshi) and a stratum of more densely populated and under-serviced neighbourhoods (Mununka and Kasulo) (Table 1). Within each stratum, two survey routes were defined. Households were selected using a sampling interval of k = 5 after a random draw of the starting point had been chosen. Inclusion criteria required respondents to (i) have consumed at least one NTFP during the previous 30 days and (ii) have resided in the household for at least six months, in accordance with standards for measuring food consumption practices [34,35]. On this basis, individual interviews were conducted with 384 household heads who were NTFP users. A "household" was defined as all persons living in the same dwelling, regardless of kinship ties [36].

To minimize potential biases, several measures were applied, including alternating survey days and times (weekdays versus weekends; morning versus afternoon) and strict substitution rules (replacement allowed only after two consecutive absences).

Table 1. Demographic characteristics and sample size of NTFP users in the different neighbourhoods covered by this study. *, Relatively well-serviced neighbourhoods.

Neighbourhoods	Street	Total Number of Households	Sample Size
Kasulo	Kimbangu	356	130
Moïse Tshombe*	Masengo	189	57
Mununka	Likasi	423	158
Mutoshi*	Masengo	127	39
Total		**1 095**	**384**

2.2.2. Data Collection

Individual interviews guided by semi-structured questionnaires, were conducted in accordance with the study objectives [37]. For NTFP sellers, the data collected included socio-demographic profile (gender, age, education level), diversity of species traded, the organs sold and their uses, supply areas, marketing channels, unit selling prices, quantities sold per month, constraints related to NTFP trade, and suggestions for improving the sector. Reported sales units were converted into kilograms (kg) to estimate monthly gross income. This conversion was based on average equivalencies established through repeated observations and occasional weighing conducted from markets.

Socio-demographic data were used to characterize the surveyed sellers and assess their capacity to provide consistent and detailed information. Respondents were grouped into three age categories (Young: 18–35 years; Adult: 36–60 years; Elderly: ≥ 61 years), following the classifications used by Dieng et al. [38]. For education level, respondents were classified into four groups: uneducated, primary level, secondary level, and university level.

Information collected from users focused on NTFP species consumed, organs used and their purposes, quantities purchased monthly, perceptions of NTFP availability in markets, perceived causes of scarcity, and proposed strategies for preserving and/or restoring NTFP abundance in urban markets. Data from individual interviews were collected using the Kobo Collect application (Version 2025.2.3), which enabled direct field entry and automatic export to Excel format, thereby reducing manual data-entry errors. Surveys were conducted between 28 June and 5 October 2025.

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Taxonomic identification of species, initially recorded under their vernacular names, was carried out using available floras (Flora of Zambia, Flora of Zimbabwe, and World Flora), as well as scientific articles, specialized books, manuals, and identification guides [12,20,22,39,40].

2.2.3. Sources of Uncertainty and Limitations

Data relating to quantities sold and purchased monthly were based on respondents' self-reports and are therefore subject to potential recall bias, social desirability bias, and under- or over-estimation. In addition, the conversion of local sales units into kilograms represents an additional source of uncertainty, as volumes may vary depending on species, freshness, and individual packaging practices.

These uncertainties were mitigated by using average equivalences based on repeated field observations and by cross-referencing responses between sellers and users. Nevertheless, the results should be interpreted as approximate estimates intended to identify orders of magnitude and general trends rather than precise absolute values.

2.2.4. Data Analysis

Qualitative data were analyzed using descriptive statistics (relative frequencies), enabling a clear representation of the distribution of responses across categorical variables. To identify the NTFPs most traded and used in Kolwezi, citation frequency (F) was calculated using R software (version 4.5.1) based on survey data. This approach relied on the assumption that species most frequently mentioned by respondents are those most sold or used [41,42]. The equation used to determine citation frequency is presented below (*Equation 1*):

$$F = \left(\frac{S}{N}\right) \text{ x } 100 \quad (1)$$

Where S represents the number of respondents citing the species, and N is the total number of respondents. A frequency (F) close to 0 indicates that the species is rarely sold or used, whereas a value of 100 indicates that it is widely sold or used [42,43].

Furthermore, the use value (UV) was calculated (*Equation 2*) to determine the relative importance of each species [44]. The UV provides an approximate measure reflecting the social and economic significance of a species, as it is proportional to its level of use among respondents. It is commonly applied to rank NTFP source species according to their domains of use (food, medicinal, handicraft, construction, etc.). The use value has been widely employed in previous studies, notably by Dossou et al. [43], Kouakou [45], and Tsobou et al. [42].

$$UV_{(i)} = \frac{\Sigma_i^n Si}{n} \quad (2)$$

Where UV(i) is the use value of species i within a given use category, Si represents the use score assigned by respondents, and n is the number of respondents in that specific use category. The use value of a species within a given category therefore corresponds to the average use score recorded for that category. An importance score was assigned to each species by respondents using a demand rating scale ranging from 0 to 3. Species with the highest use values are considered highly important and strongly sought after by local populations [41,46]. Thus, the use value allowed the identification of the most highly utilized species in Kolwezi.

3. Results

3.1. Socio-Demographic Profile of NTFP Vendors in Kolwezi

The trade in NTFPs in the markets of Kolwezi is largely dominated by women, who account for 79.1% of sellers, compared to 20.9% of men. Most respondents were adults aged 36 to 60 years (66.7%), while younger sellers (18–35 years) represented 30.8%, and those over 60 years constituted only a small proportion (2.5%). Regarding education level, more than half of the sellers attended secondary school (60.9%), and 15% had received university education (Table 2). These adult vendors, often

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experienced and socially established with relatively good educational backgrounds, are likely to have a clearer perception of the constraints associated with this trade.

Table 2. Socio-demographic characteristics of NTFP sellers across different markets in the city of Kolwezi. n, Sample size.

Profile of Sellers	Markets		Average Percentage (%)
	Manika (*n* = 20)	Kasulo (*n*= 15)	
Gender (%)			
Woman	85.0	73.3	79.1
Mame	15.0	26.7	20.9
Age range (%)			
Young (18 – 35 years)	35.0	26.7	30.9
Adult (36 – 60 years)	60.0	73.3	66.7
Old (> 60 years)	5.0	-	2.5
Education level (%)			
Uneducated	5.0	-	2.5
Primary school	30.0	13.3	21.7
Secondary school	55.0	66.7	60.9
University level	10.0	20.0	15.0

3.2. Taxonomic Diversity and Uses of Non-Timber Forest Products Sold in Kolwezi Markets

Surveys conducted in the two main urban markets of Kolwezi, which host NTFP sellers from various regions, identified 65 traded NTFP species, including 49 plant species, 14 animal species, and 2 fungal species (Figure 2; Table A1). These species belong to 57 genera and 40 families and are sold for food, medicinal, handicraft, ritual, and construction purposes. Medicinal species largely dominate the trade, accounting for 59.3% of the recorded species, followed by food species (23.4%), whereas species used for ritual, artisanal, and construction purposes remain marginal (Figure 3). Some species show particularly high citation frequencies, reflecting their socio-economic importance, notably *Albizia antunesiana*, *Terminalia mollis*, *Parinari curatellifolia*, *Piper umbellatum*, *Phyllanthus muellerianus*, and *Canarium schweinfurthii* among plant-based NTFPs, as well as *Burtoa nilotica*, *Pelusios nanus*, *Bitis gabonica gabonica*, and *Apis mellifera adansonii* (honey) among animal-derived NTFPs. Fungal NTFPs are exclusively represented by two edible species, *Cantharellus afrocibarius* and *Termitomyces microcarpus*. The plant or animal parts marketed vary according to species, reflecting the diversity of uses and valorisation practices observed in Kolwezi markets (Figure 4).

