

Competitiveness and cost structure analysis of selected wood-processing industries in Ethiopia

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Abstract: Wood-processing industries contribute to economic and social development by producing a variety of wood products, yet limited information exists on their competitiveness and cost structures in Ethiopia. In this study we examined their competitiveness by using diamond model and cost structures of chipboard, plywood, and sawn wood industries using a survey of 29 large and medium firms and detailed cost analysis of three case studies. We used both qualitative and quantitative data to ensure a comprehensive analysis; quantitative data were examined using descriptive statistics including frequencies, means, and percentages to identify measurable patterns and trends, while qualitative data provided contextual depth and insights into the operational and strategic challenges faced by respondents. Findings revealed that limited support from government was a key constraint to competitiveness, while growing demand for wood products had a positive effect. Cost structures varied by industry type: raw materials were the largest expense for chipboard (43%) and plywood (51%) producers, while overhead costs dominated (76%) for the sawn wood (sawmill) respondent from 2019 to 2024. Profitability improved across all products: chipboard margins rose from 6.9% to 7.1%, plywood from 9.6% to 22.8%, and sawn woods from 3.8% to 13.3%. Enhancing the competitiveness of Ethiopia's wood-processing sector requires addressing industry-specific challenges and costs.

Keywords: Chipboard; Diamond model; Plywood; Sawn wood; Wood products

Introduction

Trade of wood and wood products is growing across Africa (AFF 2019), with wood-processing industries playing a key role in producing diverse products that support both economic and social development (Gordeev 2020; Weiss et al. 2011). In Ethiopia, demand for forest products has steadily increased, but the supply gap continues to widen despite efforts to develop

the sector. Wood product imports rose sharply from 17,750 m³ in 1997 to 128,914 m³ in 2017, while the trade deficit grew from USD 37.2 million to USD 263.4 million over the same period. On average, Ethiopia's annual wood product imports were about USD 118.7 million, compared to just USD 1.5 million in exports, resulting in an annual trade deficit of roughly USD 117.2 million (Tolera 2021). This highlights the need to enhance the competitiveness of wood-processing industries by developing high-quality, value-added products and promoting sustainable forestry practices (Kolev et al. 2020; Milicevic et al. 2017). To succeed in an unpredictable economic environment,

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these industries must strengthen their competitive advantage, which depends on factors such as the macroeconomic context, business environment, and operational strategies (Deewong et al. 2013; Wethyavivorn et al. 2009; Porter 1990). Moreover, wood-processing industries face competition both domestically and internationally (Milicevic et al. 2017).

Competitiveness refers to a firm's ability to deliver products more effectively and efficiently than its rivals (Porter 2000). To analyze the factors that contribute to competitive advantage in an industry, Porter (2000) introduced the diamond model. Industrial competitiveness is shaped by four interrelated and mutually reinforcing elements: factor conditions, demand conditions, the presence of related and supporting industries, and the nature of firm strategy (Porter 1990). Consequently, it is essential to identify the factors influencing competitiveness to understand the positioning of wood-processing industries. This understanding will enable the formulation of targeted measures and strategies aimed at enhancing competitiveness of these industries.

In addition to the factors identified in Porter's diamond model, a firm's competitiveness is strongly influenced by how effectively it utilizes its inputs (Porter, 1998). Companies seek to maximize profit per unit, either by reducing production costs or increasing output, depending on their strategic goals (Gordeev 2020; Sujová et al. 2015; Drury 2007). A thorough understanding of a company's cost structure supports better cost management by revealing how costs behave (Akyuz et al. 2020; Siadat et al. 2007). This structure is shaped by operational efficiency and strategic cost management, directly impacting profitability and shareholder returns. However, the wood-processing industry in Ethiopia continues to face low productivity, limiting its competitiveness (Gebreyesus 2013). Globally, the forest sector is under growing pressure to respond to challenges such as climate change, ecosystem services, recreation, renewable energy, and bioeconomy demands, while meeting strict sustainability requirements. Tackling these issues requires improved sector performance, innovation in products and technologies, and greater adaptability to changing market conditions. This study aims to address these gaps by identifying the key factors influencing competitiveness and analyzing the cost structures of wood-processing industries, categorized by clusters of wood product types. We focused specifically on the chipboard, plywood, and sawn wood sectors. By generating insights into industry dynamics and cost structure, the research seeks to inform strategies and policy interventions that could enhance the competitiveness of Ethiopia's wood-processing industries and reduce import dependency.

Methodology

Study area

We conducted the study across four regional states in Ethiopia: Oromia, Amhara, Sidama, and Tigray, as well as in the Addis Ababa city administration. In the Oromia region, we focused on the towns of Shashemene, Jimma, and Arsi Negelle, and in the Amhara region, Bahirdar, Injibara, and Debrebirhan. Additionally, Hawassa city was included from the Sidama region, along with Maichew town from Tigray. The selection criteria for the wood-processing industries involved several factors: the volume of wood products produced; regional distribution to capture the diverse contexts of resource access and marketing; ownership types, both state and privately owned; and the willingness of factory owners and experts to provide accurate information. According to the Ethiopian Central Statistical Authority (CSA), the manufacturing sector is categorized into three groups: large- and medium-scale, small-scale, and cottage and handicraft industries. This classification is based on the number of individuals employed in manufacturing and the level of production means available at each establishment. Large- and medium-scale manufacturing operations employ 10 or more individuals and utilize power-driven machinery (CSA 2014). Figure 1 illustrates the locations of the cities where the studied wood-processing industries are situated. The selected sample industries produced a variety of wood products, including chipboards from 6 industries, plywood from 3 industries, and sawn wood operations from 20 industries.

