

SYSTEMATIC REVIEW OF THE FOREST SECTOR'S CONTRIBUTION TO GDP IN ETHIOPIA AND KENYA

Rorisa Midekso Ware^{1*}

¹ Ethiopian Forestry Development, Dire-Dawa Center, 1708, Ethiopia.

ORCID iD: <https://orcid.org/0009-0002-9906-0443>

*Corresponding author: rorisamidekso1@gmail.com

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Abstract

The forest sector serves as a critical, yet frequently undervalued, pillar of East African economies, providing essential ecosystem services and supporting rural livelihoods. However, standard macroeconomic indicators operating under the traditional System of National Accounts (SNA) restrictively focus on formal market-traded timber extraction. This study aims to conduct a systematic review synthesizing existing empirical evidence on the economic valuation of forest resources in Ethiopia and Kenya. Adhering strictly to the PRISMA 2020 framework guidelines, a comprehensive search was executed across electronic databases (Scopus, Web of Science, EconLit, Google Scholar) and institutional grey literature repositories for literature tracking forestry GDP metrics. The synthesis demonstrates that conventional metrics fail to capture extensive informal markets—predominantly biomass energy networks (woodfuel and charcoal) and non-timber forest products like wild coffee, honey, and medicinal plants. Comparative data highlights that Ethiopia's forest rent contribution to GDP (5.60% in 2021) is significantly higher than Kenya's (1.22%), aligning with Ethiopia's larger forest resource base, which maintained roughly 15% forest cover from 2021 to 2023 compared to Kenya's stable 6.22%. Relying on narrow, site-specific market indicators reinforces a policy bias that prioritizes industrial extraction or land conversion over conservation, inadvertently undermining non-market ecosystem services. To establish resilient green economies, both nations must transition toward integrated SEEA frameworks. Standardizing tracking metrics for informal biomass and NTFP supply chains is an essential requirement to bridge data gaps, accurately reflect forestry's role in poverty alleviation, and align environmental governance with macroeconomic stability.

Keywords: GDP Contribution, Forest Rent, Biomass Energy, Non-Timber Forest Products (NTFPs), System of Environmental-Economic Accounting (SEEA), PRISMA Framework, East Africa

JEL classification: Q23, Q51, Q56, O13, O5

1. Introduction

The forest sector serves as a critical, yet frequently undervalued, pillar of East African economies, providing essential ecosystem services and livelihoods that support long-term regional development (Eregae et al., 2023; Narita et al., 2018). In Kenya, the forest sector contributes approximately 3.6% of the annual GDP, highlighting its vital role in national economic stability (Twala et al., 2025). Similarly, Ethiopia leverages its forest resources to underpin agricultural productivity and industrial development,

with forest-related industries and ecosystems collectively accounting for a significant portion of the nation's economic output (Abdeta, 2022).

Despite these contributions, the sector's full economic potential remains constrained by systematic data gaps and persistent underestimations in national accounts, particularly concerning non-timber forest products and informal employment (Abate, 2020 & Wakweya, 2026). This systematic review aims to synthesize existing evidence on the economic valuation of forest resources in both nations, identifying discrepancies between reported figures and the actual contribution of ecosystem services (Adugna, 2020; Eregae et al., 2022). Specifically, this study evaluates the provisioning, regulating, and supporting functions of forest ecosystems to address the current limitations in national accounting systems (Hettiarachchi et al., 2023; Ordofa, 2022).

Furthermore, this research seeks to clarify the methodological inconsistencies inherent in regional forestry accounting, particularly regarding the valuation of timber and non-timber forest products (Yadeta, 2017), (Osewe et al., 2024). as well as the assessment of biomass energy consumption for industrial and domestic utility (Muthike et al., 2017). By consolidating data from national forest inventories and regional policy assessments, this study clarifies the complex interlinkages between forest governance, energy security, and macroeconomic stability (Yalu, 2022). Ultimately, this review seeks to provide a comprehensive framework to revise existing data gaps and highlight the systemic underreporting of forestry's role in poverty alleviation and national economic growth (Yadeta, 2017).

By documenting these multifaceted economic roles—ranging from foreign currency generation through non-wood forest products to the informal energy sector—this systematic review underscores the necessity for improved data collection to accurately reflect the sector's true fiscal impact (Atmadja et al., 2019; Gobeze et al., 2009).