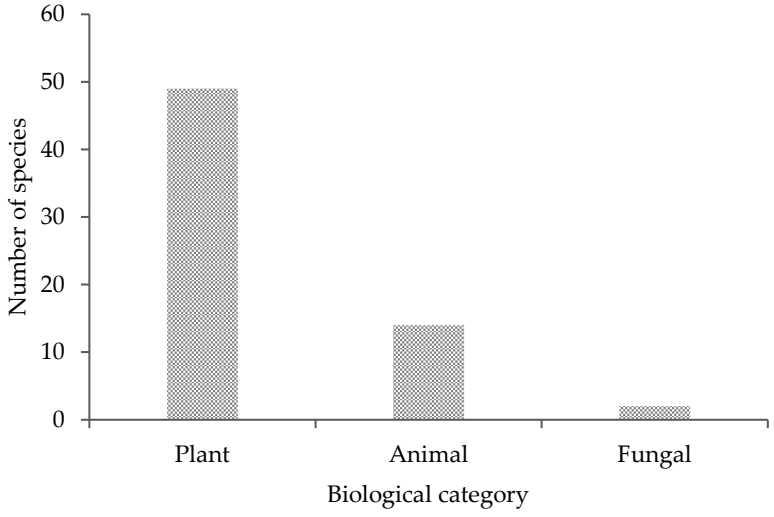

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Figure 2. Number of non-timber forest product (NTFP) species by biological category sold in the Kolwezi market, DRC.

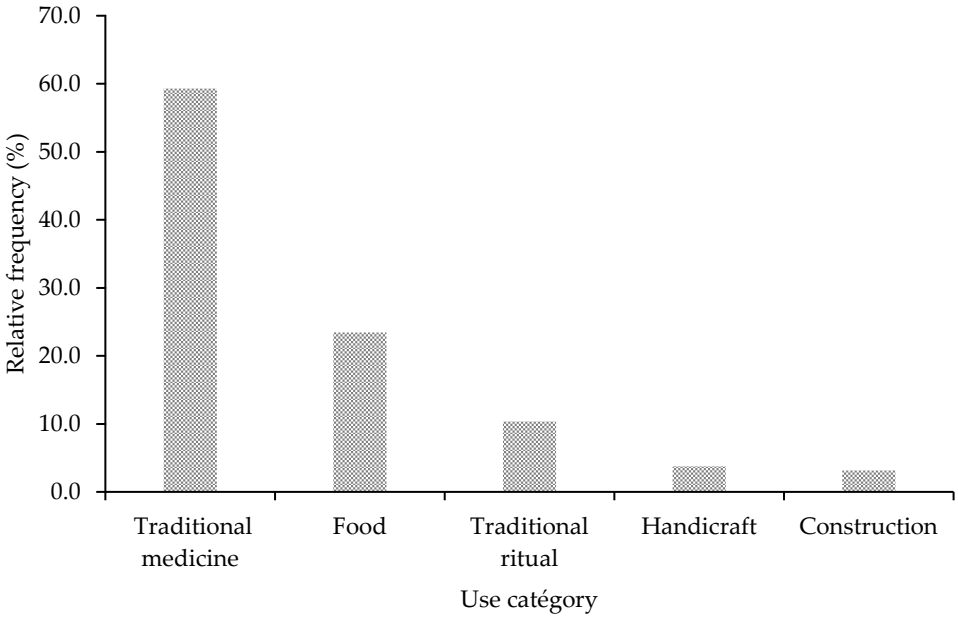

Figure 3. Use categories of non-timber forest products (NTFPs) sold in the markets of Kolwezi, DRC.

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Figure 4. Some non-timber forest products (NTFPs) sold in the markets of Kolwezi, DRC. ***a***, Stall selling NTFPs; ***b***, Leaves of *Piper umbellatum*; ***c***, Fruits of *Uapaca kirkiana*; ***d***, Barks of *Albizia adianthifolia*; ***e***, Roots of *Rhynchosia insignis*; ***f***, Fruits of *Anisophyllea boehmii*; ***g***, Resin of *Canarium schweinfurthii*; ***h***, Tubers of *Satyrium buchananii*; ***i***, Seeds of *Canarium schweinfurthii*; ***j***, *Macrotermes falciger*; ***k***, Caterpillars of *Lobobunaea saturnus*; ***l***, Carapace of *Pelusios nanus*; ***m***, Shells of *Burtoa nilotica*; ***n***, *Cantharellus afrocibarius*; ***o***, meat portion of *Bitis gabonica gabonica*; ***p***, meat portion of *Potamochoerus porcus*; ***q***, meat portion of *Sylvicapra grimmia*; ***r***, Bottles of *Canarium schweinfurthii* oil; ***s***, Bottles of honey (*Apis mellifera adansonii*). (Photo credits: Kikuni, J.T., 2025).

3.3. Supply Areas and Marketing Channels for NTFPs in Kolwezi, DRC

In total, eight provinces of the DRC contribute to the supply of NTFPs to the urban markets of Kolwezi (Figure 5, Table A2). The Lualaba province is by far the main source area, providing approximately 70% of the marketed volumes, highlighting the strong dependence of the urban market on surrounding rural areas where collection activities are concentrated. Secondary but significant flows come from Haut-Lomami (12.3%), Kasaï Central (8%), and Kasaï Oriental (5%), indicating the existence of well-established interprovincial exchange networks. More marginal

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contributions are recorded from Lomami (2%), Haut-Katanga (1%), Kasaï (0.8%), and Kwilu (0.5%). Finally, occasional inputs from Kinshasa (0.4%) underscore the sporadic integration of the Kolwezi market into national NTFP trade circuits, likely for products with high cultural or gastronomic value for a specific category of consumers.

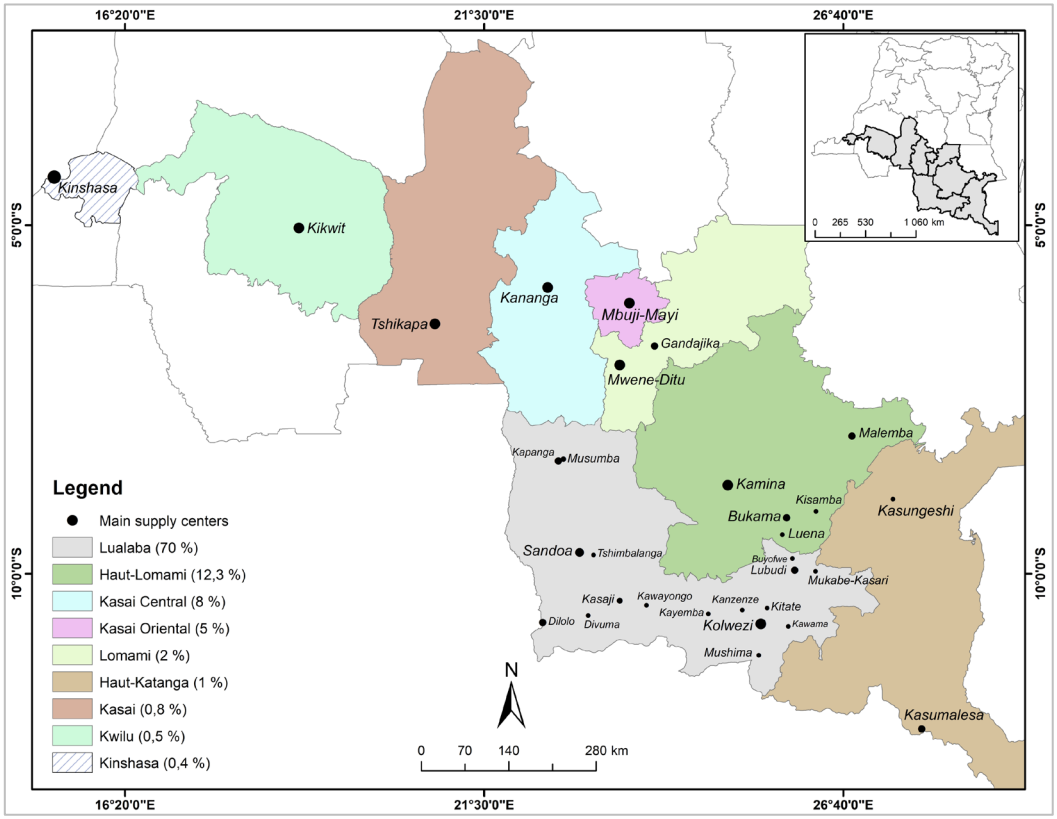

Figure 5. Main supply areas of non-timber forest products (NTFPs) sold in the Kolwezi market, DRC. Black dots indicate the villages and towns reported by sellers as sources of the NTFPs commercialized in the Kolwezi market.

