

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

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Authors

Table of Contents

List of Tables.....	iii
List of Figures	v
Acronyms.....	vi
Foreword.....	xi
Executive Summary	xii
1. Introduction.....	1
2. Objectives of the study	3
3. Methodology	3
4. The Study Area	5
5. Bamboo Resources.....	7
6. Trading Scenario for Bamboo Products.....	44
7. Enabling Environment	45
8. Bamboo Products Prioritised for Scaling up:.....	61
9. Recommendations:.....	82
10. Conclusion.....	93
References.....	95
Annexes.....	100

List of Tables

Table 1: Criteria and indicators for prioritisation of bamboo products.....	4
Table 2: Field visit location for data collection.....	5
Table 3: Bamboo area by zone and regions in Ethiopia	7
Table 4: Location details of highland bamboo in small holder farms.....	12
Table 5: Land tenure and management of bamboo	13
Table 6: Most common bamboo products available in Ethiopia	15
Table 7: Transportation cost of bamboo pole from different parts of country to Addis Ababa.....	19
Table 8: Cost increment analysis of bamboo poles.....	19
Table 9: Cost of lowland bamboo poles of different specification at different locations.....	21
Table 10: Cost Increment and profit analysis of bamboo mat trade	25
Table 11: Number of households involved in bamboo basketry production.....	27
Table 12: Cost increment and profit analysis of the bamboo mat trade	29
Table 13: Profitability analysis of modern craft products.....	30
Table 14: Number of bamboo furniture enterprises and their locations.....	32
Table 15: Profitability analysis of modern bamboo furniture products	34
Table 16: Number of housing units in Ethiopia with bamboo or reed as an important construction material.....	35
Table 17: Traditional bamboo housing type and location	36
Table 18: Location details of refugee camps using bamboo as construction material.....	37
Table 19: Nutrient content analysis of indigenous bamboo shoots.....	43
Table 20: Policy and legal framework for the bamboo sector in Ethiopia	45
Table 21: Institutions and their key role in bamboo sector development.....	48

Table 22: Electricity tariff rates for industries	56
Table 23: Prevailing public-sector wage rates in Ethiopia.....	57
Table 24: Imports and exports documentary compliance costs comparison.....	59
Table 25: Time involved in import and export documentary compliance.....	60
Table 26: Average cost of exports: 20ft container	60
Table 27: Average cost of imports: 20 ft container	61
Table 28: Prioritised bamboo value chains.....	61
Table 29: Import and export of wood panels and parquet panels in Ethiopia.....	62
Table 30: Import and export of pulp and paper.....	64
Table 31: Mechanical and physical properties of bamboo mat/ ply board	65
Table 32: Imports and exports of ply board in Ethiopia	65
Table 33: Mechanical and physical properties of Bamboo Laminated Lumber.....	66
Table 34: Import and export of packaging materials.....	67
Table 35: Mechanical and dimensional stability of Oriental Strand Board	67
Table 36: Import and export of OSB from 2014-2016, Ethiopia.....	68
Table 37: Mechanical and dimensional stability properties of MDF Board made from two bamboo species indigenous to Ethiopia.....	68
Table 38: Import and export of fibre boards in Ethiopia, 2014-2016.....	69
Table 39: Imports of active carbon in Ethiopia for years 2014, 2015 and 2016.....	71
Table 40: Ethiopia: Imports and exports of furniture from 2014-2016	73
Table 41: SWOT analysis of prioritised value chains.....	76
Table 42: Value chain categorisation for development of recommendations.....	82
Table 43: Location and Product Matrix.....	83

List of Figures

Figure 1: Map indicating field visit locations and locations of informants contacted via telephonic interview.....	6
Figure 2: Overall bamboo value chain map.....	16
Figure 3: Bamboo culm/pole value chain map	17
Figure 4: Pie chart showing the split up of cost and profit along the value chain.....	20
Figure 5: Bamboo mat value chain map.....	22
Figure 6: Number of households engaged in different regions / zones / woredas.....	23
Figure 7: Pie chart depicting the cost/ profit split up of bamboo mat value chain.....	25
Figure 8: Bamboo basketry value chain map.....	26
Figure 9: Chart showing the distribution of basketry producers in different regions/zones/woredas.....	27
Figure 10: Pie-chart showing cost/ profit for different actors.....	29
Figure 11: Bamboo furniture value chain map	30
Figure 12: Bar chart showing number of enterprises and workers in each region/ woreda.....	32
Figure 13: Regional distribution of bamboo or reed housing units	35
Figure 14: Region wise distribution of bamboo/ reed housing units.....	36
Figure 15: Industrial value chain map.....	39
Figure 16: Bamboo fodder value chain map.....	43