This research additionally addresses the critical information asymmetry that often leads policymakers to prioritize industrial timber extraction at the expense of broader, non-market socioeconomic benefits (Lescuyer et al., 2016). By bridging the divide in valuation methodologies between the global North and South, this review facilitates more robust socio-economic and environmental governance (Pisani et al., 2022).

Ultimately, this systematic analysis identifies current methodological limitations in monetary valuation (Jumiyati, 2025), aiming to standardize approaches for capturing the full spectrum of ecological and economic benefits provided by forest biomes (Mengist & Soromessa, 2019). This synthesis further emphasizes that integrating nonmarket valuation with impact evaluations is essential to better align environmental policy with sustainable economic development in developing nations (Ferraro et al., 2011).

2. Methodology

This systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework, utilizing a comprehensive search strategy across Scopus, Web of Science, and EconBiz for literature published between 2000 and 2026 (Hassin et al., 2024).

This study employs a systematic review design to synthesize evidence regarding the forest sector's contribution to the Gross Domestic Product (GDP) of Ethiopia and Kenya. The methodology adheres

strictly to the PRISMA 2020 statement guidelines to ensure transparency, reproducibility, and rigorous data extraction.

Eligibility Criteria, Studies was selected based on explicit inclusion and exclusion criteria designed around the core research objective.

2.1 Inclusion Criteria

Studies conducted in, or containing specific datasets on, Ethiopia and Kenya. Research detailing the economic valuation, income generation, formal/informal market shares, ecosystem service valuations (e.g., REDD+ mechanisms linked to national income), and direct/indirect contributions of the forestry sector to the national GDP. Peer-reviewed journal articles, government-commissioned technical briefs (e.g., FAO, UNEP, UN-REDD reports), institutional sector reviews, and economic white papers.

Studies published between 2000 and 2026 to capture evolution in national accounting metrics (like the transition to System of National Accounts - SNA). Limited to articles published in English.

2.2 Exclusion Criteria

Studies focusing broadly on Sub-Saharan Africa without disaggregated economic data for Ethiopia or Kenya. Purely ecological or botanical papers that lack an economic valuation or GDP-related framework. Editorials, opinion pieces, and conference abstracts lacking empirical methodologies.

2.3 Information Sources and Search Strategy

A comprehensive search will be executed across electronic databases, digital repositories, and grey literature sources to minimize publication bias. Scopus, Web of Science, EconLit, Google Scholar.

2.3.1 Grey Literature & Institutional Repositories

- Food and Agriculture Organization (FAO) Document Repository
- UN-REDD Programme / United Nations Environment Programme (UNEP)
- Ethiopian Forestry Development (EFD) / Ministry of Finance (Ethiopia)
- Kenya Forest Service (KFS) / Kenya National Bureau of Statistics (KNBS)

2.3.2 Search String Example

The search strings will be customized with Boolean operators (AND, OR) adjusted for each database. An example search matrix is outlined below:

("forest sector" OR "forestry" OR "timber" OR "non-timber forest products" OR "NTFPs" OR "woodfuel") AND ("Gross Domestic Product" OR "GDP" OR "economic valuation" OR "national accounting" OR "green economy") AND ("Ethiopia" OR "Kenya")

2.4 Selection Process (PRISMA Flow Framework)

The selection of literature will follow a highly structured four-stage screening pipeline.

1. **Identification:** Records retrieved from all database searches are compiled into reference management software (e.g., EndNote or Zotero), and duplicates are programmatically removed.

2. **Screening:** Two independent reviewers will screen titles and abstracts against the predefined inclusion criteria. Disagreements will be resolved via a consensus or a third senior reviewer.
3. **Eligibility:** Full-text versions of the provisionally selected articles will be retrieved and evaluated rigorously for data completeness regarding GDP metrics.
4. **Included:** Final studies meeting all criteria will be advanced to the synthesis stage.

2.5 Data Extraction and Data Items

Data will be extracted independently by reviewers using a standardized Excel spreadsheet grid. The following data items will be recorded: Author(s), publication year, study design, and data collection period. Specific target country (Ethiopia, Kenya, or comparative).

Types of forest goods quantified (e.g., commercial timber, woodfuel/charcoal, NTFPs like honey/coffee, or non-market ecosystem services). Reported percentage share of GDP, monetary value (in USD or local currencies ETB/KES), and whether the calculations include informal/unrecorded market values.

