



RESEARCH ARTICLE

Value Chain Analysis of Isoberlinia Spp. in Northern Benin: Stakeholders, Governance, and Economic Performance

ADAMOU Aïman^{1*}, AGADAN Missirikou³, ADJOVI Ingrid Sonya Mawussi¹, TCHANTIPO Sai Sotima², DEGLA Pamphile³, YABI Afouda Jacob³, MOUMOUNI-MOUSSA Ismaïl¹

¹Laboratory for Research on Innovation for Agricultural Development (LRIDA), University of Parakou (UP), Benin

²Laboratory for the Study and Research on Social Dynamics and Local Development (LASDEL), University of Parakou (UP), Benin

³Laboratory for Analysis and Research on Economic and Social Dynamics (LARDES), University of Parakou (UP), Benin

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ABSTRACT

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Corresponding Author:

aiman.adamou@lrda-up.org
bouremaan@gmail.com

The exploitation of *Isoberlinia* spp. holds an important place in the livelihoods of populations in northern Benin. However, knowledge about the organization of the value chain, relationships among stakeholders, and the economic performance of the sector remains limited. This study aims to analyze the structure of the *Isoberlinia* spp. value chain, the governance mechanisms regulating interactions among stakeholders, as well as the economic performance of the different links. Data were collected from 152 stakeholders in the communes of Kandi and Tchaourou using a questionnaire administered on KoboToolbox and then analyzed according to the valueLinks approach. The results show that the sector is organized around several categories of stakeholders involved in the exploitation, processing, transport, and marketing of the products. The main products traded are construction poles and charcoal, which are the most highly valued products in the sector. Governance is based primarily on informal relationships and verbal agreements, while the level of stakeholder organization remains low. Furthermore, economic performance varies depending on the link in the chain, with processing, transport, and marketing activities generating the highest margins. These results highlight the need to strengthen governance and stakeholder organization in order to improve the sustainable valorization of *Isoberlinia* spp. in Benin.

INTRODUCTION

Forest resources play a vital role in the socio-economic development of sub-Saharan African countries. They contribute to meeting energy needs, supplying raw materials for the wood industries, and improving the livelihoods of rural populations (Amadu & Miller, 2024 ; Sourokou & Vodouhe, 2024). Forest products constitute an important source of income for many households and make a significant contribution to the local economy.

However, the growing pressure on forest resources, resulting from population growth, urbanization, and the demand for timber and fuelwood, is leading to increasingly intensive exploitation of certain tree species. Among these species is *Isoberlinia* spp., a group of species characteristic of Sudanian and Sudanian-Guinean vegetation formations. Long considered a secondary species, it now occupies an important place in supplying markets with utility wood, timber, charcoal, and other derived products (Adjahossou et al., 2019 ; den Braber et al., 2024 ; Glèlè Kakai & Sinsin, 2009).

This growing economic importance has encouraged the emergence of numerous stakeholders involved in the exploitation, processing, transportation, marketing, and consumption of products derived from *Isoberlinia* spp. The interactions among these stakeholders form a genuine value

chain, the understanding of which appears essential for sustainable resource management (Ahmad et al., 2024 ; Dalla Valle et al., 2026).

Despite the economic importance of *Isoberlinia* spp., its exploitation is intensifying in a context marked by the gradual dwindling of other traditionally harvested forest species. This situation raises concerns regarding the sustainability of harvesting, the organization of the stakeholders involved, and the distribution of benefits generated throughout the value chain (den Braber et al., 2024; Martin et al., 2016; Nangia et al., 2024).

Moreover, the governance mechanisms that regulate the relationships between the different stakeholders remain poorly documented. Modes of coordination, power dynamics, product and information flows, as well as the economic performance of the various links in the chain, are still scarcely documented (Bair & Mahutga, 2023a; Gereffi et al., 2005; Marquart-Pyatt et al., 2025). This lack of information limits the implementation of effective strategies aimed at promoting the sustainable and economically viable exploitation of the resource. In this context, the present study seeks to answer the following question : how is the *Isoberlinia* spp. value chain structured in Northern Benin, and what are the implications of governance mechanisms on the economic performance of stakeholders ?

The value chain is now recognized as a relevant analytical tool for understanding the organization of production and marketing sectors. According to this approach, the value of a product results from all activities carried out from the procurement of raw materials to final consumption (den Braber et al., 2024).

In the forestry sector, value chain analysis makes it possible to identify key stakeholders, understand physical, financial, and informational flows, assess governance mechanisms, and measure the economic performance generated at each link (Dawson et al., 2018; Nangia et al., 2024). Several studies have shown that mastering these elements fosters improved competitiveness of the sectors, increased stakeholder incomes, and the promotion of sustainable natural resource management (Goussanou et al., 2017).

However, studies conducted on *Isoberlinia* spp. in Benin and West Africa have mainly focused on its ecological distribution, dendrometric characteristics, ethnobotanical uses, and socio-economic importance. Despite these advances, several gaps remain. First, the stakeholders involved in the value chain and their respective roles are still insufficiently characterized. Second, governance mechanisms, particularly coordination relationships, information flows, and power dynamics among stakeholders, are poorly documented. Third, the economic performance of the different segments of the value chain, in terms of costs, margins, added value, and profitability, remains weakly analyzed. These shortcomings limit the overall understanding of the functioning of the *Isoberlinia* spp. value chain and justify the present research.