Acronyms

AGOA	African Growth and Opportunities Act
AFR	African Forest Landscape Restoration Initiative
ARRA	Administration of Refugee and Returnee Affairs
BEGRC	E-glass fiber reinforced epoxy hybrid composite
BMB	Bamboo Mat / Ply Board
BoANR	Bureau of Agriculture and Natural Resources
BSG	Benishangul Gumuz
C	Centigrade
Ca	Calcium
CFC	Common Fund for Commodities
cm	Centimetre
COMESA	Common Market for Eastern and Southern Africa
CPTC	Common Production and Training Center
CRGE	Ethiopia's Climate Resilient Green Economy Strategy
CSA	Central Statistical Agency
DFTP	Duty Free Tariff Preference
EARO	East Africa Regional Office
EBA	Everything But Arms
EEFRI	Ethiopian Environment and Forest Research Institute
EiABC	Ethiopian Institute of Architecture, Building Construction and City Development
EIC	Ethiopian Investment Commission
ETB	Ethiopian Birr
ETTE	Ethiopian Tourist Trading Enterprise
EU	European Union
Fe	Iron
FeSMMIDA	Federal Small and Medium Manufacturing Industries Development Agency
FGD	Focus Group Discussion
FLR	Forest and Landscape Restoration
Ft.	Feet
G/cm ³	Grams / Cubic Centimetre
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GPa	Gigapascal

GSP	General Systems of Preference
GTP	Growth and Transformation Plan
Ha	Hectare
Hrs	Hours
HS	Harmonised System Code
ICBR	International Centre for Bamboo and Rattan
INBAR	International Bamboo and Rattan Organisation
INDC	Intended Nationally Determined Contributions
IPIRTI	Indian Plywood Industries Research and Training Institute
K	Potassium
kg	Kilogram
KII	Key Informants Interview
km	Kilometre
km ²	Square Kilometre
kV	Kilo Volt
kW	Kilowatt
kWh	Kilowatt hour
L	Length
m	Metre
m ²	Square Metre
m ³	Cubic Metre
m ASL	Metres above Sea Level
MDF	Medium Density Fiber Board
Mg	Magnesium
MIGA	Multilateral Investment Guarantee Agency
mm	Millimetre
Mn	Million
MoANR	Ministry of Agriculture and Natural Resources
MoE	Modulus of Elasticity
MoEFCC	Ministry of Environment, Forest and Climate Change
MoI	Ministry of Industries
MoR	Modulus of Rupture
MSE	Micro and Small Enterprise
MT	Metric Ton
N	Nitrogen

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

NA	Not Available
NFTP	Non-Timber Forest Product
NGO	Non-Governmental Organisation
N/mm ²	Newton/square millimetre
OECD	Organisation of Economic Co-operation and Development
OSB	Oriented Strand Board
PD	Person Days
PFM	Participatory Forest Management
PIC	Production and Incubation Center
PLC	Private Limited Company
PPP	Public Private Partnership
ReMSEDA	Regional Micro and Small Enterprise Development Agency
RTPC	Rural Technology Promotion Center
SFA	China State Forestry Administration
SLMP	Sustainable Land Management Programme
SNNP	Southern Nations Nationalities and Peoples'
SNNPRS	Southern Nations Nationalities and Peoples' Regional State
SPTT	Special Preferential Tariff Treatment
SWOT	Strength Weakness Opportunity and Threat
Sq. Km	Square Kilometre
TIN	Tax Identification Number
Ts	Thickness Swelling
TVET	Technical Vocational Education Training
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNDP	United Nations Development Programme
UNIDO	United Nations Industrial Development Organisation
USA	United States of America
USD	United States Dollar
VAT	Value Added Tax
W	Width
WA	Water Absorption
WCO	World Customs Organisation
WIPO	World Intellectual Property Organisation

Foreword

Bamboo is a fast-growing, renewable and versatile resource, which is found across the Global South and is interlinked with the lives and livelihoods of numerous communities. It is well accepted that bamboo development could contribute directly to at least seven of the UN Sustainable Development Goals, including poverty alleviation, affordable and clean energy, affordable and resilient housing, sustainable consumption, climate change mitigation, and terrestrial ecosystem protection.