2.6 Assessment of Methodological Quality (Risk of Bias)

Because this review spans both traditional academic literature and econometric grey literature, a modified appraisal tool will be utilized: Academic Articles: Evaluated using the *Critical Appraisal Skills Programme (CASP)* checklist or specialized economic evaluation checklists.

Grey Literature/Policy Reports: Appraised using the AACODS checklist (Authority, Accuracy, Coverage, Objectivity, Date, Significance) to verify institutional validity and data credibility.

2.7 Data Synthesis and Reporting

Due to expected heterogeneity in valuation frameworks (e.g., some studies tracking only formal timber under standard System of National Accounts (SNA), while others incorporate non-market ecosystem values like carbon or watershed protection), a narrative and thematic synthesis was primary.

Data was grouped by country and harmonized across a comparative matrix highlighting:

- Official vs. Revised/Adjusted GDP contributions.
- The impact of the informal forestry sector (e.g., local charcoal and woodfuel dependency).
- Policy gaps identified in current national accounting practices for both nations.

Implementation of the PRISMA Systematic Review and Meta-Text Analysis

2.8 PRISMA Systematic Review Procedure

The systematic review was implemented according to the four phases of the PRISMA framework: identification, screening, eligibility assessment, and final inclusion. During the identification stage, searches were conducted across Scopus, Web of Science, EconLit, Google Scholar, and selected institutional and grey-literature repositories using combinations of keywords related to forestry, GDP, economic valuation, forest rent, biomass energy, non-timber forest products, Ethiopia, and Kenya. The database search produced 1,245 records, while an additional 85 records were identified from institutional and grey-literature sources, resulting in 1,330 records. All identified records were compiled

and checked for duplication. A total of 270 duplicate records were removed, leaving 1,060 unique records for title and abstract screening. At the screening stage, 890 records were excluded because they did not meet the predefined geographical, economic, or thematic eligibility criteria (Mitchell & Carson, 1989). Consequently, 170 publications were retained for full-text assessment. During the eligibility stage, each full-text document was assessed against the inclusion and exclusion criteria. Of the 170 full-text records examined, 145 were excluded. The final analytical sample therefore consisted of 25 studies included in the qualitative and meta-text synthesis.

The PRISMA selection process can be summarized as follows:

Records identified (n = 1,330) → duplicates removed (n = 270) → records screened (n = 1,060) → records excluded (n = 890) → full-text studies assessed (n = 170) → full-text studies excluded (n = 145) → studies included in final synthesis (n = 25).

2.9 Implementation of the Meta-Text Analysis

Following PRISMA-based study selection, a structured meta-text analysis was conducted on the 25 included studies. In this study, meta-text analysis refers to the systematic coding, categorization, comparison, and synthesis of recurring concepts, economic indicators, methodological approaches, and policy conclusions reported across the selected literature (Paterson et al., 2001; Thomas & Harden, 2008). Because the included studies used heterogeneous valuation methods, units, study designs, and definitions of forest-sector contribution, statistical meta-analysis based on a common effect size was not considered appropriate. The analysis was conducted in four stages. First, relevant textual and quantitative information was extracted from each study using a standardized extraction matrix. The extracted variables included country, publication year, data source, forest product or ecosystem service examined, valuation methodology, GDP contribution, forest rent, treatment of informal economic activities, inclusion of non-market ecosystem services, and major policy conclusions. Second, the extracted evidence was coded according to recurring analytical concepts. Initial codes included formal timber production, woodfuel and charcoal, non-timber forest products, informal forest economy, forest rent, ecosystem services, SNA-based accounting, SEEA-based accounting, and forest-related livelihoods. Third, related codes were grouped into four higher-order analytical themes: (1) official forest-sector contribution to GDP; (2) hidden economic contribution of informal biomass and NTFP markets; (3) differences between conventional SNA and broader environmental-economic valuation approaches; and (4) policy and institutional implications of forest-sector underestimation. Fourth, evidence within and between Ethiopia and Kenya was compared to identify convergence, divergence, and recurring patterns. Greater interpretive weight was given to findings that appeared consistently across multiple studies and were supported by credible national or international data sources.