The marketing circuit of NTFPs in the Kolwezi region is illustrated in Figure 6, showing the relationships among the different actors in the value chain. Collectors (gatherers, harvesters, hunters), mainly residing in rural areas, exploit wild resources for both subsistence and sale. They sell their products to wholesale resellers, who sometimes spend several days in the villages awaiting deliveries. Once in the city, whether they use transporters, these wholesalers sell the products to retailers, who then make them available to consumers. In some cases, collectors bring their products directly to urban markets, with or without using transporters, where they sell them in bulk to retailers or in small quantities to consumers. This indicates that some actors may simultaneously act as collectors and retailer-sellers. The largely informal nature of this marketing circuit reflects the lack of formal organization by public authorities and the absence of structured trade associations.

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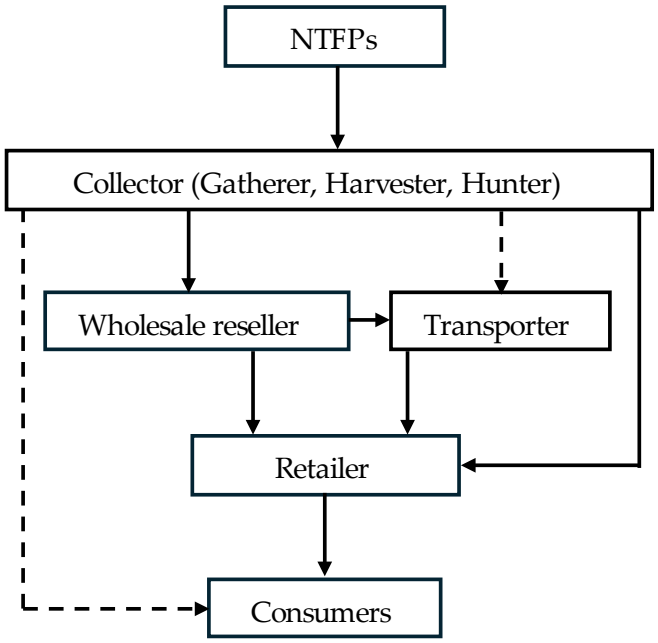

Figure 6. General diagram of the marketing channels for non-timber forest products (NTFPs) in the Kolwezi region. Solid arrows indicate the most frequent trade pathways, while dashed arrows represent less frequent ones.

3.4. Market Value of NTFPs and Their Contribution to Sellers' Income in Kolwezi, DRC

The market value of NTFPs, the quantities sold per month, and the monthly gross income earned by a seller in Kolwezi vary according to different use categories, ranging from USD 0.9 to 160 per kg, 0.8 to 110.4 kg, and USD 9 to 429.3 per month, respectively. The highest market value was recorded for NTFPs used in traditional rituals (*C. schweinfurthii*), while the lowest was observed for food-use NTFPs (P. aquilinum). The highest quantity sold was noted for NTFPs used in handicrafts (*A. adianthifolia*). In contrast, the highest gross income was generated by food-use NTFPs (*Sylvicapra grimmia*), and the lowest by those used for handicrafts (*Albizia versicolor*) (Table 3).

Table 3. Market value, quantities sold, and commercial margins of the five most traded NTFPs on the Kolwezi market, DRC. Species are listed alphabetically according to NTFP categories. NTFPs sourced from areas outside Lualaba Province were excluded from this table, and in cases of equal values, species were counted as a single entry. Cf, indicates the frequency of citation, "–" indicates that the species was not reported by the seller. *, plant-based species; **, animal-based species; ***, fungal species. All liquid products were converted and expressed in kilograms (kg). Average weights of pestle = 1.81 kg; mortar = 9.2 kg; blender = 0.25 kg; handle = 0.78 kg. Exchange rate : 1 USD = 2500 CDF.

Species	Markets (Cf %)		Organ/part or object sold	Selling price (USD/kg)	Quantity sold per month (kg)	Monthly gross income (USD)
	Manika (*n*= 20)	Kasulo (*n*=15)				
Food use						
*A. boehmii**	40.0	33.3	Fruit	2.8	40.0±2.1	112.0±5.8
*A. marginata***	-	13.3	Snail	4.4	9.1±0.2	40.0±0.8
*A. senegalensis**	-	20.0	Fruit	1.0	19.0±1.0	19.0±1.0
*B. gabonica gabonica***	-	13.3	Meat portion	57.4	2.3±0.2	132.0±11.5
*C. afrocibarius****	35.0	-	Cap + Stipe	4.0	19.8±0.5	79.2±0.2
*C. gambianus***	-	13.3	Whole animal	22.2	7.0±1.1	155,4±24.4
*C. hottentotus***	-	20.0	Whole animal	28.6	6.5±1.5	185.9±42.9
*E. benguelensis**	-	13.3	Fruit	4.0	7.0±0.2	28.0±0.8
*E. lactea***	-	20.0	Caterpillar	20.0	15.3±0.5	306.0±10.0
*I. epimethea***	-	20.0	Caterpillar	18.0	10.5±0.5	189.0±9.0
*M. falciger***	-	13.3	Termite	6.7	10.8±0.2	73.4±1.3

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Species	Markets (Cf %)		Organ/part or object sold	Selling price (USD/kg)	Quantity sold per month (kg)	Monthly gross income (USD)
	Manika (*n*= 20)	Kasulo (*n*=15)				
*A. mellifera***	-	33.3	Bottle	6.8	19.6±0.9	133.3±6.12
P. aquilinum	-	33.3	Frond	0.9	19.4±0.2	17.5±0.18
*P. umbellatum**	50.0	53.3	Leaf	4.0	60.5±0.4	242.0±1.6
*P. porcus***	-	13.3	Meat portion	21.1	4.7±1.0	99.2±21.1
*R. insignis**	25.0	20.0	Root	1.8	19.8±0.9	35.64±1.6
*S. buchananii**	40.0	53.3	Tuber	8.0	15.6±0.2	124.8±1.6
*S. cocculoides**	40.0	53.3	Fruit	1.4	9.1±0.6	12.7±0.8
*S. grimmia***	30.0	-	Meat portion	40.5	10.6±1.1	429.3±44.55
*T. microcarpus****	35.0	33.3	Cap + stipe	5.7	16.8±2.3	95.8±13.1
*U. kirkiana**	-	13.3	Fruit	1.0	50.8±3.5	50.8±3.5
Use in traditional medicine						
*A. adianthifolia**	60.0	73.3	Bark or root	10.4	6.5±0.3	67.6±3.1
*A. antunesiana**	95.0	66.7	Root	3.0	86.4±1.4	259.2±4.2
*B. madagascariensis**	55.0	-	Root or bark	5.0	56.8±0.1	284.0±0.5
*C. schweinfurthii**	50.0	46.7	Resin	4.0	36.3±0.5	145.2 ±2.0
*C. cobisieri**	-	40.0	Root (powdered)	16.0	2.5±0.1	40.0±1.6
*D. condylocarpon**	50.0	-	Root	4.0	21.9±1.0	87.6±4.0
*P. curatellifolia**	50.0	53.3	Root	10.0	6.1±1.3	61.0±13.0
*P. muellerianus**	50.0	40.0	Root	8.0	5.4±0.6	43.2±4.8
*S. longipedunculata**	45.0	40.0	Root	12.0	12.9±2.0	154.8±24,0
*T. mollis**	85.0	53.3	Root or bark	10.0	25.4±1.2	254.0±12.0
*Z. chalybeum**	-	46.7	Root	10.0	6.4±2.4	64.0±24.0
Use in traditional rituals						
*B. nilotica***	35.0	-	Shell	32.7	2.8±0.1	91.6±3.3
*B. gabonica gabonica **	25.0	6.7	Root or bark	31.9	1.5±0.1	47.9±3.2
C. schweinfurthii	35.0	46.7	Resin / Seed	4.0/160.0	36.3±0.5 / 0.8±0.0	145.2±2.0 / 128.0±0.3
*P. nanus***	30.0	13.3	Carapace	102.0	0.4±0.0	40.8±0.2
*S. longipedunculata**	40.0	40.0	Root	12.0	12.9±3.5	154.8±42.0
*S. quinqueloba**	45.0	20.0	Bark or root	9,3	6.6±1.0	61.4±9.3
Handicraft use						
*A. adianthifolia**	35.0	33.3	Pestle / Mortar	1.7 / 0.92	10.8±0.3 / 110.4±1.5	18.4±0.5 / 101.6±1.4
*A. antunesiana**	45.0	40.0	Pestle / Blender	1.7 / 3.0	9.1±0.5 / 3.5±0.1	15.5±0.9 / 10.5±0.3
A. versicolor	25.0	13.3	Handle / Blender	3.2 / 3.0	3.9±0.2 / 3.0±0.1	12.5±0.6 / 9.0±0.3
*A. senegalensis**	5.0	20.0	Handle	3.2	6.2±2.5	20.0±8.0
*B. madagascariensis**	40.0	26.7	Handle / Mortar	3.2 / 1.7	3.1±1.6 / 25.0±1.2	9.9±5.1 / 42.5±2.0
*B. nilotica***	5.0	-	Carapace	32.7	2.8±0.5	91.6±16.4
Use in hut construction						
*A. adianthifolia**	5.0	20.0	Stem	1.0	31.5±2.3	31.5±2.3
*B. boehmii**	25.0	33.3	Stem	1.0	23.3±4.1	23.3±4.1
B. spiciformis	15.0	40.0	Stem	1.0	25.0±1.6	25.0±1.6
J. paniculata	40.0	46.7	Stem	1.5	60.6±3.8	90.9±5.7
*P. angolensis**	45.0	13.3	Stem	2.0	37.5±0.8	75.0±1.6
*P. tintorius**	5.0	-	Stem	2.0	26.1±2.5	52.2±5.0