Ethiopia has one of the largest bamboo sectors in Africa. Currently, bamboo in Ethiopia is mainly used for constructing fences and households, as well as to create agricultural utility products, furniture, fuelwood, feed and fodder. In recent years, a few industries have started to produce industrial bamboo products, such as parquet flooring and bamboo stick-based products.

However, although competitive compared to other countries in Africa, Ethiopia's bamboo sector development is still in its infancy, dominated by low value and low priced products. Despite possessing enormous bamboo resources, Ethiopia currently makes up small part of the global bamboo trade. It accounts for about 0.4 percent of global imports and 0.2 percent of global exports.

The Government of Ethiopia have given high priority to the development of the bamboo sector. The country's 2016-2020 Growth and Transformation Plan includes bamboo as a strategic species for livelihood development and environmental rehabilitation. Bamboo has been chosen to reforest 700,000 hectares of degraded land, and 500,000 m³ has been earmarked for value-added product creation.

This market study was conducted as part of INBAR's Dutch-Sino East Africa Bamboo Development Programme, supported by: the Ministry of Foreign Affairs, the Netherlands; China's State Forestry Administration; Wageningen University; Moso Bamboo BV; the Netherlands and local partners. It aims to assess Ethiopia's existing bamboo products, and identify potential bamboo products which provide access to international markets. It also identifies opportunities for Ethiopia to grow its bamboo sector and build robust value chains, and suggests several interventions by the government and non-government agencies, which can leverage the potential of bamboo.

As this market study shows, bamboo has a huge potential to contribute in the development of Ethiopia's green economy. We believe this report should make a valuable addition to the existing knowledge of the bamboo sector in Ethiopia, and we hope it will be of use to policy makers, development practitioners and the private sector.

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Executive Summary

Ethiopia has one of the largest resources of bamboo in Africa, belonging to two main indigenous species (a) *Yushania alpina* (highland bamboo), and *Oxytenanthera abyssinica* (lowland bamboo) concentrated in Amhara, Benishangul Gumuz, Gambela, Oromia, SNNP and Tigray regional states. Bamboo is one of the most important Non-Timber Forest Products (NTFP) in Ethiopia, contributing an estimated Ethiopian Birr (ETB) 56,250,000 to GDP, and an estimated 750,000 people are dependent on bamboo for their livelihoods (MoEFCC, 2017). Despite bamboo being a versatile re with proven application to higher value-addition technologies and an enormous potential to provide triple bottom line benefits (social, economic and environmental), it remains underutilised in Ethiopia.

The Government of Ethiopia have accorded a high priority to the bamboo sector. In its 2016-2020 Growth and Transformation Plan (GTP II), bamboo has been targeted as a strategic species for promoting livelihood development and environmental rehabilitation. A target was set under the GTP II plan to afforest / reforest 0.7 million ha of degraded land with bamboo, and utilise 0.5 million m³ of bamboo for creation of value-added products (Wondimu, 2017).

The general objective of this study is to identify existing and potential bamboo value chains for upscaling. The specific objectives are shown in Section 2. The study used both primary data and secondary data. Primary data was gathered through key informant interviews (both in person and telephone interviews), focus group discussions (FGD) and personal observations during field visits. Secondary data was accessed through review of relevant published and unpublished reports and studies of government and non-governmental organisations (NGOs). Data of the existing value chains was analysed by adopting standard methods of value chain analysis (Kaplinsky and Morris, 2000; and Riisgaard et al, 2008). Prioritisation of potential value chains was carried out using multi-objective/ criteria analysis methods, as shown in Section 3.

Data on domestic trade value and volumes was not available due to the unorganised nature of the sector. Trade data for bamboo products specific to Ethiopia, regional markets (Common Market for Eastern and Southern Africa [COMESA]), entire Africa and global markets for the recent three years (2014, 2015 and 2016) was downloaded from United Nations Comtrade Database (<https://comtrade.un.org/data/>) using specific HS codes, and was compiled for analysis.