This research contributes to enriching scientific knowledge on the value chains of forest resources in Benin. It provides a better understanding of the relationships between stakeholders, coordination mechanisms, and the economic performance observed along the chain. On a practical level, the results will enable policymakers, forestry services, professional organizations, and development partners to access reliable information for developing sustainable valorization strategies for *Isoberlinia* spp. They will also contribute to improving the governance of the sector and to optimizing the economic benefits generated for local stakeholders, while promoting the conservation of the resource.

Theoretical analysis and formulation of hypotheses

Structuring of the *Isoberlinia* spp. value chain

The governance of a value chain refers to all the mechanisms that organize the relationships between the actors involved in the production, processing, transport, and marketing of a product. It is manifested in particular by the exchange of information, agreements between actors, relationships of trust, as well as the forms of coordination that facilitate the functioning of the sector. According to Porter (1985), value creation depends not only on the activities carried out by each actor, but also on the way these activities are coordinated. When actors collaborate

effectively, transaction costs decrease, products circulate more easily, and economic opportunities are better seized.

This idea is also supported by Callon's (1986) actor-network theory, which holds that the performance of a sector depends heavily on the quality of relationships developed among the various stakeholders. Regular information exchange, cooperation, and trust contribute to reducing uncertainty and improving the efficiency of economic activities.

In the forestry sectors, several studies show that stakeholders who maintain good relationships with other links in the chain gain easier access to markets, business information, and business opportunities. They are therefore more likely to improve their incomes, margins, and profitability.

Thus, effective governance appears as an important factor in improving the economic performance of the actors involved in the *Isoberlinia* spp. value chain.

H1: The *Isoberlinia* spp. value chain is structured around several categories of actors

Governance and Relationships Among Value Chain Actors

Professional organizations play an important role in the functioning of value chains. They enable stakeholders to share information, defend their common interests, and strengthen their bargaining power with respect to other participants in the sector.

Actor-network theory highlights that relationships between individuals are built more easily when they belong to organized structures. Associations, cooperatives, or groups foster exchanges, facilitate the dissemination of information, and strengthen coordination mechanisms between actors.

In the forestry sector, several studies show that stakeholders grouped within professional organizations participate more actively in collective activities and more easily develop collaborative relationships. These interactions help to improve information flow and to strengthen information sharing as well as the coordination of activities throughout the value chain.

In contrast, isolated actors often have less information and encounter greater difficulties accessing markets or defending their economic interests.

Therefore, the degree of organization among stakeholders constitutes an essential element of value chain governance.

H2: Relationships between stakeholders contribute to sector governance.

Economic Performance of the Links in the Value Chain

Not all players in a value chain enjoy the same economic benefits. Income, margins, and added value often vary depending on their position within the sector.

According to the value chain approach developed by Gereffi and his collaborators (2005), certain links hold greater economic power because they exert more control over product flows, commercial information, or market access. This situation enables them to capture a larger share of the value created.

The theory of the economics of production developed by Coase (1937) also shows that actors capable of reducing transaction costs or of adding greater value to their products generally achieve better economic performance.

In forest sectors, processing and marketing activities often generate more added value than collection or production activities. Actors located near markets generally have greater bargaining power and benefit from higher margins. Thus, the position occupied within the value chain can strongly influence the income and profitability of the actors.

H3: Economic performance varies across segments of the value chain

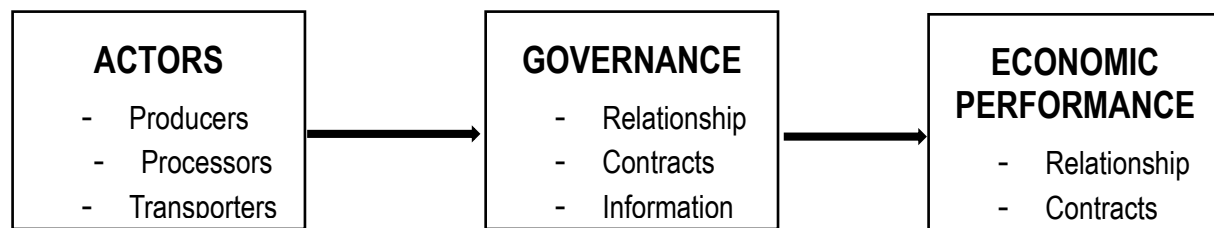


Figure 1: Analytical framework of the study

METHODOLOGY

Study Framework and Methodological Approach

The study adopts a quantitative approach based on value chain analysis of *Isoberlinia* spp. The objective is to understand the organization of the sector by identifying the actors involved, analyzing the governance mechanisms structuring their interactions, and assessing the economic performance generated at the various links in the chain.

The analysis is based on the value chain approach developed by Springer-Heinze (2007) through the Value Links methodology. This approach makes it possible to identify the stakeholders involved in the value chain, to characterize the functions they perform, to analyze the flows of products and information, as well as to assess the governance mechanisms and value creation within the chain.

Study Area

The study was conducted in the municipalities of Kandi and Tchaourou located in the northern part of the Republic of Benin. These municipalities were chosen because of their significance in the harvesting, processing, and marketing of products derived from *Isoberlinia* spp. They host significant natural stands of this forest species and serve as strategic supply areas for local markets (Figure 2).