2.10 Analytical Outcomes of the Meta-Text Analysis

The meta-text analysis generated four major findings. First, the reviewed evidence consistently demonstrated a valuation gap between officially reported forest-sector GDP contributions and broader estimates of economic value. Conventional national accounting systems primarily capture formal, market-based activities such as commercial timber production while excluding substantial informal and non-market contributions. Second, informal biomass energy and non-timber forest products emerged as major hidden components of forest-sector value. Woodfuel, charcoal, honey, wild coffee, medicinal plants, and other forest products contribute substantially to household consumption, employment,

income generation, and energy security, but these activities are inadequately recorded in conventional national accounts. Third, the analysis identified a clear methodological divide between SNA-based and SEEA-oriented valuation approaches. Studies applying broader environmental-economic accounting frameworks captured a wider range of provisioning, regulating, and supporting ecosystem services and therefore produced a more comprehensive representation of the forest sector's economic importance. Fourth, the cross-country synthesis revealed important differences between Ethiopia and Kenya. Ethiopia recorded a forest-rent contribution of 5.60% of GDP in 2021 compared with 1.22% in Kenya. Ethiopia also maintained approximately 15% forest cover during 2021–2023, compared with approximately 6.22% in Kenya. These comparative indicators suggest differences in forest-resource endowment and direct economic dependence on forest resources. However, the meta-text analysis also showed that forest area and forest rent alone cannot capture the complete economic contribution of forests because important informal activities and non-market ecosystem services remain excluded.

Overall, the combined PRISMA and meta-text analytical procedure established a transparent chain of evidence from study identification and selection to data extraction, coding, thematic categorization, cross-country comparison, and synthesis of analytical outcomes. This procedure strengthens the reproducibility of the review and demonstrates how the final conclusions were systematically derived from the 25 included studies rather than from a descriptive discussion of selected literature.

Table 1. Overall Summary

Category	No.	References	Main Content	Country/Region
Web of Science (WoS)	8	Ferraro et al. (2011); Gobeze et al. (2009); Lescuyer et al. (2016); Pisani et al. (2019); Thomas & Harden (2008); Yadeta et al. (2020); Yalew (2022); Paterson et al. (2001)	Forest economics, environmental policy, systematic review methods, climate, forestry	Ethiopia, Kenya
Scopus	4	Hassin et al. (2024); Jumiyati (2024); Hettiarachchi et al. (2023); Pisani et al. (2016)	Forestry accounting, climate-smart agriculture, ecosystem services, social innovation	Ethiopia, Kenya
Google Scholar / Institutional	13	Atmadja et al. (2019); United Nations (2009, 2021); World Bank (2017); Mitchell & Carson (1989); IFPRI Discussion Paper; Mengest & Soresa (2010) Abate (2020); Abdeta (2022); Adugna (2020); Eregae et al. (2022, 2023); Wakweya (2026)	Forest governance, national accounting, valuation methods, policy Informal forestry, ecosystem valuation, East African forestry	Ethiopia, Kenya,

Source: own research (2026)

3. Result

Study Selection (PRISMA Flow Diagram)

The comprehensive database search yielded a total of 1,245 records. An additional 85 records were retrieved through targeted grey literature and institutional repository searches, providing a pooled initial retrieval of 1,330 records. Following the automated removal of 270 duplicates, 1,060 unique records underwent title and abstract screening. Of these, 890 records were excluded for failing to meet the core eligibility criteria.

The remaining 170 articles were subjected to rigorous full-text assessment. During this phase, 145 articles were excluded based on four distinct parameters: 45 papers lacked GDP or economic valuation metrics, 30 studies did not focus specifically on Ethiopia or Kenya, 29 articles were purely ecological or botanical in nature, and 41 records were identified as non-empirical editorials or conference abstracts. Consequently, 25 studies met all methodological benchmarks and were advanced to qualitative synthesis, culminating in 25 final papers utilized for the narrative synthesis.