3.5. Constraints in the NTFP Trade in Kolwezi and Suggestions for Improvement

The main constraints reported by NTFP sellers in Kolwezi are the remoteness from supply areas (34.2%) and seasonality (25.8%), which limit regular supply and increase transaction costs. Product scarcity (8.3%) and the lack of processed by-products (8.3%) also hinder the competitiveness of NTFPs on the local market. Intermediate constraints include limited access to finance (6.7%) and consumer preference for imported products (5%), reflecting the weak organization of the NTFP trade and growing competition from modern supply chains. Marginal constraints include poor packaging by intermediaries (3.4%), high taxation (3.4%), short shelf life (2.5%), and consumers' limited knowledge

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of NTFP properties (2.5%) (Table 4). These results highlight the weight of structural and logistical constraints affecting the competitiveness and sustainability of NTFP trade in Kolwezi.

Table 4. Constraints affecting the NTFP market in Kolwezi, DRC.

Constraints	Markets (Cf%)		Average percentage (%)
	Manika (*n* =20)	Kasulo (*n* =15)	
Remoteness from supply areas	35,0	33,3	34,2
Seasonality	25,0	26,7	25,8
Lack of processed by-products	10,0	6,7	8,3
Scarcity	10,0	6,7	8,3
Limited access to finance	-	13,3	6,7
Consumer preference for imported products	10,0	-	5,0
Poor packaging of NTFPs by intermediary sellers	-	6,7	3,4
High taxation	-	6,7	3,4
Limited consumer knowledge of NTFP properties	5,0	-	2,5
Short shelf life of NTFPs	5,0	-	2,5

The results presented in Table 5 show that establishing NTFP processing chains is the top priority for sellers in both markets (average 35%), followed by the promotion of cultivation of source species (30.8%), reflecting a strong demand for product valorisation and sustainable availability. Recommendations related to raising awareness of the benefits of local NTFPs (13.4%) and standardizing sales units (5.9%) were less frequent, suggesting that information dissemination and market regulation are considered secondary. In contrast, measures such as tax reduction (5%) and rehabilitation of rural access roads (10%) were specific to certain markets, reflecting fiscal constraints in Manika and infrastructure limitations in Kasulo.

Table 5. Sellers' suggestions for improving the NTFP trade in Kolwezi, DRC.

Recommendations	Markets (Cf%)		Average percentage (%)
	Manika (n =20)	Kasulo (n =15)	
Establish NTFP processing chains	30,0	40,0	35,0±5,0
Promote the cultivation of NTFP source species	35,0	26,6	30,8±4,2
Raise awareness among the population about the benefits of local NTFPs	20,0	6,7	13,4±6,6
Rehabilitating rural access roads	-	20,0	10,0±10,0
Standardize NTFP sales units	5,0	6,7	5,9±0,9
Reduce taxes	10,0	-	5,0±5,0

3.6. Non-Timber Forest Products Commonly Used by the Population of Kolwezi

Use value (UV) and use frequency (Uf) analyses identified seventeen (17) NTFPs as the most used by the population of Kolwezi. The results presented in Table 6 show that several species play a central role in local livelihood systems due to their functional versatility, economic importance, and relative availability. The most highly valued species include *Bobgunnia madagascariensis* (UV = 2.4; Uf = 43.2%), *Canarium schweinfurthii* (UV = 2.3; UF = 60.9%), *Terminalia mollis* (UV = 2.2; Uf = 45.1%), *Gardenia ternifolia* (UV = 2.2; Uf = 36.9%), *Albizia antunesiana* (UV = 2.1; Uf = 76.6%), *Cussonia cobisieri* (UV = 2.0; Uf = 41.1%), *Bitis gabonica gabonica* (UV = 2.0; Uf = 43.2%), and *Zanthoxylum chalybeum* (UV = 2.0; Uf = 48.2%). These species show average monthly household use volumes ranging from 0.5 to 4.3 kg. Their high use values reflect multifunctional uses (food, medicinal, handicraft, ritual, and

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construction) and sustained demand in local markets. However, some of these species have become infrequent (*C. schweinfurthii*, *C. cobisieri*, *B. gabonica gabonica*) or rare (*G. ternifolia* and *Z. chalybeum*).

In contrast, species such as *Strychnos cocculoides*, *Piper umbellatum* (UV = 1.1; Uf = 72.4%), *Anisophyllea boehmii* (UV = 1.0; Uf = 57%), *Sarcocephalus latifolius* (UV = 1.0; Uf = 53.1%), *Elaphrodes lactea* (UV = 1.1; Uf = 33.3%), *Dracaena reflexa* (UV = 1.0; Uf = 34.1%), *Uapaca kirkiana* (UV = 1.0; Uf = 47.1%), *Imbrasia epimethea* (UV = 1.0; Uf = 41.1%), and *Cantharellus afrocibarius* (UV = 1.0; Uf = 45.1%), although sometimes purchased in relatively large quantities, exhibit use values below 2, indicating functional specialization mainly limited to food use.

Table 6. The 10 most frequently used NTFPs by households in Kolwezi. Species are ranked in descending order based on their use values (UV). NTFPs sourced from outside Lualaba Province were excluded from this table, and in cases of equal values, species were counted as a single entry. "–" indicates that the species or use was not mentioned by the respondent; * plant-based species, ** animal-based species, *** fungi. Uf, use frequency; Fo., food; Med., medicinal, Ha., handcraft; Co., construction; Ri, Ritual; Ba, bark; Fl, flower; Fr, fruit; Le, leaf; Ro, root, St, Stem; Re, resin; Se, Seed; Cat, caterpillar; Me, meat.