The selection of these municipalities is also justified by the intensity of economic activities related to the exploitation of *Isoberlinia* spp., particularly the production of fuelwood, service wood, charcoal, and other derivative products. They thus provide a relevant framework for analyzing interactions between stakeholders and the overall functioning of the value chain.

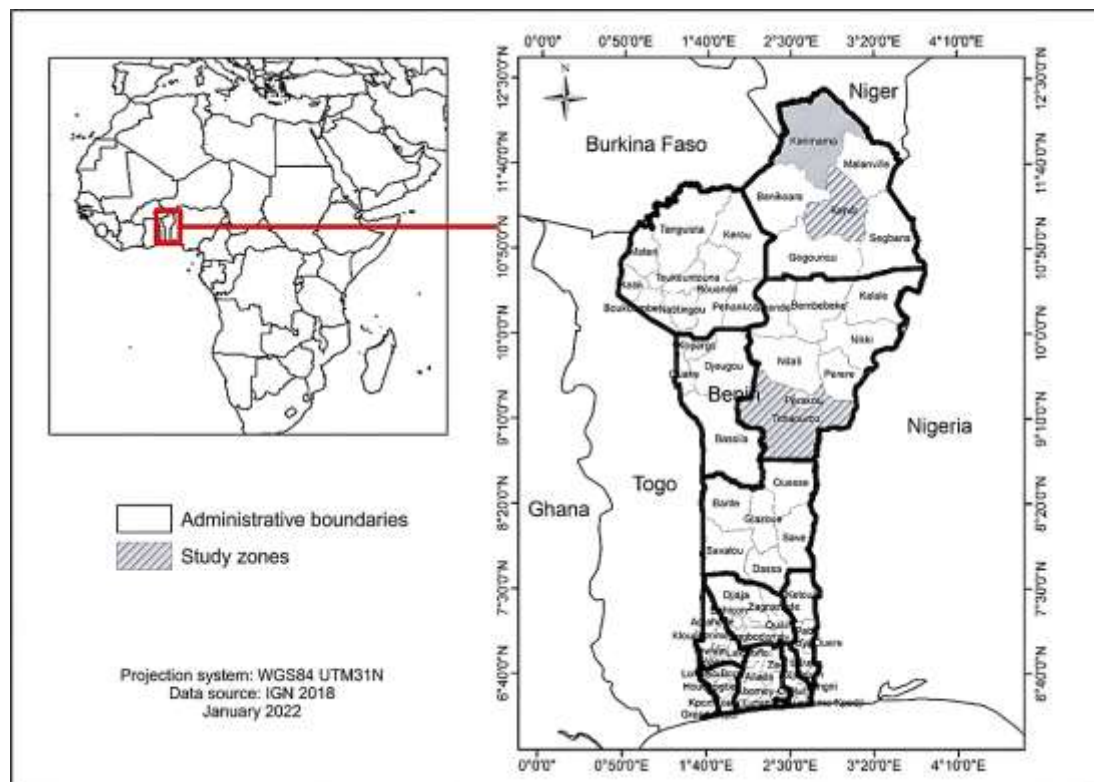


Figure 2: Study area

Study Population, Sampling, and Data Collection

The target population consists of all stakeholders involved in the *Isoberlinia* spp. value chain, namely forest operators, processors, transporters, traders, and consumers. Data collection took place in two phases. An exploratory phase first made it possible to identify the main stakeholders in the sector through discussions with forestry services, authorities, professional organizations, and key informants involved in the forestry sector. The second phase consisted of a formal survey of the identified stakeholders.

Sampling was conducted using a stratified approach, with the different segments of the value chain forming the investigation strata. Within each stratum, respondents were selected using the snowball sampling technique. This method is particularly suited to value chain studies characterized by the absence of an exhaustive sampling frame and allows for the progressive identification of actors based on recommendations from the initial respondents. In total, 152 stakeholders were surveyed along the value chain.

Primary data were collected using a semi-structured questionnaire administered to respondents through the KoboToolbox platform. The information collected covers the socio-economic characteristics of stakeholders, activities carried out in the value chain, relationships with other actors, coordination mechanisms, and economic data on costs, revenues, and profits generated by activities related to *Isoberlinia* spp.

To ensure the quality of the data collected, a pretest of the questionnaire was carried out before the final surveys. Observations from this phase made it possible to improve the formulation of questions and ensure better consistency of the questionnaire prior to the final data collection.

Variables and Analysis Indicators

The analysis was structured around three main dimensions: the value chain actors, the sector governance, and the economic performance.

The stakeholder analysis focused on identifying the different links in the chain as well as the functions performed by each category of stakeholders.

Governance was assessed using several indicators relating to interactions between stakeholders, the existence of agreements or commercial contracts, information exchange, and stakeholders'

membership in professional organizations. Vertical governance was evaluated based on business relationships between the various links in the chain, while horizontal governance was analyzed through the level of collective organization among stakeholders.

Economic performance was measured based on production or marketing costs, net margins, value added, income, and the profitability rate observed for each category of stakeholders.