Bamboo species, ownership and the quantity of bamboo resources varies across regions. Low land bamboo is predominantly found in natural forests or state forests, concentrated in Amhara, Benishangul Gumuz, Gambella, Southern Oromia, and in some parts of the Tigray region. Highland bamboo is found both in state forests and on farmland concentrated in the Southern Nations Nationalities and Peoples' Regional State (SNNPRS), and Amhara and Oromia regional states. Highland bamboo (*Yushania alpina*) is preferred and grown by farmers on their farmland due to its advantages for use in the existing market for bamboo poles, applicability for use in multiple areas, and for its ease of processing and management.

Bamboo forest resources are degraded in most state forests and communal bamboo forests owing to the lack of sustainable management and harvesting practices. Depending on the accessibility and remoteness of the location there are both instances of "over harvesting" as well as "no harvesting". The bamboo grown by smallholder farmers and institutions (churches) is comparatively better managed due to regular harvesting and more effective management. However, instances of harvesting of young bamboo poles (< three years of growth) has been observed in some cases, mainly due to market forces and the effects of poverty leading to higher demand.

Ethiopia is a negligible player in the global bamboo trade. Average annual imports and exports of bamboo products for the years 2014, 2015 and 2016 show that Ethiopia on average imports bamboo commodities worth USD 5.7 million annually, accounting for about 0.43 per cent of global imports (UN Comtrade Database, 2017). Ethiopia's exports of bamboo products are worth USD 0.23 million annually, accounting for about 0.02 per cent of global exports. Important bamboo commodities imported into Ethiopia are (a) bamboo plywood (USD 1.5 million); (b) bamboo pulp and paper (USD 1.07 million); (c) bamboo and rattan furniture (USD 2.66 million) and (d) bamboo flooring (0.18 million). The most commonly exported bamboo commodity is bamboo pole, accounting for approximately USD 0.23 million.

Bamboo value chain actors consists of bamboo resource producers (smallholder farmers, institutions, communal forests and state forests), processing enterprises (household, micro and small-scale enterprises and industries), traders/ middlemen, and consumers. Existing bamboo value chains or product lines identified are (1) bamboo poles; (2) bamboo mats; (3) bamboo crafts and basketry; (4) bamboo furniture; (5) construction materials; (6) industrial products (panel and stick-based); (7) bamboo bioenergy; (8) feed and fodder and (9) bamboo shoots. The role of the actors, raw materials, processing (skills and techniques, tools involved), producers (locations and estimated numbers), trading / logistics and transport, market / consumers, and cost increments or cost-benefits were analysed, as shown in Section 5.5 to 5.13.

A number of institutions (government, research agencies, non-governmental agencies) have a mandate to promote the bamboo sector. However, there is a general lack of coordination, overlapping of roles and responsibilities, a lack of policy and planning, and limited dedicated manpower and resources to effectively promote the bamboo sector. Currently, there is no national level bamboo policy, strategy or action plan.

Policy and institutional influence on the bamboo sector is limited, except for in regulating the transport of bamboo poles and promoting skills development. Public sector and private sector value chain governance mechanisms are poor, and there is a lack of vertical and horizontal integration of the bamboo sector. Intervention by the government and non-government agencies is confined to "product innovation" in the Micro and Small Enterprise (MSE) sector, developing new designs and providing training to MSEs on new products and skills. There is also a lack of "process upgradation": inter-organisational practices for promoting quality, production improvement and "functional innovation", value chain governance, new market development, institutional innovation, etc.

Based on the multi-objective criteria analysis, market availability and technical suitability for value addition, key bamboo value chains that were prioritised and analysed are (a) industrial products, (b) bamboo energy products, (c) bamboo poles, (d) furniture, (e) construction materials, (f) mats, and (g) basketry and crafts. In addition, a Strength, Weakness, Opportunities and Threats (SWOT) analysis of each of the identified value chains was undertaken.

Industrial Value Chains: Ethiopia currently has industries equipped with machines, equipment and technology suitable for the production of bamboo panels (flooring, ceiling tiles and boards), bamboo stick-based products (bamboo sticks, curtains, table mats, incense sticks and tooth picks) and energy products (charcoal, briquettes and pellets). In addition, development of new industrial value chains such as bamboo pulp and paper, Laminated Bamboo Lumber, Oriented Strand Board (OSB), and Medium Density Fiber boards (MDF), which have a huge domestic, regional and global markets, is technically possible. Ethiopia annually imports about USD 450 million worth of panels, boards, pulp and paper and packaging products, which could be easily substituted with bamboo-based products (UN Comtrade Database, 2017).