Species	Uses/parts and organs used					Uf (%), *n* =384	Average quantity purchased per month (kg)	UV	Availability
	Fo.	Med.	Ri.	Ha.	Co.				
*B. madagascariensis**	-	Ro, Ba	Ro, Ba	St	St	43.2	2.8±0.2	2.4	Frequent
*C. schweinfurthii**	Fr	Re	Re, Se	-	-	60.9	1.4±0.1	2.3	Infrequent
*T. mollis**	-	Ro, Ba	-	St	St	45.1	3.1±0.0	2.2	Frequent
*G. ternifolia**	-	Ro	-	St	-	36.9	1.8±0.1	2.2	rare
*A. antunesiana**	-	Ro, Ba	-	St	St	76.6	4.3±0.1	2.1	Frequent
*C. cobisieri**	-	Ro	Ro	-	-	41.1	0.5±0.0	2.0	Infrequent
*B. gabonica gabonica***	Me	Oil	Oil	-	-	43.2	1.2±0.2	2.0	Infrequent
*Z. chalybeum**	-	Ro	-	St	-	48.2	3.0±0.1	2.0	rare
*S. cocculoides**	Fr	Ro	-	-	-	63.8	2.7±0.0	1.2	Infrequent
*P. umbellatum**	Le	Le	-	-	-	72.4	3.6±0.1	1.1	Frequent
*A. boehmii**	Fr	Ro	-	-	St	57.0	2.5±0.2	1.0	Infrequent
*S. latifolius**	-	Ro	-	-	-	53.1	0.6±0.1	1.0	Frequent
*E. lactea***	Cat	-	-	-	-	33.3	1.9±0.0	1.0	Infrequent
*D. reflexa**	Fl	-	-	-	-	34.1	1.9±0.1	1.0	Frequent
*U. kirkiana**	Fr	Ro	-	-	-	47.1	3.5±0.4	1.0	Infrequent
*I. epimethea***	Cat	-	-	-	-	41.1	2.7±0.0	1.0	Frequent
*C. afrocibarius****	Cap+Stipe	-	-	-	-	45.1	4.0±0.0	1.0	Frequent

3.7. Perceptions of the Causes of NTFP Decline in the Market Among the Population of Kolwezi and Suggested Measures for Restoring Their Abundance

According to respondents, deforestation was perceived as the main factor responsible for the decline of NTFPs in Kolwezi markets, cited by 39.8% of respondents. It was followed by mining activities (19.5%) and resource overexploitation (14.8%), reflecting a widely shared perception of increasing anthropogenic pressure on natural ecosystems. The effects of climate change (10.7%) and shifting cultivation (9.5%) were also mentioned as contributing factors, whereas the rise in urban demand for NTFPs was more marginally reported (5.7%) (Figure 7a). Regarding proposed measures to restore and conserve NTFPs, reforestation was cited by 45.1% of respondents. In addition, domestication of NTFP source species and the promotion of sustainable agriculture were mentioned by 30.2% and 14.6% of the surveyed household heads, respectively, compared with 10.1% who suggested regulating NTFP harvesting (Figure 7b).

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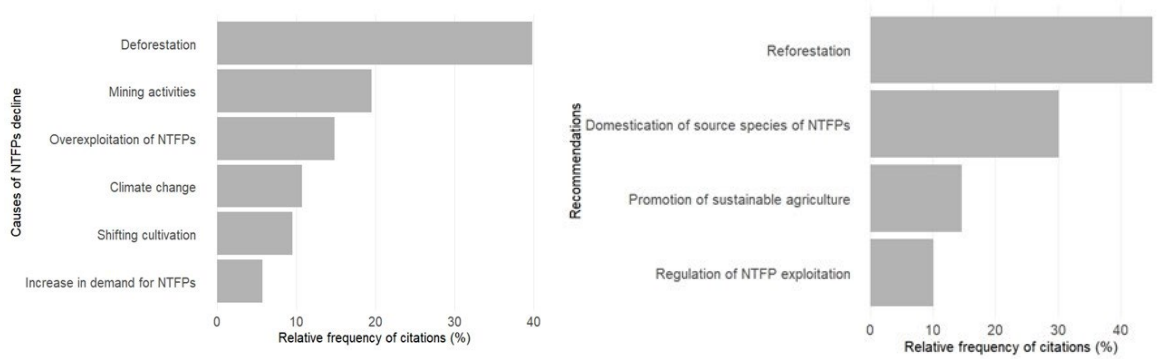

(**a**) (**b**)

Figure 7. (a) Perceived causes of NTFP scarcity and (b) sustainability perspectives according to users.

4. Discussion

4.1. Profil Socio-Démographique des Vendeurs des PFNL à Kolwezi

Le profil socio-démographique des vendeurs de PFNL à Kolwezi se caractérise par une forte prédominance féminine (79,1%), confirmant le rôle central des femmes dans les chaînes de collecte et de commercialisation des PFNL en Afrique subsaharienne [8,9]. Les acteurs étant majoritairement des adultes de 36 à 60 ans, cela suggère une activité relativement stable fondée sur l'expérience accumulée, les réseaux d'approvisionnement consolidés et une bonne connaissance des marchés locaux. Ces atouts favoriseraient leur capacité à s'adapter aux fluctuations de la demande ou aux contraintes d'approvisionnement [9]. La présence notable de jeunes vendeurs suggère un renouvellement progressif des acteurs, probablement lié aux difficultés d'emploi urbain et à l'attractivité des PFNL comme source alternative de revenus [47,48]. A l'inverse, la faible proportion de personnes âgées (plus de 61 ans) pourrait s'expliquer par les exigences physiques liées à l'approvisionnement ou à la tenue des étals. Le niveau d'instruction relativement élevé observé constitue un atout pour l'adoption de pratiques commerciales améliorées et l'intégration d'exigences de durabilité dans la gestion des filières. L'éducation est en effet reconnue comme un levier clé de professionnalisation et de gouvernance des chaînes de valeur des PFNL [42,49].

4.2. Species and Functional Diversity of NTFPs Sold in the Kolwezi Market: Multiple Uses and Sustainability Issues

Surveys conducted in Kolwezi markets recorded 65 species, including 49 plant species, 14 animal species, and 2 fungal species sold as NTFPs (Figure 2). This diversity of species highlights the central role of NTFPs in local socio-economic systems, providing food, medicinal, handicraft, ritual, and construction products. This diversity is comparable to that observed in other urban markets in Central Africa, where NTFPs serve as a vital link between ecological systems and local economic dynamics [9,50,51]. Compared with edible species listed by ref. [20], and ref. [40], this diversity is relatively low. This may be explained, on one hand, by the four-month survey period, which does not cover the full maturation cycle of all edible NTFPs and by the limited level of local processing; and, on the other hand, by the gradual shift in urban dietary habits toward processed and manufactured products [21].

The predominance of medicinal uses (59.3%) underscores the importance of traditional pharmacopoeia in local health practices, as observed in other African urban markets [42,52,53], and in the DRC [19,22]. Food uses also reflect an important aspect of nutritional security, particularly through the seasonal availability of wild fruits (*U. kirkiana*, *S. cocculoides*), edible mushrooms (*C. afrocibarius*, *T. microcarpus*), and animal protein from wildlife or insects (*I. epimethea*, *M. falciger*). These products often serve as essential protein and micronutrient supplements for low-income urban households [17,54–56].

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The presence of species used in traditional rituals and for handicraft or construction purposes reflects the persistent cultural importance of NTFPs, confirming their role in symbolic, spiritual, and identity-related practices [57]. The diversity of harvested plant and animal parts (roots, tubers, bark, leaves, fronds, fruits, resins, oils, whole animals, caterpillars, mushrooms, etc.) demonstrates a multidimensional exploitation of biodiversity, but also highlights potential sustainability risks, particularly for underground parts (roots, tubers) and vulnerable faunal species [9,59]. While this diversity of NTFP parts and uses supports a wide range of socio-economic needs, it calls for sustainable management strategies that integrate ecological monitoring, trade regulation, and community support to limit overexploitation. Indeed, the combination of non-exclusion properties of a collective resource and rivalry in its use by economic agents can lead to its depletion [58].

4.3. Marketing Channels of NTFPs and Supply to the Urban Market in Kolwezi

The supply of NTFPs to the urban market in Kolwezi relies predominantly on the Lualaba Province, which provides nearly two-thirds of the products sold (Figure 4). This situation reflects a close link between rural areas of Lualaba and the urban market, as observed in other contexts of the Congo Basin, where urban markets largely depend on rural communities for the majority of NTFPs [9,59]. This rural–urban connection aligns with the documented role of the *miombo* in the local socio-economic system, where NTFPs support both food security and local incomes [9,11,14,21,49]. However, *miombo* forests face increasing anthropogenic pressures [28,61,62], threatening the long-term availability of NTFPs. Furthermore, ref. [28] reported the regression of natural cover around Kolwezi, which can lead to the remoteness to supply areas. These dynamics can reduce the resilience of supply chains and the capacity of local communities to derive sustainable benefits from natural resources.