DATA ANALYSIS METHODS

The value chain analysis was conducted according to the steps proposed by the Value Links approach. An initial descriptive analysis made it possible to identify the actors and map the product flows along the value chain. The governance analysis focused on characterizing the relationships between the various actors as well as the coordination mechanisms observed within the sector. The assessment of economic performance focused on calculating several economic indicators. The net margin (MN) was obtained by the difference between the gross product in value (PBV) and the total cost (CT):

$$MN = PBV - CT \dots\dots\dots(1)$$

Value added (VA) was calculated as the difference between the value of production (VP) and intermediate consumption (CI):

$$VA = VP - CI \dots\dots\dots(2)$$

The rate of return (RR) was determined based on the following equation:

$$TR = (MN/CT) \times 100 \dots\dots\dots(3)$$

These indicators made it possible to assess the economic contribution of the different segments of the value chain and to analyze the distribution of profits generated by the exploitation and commercialization of *Isoberlinia* spp.

The data were processed using descriptive statistics, including frequencies, proportions, means, and economic indicators calculated for each category of stakeholder.

RESULTS

Structuring of the Isoberlinia Spp. Value Chain

This section presents the stakeholders involved in the *Isoberlinia* spp. value chain, the marketed by-products, as well as the physical flows connecting the different segments. In total, 152 stakeholders were surveyed in the communes of Kandi and Tchaourou (Table 1).

Table 1: Distribution of the respondents

Stakeholders	Name
Traders	20
Consumers	04
Producteurs	43
Producers	34
Transporters	16
Other stakeholders involved	35
Total	152

Source: field data, 2024

Characteristics of the Value Chain Actors

The analysis of the sociodemographic characteristics of respondents reveals a diversity of stakeholders involved in adding value to the resource. The various links perform complementary functions ranging from the exploitation of natural stands to the marketing of finished products (Table 2). The results show that the stakeholders are predominantly men (90.79%), with an average age of 39 years. Most are not affiliated with any professional organization (62.50%) and have between 2 and 5 years of experience (48.03%). Primary (50.00%) and secondary (48.68%) education levels are the most represented. The Tchabè/Nago (29.60%) and Bariba (27.63%) ethnic groups dominate value chain activities, while product purchases are made mainly on a monthly basis (64.20%). These results highlight a value chain dominated by relatively young, loosely organized stakeholders who mainly possess practical experience. This reflects a low level of

stakeholder structuring, which may limit coordination and capacity-building. These results thus underscore the importance of promoting stakeholder organization in order to improve the functioning of the value chain.

Table2: Sociodemographic characteristics of the respondents

Variables	Proportions
Sex	
Male	90.79%
Female	9.21%
Age	
Average	38.98684
Minimum	20
Maximum	65
Membership in an organization	
Yes	37.50%
No	62.50%
Experience in the value chain	
0 to 1 year	7.89%
2 to 5 years	48.03%
5 to 10 years	15.79%
More than 10 years	28.29%
Level of education	
Primary	50.00%
Secondary	48.68%
Superior	1.32%
Ethnic groups engaged in the activity	
Adja	3.29%
Bariba	27.63%
Ditamari/Somba	1.32%
Goun	0.66%
Groumatche	0,66%
Kotafon	1.32%
Maxi	1.32%
Wama	1,97%
Fon	18.42%
Tchabè/Nago	29.60%
Yoruba	2.63%
Dendi	4.61%
Biali	6.58%
Purchase frequency	
Occasional	12.40%
Quotidienne	7.60%
Daily	15.80%
Mensuelle	64.20%

Source: field data, 2024

Distribution of Stakeholders and Products within the Chain

Products derived from *Isoberlinia* spp. primarily include service wood, timber, charcoal, firewood, construction poles, and other value-added by-products marketed locally and regionally. Table 3 presents the main products handled by the different stakeholders.

Table3: Main commercialized derivative products

Stakeholders	Firewood (%)	Charcoal (%)	Construction poles (%)	Other derivative products (%)
Collectors	0	0,7	0	0
Traders	4,6	5,3	0,7	0
Consumers	0	0,7	0	0
Harvesters	0	0	0,7	0,7
Producers	0,7	15,1	3,9	0
Processors	0	2	33,6	3,9
Transporters	0	4,6	0,7	0
Total (%)	5,3	28,3	39,5	4,6

Source : field data, 2024

Table 3 shows that construction poles are the main by-product (39.5%), followed by charcoal (28.3%). The processors dominate the production of poles (33.6%), while the producers are the main actors in charcoal production (15.1%). This distribution reflects a specialization of actors according to their roles in the value chain and highlights an organization that promotes the valorization of the resource. The other identified by-products are presented in Table 4.

Table4: Other derivatives of *Isoberlinia* spp.

Category	Items
Furniture	Bench, Table, Chair, Bed, Desk, School desk, Shelf, Stool
Framing and Wood	Beam, Rafter, Panel, Boards, Joint cover, Valance, Framework, Ceiling, Ceiling frame, Formwork, Bed rail
Miscellaneous materials	Rubble, Pallets

Source : field data, 2024

Derivative products mainly concern furniture, structural components, and various construction materials. This diversity shows that *Isoberlinia* spp. offers several value-added opportunities, thus contributing to value creation and income diversification for stakeholders in the sector.