Methods of data collection and analysis

Secondary data for this study were gathered from both published and unpublished sources, including reports from relevant government agencies and other organizations at both federal and regional levels. Following this, a formal survey was conducted involving 29 wood-processing industries, which represented 30% of the total of 96 large- and medium-sized wood-processing industries in Ethiopia, as reported by CSA in 2016. Notably, 78% of these industries were sawmills (Indufor 2016). From the sample of 29 wood-processing industries, 20 sawmills were randomly selected for further analysis. Additionally, the sample included six chipboard processing manufacturers and three plywood-processing industries, accounting for 60% and 27% of the categories, respectively. The survey questions were crafted to align with the diamond model, focusing on production factors, demand, firm strategy and rivalry, related and supporting sectors, and government support conditions to evaluate industry competitiveness.

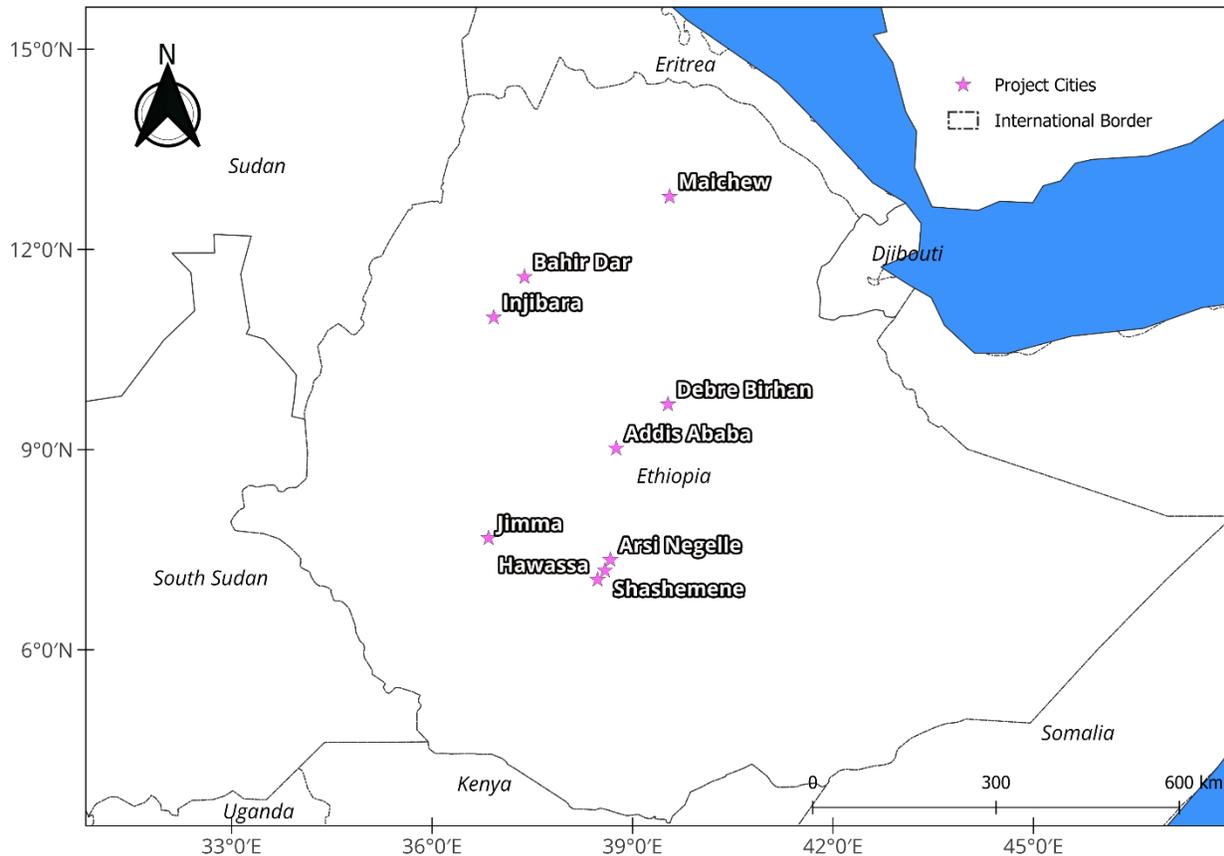


Figure 1. Map of Ethiopia showing nine urban centers where respondent wood-processing manufacturers were located.