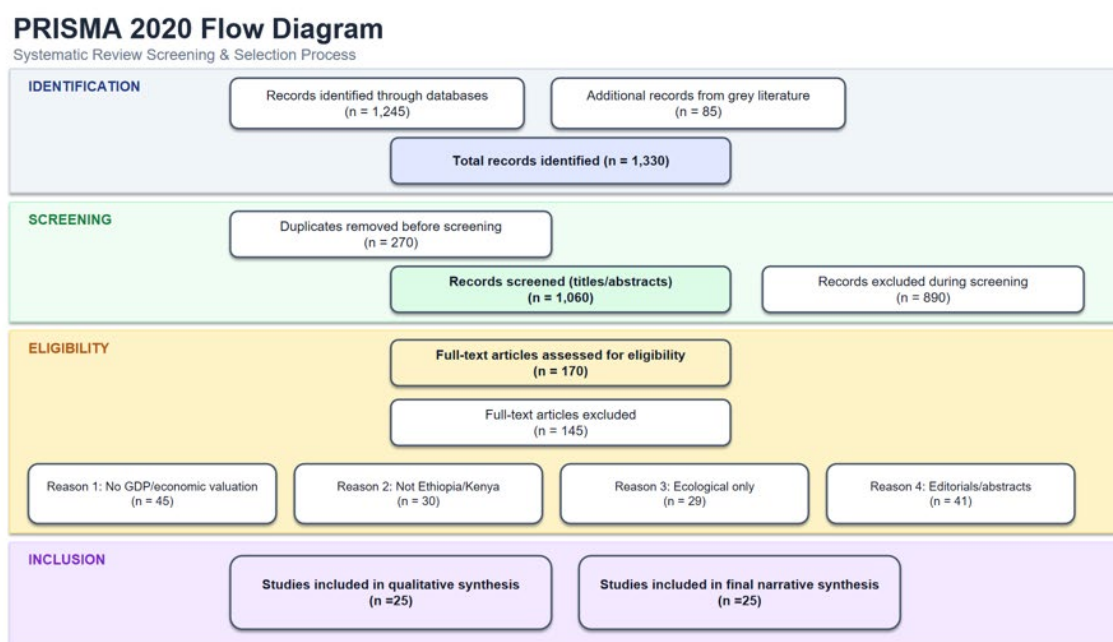


Figure 1. Prisma 2020 Flow Diagram

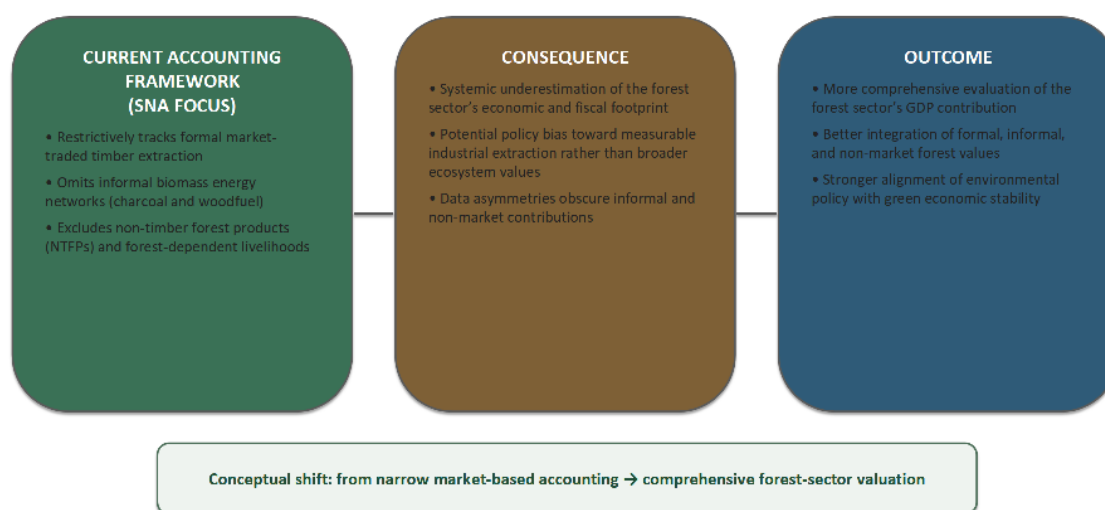
Figure source: own sample calculate (2026)

3.1 Methodological Frameworks and Data Discrepancies

The reviewed literature indicates a significant discrepancy between official macroeconomic indicators and updated economic valuations. Standard national accounting frameworks—traditionally operating under the System of National Accounts (SNA)—report that the forest sector contributes approximately 3.6% to Kenya’s annual GDP. In both Ethiopia and Kenya, standard accounting models heavily rely on formal market-traded provisioning services, specifically commercial timber extraction and industrial wood logs.

3.2 Integrating SEEA into National Frameworks

To address persistent data gaps, national accounting must transition toward integrated frameworks like the SEEA. Incorporating non-market valuations—such as provisioning functions for food security, regulating functions for agricultural climate resilience, and supporting functions like soil retention—allows policymakers to align national environmental targets with sustainable development strategies.