Value Chain Mapping

The mapping of physical flows shows a relatively structured organization of the sector. Products move from production areas to processing centers and then to consumer markets through several intermediaries. This organization highlights the existence of functional links between the different segments of the value chain (Figure 2).

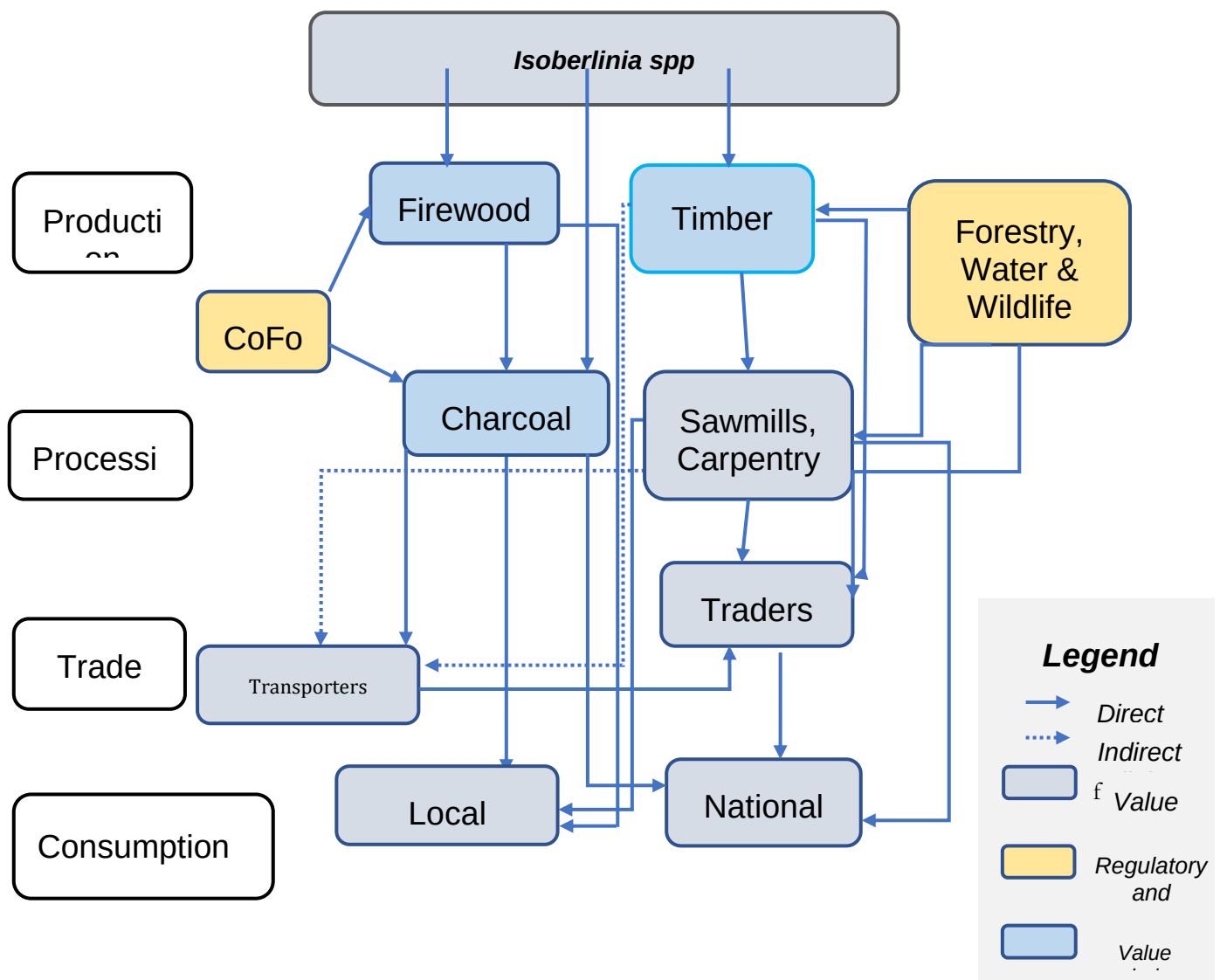


Figure3: Mapping of *Isoperlinia* spp value chains

Figure 3 shows that products move from the extraction areas to the processing units, before being transported to traders and then consumers. Transporters provide the link between these different segments, thus facilitating the movement of products. This organization reflects a relatively structured value chain, based on the understanding by stakeholders and the sequence of production, processing, and marketing operations.

Governance and Relationships Among Value Chain Actors

Coordination relationship between stakeholders

The governance of the value chain was analyzed based on the coordination relationships between the stakeholders. Table 5 shows the contribution of the different stakeholders to the formation of the factorial axes, making it possible to identify the main coordination profiles within the sector.

Table5: Contribution Of The Stakeholders To The Formation Of The Factorial Axes

Stakeholders	Dim 1	Dim 2	Dim 3	Dim 4	Dim 5
Collectors	29.48068809	3.8667744	0.5389327	62.49504906	0.004418262
Traders	0.43992210	62.2581852	13.0272826	0.08728443	6.285485141
Consumers	35.59225545	0.1075683	0.8785413	19.42891085	0.021415375
Harvesters	16.57146009	3.1184731	0.5743362	14.85356628	11.753939943
Producers	3.06029031	8.2848012	39.4752193	1.88168690	21.414459404
Processors	14.75882772	18.1154440	22.9444340	0.17121035	0.620909216
Transporters	0.09655625	4.2487538	22.5612539	1.08229213	59.899372659

Source : field data, 2024

The results show that traders contribute primarily to the second dimension (62.26%), producers to the third (39.48%), collectors to the fourth (62.50%), and transporters to the fifth (59.90%). This distribution highlights the differentiated roles of stakeholders in the functioning of the value chain.