Respondents utilized a five-point Likert scale to rate their perceptions, with scores ranging from 1 (most constraining) to 5 (most enhancing). To gain deeper insights into the cost structures of the manufacturers, case studies were also conducted for three wood-processing manufacturers. The cost-structure analysis is based on revenue and expense data collected from wood-processing industries for two fiscal years: 2019, covering the period from July 8, 2018, to July 7, 2019, and 2024, covering July 8, 2023, to July 7, 2024. Data collection involved both surveys and case studies. The initial survey was conducted between April and June 2017, while in-depth case studies were carried out in October 2019 and June 2025 to gather detailed and relevant cost structure information. Analyzing a firm's competitiveness necessitates examining the underlying factors that influence individual firms and industries (Porter 1998). Consequently, this descriptive study employed Porter's framework to identify the factors impacting the competitiveness of Ethiopia's wood-processing industries. The quantitative data obtained from the survey were analyzed using descriptive statistics, including means, frequencies, and percentages using Microsoft Excel®.

Results and Discussion

Descriptive analysis of wood-processing industries

The surveyed wood-processing industries, specifically chipboard manufacturers, have been established for 6 to 55 years and employ between 26 and 350 people. Of the six manufacturers, four (67%) are privately owned and two (33%) are state-owned. Four (67%) manufacturers plan to expand, while two (33%) wish to maintain their current operations. All manufacturers primarily use Eucalyptus logs, with three also utilizing sawdust from nearby sawmills. They mainly produce various sizes of chipboard products, relying on bank loans and profits for capital, with reinvestment of profits being the primary source. Decision-making differs in privately owned manufacturers, the owner decides, while in state-influenced or state-owned manufacturers, the general manager makes decisions, subject to board approval.

Among the three plywood manufacturers, two were established in the 1960s, while the Debrebirhan plywood factory opened in 2017. Employee numbers are 76 at Jimma plywood factory,

82 at Debrebirhan, and 89 at Ethiopian Plywood Enterprise. Two (67%) manufacturers plan to expand, while one (33%) intends to maintain its current status. All manufacturers stock raw materials before the rainy season due to forest inaccessibility in winter, using Eucalyptus logs and urea-formaldehyde for production. They primarily produce various sizes of plywood, relying on reinvested profits and bank loans for capital. Decision-making is led by general managers, with oversight from boards in two (67%) manufacturers and a private owner in one (33%).

The analysis of 20 medium- and large-sized sawmills reveals that their establishment dates range from 2 to 20 years, with employee numbers varying from 12 to 162. Among these, three (15%) are state-owned and 17 (85%) are privately owned. Eleven (55%) sawmills plan to expand, five (25%) intend to maintain their current status, and four (20%) aim to downsize and close.

The primary log species used include *Cupressus lusitanica* (all sawmills), *Juniperus procera* (13 sawmills), *Cordia africana* (11 sawmills), and *Pinus patula* (10 sawmills), with some also using *Persea americana*. Financial capital comes from bank loans, home equity loans, and reinvested profits. Decision-making is led by general managers, with oversight from boards in state-owned mills and primarily by the owners in private mills. Key characteristics of the manufacturers are summarized in Table 1.

Factors affecting competitiveness of wood-processing industries

The competitiveness of the wood-processing industries is a prerequisite for developing high-quality and value-added products and contribute to sustainable forestry (Milicevic et al. 2017). Competitiveness is the firm's ability to provide products

more effectively and efficiently compared to its competitors (Porter 2000). Firms in each nation compete in both domestic and global markets (Porter 1998). Porter (2000) developed the diamond model to identify factors affecting the competitive advantage of industry. According to Porter (1990: Figure 2.), industrial competitiveness is determined by four interdependent and mutually reinforcing attributes and by the level of government support. These are production factor conditions, demand conditions, presence of related and supporting sectors, and the nature of firm strategy.

Production factors

Chipboard manufacturers face several constraints impacting competitiveness, as shown in Table 2. Five manufacturers primarily struggle with limited physical resources, particularly forest and land availability. Meanwhile, four manufacturers identify human resources, capital, infrastructure, and knowledge gaps as significant hindrances. Key informants indicate a scarcity of modern machinery and spare parts in the domestic market, leading to reliance on imports. Additionally, investments in chipboard production and forest resource development encounter difficulties in securing loans, as banks prioritize export-oriented agricultural and manufacturing sectors over forestry investments due to the latter's longer gestation period.

We identified key production factors affecting the competitiveness of plywood, including human capital, land, capital resources, and infrastructure (Table 2). Respondents from two of the three manufacturers emphasized that the availability of human resources enhances competitiveness, while limitations in physical resources, capital, infrastructure, knowledge, and skills serve as significant constraints.

Out of 20 sawmills surveyed, 17 respondents identified the availability of low-cost human resources as a key factor enhancing competitiveness (Table 2). However, limitations in physical resources, lack of knowledge, and capital shortages were noted as constraints by 14, 12, and 11 sawmills, respectively. Key informants highlighted that government control over most forest resources restricts raw material supply, particularly for privately owned sawmills.

Demand factors

The results indicate that demand factor conditions significantly enhance the competitiveness of chipboard manufacturers, with respondents from five manufacturers highlighting market size as crucial. Additionally, four manufacturers emphasized the importance of customer satisfaction regarding service and product quality, as well as the adoption of new products. This suggests that effectively responding to consumer needs

Table 1. Description of respondent wood-processing manufacturers.