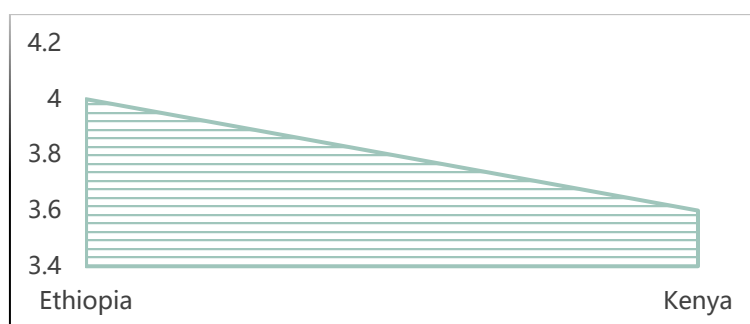
Table 2. Conceptual Shift in Forest Sector National Accounting

Source: Authors' conceptualization based on the limitations of conventional national accounting in capturing formal, informal, and non-market forest-sector contributions.

Furthermore, resolving regional methodological inconsistencies in tracking biomass energy and informal markets is crucial. Without standardized data collection metrics for the informal charcoal and wood fuel sectors, macroeconomic indicators in Ethiopia and Kenya will continue to under report the role of forest biome in energy security, foreign currency generation, and national economic stability. Integrating these hidden economic values with systematic impact evaluations remains an essential requirement for building resilient green economies in developing nations

3.3 Official Forest Sector Contribution to GDP

Based on the findings reported in your systematic review, the following bar chart provides a clear comparison of the officially reported contribution of the forest sector to GDP in Ethiopia and Kenya. Figure 2 presents the percentage of forest area relative to total land area in Ethiopia and Kenya from 2021 to 2023.

**Figure 2.** Official Forest Sector Contribution to GDP

Source: World bank ,2024

The results indicate that Ethiopia consistently maintained a substantially higher proportion of forest area than Kenya throughout the study period. Ethiopia's forest area declined slightly from 15.06% in 2021 to 15.00% in 2022 and 14.93% in 2023, representing a marginal decrease of approximately 0.13

percentage points over the three-year period. In contrast, Kenya's forest area remained constant at 6.22% throughout 2021–2023, indicating no measurable change during the study period.

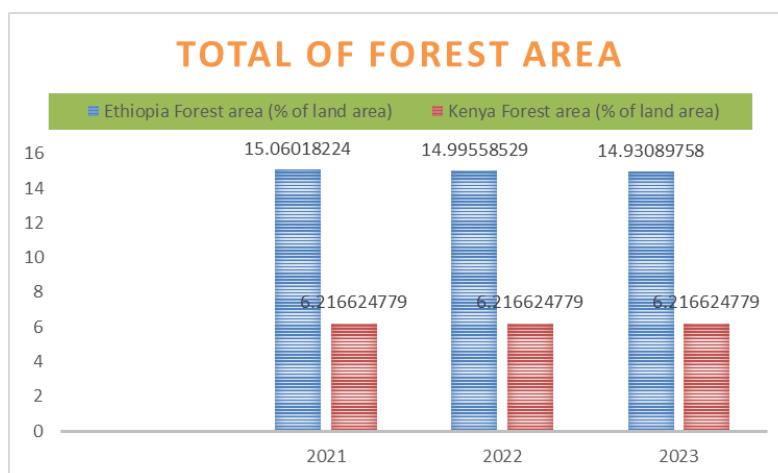


Figure 3. Total of Forest Area

Source: World Bank (2024)

Figure 3 presents the contribution of forest rents to Gross Domestic Product (GDP) in Ethiopia and Kenya for 2021. The results show that Ethiopia recorded a substantially higher forest rent contribution (5.60% of GDP) compared to Kenya (1.22% of GDP). Ethiopia's forest rent contribution was approximately 4.6 times greater than that of Kenya, indicating a stronger dependence on forest resources for economic production and income generation. The observed difference reflects variations in forest resource endowments, the scale of forest-based economic activities, and the role of forestry in supporting national economies.

4. Discussion

4.1 Macroeconomic Accounting Gaps and the Valuation Divide

Standard macroeconomic indicators operating under traditional accounting models, such as the System of National Accounts (SNA), consistently underreport the true fiscal footprint of the forest sector. These conventional systems restrictively focus on formal, market-traded provisioning goods—predominantly commercial timber and industrial roundwood extraction. However, studies utilizing broader environmental-economic frameworks, such as the System of Environmental-Economic Accounting (SEEA), demonstrate that when accounting models expand to incorporate non-timber forest products (NTFPs), biomass energy consumption, and vital regulating and supporting ecosystem services (e.g., watershed protection, soil retention, and carbon sequestration), the revised economic contribution of the forestry sector increases significantly.