Organization of Stakeholders and Governance Mechanisms

Table 6 presents the socio-professional profiles of the stakeholders as well as the main governance mechanisms observed within the Isoberlinia spp. value chain. It reflects an organization in which each category of actors operates according to specific functions, facilitating the exchange of products, information, and the coordination of activities throughout the sector.

The results show that 70% of stakeholders do not belong to any professional organization, compared with only 30% who are organized. Relationships between stakeholders are primarily competitive (60%), followed by collaborative relationships (25%) and independent ones (16%). Furthermore, the coordination of activities is based mainly on verbal agreements (85%) and informal relationships (96%).

These results indicate that value chain governance is largely based on informal mechanisms rather than institutional arrangements. This reflects a low level of structuring among stakeholders, where exchanges rely more on trust and personal relationships than on formal contracts. This situation can facilitate short-term transactions but limits the strengthening of professional organizations and the establishment of sustainable coordination among stakeholders. The main takeaway is that improving sector governance requires better organization of stakeholders and the gradual formalization of their business relationships.

Table6: Socio-professional profiles of the stakeholders

Indicators	Dominant modality	Proportion (%)
Stakeholders belonging to an organization	Yes	30
	No	70
Type of relationship between stakeholders	Competitive	60
	Collaborative	25
	Independent	16
Coordination mode	Verbal agreements	85
	Formal contracts	15
Nature of exchanges	Informal relationships	96

Source : field data, 2024

The factorial representation of relationships between actors highlights several groups of actors sharing similar characteristics in terms of organization and information exchange (Figure 4). Similarly, the mapping of actor networks illustrates existing interactions between the different links as well as the central role played by certain actors in the circulation of products and information (Figure 5)

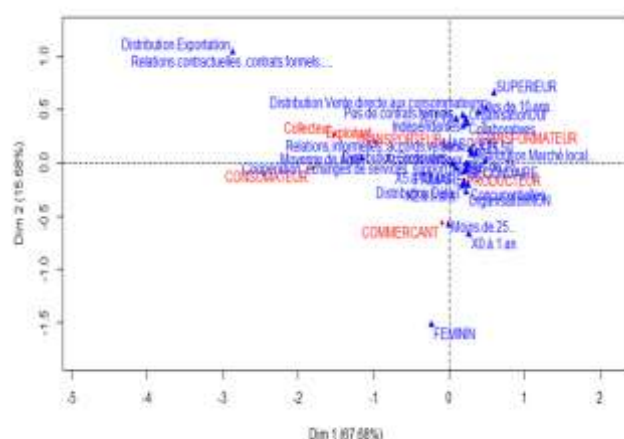


Figure5: Factual map of the different

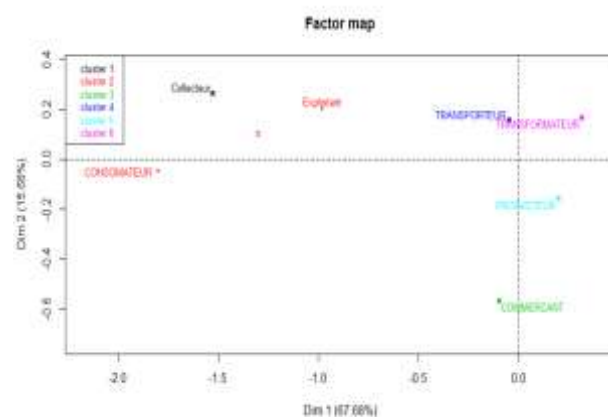


Figure 4: Factorial distribution of the socio-professional profiles of the participants

These results suggest that value chain governance relies primarily on the horizontal and vertical coordination mechanisms developed between the various stakeholders in the sector.

Economic Performance of the links in the Value Chain

Cost structure by segment

The assessment of economic performance focused on production costs, marketing costs, margins achieved, value added created, as well as the profitability of the various segments of the value chain. Table 7 presents the key indicators of overall production costs.

Table7. Value of total production costs

	Overall production cost				
	Average cost (FCFA)	MI N	MAX	Std. deviation	Variance
Unit price	5326,31579	100 0	40000	5208,1792 12	27125130,7 1
Fixed costs	318120,664	107 5	35500 00	489651,60 88	2,39759E+1 1
Variable costs	173106,757	200 0	42600 00	415607,27 75	1,72729E+1 1
Total (fixed + variable costs)	491227,421	307 5	78100 00	905258,88 63	8,19494E+1 1
Production in tons/month	30,3578947	1	700	73,533678 84	5407,20192 4
Average production cost	161695,734	200 0	14000 00	187676,73 83	352225580 99

Source : field data, 2024

The results show that the average total production cost is estimated at 491,227 FCFA, including 318,121 FCFA in fixed costs and 173,107 FCFA in variable costs. The average production cost amounts to 161,696 FCFA for an average monthly output of 30.36 tons. The differences observed between the minimum and maximum values indicate a high variability in costs depending on the stakeholders and activities within the value chain.