The presence of NTFPs from Haut-Lomami, Kasaï Central, and Kasaï Oriental in Kolwezi markets indicates established interprovincial trade networks, characteristic of functional but informal value chains [59,63]. In contrast, marginal contributions from distant provinces, such as Kinshasa or Kwilu, suggest the circulation of products with high cultural or gastronomic value, a phenomenon already documented for rare or culturally demanded NTFPs [4].

The observed marketing circuit (Figure 4), dominated by direct interactions among rural collectors, wholesale resellers, transporters, retailers, and sometimes end consumers, reflects the typical informal structure of NTFP value chains in Central Africa [63–65]. The coexistence of collector–sellers, capable of integrating multiple links of the chain, illustrates an adaptation strategy aimed at maximizing profit margins under precarious economic conditions, a phenomenon also described by Ingram and Schure [66] in the marketing of NTFPs in Central Africa. However, the informal nature of the Kolwezi sector constitutes a major constraint to its sustainable development. The absence of professional structures, recognized cooperatives, or trade unions would limit actors' capacity to negotiate collectively, regulate resource access, or enhance product value in more remunerative markets. Numerous studies emphasize that the organization of collectors and traders is a key factor for improving both the ecological and economic sustainability of NTFPs, particularly through securing usage rights, providing actor training, and certifying marketed NTFPs [7,9,67–69].

4.4. Socio-Economic Value, Constraints, and Sustainable Prospects of the NTFP Trade in Kolwezi

The sale of NTFPs is a permanent activity and constitutes a significant source of income as well as an employment driver in the informal sector in Kolwezi. Most NTFPs sold in Kolwezi have notable economic value, as evidenced by the prices observed in urban markets and the monthly income generated by sellers (Table 3). These findings are consistent with previous studies highlighting the important socio-economic role of NTFPs [9,21,41,45,51,63,70–73].

However, market value, quantities sold, and gross incomes vary according to the category of use. NTFPs used in traditional rituals command the highest unit prices, reflecting their rarity and strong cultural value, whereas edible NTFPs show lower prices, linked to their availability, status as

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common consumer goods (Shackleton et al., 2011b), and the shift in urban dietary habits toward manufactured products [21].

However, edible NTFPs generate the highest monthly gross incomes due to larger quantities sold and consistent demand. In contrast, ritual NTFPs, despite their high unit price, contribute little to overall income because of low sales volumes. These results demonstrate that income from NTFPs depends more on volumes and frequency of sales than on unit price or symbolic value, as widely documented in NTFP markets across sub-Saharan Africa [48,65,74].

Furthermore, the high monthly sales volumes observed for NTFPs used for artisanal and construction purposes indicate their functional integration into local value chains but also raise sustainability concerns. High harvesting pressure may increase the vulnerability of certain species in the absence of appropriate management and regulatory mechanisms [48,74].

Moreover, the NTFP trade in Kolwezi is primarily constrained by structural and logistical limitations (Table 4). Indeed, the remoteness of supply areas and seasonality reduce the regularity of supply and increase transaction costs, a pattern already observed in African urban markets where distance and seasonal variability undermine the competitiveness of value chains [9,66]. Product scarcity and the absence of processed by-products indicate a lack of local value addition, limiting both the creation of added value and the capacity to compete with modern supply chains, as highlighted by ref. [7], and ref. [65]. Intermediate constraints, such as limited access to finance and preference of consumers for imported products, reflect the weak structuring of the NTFP trade [63–65], while high taxation, poor NTFPs packaging by intermediary sellers, and short shelf life, although marginal, further limit market competitiveness and the stability of NTFP-derived incomes [7,75].

In response to these challenges, sellers suggested the establishment of processing chains and the domestication of NTFP source species as priority solutions (Table 5). These proposals reflect a desire to improve the competitiveness and sustainability of the sector, in line with strategies recommended for areas under anthropogenic pressure [7,76,77], such as the Kolwezi region. On one hand, domestication of NTFP source species represents an alternative to stabilize local supply while contributing to biodiversity conservation [77]. On the other hand, NTFP processing increases shelf life and enhances product quality, thereby further increasing income while reducing pressure on wild stocks [7].

4.5. From abundance to Scarcity: Household Dependence on Miombo NTFPs, Perceived Causes of declining Abundance on the Market, and Pathways for Sustainable Restoration

The value attributed to species is shaped by the ways in which they are used by local populations. This study identified 17 NTFP species as the most frequently used by households in Kolwezi (Table 6). High use values (UV > 2) observed for species such as *B. madagascariensis*, *C. schweinfurthii*, *T. mollis*, *G. ternifolia*, and *A. antunesiana* reflect their functional versatility and strong integration into local socio-economic practices. These species are used for food, traditional medicine, rituals, and construction, which explains their high demand on the local market and highlights their importance in the daily lives of Kolwezi's urban population. Indeed, the importance assigned to a species depends not on its availability but on its capacity to meet population needs across different use categories [78,79].

However, several species with high social and economic value, such as *C. schweinfurthii*, *C. cobisieri*, *B. gabonica gabonica*, *G. ternifolia*, and *Z. chalybeum*, have become less common or rare on the market. This low abundance of high-use-value species likely reflects the strong harvesting pressure they face [80]. Moreover, the contrast between high household consumption (0.5–4.3 kg month^{-1} per household) and low market availability indicates an imbalance between supply and demand.

The perceived causes of scarcity (Figure 6a)—deforestation (39.8%), mining activities (19.5%), and overexploitation (14.8%)—are consistent with previous assessments of anthropogenic pressure in the Congo Basin [81–84]. These results reflect the specific context of Kolwezi, where mining represents a major threat to natural ecosystems. Additional pressures include climate change (10.7%) and shifting cultivation (9.5%), which further exacerbate habitat fragmentation and hinder natural

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regeneration [15]. Furthermore, the increase in demand for NTFPs (5.7%) reinforces this trend, illustrating the complex interaction between socio-economic and environmental drivers.

In response to these pressures, respondents proposed reforestation (45.1%), domestication of NTFP source species (30.2%), and the promotion of sustainable agriculture (14.6%) as key strategies for restoring and sustaining natural resources (Figure 6b). Reforestation using native *miombo* woody species would help maintain forest floristic composition, structure, and function in the region [86–88]. In addition, domestication of high-use-value species, combined with multipurpose exotic NTFP species within agroforestry systems, has proven effective in reducing pressure on natural forests while generating economic benefits [7,89]. Finally, the establishment of local regulations and sustainable NTFP value chains is essential to reconcile conservation objectives with economic valorisation [90,91].

5. Conclusions

This study aimed to analyse the urban trade of NTFPs in Kolwezi to characterize their diversity and uses, understand their socio-economic importance, and identify the main factors perceived as responsible for the decline in the availability of these resources in urban markets. The results highlight a high biocultural diversity with 65 species recorded (49 plant, 14 animal, and 2 fungal), closely linked to miombo ecosystems. The predominance of medicinal NTFPs (59.3%), coupled with a substantial share of food products (29.4%), underscores the central role of traditional medicine and the importance of these resources in urban diets. Seventeen NTFPs are the most used, with a predominance of *Bobgunnia madagascariensis*, *Canrium schweinfurthii*, *Terminalia mollis*, *Gardenia ternifolia*, and *Albizia antunesiana* due to their functional versatility.

Although largely informal, the NTFP trade constitutes a permanent activity and a vital socio-economic pillar for the households involved, particularly women, who represent 79.1% of sellers. Market values and monthly gross incomes generated range from USD 0.9 to 160 per kg and from USD 9 to 429.3, respectively, depending on species, uses, and volumes traded. However, incomes depend more on quantities sold and sales frequency than on unit price alone or the symbolic value of products, which represents a major challenge for conservation.