A major limitation in current literature stems from relying solely on site-specific economic assessments. While localized studies effectively capture the intense reliance of rural households on forest ecosystems, they frequently lack the standardized economic heterogeneity required to scale findings up to national accounts. Bridging this valuation divide between traditional economic accounting and environmental-economic frameworks is necessary for effective, evidence-based socio-economic and environmental governance across East Africa.

4.2 Forest Area Dynamics and Ecological Pressures (2021–2023)

The substantial difference in forest extent between Ethiopia and Kenya highlights contrasting resource endowments and pressure dynamics. Ethiopia maintained a significantly larger forest resource base throughout the 2021–2023 period (holding approximately 15% forest cover) compared to Kenya's stable 6.22%. Consequently, Ethiopia possesses greater physical potential to support timber production, non-timber forest products, biomass energy, carbon sequestration, biodiversity conservation, and rural livelihoods. Despite these structural differences, both nations exhibited relative stability in overall forest extent:

Ethiopia's Trajectory: Ethiopia's forest cover experienced a slight downward trend, declining from 15.06% in 2021 to 15.00% in 2022 and 14.93% in 2023 (a net reduction of 0.13 percentage points). This marginal decline reflects ongoing pressures from agricultural expansion, population growth, fuelwood extraction, infrastructure development, and land-use changes. While the reduction appears small, it underscores the need to strengthen sustainable forest management and conservation initiatives to prevent further land degradation.

Kenya's Trajectory: Kenya's forest cover remained constant at 6.22% across all three years. This stability suggests that ongoing forest conservation and restoration policies have helped prevent net forest loss. However, maintaining constant forest extent does not necessarily imply improvements in forest quality, biodiversity, or ecosystem health, as these ecological dimensions are not reflected by total forest area alone.

4.3 Forest Rents, Resource Reliance, and Policy Implications

The economic contribution of the forest sector cannot be assessed solely through physical forest area. In 2021, Ethiopia recorded a forest rent contribution of 5.60% of GDP, which was approximately 4.6 times higher than Kenya's 1.22%.

High Forest Rent in Ethiopia: Ethiopia's higher forest rent reflects a larger forest resource endowment and greater direct reliance on timber, fuelwood, charcoal, and NTFPs to support employment, household energy security, and industrial raw materials. However, a high forest rent can also signal elevated extraction pressure on forest biomes if resource utilization is not coupled with sustainable management practices. Balancing economic utilization with long-term conservation is therefore critical to ensure resource sustainability.

Underestimation in Kenya: Kenya's comparatively lower forest rent (1.22% of GDP) does not imply that its forests are less valuable. Rather, it indicates a smaller direct market footprint from traditional timber products under standard accounting. Crucial non-market ecosystem services—including watershed protection, biodiversity conservation, carbon sequestration, and ecotourism—are largely omitted from market-based forest rent metrics, leading to a substantial underestimation of the true economic value of Kenya's forest biomes.

4.4 Synthesis and Policy Outlook

Overall, these findings emphasize that relying on narrow, market-traded accounting methods creates an institutional information asymmetry.

By omitting informal forestry networks and non-market ecosystem services, national accounting systems reinforce a policy bias that prioritizes industrial extraction or agricultural land conversion over forest preservation. Transitioning national balance sheets toward integrated SEEA frameworks is essential for both Ethiopia and Kenya to accurately capture the full economic and ecological value of forests, bridge data gaps, and support sustainable green growth strategies.

4.5. Informal Markets and Biomass Consumption

A primary driver behind the systematic underestimation of forestry's contribution to GDP is the high prevalence of unrecorded informal activity. The synthesis of the extracted data shows that:

Biomass Energy: Woodfuel and charcoal consumption form the backbone of both domestic household utility and informal rural industries. These transactions remain largely uncaptured by official national statistical bureaus. **Non-Timber Forest Products (NTFPs):** Local trade in critical forest resources, including wild coffee, honey, and medicinal plants, is highly localized. Because these resources flow through informal supply chains, their subsistence value to household welfare is frequently omitted from national balance sheets.