Factors	Shares in number (%)			
	Chipwood	Plywood	Sawmill	
Ownership	Private	4 (67%)	1 (33%)	17 (85%)
	Shareholder	2 (33%)	2 (67%)	3 (15%)
Expansion	Plan to expand	4 (67%)	2 (67%)	11 (55%)
	Maintain the status	2 (33%)	1 (33%)	5 (25%)
	Plan to close			4 (20%)
Employment	Minimum	26	76	12
	Maximum	350	91	162
Raw material	Urea-formaldehyde	6 (100%)	3 (100%)	
	Log	6 (100%)	3 (100%)	20 (100%)

Table 2. Factors affecting respondent competitiveness.

Categories of factors		Chipwood		Plywood		Sawmill	
		Enhancing (n)	Constraining (n)	Enhancing (n)	Constraining (n)	Enhancing (n)	Constraining (n)
Production factor condition	Human	2	4	2	1	17	3
	Physical	1	5	1	2	6	14
	Capital	2	4	1	2	9	11
	Knowledge	2	4	1	2	8	12
Demand condition	Market size	5	1	2	1	14	6
	Adoption of new product	4	2	3	-	14	6
	Satisfaction with products	4	2	1	2	7	13
Firm strategy, structure, and rivalry	Work plan	4	2	3	-	17	3
	Innovation activity	3	3	2	1	6	14
	Age of establishment	4	2	2	1	17	3
	Competition in the market	3	3	1	2	15	5
Related and supporting sector	Energy supplier	2	4	1	2	11	9
	Research institutions	2	4	1	2	6	14
	Higher learning institutions	2	4	1	2	4	16
Government support	Incentives	4	2	2	1	13	7
	Availability of foreign currency	1	5	-	3	8	12
	Illegal forest harvest	2	4	1	2	5	15

through innovative offerings can lead to increased business size and profitability.

For all the plywood manufacturers, adoption of new products was identified as a factor that positively affects competitiveness. Respondents in two of the plywood manufacturers identified market size as enhancing factor, and the lack of satisfaction of customer in terms of product quality, prices, and services as constraining factors for competitiveness (Table 2).

The respondents in the 14 sawmills considered the availability of a relatively large wood product market and customer adoption of new products as sources of competitive advantage for the sawmills. Field level observations helped reveal that in local markets, products from the Shashemene sawmill had much higher demand. A low level of customer satisfaction on price, product quality, and customer services was identified as a constraining factor by 13 sawmills. Key informant interviews revealed that the lack of customer satisfaction is due to a lack of standard dimensions and defects in the products.

Firm strategy, structure, and rivalry

Results revealed that four chipboard manufacturers viewed work planning and establishment time as key factors for enhancing competitiveness, suggesting that longer establishment periods correlate with increased profits and competitive

advantages. Additionally, these manufacturers emphasized the importance of securing raw materials before the rainy season. While three manufacturers identified innovation and market competition as enhancing factors, the other three viewed them as constraints.

The competitiveness of plywood manufacturers is influenced by several factors, including the factory work plan, innovation activity, presence and strength of competitors, and age of establishment. All manufacturers recognized the importance of a work plan, while two identified innovation activity and age of establishment as enhancing factors. Additionally, only two manufacturers noted the lack of certification and weak competition as constraints negatively impacting their competitiveness.

Respondents from 17 sawmills identified work plan and age of establishment as enhancing factors of competitiveness, while 15 sawmills highlighted market competition as a key factor. Key informants noted that a flexible work plan boosts competitiveness, but limited technical support and a lack of skilled workforce in wood technologies hinder innovation, which was recognized as a constraining factor by 14 sawmills.

Related and supporting sectors

The competitiveness of four manufacturers is constrained by the limited involvement of energy suppliers, research institutions,

and universities in supporting the wood-processing industry. Key informants noted that higher education and research institutions contribute insufficiently to innovation and new technology development, while frequent power interruptions significantly disrupt production processes.

In this study, electricity generating companies and research institutions were identified as key supporting sectors for plywood manufacturers; however, two manufacturers viewed their current roles as constraints to competitiveness due to the lack of a reliable power supply in Ethiopia. Additionally, the insufficient engagement of research institutions and universities in wood-processing technology research and training has led to a low level of human resource capacity within the industry.

Universities, research institutions, and electric suppliers were identified as related and supporting sectors for sawmills (Table 2). Inadequate support universities and research institutions were reported as constraining factors by respondents from 16 and 14 sawmills, respectively. This is mainly because these institutions have had limited links with sawmills to make a meaningful contribution in making them more competitive. Electricity supply was considered as an enhancing factor by respondents from 11 sawmills, while 9 sawmills identified it as constraining factor. Key informants revealed that frequent blackouts and voltage fluctuations were common affecting production processes and capacities of sawmills, and thereby their profitability.

Government support

The results indicated that the main constraints faced by chipboard manufacturers are a lack of foreign currency and illegal wood product harvesting, identified by five and four manufacturers, respectively. A key informant noted that the foreign currency shortage particularly impacts the import of raw materials like urea-formaldehyde. Conversely, tax incentives for imported machinery and plantation development offered by the government are viewed as beneficial by four manufacturers.

To enhance the competitiveness of plywood manufacturers, government support conditions include providing incentives for wood-processing, improving foreign currency availability, and controlling illegal wood harvesting. While two manufacturers view government incentives, such as low tariff rates on imported machinery, as beneficial, all manufacturers identify foreign currency access as a significant constraint, essential for importing chemicals, spare parts, machines, and equipment.