However, NTFP value chains remain weakened by structural and logistical constraints, including the remoteness of supply areas, seasonality, increasing scarcity of certain products, lack of local processing, limited access to finance, competition from manufactured goods, tax pressure, inadequate packaging, and short shelf life. Moreover, some of the most widely used species, such as *C. schweinfurthii*, *Cussonia corbisieri*, *Bitis gabonica gabonica*, *G. ternifolia*, and *Zanthoxylum chalybeum*, have become rare or less frequent in markets. Respondents largely attribute this decline in availability to deforestation, expansion of mining activities, overexploitation of NTFPs, and the combined effects of climate change and shifting cultivation.

Therefore, ensuring the sustainability of NTFP value chains in Kolwezi requires integrated strategies combining local processing, domestication of priority NTFP source species, restoration of *miombo* landscapes, promotion of sustainable agricultural practices, regulation of harvesting, and organizational structuring of stakeholders. Such actions are essential to stabilize supply, increase local value addition, and reduce anthropogenic pressure on natural ecosystems while maintaining the socio-economic benefits associated with NTFPs in a context of rapid urban growth.

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Institutional Review Board Statement: Ethical review and approval were waived for this study from the Faculty of Agronomic Sciences of the University of Kolwezi.

Informed Consent Statement: Informed consent was obtained orally from participants after a clear and accessible explanation in the local language regarding the study's objectives, the voluntary nature of participation, guarantees of confidentiality and anonymity, and the right to withdraw from the survey at any time without consequence. Furthermore, market chiefs and neighbourhood leaders, as local administrative representatives, were consulted beforehand and their prior authorization was obtained.

Data Availability Statement: The data related to the present study will be available upon request from the interested party.

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Appendix A

Appendix A.1. List of Non-Timber Forest Products (NTFPs) Sold in the Markets of Kolwezi, DR Congo

Table A1. List of non-timber forest products (NTFPs) sold in the markets of Kolwezi, DR Congo. Species are listed alphabetically according to NTFP categories. Cf, indicates the frequency of citation. Plant parts and products traded include: Ro, root; Tu, tuber; Ba, bark; St, stem; Le, leaf; Fd, frond; Fl, flower; Fr, fruit; Se, seed; Re, resin, Bf, biological fluid; Cp+S, cap + stipe; Sh, shell; Ca, carapace; Cat, caterpillar; Wa, whole animal; Mp, meat portion; Oi, oil; Ins, Insect. Use categories are: Fo, food; Tm, traditional medicine; Tr, traditional ritual; Co, construction; and Ha, handicraft. –, indicates that the species was not found among sellers in the surveyed markets. Local vernacular names are provided in the following languages: (1) Kibemba, (2) Lingala, (3) Kiluba, (4) Kikaonde, (5) Swahili, (6) Tshiluba, (7) Kilamba, (8) Lunda, and (9) Kisanga.

Species	Family	Local name	Markets, Cf (%)		Organs sold		Uses	
			Manika (*n*=20)	Kasulo (*n*=15)	Manika	Kasulo	Manika	Kasulo
Plant-based NTFPs								
Acacia polyacantha Wild.	Fabaceae	Kiombwe(1)	30.0	20.0	Ba, Ro	Ba	Tm	Tm
Afromomum melegueta K. Schum	Zingiberaceae	Mondongo(2)	10.0	-	Fr	-	Mt	-
Albizia adianthifolia (Schumach.) W. Wight	Fabaceae	Kapetansofu(1), Kikolo(4)	60.0	73.3	Ba, Ro, St	Ba, Ro, St	Tm, Ha, Co	Tm, Ha, Co
Albizia antunesiana Harms	Fabaceae	Mukoso(1), Musase(4), Muyeye(3)	95.0	66.7	Ro, St	Ro	Tm, Co, Ha	Tm, Ha
Albizia versicolor Welw. ex Oliv.	Fabaceae	Mubamba Ngoma(3), Ifumangoma(1)	25.0	13.3	Ro, St	Ro	Tm, Ha	Tm, Ha
Anisophyllea boehmii Engl.	Anisophilleaceae	Nfungo(4), Mufungo(1)	5.0	33.3	Ba, Fr	Ba, Fr	Fo, Tm	Fo, Tm
Annona senegalensis Pers.	Annonaceae	Mulolo(3)	5.0	20.0	St	Fr, St	Ha	Fo, Ha
Bobgunnia madagascariensis (Desv.) J.H. Kirkbr. & Wiersama	Fabaceae	Ndale(1), Kapwipu ou Mpampi(3)	55.0	20.0	Ba, Ro, St	Ro, St	Tm, Tr, Ha	Tm, Co, Ha
Brachycorythis spp.	Orchidaceae	Kikanda(1)	5.0	13.3	Tu	Tu	Fo	Fo

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Species	Family	Local name	Markets, Cf (%)		Organs sold		Uses	
			Manika (*n*=20)	Kasulo (*n*=15)	Manika	Kasulo	Manika	Kasulo
Brachystegia boehmii Taub.	Fabaceae	Ngasa[1], Musamba[3]	25.0	20.0	Ba, St	St	Tm, Co, Ha	Co
Brachystegia spiciformis Benth.	Fabaceae	Muputu ou Kaputu[3]	45.0	13.3	Ro, St	Ra, St	Tm, Co	Tm, Co
Canarium schweinfurthii Engl.	Burseraceae	Mpafu[3]	50.0	13.3	Fr, Re, Se	Re, Se	Fo, Tm, Tr	Tm, Tr
Cassia abbreviata Oliv.	Fabaceae	Mukalafya[1], Mulandankamba[3]	5.0	-	Ba, Ro	-	Tm	-
Combretum molle Eng. & Diels	Combretaceae	Montamfumu[1]	30.0	13.3	Ro	Ro	Tm	Tm
Crossopteryx febrifuga (Afzel. Ex. G. Don) Benth	Rubiaceae	Mutoshi/Kimami[3]	30.0	20.0	Ba	Ba	Tm	Tm
Cussonia corbisieri De Wild	Araliaceae	Ntambo mutshi[3], Pudriko[5]	40.0	40.0	Ro	Ro	Tm	Tm, Tr
Cyperus sp.	Cyperaceae	Tshikota[3 & 6]	35.0	40.0	Fl, Se	Fl, Se	Tm, Fo	Tm, Fo
Diospyros mespiliformis Hochst. ex A. DC.	Ebenaceae	Muchenja[1], Mutshi Mufita[3]	5.0	-	Ro	-	Tm	-
Diplorhynchus condylocarpon (Müll. Arg.) Pichon	Apocynaceae	Mwenge[1 & 3]	50.0	20.0	Ro	Ro	Tm	Tm
Dracaena reflexa Lam. Var. nitens	Agavaceae	Mungonda/Muleng elenge[1]	5.0	33.3	Fl	Fl	Fo	Fo
Ekebergia benguelensis Welw. ex C.DC.	Meliaceae	Kalayi[1], Kalaya[3]	25.0	40.0	Ba, Ro	Fr, Ba, Ro	Tm	Tm
Gardenia ternifolia subsp. jovis-tonantis (Welw)	Rubiaceae	Kapanga nzevu[1]	40.0	20.0	Ro, St	Ro, St	Tm, Ha	Tm, Ha
Hymenocardia acida Tul.	Phyllanthaceae	Kapempe[1]	25.0	-	Ro	-	Tm	-
Ipomoea aquatica Forsk	Convolvulaceae	Mulapalala[6]	20.0	13.3	Le	Le	Fo	Fo
Julbernardia paniculata (Benth.) Troupin	Fabaceae	Mutondo[1&3]	40.0	40.0	Ro, St	St	Tm, Co	Co
Lippia multiflora	Verbenaceae	Nyemba lukuitshi[6], Bulukutu[2]	10.0	-	Le	-	Fo, Tm	-
Ocimum basilicum L.	Lamiceae	Tshilwabwenu[6]	15.0	-	Le	-	Fo, Tm	-
Parinari curatellifolia Planch. Ex Benth.	Chrysobalanaceae	Kifulu muti[2], Mpundu[1]	50.0	53.3	Ro	Ro	Tm	Tm
Phyllanthus muellerianus (O. Kuntze) Exell	Euphorbiaceae	Lulembalemba[3], Mulembalemba[1]	50.0	40.0	Ro	Ro	Tm	Tm
Piliostigma thonningii (Schumach.) Milne-Redh.	Fabaceae	Kifumbe[1]	20.0	13.3	Ro	Ro	Tm	Tm
Piper guineense Shumach. & Thonn.	Piperaceae	Nketu[2]	5.0	-	Se	-	Tm	-
Piper umbellatum L.	Piperaceae	Dilombolombo[6]	55.0	53.3	Le	Le	Fo, Tm	Fo, Tm
Pteridium aquilinum (L.) Kuhn subsp. Centrali-africanum Hieron	Dennstaedtiaceae	Mushilu[1]	20.0	33.3	Fd	Fd	Fo	Fo
Pterocarpus angolensis DC.	Fabaceae	Mulombwa[1]	45.0	13.3	Ro, St	Ro, St	Tm, Co	Mt, Co
Pterocarpus tintorius Welw.	Fabaceae	Mukula/Kakula[1], N'golo[3]	50.0	-	Ba, St	-	Tm, Co	-
Rhynchosia insignis (Holfm) R.E.	Fabaceae	Munkoyo[1]	25.0	20.0	Ro	Ro	Fo	Fo
Samanea leptophylla (Hams) Brenan & Brummitt	Caesalpiniaceae	Munyenze[3]	45.0	20.0	Ba	Ba	Tm	Tm
Sarcocephalus latifolius (Sm.) E. A. Bruce	Rubiaceae	Mujilanga[6]	40.0	33.3	Ba	Ba	Tm	Tm
Satyrium buchananii Schltr.	Orchidaceae	Kikanda[1]	45.0	53.3	Tu	Tu	Fo	Fo
Securidaca longipedunculata Fresen.	Polygalaceae	Mweyeye (Lupapi)	45.0	46.7	Ro	Ro	Tm, Tr	Tm, Tr
Senna petersiana (Bolle) Lock	Leguminisae	Kavungu mbele[3], Kafungunansha[1]	-	13.3	-	Ro	-	Tm
Solanum incanum L.	Solanaceae	Tuntunya[7]	15.0	-	Fr	-	Tm	-