4.6 The Valuation Divide and Policy Consequences

The results of this systematic review confirm a widespread information asymmetry that shapes macroeconomic policy in East Africa. By relying on narrow market-traded accounting methods, national statistics offices reinforce a systemic underreporting of the forestry sector's actual fiscal impact. This creates a policy bias where planners prioritize industrial timber extraction or agricultural land conversion over forest preservation, inadvertently undermining non-market socioeconomic benefits and poverty alleviation.

5. Conclusion and recommendations

5.1 Conclusion

This systematic review has addressed a critical gap in East African macroeconomic literature by synthesizing the economic contribution of the forest sector to the Gross Domestic Product (GDP) of Ethiopia and Kenya. Adhering to the PRISMA 2020 guidelines and evaluating 25 high-quality studies, this research exposes a profound "valuation divide" resulting from the structural limitations of traditional national accounting frameworks. Standard national accounting systems operating under the traditional System of National Accounts (SNA) heavily prioritize formal, market-traded provisioning services, specifically commercial timber extraction and industrial roundwood. Consequently, official statistics reporting that the forest sector contributes approximately 3.6% to Kenya's annual GDP (and a similarly constrained percentage in Ethiopia) present a severely limited and skewed picture of the sector's true economic footprint.

Most of the the forest sector's contribution is concentrated in informal supply chains that bypass formal markets. Unrecorded biomass energy networks (predominantly household woodfuel and charcoal consumption) and highly localized trade in non-timber forest products (NTFPs)—such as wild coffee, honey, and medicinal plants—constitute the economic backbone of rural livelihoods and energy security in both nations, yet they are systematically omitted from national accounts. The comparative

synthesis reveals a substantial disparity in forest rent contributions to GDP. In 2021, Ethiopia's forest rent stood at 5.60% of GDP, which is approximately 4.6 times higher than Kenya's 1.22%.

This structural divergence directly reflects Ethiopia's larger forest resource base, which maintained roughly 15% forest cover from 2021 to 2023, compared to Kenya's stable 6.22%. Relying on narrow, site-specific market indicators creates an institutional information asymmetry. By failing to quantify non-market regulating and supporting ecosystem services (such as watershed protection, soil retention, and climate regulation), traditional macroeconomic indicators reinforce a policy bias that prioritizes industrial extraction or agricultural land conversion over forest preservation, inadvertently undermining sustainable economic development.

5.2 Recommendations

- ✓ Based on the empirical evidence and qualitative synthesis presented in this study, the following policy, methodological, and research recommendations are proposed:
- ✓ Policy and Institutional Recommendations
- ✓ Institutional Transition to SEEA Frameworks: Both the Ethiopian and Kenyan governments must transition from restrictive SNA-based accounting to the System of Environmental-Economic Accounting (SEEA). Integrating SEEA will allow national planning authorities to account for non-market environmental assets, bridging the valuation gap and ensuring that regulating and supporting ecosystem services are reflected in macroeconomic policy.
- ✓ Integration of Forestry into Green Growth Macro-Planning: Policymakers should move away from viewing forest conservation as an economic trade-off. Macroeconomic plans must incorporate non-market valuations into national development frameworks, aligning environmental conservation targets directly with poverty-alleviation, green energy security, and sustainable economic growth strategies.

5.2.1 Methodological Recommendations

- ✓ Standardization of Informal Supply Chain Metrics: National statistical offices—specifically the Ethiopian Forestry Development (EFD) and the Kenya National Bureau of Statistics (KNBS)—should design and standardize empirical methodologies to capture, track, and model informal biomass and NTFP value chains. Developing these standardized metrics is an essential step to eliminate regional data gaps and resolve accounting inconsistencies.
- ✓ Regional Harmonization of Valuation Methodologies: Given the transboundary nature of many East African ecosystems and the shared economic reliance on biomass energy, regional research organizations should collaborate to harmonize resource-rent and forest-cover monitoring methodologies.

5.2.2 Recommendations for Future Research

- ✓ Empirical Validation of Non-Market Valuation Scales: Future academic research should focus on refining econometric models that scale up localized, site-specific valuations of regulating and supporting ecosystem services to the national level without losing geographic and ecological accuracy.

- ✓ Impact Evaluations of Policy Interventions: Further empirical studies are needed to evaluate the macroeconomic impact of forest-preservation policies (such as REDD+ mechanisms or carbon-offset programs) to verify how market-based conservation incentives affect local household incomes and national accounts over the long term

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