Government support conditions identified to enhance the competitiveness of sawmills include incentives for wood-processing, improved foreign currency availability, and control

of illegal wood harvesting. Out of 20 sawmills surveyed, 13 respondents viewed these conditions positively, particularly appreciating tax incentives for establishing sawmills, while 7 considered them constraining. Key informants noted that the low 5% tariff on lumber imports (ERCA 2016), intended to curb illegal harvesting, has not effectively addressed the issue, as restrictions on legal harvesting from natural forests have led to increased illegal logging and deforestation. Respondents from 15 sawmills identified the failure to control illegal harvesting and the restrictions on legal harvesting from forests as significant constraints, while 12 sawmills highlighted limitations in accessing foreign currency for importing essential raw materials, spare parts, machines, and equipment. Additionally, specific species like *J. procera*, *Podocarpus falcatus*, *Hagenia abyssinica*, and *Cordia africana* are scarce in the market due to the requirement of permits for their cutting and harvesting.

Production process and cost structure analysis

The cost structure of the three manufacturers' production system encompasses three main steps: inputs, production, and outputs. The inputs stage includes raw materials, direct labor, and overhead costs (such as insurance, salaries, electricity, maintenance, and depreciation), while the production stage involves transforming raw materials into finished products through various processing operations. Finally, the output stage entails producing different categories of wood products, which includes labor charges for loading and unloading, as well as cutting the wood to meet buyer specifications.

Production and the associated cost structure of Ethiopian Chipboard and Furniture Company (ECAFCO)

The company produces 1st- and 2nd-grade chipboard using the same process, with grading based on quality factors like smoothness and defects. Internal quality control determines the grade. Production volume declined from 2,458 m³ in 2019 to 846 m³ in 2024. Ethiopian Chipboard and Furniture Company factory generated a total revenue of USD 922,231, primarily from 1st-grade chipboard, which contributed 97% of sales, while 2nd-grade chipboard and labor charges accounted for 0.5% and 2.5%, respectively. Despite both chipboard grades undergoing the same production process, they are differentiated by quality through internal controls. Table 3 compares key financial figures between the years 2019 and 2024, highlighting changes in sales, expenses, and profitability. Gross sales revenue saw a significant decrease from USD 922,231 in 2019 to USD 362,381 in 2024, indicating a sharp decline in business volume or pricing. Correspondingly, total operating expenses also dropped from USD 830,742 to USD 325,531, showing that cost-cutting measures were likely implemented to align with

reduced revenue. Despite the fall in absolute figures, operating profit before tax decreased less dramatically, from USD 91,488 to USD 36,850, suggesting improved operational efficiency. Similarly, net profit declined from USD 64,042 to USD 25,795. Interestingly, the net profit margin slightly increased from 6.9% in 2019 to 7.1% in 2024, which indicates that the company became marginally more profitable relative to its revenue, despite the overall contraction in financial performance. The decline in total revenue production for 2024 can be primarily attributed to a series of operational challenges faced by the factory. One of the main reasons was a shortage of essential raw materials, particularly formaldehyde, which is critical for the factory's manufacturing processes. This shortage disrupted production schedules and limited the volume of chipwood product that could be produced and sold. Additionally, the company faced repeated mechanical breakdowns due to aging equipment, which further hampered production efficiency. These machines, being outdated, frequently required maintenance, but sourcing spare parts became increasingly difficult, causing prolonged downtimes. Furthermore, the factory was in the process of relocating its operations to a new production center, which introduced additional disruptions. Collectively, these issues significantly affected the company's ability to maintain previous levels of output, leading to a notable drop in revenue for 2024, although the net profit margin slightly increased in 2024.

The total estimated production cost for ECAFCO was allocated as follows: 43% for raw materials, 20% for direct labor, and 37% for overhead (Figure 2). ECAFCO's production of chipboard relies on raw materials, primarily round logs and urea-formaldehyde resin powder, with a total raw material cost of which 55% is attributed to glue and the remainder to eucalyptus logs. The direct labor cost, predominantly consisting of salaries (76%), followed by wages (13%) and overtime payments (11%), benefited from Ethiopia's high labor supply that helps lower overall production costs. Overhead costs made up 37% of total input costs, with administrative expenses representing 74% of the overhead, covering customer service, production scheduling, transport planning, and vendor costs.

Production and the associated cost structure of the Ethiopian Plywood Enterprise

The Ethiopian Plywood Enterprise primarily produces plywood, with production decreasing from 670 m³ in 2019 to 129 m³ in 2024. The analysis presents a comparison of financial performance between 2019 and 2024 (Table 4). Gross sales revenue declined significantly from USD 450,463 in 2019 to USD 113,420 in 2024, reflecting a major reduction in overall

Table 3. Revenue and profit of the Ethiopian Chipboard and Furniture Company.