Bamboo Energy: Ethiopia consumes about 116 million m³ of wood fuel annually, and the demand for wood fuel is estimated to grow to 142 million m³ by 2033 (MoEFCC, 2017). There is also enormous market potential for use of bamboo as fuelwood and bamboo poles, as well as converting waste generated from industrial and MSE processing into energy products such as charcoal, briquettes, wood

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

chips and pellets. Lowland bamboo, which has a comparatively high capacity of biomass production, grows in a larger area, and due to the semi-solid to solid nature of its poles, is highly suitable for bamboo bioenergy production. In addition, bamboo charcoal could also be further value added into higher valued active carbon. Ethiopia is a net importer of active carbon, and on average imports USD 445,237 worth of its products per year.

Bamboo Pole: Development of a supply chain with inclusion of smallholder farmers through Participatory Forest Management (PFM), intermediary processing and industry or MSE linkages provides the opportunity for smallholder farmers to generate additional income; unemployed youth for primary processing (grading and componentisation) and industries with guaranteed age and size graded raw material. Increasing demand for bamboo poles will propel smallholder farmers to plant and manage bamboo on their farms, which could contribute to filling the gaps of current timber shortages and contribute to achievement of GTP II, Ethiopia's Climate Resilient Green Economy Strategy (CRGE), the Bonn Challenge, Intended Nationally Determined Contributions (INDC) and African Forest Landscape Restoration Initiative (AFR) 100 targets.

Bamboo Furniture: Ethiopia imports large quantities of furniture and its components. On average, in 2014, 2015 and 2016 Ethiopia imported furniture made from metal, wood, plastic, bamboo, rattan and other materials worth USD 125 million per year (UN Comtrade database, 2017). Wood-based furniture, metal-based furniture, plastic, other materials and bamboo or rattan-based furniture imports are valued at USD 74, 14.4, 2.27, 24 and 2.66 million respectively. There is a large domestic market, and alternating bamboo furniture with imported furniture will not only reduce the import burden but also to create local employment opportunities. A wide range of bamboo furniture such as whole culm, slat based, sliver based and board based furniture are possible, and could cater to different market segments.

Bamboo construction: 400,000 new housing units and another 450,000 old housing units are repaired in Ethiopia annually, which consumes about 6.6 million m³ of wood. The demand for wood for construction is projected to increase to 11.3 million m³ by 2033, valued at USD 384 million (MoEFCC, 2017). Currently, usage of bamboo as a construction material in Ethiopia relates to the construction of traditional or rural housing segments, relying on traditional construction techniques and methods. About 2.5 per cent of the housing units in Ethiopia are made from bamboo. However, the utilisation of bamboo as a modern construction material, such as for construction of whole culm based housing material and bamboo industrial or engineering product usage has not picked up due to poor perception regarding bamboo as a less durable material, as well as a lack of technology and trained manpower on treatment methods and construction techniques. Bamboo could be a suitable alternative for construction of rural housing units, urban housing units, eco-tourism resorts and for interior and exterior decoration.

Bamboo Mats: Bamboo mat production is primarily a household activity which provides additional income for rural households. Existing bamboo mat value-addition and processing systems can be easily upgraded to produce bamboo mats that are suitable for production of bamboo mats / ply boards (BMB). Ethiopia imports bamboo mats / ply boards and wooden ply boards worth USD 1.5 million and USD 32 million respectively. Machines and processing equipment set up for production of bamboo mat boards already exist in Ethiopia. There is a need for capacity building of bamboo mat processors to produce quality bamboo mats to suit bamboo mat board production, and to operationalise the Production and Incubation Centre (PIC) of the Federal Small, Medium Manufacturing Industries Development Agency (FeSMMIDA) and Ministry of Industries (MoI).

Bamboo Crafts and Basketry: Communities across bamboo growing regions of Ethiopia are producing bamboo basketry products to cater to traditional (rural, agriculture and horticulture) market segments. On a global scale, bamboo basketry or plaited material constitutes one of the important traded commodities, representing 14.3 per cent of export value. Annually an average of USD 215 million worth of basketry products are exported globally. Ethiopia is a minor player at the global scale, importing bamboo basketry products worth USD 23,274. Its export contribution is NIL. Bamboo basketry and craft value chains could be upscaled to produce

bamboo basketry for rural, agriculture, horticultural and floriculture sector application. Tourism and high-end packaging, such as coffee packaging, is another sub-sector where bamboo value added basketry or woven products could be introduced in short term.