Margins, Added Value And Profitability

Detailed analysis by stakeholder shows significant differences in the cost structure borne within the sector. Analysis of Table 8 highlights cost differences between the links of the value chain. Producers/collectors/operators record the highest average total cost (762,308 FCFA), while transporters bear the lowest costs (197,835 FCFA). In contrast, processors have the highest average production (50.44 tons/month). These results show that production costs vary depending on the activities carried out by the stakeholders. This reflects different levels of investment and

resource needs across the links of the value chain. Thus, stakeholders involved in production bear higher expenses, whereas transport activities require relatively lower costs (Table 8).

Table8: Production costs by value chain actor

Stakeholders	Unit price (FCFA)	Fixed costs (FCFA)	Variable costs (FCFA)	Total cost (FCFA)	Production (tons/month)
Traders	5 980	267 840	159 325	427 165	19.2
Producers / Collectors / Harvesters	4 797	454 716	307 592	762 308	36.71
Processors	4 491	260 253	118 150	378 403	50.44
Transporters	5 625	126 269	71 567	197 835	20.75
Overall average	5 081	314 354	187 155	501 509	35.12

Source: Field data, 2024

Marketing costs are also a significant component of the expenditures incurred by the stakeholders, particularly due to the transport, handling, and transaction fees observed along the chain (Table 9).

Analysis of Table 9 shows that marketing costs vary according to the categories of stakeholders, with transporters incurring the highest fixed and variable expenses, while consumers bear the lowest costs. This reflects differences in expenditures associated with the functions performed by each stakeholder within the value chain. These results highlight the need to improve the efficiency of marketing activities in order to strengthen the economic performance of the sector.

Table9: Marketing costs of the various stakeholders

Stakeholders	Fixed costs (FCFA/month)	Variable costs (FCFA/month)	Average marketing cost (FCFA)
Traders	324 025	89 825	34 206.95
Consumers	15 000	0	200
Producers / Harvesters / Collectors	181 394.60	129 067.57	119 556.22
Processors	56 097.06	37 323.53	316 990.79
Transporters	562 250	642 173.44	66 508.94
Overall average	223 244.44	167 738.66	156 942.12

Source: field data, 2024

Analysis of Table 10 shows that revenues and margins vary depending on the categories of stakeholders. Transporters record the highest marketing margin, while processors have the largest production margin. This reflects differentiated value creation among the segments of the value chain, linked to the roles performed by each stakeholder. These results indicate that the profits generated by the sector are not distributed uniformly.

Table10: Revenues and profit margins of the different stakeholders

Stakeholders	Production margin (FCFA)	Marketing margin (FCFA)	Monthly income (FCFA)
Traders	1 800	15 000	68 450.00
Producers / Harvesters / Collectors	10 000	166 837.84	112 364.87
Processors	100 000.00	180 591.77	98 147.06
Transporters	25 000.00	710 451.56	308 375.00

Source: field data, 2024

Finally, the economic performance indicators highlight the most profitable segments as well as their contribution to value added creation within the sector. The results show that certain stakeholders benefit from greater economic advantages than others, depending on their position in the chain and the nature of the activities carried out (Table 11).

Producers/operators/collectors and processors are the most represented categories. This reflects varying levels of performance across links in the value chain. These results highlight the importance of strengthening stakeholders' capacities in order to improve the overall performance of the sector.

Table11: Economic performance of value chain actors

Stakeholders	Low (%)	Average (%)	Good (%)	Total (%)
Traders	1,85	13,89	2,78	18,52
Consumers	0,00	0,93	0	0,93
Producers / Harvesters / Collectors	0,93	23,15	10,19	34,26
Processors	5,56	18,52	7,41	31,48
Transporters	0	5,56	9,26	14,81
Total	8,33	62,04	29,63	100

Source: field data, 2024

DISCUSSION

The study highlights a relatively functional value chain for *Isoberlinia* spp., in which harvesting, processing, transportation, and marketing activities are carried out by actors with well-defined roles. Products move from one link in the chain to another according to an organization that enables their valorization up to the final consumer. However, beyond this apparent organization, the results reveal a sector whose governance remains poorly structured. The weak membership of actors in professional organizations, the absence of formal coordination mechanisms, and the almost exclusive reliance on verbal agreements reflect an organization based more on interpersonal relationships than institutional arrangements. These observations suggest that the main constraints of the sector are not limited to production conditions or resource availability, but also relate to the modes of coordination between the various actors. These results align with the analyses developed by Gereffi, Humphrey, and Sturgeon (2005), according to which the performance of a value chain largely depends on the quality of its governance (Gereffi et al., 2005). A sector in which relationships between actors are organized, responsibilities are clearly defined, and exchanges are regulated generally promotes better information flow, a reduction in transaction costs, and a more balanced distribution of the value created (Amadu & Miller, 2024a; Assens, 2014; Ballet, 2007). Conversely, when coordination mechanisms remain limited, actors struggle to develop common strategies likely to sustainably improve the sector's competitiveness (Ahmad et al., 2024b). The results obtained in this study illustrate this situation. Although the different links are interdependent, this interdependence does not translate into a genuine collective dynamic capable of sustaining the development of the sector.