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Species	Family	Local name	Markets, Cf (%)		Organs sold		Uses	
			Manika (*n*=20)	Kasulo (*n*=15)	Manika	Kasulo	Manika	Kasulo
Sterculia quinqueloba (Garcke) K. Schum.	Malvaceae	Kapombo[1], Mwabi[3]	25.0	13.3	Ba, Ro	Ba, Ro	Tm, Tr	Tm, Tr
Strychnos cocculoides Baker	Loganiaceae	Kasongole[1&4], Kisongole[5]	40.0	53.3	Fr, Ro	Fr	Fo, Tm	Fo
Strychnos spinosa Lam.	Loganiaceae	Sansa[1]	10.0	-	Fr	-	Fo	-
Sygygium guineense DC.	Myrtaceae	Musafwa[1], kibumbia[3]	5.0	-	Ro, Fr	-	Tm, Fo	-
Terminalia mollis M.A.Lawson	Combretaceae	Mbubu[3], Mubobo/Kibobo[1&7]	85.0	66.7	Ba, Ro	Ro, St	Co, Tm, Ha	Tm, Ha
Uapaca kirkiana Müll.Arg.	Phyllanthaceae	Masuku[1]	10.0	13.3	Ro, Fr	Ro, Fr	Tm, Fo	Tm, Fo
Zanthoxylum chalybeum Engl.	Fabaceae	Pupwekyulu[3], Pupwe/Chipupa[1&7]	15.0	73.3	Ro	Ro	Tm	Tm
Mushrooms								
Cantharellus afrocibarius Buyck & V. Hofst	Hydnaceae	Butondo[1&7]	35.0	-	Cp+S	-	Fo	-
Termitomyces microcarpus (Berk. & Br.) Heim	Lyophyllaceae	Wiskansik[8], Musangwa[7&9], Tande ou Kasangwa[1]	35.0	33.3	Cp+S	Cp+S	Fo, Tm	Fo, Tm
Animal-based NTFPs								
Achatina fulica (Bowdich, 1822)	Achatinidae	Kikalanyonga[3]	-	13.3	-	Ins	-	Fo
Apis mellifera adansonii (Latr.)	Apinae	Nsali[5], Buki[1]	15.0	33.3	Bf	Bf	Fo	Fo
Bitis gabonica gabonica (Duménil & Bibron, 1854)	Viperidae	Moma[5], Lumwengo[4]	20.0	20.0	Mp, Oi	Mp, Oi	Fo, Tm, Tr	Fo, Tm, Tr
Burtoa nilotica (L.Pfeiffer, 1861)	Achatinidae	Kikolokofyo[1&7], Kikalanyonga[3]	40.0	20.0	Sh	Sh	Tm, Tr	Tm, Tr
Cricetomys gambianus (Waterhouse, 1840)	Nesomyidae	Mamanambao[1], Nkumbi[4]	-	13.3	-	Wa	-	Fo
Cryptomys hottentotus (Lesson, 1826)	Batyergidae	Bombomfuko[1]	15.0	20.0	Wa	Wa	Fo	Fo
Elaphrodes lactea (Gaede, 1932)	Notodontidae	Tunkubiu[1], Nkuyu[4]	35.0	20.0	-	Cat	Fo	Fo
Imbrasia epimethea (Drury, 1773)	Saturniidae	Masese[4]	30.0	20.0	-	Cat	Fo	Fo
Lobobunaea saturnus (Fabricius, 1793)	Saturniidae	Finkubala[1]	10.0	20.0	Cat	Cat	Fo	Fo
Macrotermes falciger Gerstäcker	Termitidae	Makalo[3]	10.0	13.3	Ins	Ins	Fo	Fo
Pelusios nanus (Laurent, 1956)	Pelomedusidae	Bandakwe[3], Nkovu[4]	30.0	13.3	Ca	Ca	Tm, Tr	Tm, Tr
Potamochoerus porcus (Linnaeus, 1758)	Suidea	Ngulube wa mpanga[1]	5.0	20.0	Mp	Mp	Fo	Fo
Sylvicapra grimmia (Linnaeus, 1758)	Bovidae	Kashia[5]	30.0	13.3	Mp	Mp	Fo	Fo
Syncerus caffer nanus (Sparman, 1779)	Bovidae	Mboko[5]	15.0	13.3	Mp	Mp	Fo	Fo

Appendix A.2. Straight-Line Distances Between Kolwezi and NTFP Supply Areas

Table A2. Geographic origins of NTFPs sold in Kolwezi markets: main supply areas by province and straight-line distance.

Province	Supply entity	Straight-line Distance (km)	Proportion of NTFP Supply (%)	
Lualaba	Kitate	27.0	25.6	70.0
	Mushima	51.6	21.7	
	Kanzenze	34.9	13.5	

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Province	Supply entity	Straight-line Distance (km)	Proportion of NTFP Supply (%)	
	Kasaji	222.8	7.3	
	Kawama	45.8	6.9	
	Kawayongo	180.6	6,1	
	Musumba	404.0	4.0	
	Sandoa	304.9	3.6	
	Kapanga	407.9	3.2	
	Dilolo	341.3	1.9	
	Tshimbalanga	282.6	1.5	
	Lubudi	100.2	1.5	
	Divuma	269.5	1.3	
	Mukabe	120.5	0.9	
	Buyofwe	114.5	0.5	
	Kayemba	82.0	0.5	
Haut-Lomami	Malemba	329.8	3.5	12.3
	Bukama	171.9	3.0	
	Luena	144.6	2.0	
	Butumba	197.9	1.9	
	Kamina	223.9	1.9	
Kasaï Central	Kananga	629.1	8.0	8.0
Kasaï Oriental	Mbuji-Mayi	547.5	5.0	5.0
Lomami	Mweneditu	464.6	1.3	2.0
	Ngandajika	469.1	0.7	
Haut-Katanga	Kasumbalesa	305.0	0.7	1.0
	Kasungeshi	284.9	0.3	
Kasaï	Tshikapa	699.1	0.8	0.8
Kwilu	Kikwit	962.5	0.5	0.5
Kinshasa	Kinshasa	1324.4	0.4	0.4

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