Activity cost in USD	2019	2024
Gross sales revenue	922,231	362,381
Total operating expenses	830,742	325,531
Operating profit before tax	91,488	36,850
Expense on tax	27,447	11,055
Net profit	64,042	25,795
Net profit margin (%)	6.9%	7.1%

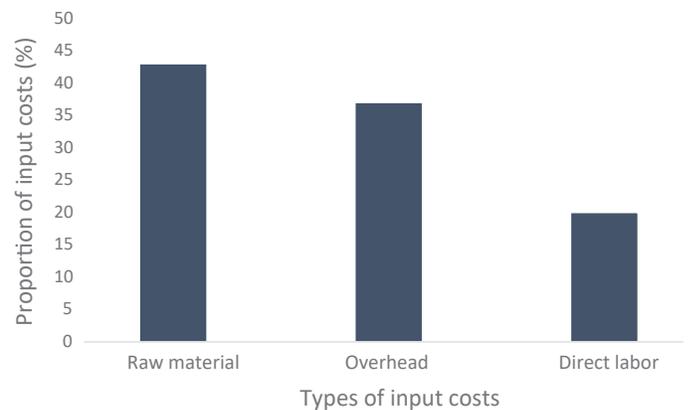


Figure 2. Percentage share of production input costs (ECAFCO).

Table 4. Revenue and profit of the Ethiopian Plywood Enterprise.

Activity cost in USD	2019	2024
Gross sales revenue	450,463	113,420
Total operating expenses	388,638	76,433
Operating profit before tax	61,825	36,986
Expense on tax	18,547	11,095
Net profit	43,277	25,890
Net profit margin (%)	9.6%	22.8%

sales. Correspondingly, total operating expenses also decreased from USD 388,638 to USD 76,433, indicating cost reductions aligned with the lower production. Despite the decline in revenue and expenses, operating profit before tax decreased only moderately, from USD 61,825 to USD 36,986, showing improved efficiency in managing costs. Tax expenses fell from USD 18,547 to USD 11,095, while net profit declined from USD 43,277 to USD 25,890. Notably, the net profit margin increased sharply from 9.6% in 2019 to 22.8% in 2024, suggesting that the factory became significantly more profitable relative to its revenue, successfully enhancing profitability despite the drop in sales. The decline in 2024 revenue was mainly due to raw material shortages, especially formaldehyde, frequent breakdowns of aging equipment, and the factory having been

affected by a government infrastructure development road in the factory campus. These challenges disrupted production and reduced output. Despite the lower revenue, the net profit margin slightly improved in 2024.

The total annual production costs for Ethiopian Plywood Enterprise are illustrated in Figure 3. Raw materials, costing 51%, include logs, glue, hardener, wheat flour, and imported adhesive chemicals like urea-formaldehyde resin, which alone make up 32.82% of raw material costs due to their high import expense. Direct labor, costing (13%), is mostly salary-based (74%), with additional costs for wages (16%), overtime (1%), and performance-based incentives (9%). Overhead costs total (36%), covering administrative expenses (44%), depreciation (35%), and indirect labor (20%).

Production and the associated cost structure of the Arsi Negelle Sawmill

At the Arsi Negelle Sawmill (ANS), logs are crosscut and sawn to produce lumber as the main product, with by-products such as firewood, sawdust, slabs, and resizing leftovers. In 2019, the sawmill produced 10,886.5 m³ of output, including 4,020.5 m³ of lumber and 6,866 m³ of by-products like firewood, sawdust, and slabs. By 2024, total output dropped to 5,699.8 m³, with 2,699 m³ of lumber and 3,000 m³ of by-products. Lumber prices vary by grade, size, species, and use, and are set by the enterprise. In 2019, the factory generated a gross revenue of USD 1,396,463, with 93% from lumber sales, 4% from slabs, and the rest from other products and services, mainly serving the domestic market (Table 5). With total operating expenses of USD 1,319,488, the factory achieved a profit before tax of USD 76,974 and paid USD 23,092 (30%) in income tax, resulting in a net profit of USD 53,882. Access to raw materials from its own plantations and the high quality of its lumber support the factory's full production capacity and strong market preference.

The total annual production costs for ANS, as shown in Figure 4, were dominated by overhead costs (76.3%), followed by raw materials (15.7%) and direct labor (8%). Direct labor was the lowest cost component, with salaries and wages making up 79.5% and 19.5%, respectively, reflecting low daily labor rates. Overhead costs, mainly from administrative expenses (49.2%) and indirect labor (44.9%), also include depreciation (5.5%) and electricity (0.3%), highlighting the factory's cost structure as heavily overhead-driven.

Comparison of the production costs of the three case study manufacturers

The analysis of the three case study manufacturers (ECAFCO, EPE, and ANS) reveals both similarities and differences in

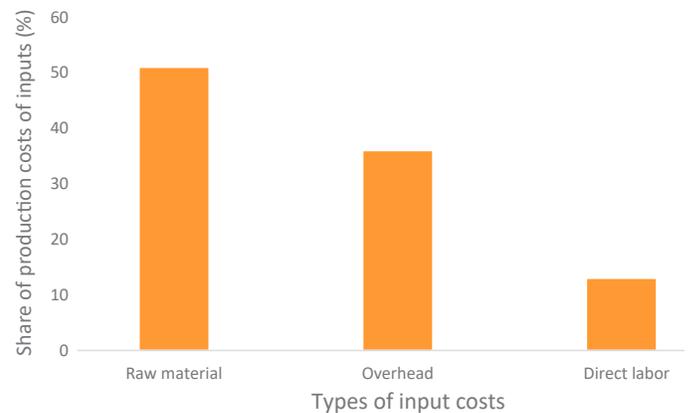


Figure 3. Percentage share of production input costs of the Ethiopian Plywood Enterprise.