The weak structuring of actors is, moreover, a widely shared observation in studies on forest products in sub-Saharan Africa. Markelova et al. (2009) show that producer organizations represent an important lever for improving market access, strengthening the bargaining power of producers, and reducing transaction-related costs. For its part, FAO (2022) emphasizes that forest product value chains are still often hampered by a low level of professional organization, which limits opportunities for pooling investments, disseminating innovations, and accessing financing (Bair & Mahutga, 2023b; Gniza, 2024). The results obtained in this study confirm this trend. Despite the existence of regular interactions among stakeholders, these remain essentially sporadic and respond more to immediate needs than to a collective development strategy.

The significant role played by verbal agreements in commercial exchanges also deserves special attention. In rural areas, transactions often rely on trust, close relationships, and networks built over time. Williamson (1985) explains that this type of governance arises when formalizing contracts generates costs deemed higher than the expected benefits. Similarly, Ostrom (1990) considers that trust-based relationships can serve as an effective coordination mechanism within local communities. However, when economic activities expand or exchanges become more complex, these mechanisms quickly reveal their limitations. The difficulties related to honoring

commitments, price fluctuations, or securing supplies observed in this study illustrate the vulnerabilities of governance that is essentially informal.

Economic analysis also highlights a differentiated distribution of added value among the different links in the chain. Producers and operators bear the main costs associated with access to the resource, harvesting operations, and primary transport, while processing and marketing activities generate relatively higher margins. This configuration matches observations made in numerous agricultural and forestry value chains, where value creation gradually increases as products are processed and brought closer to the final consumer. Porter (1985) notes that economic value does not result solely from the production of raw material, but also from all activities that improve its quality, packaging, processing, and marketing (Sjaastad & Vedeld, 2007.; Yelkouni et al., 2023.). Kaplinsky and Morris (2001) reach similar conclusions by showing that downstream actors generally have a greater ability to capture added value thanks to their stronger command of markets.

The results obtained are also consistent with several studies devoted to non-timber forest products in Africa (Hirczak et al., 2022 ; Moussa et al., 2017). Ingram et al. (2020) show that the weak organization of stakeholders is one of the main obstacles to the economic development of forest-based value chains, even when the available resources have significant commercial potential. Similarly, FAO (2022) highlights that the performance of forest value chains depends as much on the quality of their governance as on the abundance of the resources exploited. Observations made on *Isoberlinia* spp. point in the same direction by showing that the difficulties faced by stakeholders originate from institutional as much as economic factors (Adjahossou et al., 2019b).

One of the main contributions of this study is precisely to demonstrate that the valorization of *Isoberlinia* spp. cannot be analyzed solely from the perspective of resource exploitation. Studies devoted to this species have so far focused primarily on its distribution, ecology, regeneration, or uses by local communities (Amadu & Miller, 2024b; Dalla Valle et al., 2026b). By simultaneously incorporating organizational, economic, and institutional dimensions, this research offers an additional perspective on how the sector operates. It shows that opportunities for improvement lie not only in increasing production, but also in enhancing coordination mechanisms, strengthening stakeholder organizations, and improving information flow between the different links in the chain.

These results thus invite us to consider governance as an essential lever for the development of the *Isoberlinia* spp. sector. Better structuring of stakeholders, combined with more formalized consultation mechanisms and strengthened organizational capacities, could help improve transaction transparency, reduce coordination costs, and promote a more balanced distribution of added value. From this perspective, efforts to increase the sector's competitiveness would benefit from being accompanied by actions targeting not only the technical aspects of production and processing, but also the strengthening of local institutions that regulate exchanges.

This study nevertheless presents certain limitations. The data were collected from stakeholders located within the study area and reflect a situation observed at a given point in time. They do not allow for an assessment of changes in the supply chain over time, nor the effect of seasonal variations on costs, prices, or margins. Future research could adopt a longitudinal approach in order to track changes in the value chain over several cycles. It would also be useful to analyze the influence of public policies, certification schemes, and sustainable management mechanisms on the economic and organizational performance of the *Isoberlinia* spp. sector.

CONCLUSION

The present study has provided a better understanding of how the *Isoberlinia* spp. value chain operates in northern Benin. The results show that the sector brings together several categories of stakeholders with complementary roles, but remains weakly structured, with governance based mainly on informal relationships and verbal agreements. Furthermore, economic performance varies across segments, with processing, transport, and marketing activities generating higher profit margins than production. These results indicate that improving the sector's competitiveness depends as much on better organization of stakeholders as on strengthening coordination mechanisms. The development of professional organizations, the gradual formalization of

commercial relationships, and support for the different segments thus emerge as important approaches to ensure the sustainable valorization of *Isoberlinia* spp. and a better distribution of benefits within the value chain.

AUTHOR CONTRIBUTIONS

All the authors contributed to the design of the study and to the interpretation of the results of this study. AA collected and analyzed the data and drafted the first version of the manuscript. Scientific supervision, critical revision, and validation of the manuscript were carried out by AISM, MMI, AJY, and PD. AISM also participated in data collection. All the authors read and approved the final version of the manuscript.

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CONFLICT OF INTEREST

The authors declare that this study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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