Table 5. Revenue and profit of the Arsi Negelle Sawmill.

Activity cost in USD	2019	2024
Gross sales revenue	1,396,463	791,956
Total operating expenses	1,319,488	641,303
Operating profit before tax	76,974	150,653
Expense on tax	23,092	45,195
Net profit	53,882	105,457
Net profit margin (%)	3.8%	13.3%

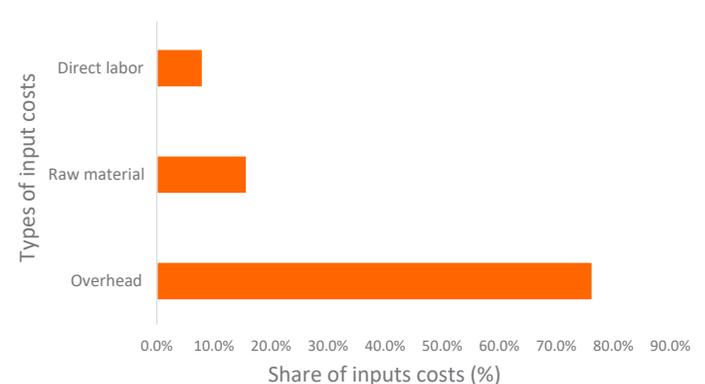


Figure 4. Percentage share of production input costs of the Arsi Negelle Sawmill.

their production cost structures, particularly in the input costs for chipboard, plywood, and sawmill operations (Table 6). Notably, raw materials constituted a significant portion of costs in the chipboard and plywood manufacturers, with urea-formaldehyde accounting for about half of these expenses due to its high market price as an imported material. Conversely, ANS had the lowest raw material costs, primarily utilizing logs sourced from nearby plantations, which minimizes transportation expenses and contributes to its cost efficiency.

Table 6. Comparison of the production costs of the three case study enterprises

Input costs	Production cost in % share		
	Case study- ECAFCO	Case study- EPE	Case study- ANS
Raw material	43	51	15.7
Direct labor	20	13	8
Overhead	37	36	76.3

The overhead cost constituted the second largest part of the total production costs for the chipboard and plywood manufacturers. The overhead cost of the chipboard and plywood manufacturers included depreciation, electricity, indirect labor, and intermediate inputs. Of the manufacturers, the highest overhead cost (76.3%) was observed in the sawmill, accounted for mainly by the indirect labor cost. This may be associated with the largest number of employees in this sawmill to support the production activities.

We found that all three manufacturers had relatively low direct labor costs, but they differ in net profit margins, with EPE achieving the highest at 9.6% of gross sales, followed by ECAFCO at 6.9%, and ANS at 3.8% in 2019. This suggests that ownership status may influence profitability, as privately owned firms like EPE and ECAFCO tend to maximize profits by minimizing costs, unlike the state-owned ANS, which aligns with findings from empirical studies indicating that private firms often outperform state-owned ones in profit generation (Goldeng et al. 2008).

Discussion

In Ethiopia, the manufacturing sub-sector faces several challenges that hinder its contribution to the national economy (Gebreyesus 2013). This study identified key factors affecting the competitiveness of wood-processing industries through the lens of Porter's diamond model (Porter 1990). Among these factors, production conditions emerged as the most significant constraint on the competitiveness of wood manufacturers. The limited availability of raw material supply consisting of forest resources in the market, inadequate human resource capacity, and underdeveloped infrastructure are critical barriers. These findings resonate with the work of Ogunwusi and Olife (2012), Chamshama et al. (2009), and Asumadu (2004), who noted that technological limitations, a lack of skilled labor, insufficient access to machinery, and scarce forest resources can impede productivity and growth in forest industries across developing nations. Additionally, there is a notable shift in industrial wood production from natural forests to plantations (Kok et al. 2014).

The positive factor identified in this study is the increasing demand for wood products within the country, which reflects a broader trend of rising wood product consumption across African nations (AFF 2019; GEF 2013; Huang et al. 2013). The levels of access to energy, government support, and firm strategy varied among the three wood-processing industries. Sawmill and chipboard manufacturers, in particular, suffer from low levels of government assistance, corroborated by reports indicating that only 8% of enterprises in Ethiopia have received such support (Gebreyesus and Mohnen 2013). Furthermore, a lack of collaboration among wood-processing industries undermines their competitive advantages. To enhance competitiveness, it is essential to foster strong relationships and cooperation between producers and users of raw materials, as well as with technology providers and market information sources (Porter 2000).

We highlighted notable differences in the cost structures among the three wood-processing industries due to the types of inputs utilized. Ethiopian Chipboard and Furniture Company and the Ethiopian Plywood Enterprise incurred relatively high raw material costs, comprising 43% and 51% of their total expenses, respectively. This finding aligns with the observations of Ogunwusi (2012) and Asumadu (2004), who noted challenges such as a scarcity of domestic raw material suppliers and inadequate infrastructure for wood product inputs in sub-Saharan Africa. Additionally, other research has emphasized the necessity for the forest industry to explore alternative processes that leverage more affordable raw materials, while maintaining product quality (Dieter and Englert 2006; Lantz 2005). These insights can be applied to other wood-processing industries, taking into account the unique circumstances and contexts of each factory.

The findings reveal that the Arsi Negelle Sawmill experienced the highest overhead cost component, accounting for 76.3% of its total expenses. Studies indicate that elevated overhead costs often stem from inaccurate decision-making, ineffective production planning, low plant productivity, and increased production costs within the industry (Golub et al. 2017). This significant overhead suggests that the factory employs a considerable number of staff who are not directly involved in lumber production. Conversely, the sawmill benefits from lower costs for log raw materials due to its proximity to its own plantation. This trend is reflected in the direct labor costs, which represent the smallest expense across all three wood-processing industries. Previous studies (e.g., Ogunwusi and Olife 2012; Ukrainski and Varblane 2005) have highlighted that low labor costs in the forest industry can bolster competi-

tiveness. However, a predominant portion of the workforce consists of unskilled laborers, which ultimately constrains the industry's capacity for innovation and, consequently, its overall competitiveness (Tether et al. 2005).

We also assessed the profitability of three wood product-processing manufacturers, revealing that the EPE achieved the highest net profit margin at 9.6% of gross sales revenue, followed by ECAFCO with 6.9%. In contrast, the ANS exhibited the lowest net profit share at 3.8%, primarily attributed to high overhead costs. This indicates that the private plywood factory outperformed both the shareholder chipboard company and the state-owned sawmill in terms of profitability. To enhance competitiveness within the industry, it is crucial for the government to facilitate access to raw materials, particularly urea-formaldehyde, which is essential for cost-effective panel production. Additionally, managing overhead costs is recommended as a strategy for the sawmill to achieve its profit maximization objectives. The insights gained from this study could be valuable for other countries facing similar challenges in their wood-processing sectors, provided that the unique contexts of each factory are considered. Furthermore, a recommendation for future research includes employing the same research design over an extended period and with a larger sample size to gain a deeper understanding of the cost structures within wood-processing industries. The findings related to competitiveness, cost structure, and profit analysis can serve as a foundation for further studies in Ethiopia.

Conclusion and policy implications

The findings of this study indicate that the wood-processing industry in Ethiopia faces significant constraints that hinder its competitiveness. Utilizing Porter's determinants, it is evident that factors such as production conditions, related and supporting industries, and government support are critical barriers impacting the competitiveness of chipboard, plywood, and sawmill manufacturers. Conversely, the strategies, structures, and rivalry among firms, along with the growing demand for wood products, positively influence the competitiveness of these industries. The finding by Avenyo (2018) and Jacobson et al. (2008) highlights that key elements affecting the competitiveness of forest industries in sub-Saharan Africa include the availability of raw materials, energy resources, and well-developed infrastructure. These results underscore the urgent need to transform the current state of the sector into a more competitive environment. It is essential for the business landscape to enable wood-processing companies to operate effectively, thereby fostering competitiveness. Additionally,

government regulations and services should facilitate competitive success rather than impose constraints. Access to reliable and efficient services from related and supporting industries must be equitable for all firms in terms of cost. Ultimately, collaboration among all stakeholders including input suppliers, producers, processors, manufacturers, marketers, distributors, service providers, and government is crucial to cultivating a competitive environment that benefits the entire sector.

We aimed to analyze the cost structure of wood-processing industries, concluding that the financial performance of the manufacturers was favorable. The cost structure analysis encompassed raw material costs, direct labor costs, and overhead costs within the production cycle of the wood-processing sector. Notably, raw material costs accounted for approximately 50% of total production expenses in both chipboard and plywood manufacturers, with a significant portion attributed to the imported urea-formaldehyde. A comparative analysis revealed that the Arsi Negelle Sawmill had an exceptionally high overhead cost share, comprising 76.3% of its total expenses, primarily due to substantial indirect labor costs that do not directly contribute to lumber production. Interestingly, direct labor, a crucial input, represented the lowest cost among the three wood-processing industries examined. This finding aligns with similar observations made by Adenikinju et al. (2002) regarding other African countries. The evidence suggests that reducing overhead costs at the sawmill and enabling cost-effective access to urea-formaldehyde for chipboard and plywood manufacturers could enhance the sector competitiveness and its contribution to the national economy. ECAFCO's net profit margin modestly increased from 6.9% in 2019 to 7.1% in 2024, reflecting a slight rise in profitability despite a general financial downturn. Conversely, Ethiopia Plywood's margin jumped from 9.6% to 22.8%, showing a substantial improvement in profitability despite reduced sales. Despite high production costs, all studied industries remain profitable; however, they must focus on improving competitiveness and sustaining profits through effective cost management and output maximization. Our scope was limited to three case study industries due to insufficient financial data from a larger sample of wood-processing firms. Additionally, the reliance on a single year of data restricted a more comprehensive longitudinal analysis of costs, revenues, and production volumes in the industry. Given the rising demand for wood products in Ethiopia and their potential economic impact, further quantitative research is essential across the wood-processing sector nationwide. The current lack of understanding poses a significant barrier for policymakers aiming to effectively integrate wood-processing

industries into the Ethiopian economy. The insights derived from this study may provide valuable information for assessing the competitiveness of selected wood-processing industries within the country.

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