Based on the synthesis of bamboo resources, existing bamboo value chain and products, prioritised bamboo products (technical and market suitability), the enabling environment (policy, institutions, government and innovation) and SWOT analyses, a set of recommendations were proposed for the of the potential value chains and for governance of the value chain. Recommendations are further split into two categories as follows:

- 1) Location, species and product matrix: A matrix showing the location (Region, Zone and Woreda [a third-level administrative division, equivalent to a district]), with available bamboo species, bamboo working communities, bamboo value chains and products that are suitable for upscaling.
- 2) A specific set of recommendations for promoting each of the value chains (enhance raw material, processing, skills and technology, innovation, research and development and market development).

To conclude, this study was not without its limitations. Key limitations include the availability of exact quantitative data on the number of actors in each of the value chain (number of producers, number of traders, number of wholesalers / retailers) in different regions or locations of the country. This study used snow balling techniques in data collection related to on-farm bamboo resource locations, processor and MSE details. Other limitations arose due to the lack of sufficient resources and time available to complete the study. It is recommended to include bamboo growing and processing activities as a separate item during household and enterprise census, which will provide an exact number of beneficiaries and actors in the bamboo sector.

1. Introduction

Ethiopia has achieved remarkable economic and social progress in past decade, with an average of over 10 per cent GDP growth per annum (Shiferaw, 2017). Despite these gains, Ethiopia still ranks among the least developed countries in the world, ranking 174th out of 188 countries in the Human Development Index (HDI) (UNDP, 2014). Over 30 million Ethiopians (33 per cent of population: 2010 data) live below the poverty line, based on the measure of US \$ 1.90 per day. Youth unemployment, high prevalence of poverty, low HDI, food security and income disparity among the population are some of the major challenges Ethiopia is facing (UNDP, 2014). Ethiopia is an agriculture dependent society with more than 80 per cent of the population dependent on agriculture as their primary source of livelihoods and income, and is also affected by frequent droughts which can lead to subsequent famine. The abovementioned problems are all exacerbated by the impacts of climate change.

To address these development challenges and to drive inclusive economic growth, the Government of Ethiopia has been devising multiple plans, strategies and programmes such as its “Growth and Transformation Plan II (GTP II)”, “Productive Safety Net Programme”, “Sustainable Land Management Programme”, “Women Entrepreneurship Development Programme” and the CRGE. Considering that a majority of the population is dependent on agriculture and forestry for their sustenance, livelihoods and income, the Government of Ethiopia is focusing on promoting inclusive green economy development through the agriculture and forestry sectors.

Forestry and Agriculture are two of the key sectors and drivers for poverty reduction, improved nutritional outcomes, and inclusive growth in rural areas. They are also important for meeting food and energy demand in urban areas, and critical for reversing natural resource degradation and rehabilitating degraded landscapes. In 2015, Ethiopia had a total forest area of 129,440 Sq. km, which accounts for about 12.5 per cent of the total land area. The forestry sector creates about 276,300 jobs and contributes approximately 4 per cent of the Ethiopia's GDP (MoEFCC, 2017). Agricultural land in Ethiopia covers about 362,590 Sq. km, occupying about 36 per cent of the total land area, employing about 80 per cent of the total population and contributing to about 40 per cent of GDP (World Bank, 2015). In addition to agriculture-based employment and income, Non-Timber Forest Products (NTFPs) play an important role in rural livelihoods and household income (MoEFCC, 2017).

Bamboo is one of the most important NTFPs in Ethiopia. Its annual economic contribution to GDP is estimated at ETB 56,250,000, and close to 750,000 people are dependent on bamboo for their livelihoods (MoEFCC, 2017). Bamboo is both an agriculture and forestry crop, and can be found in natural or state-owned forests. It is also widely domesticated by farmers on their farms for block planting, farm boundary planting and as shelter belts. Ethiopia has over one million hectares of bamboo resources, with two main indigenous species (a) *Yushania alpina* (highland bamboo), and *Oxytenanthera abyssinica* (lowland bamboo). Most of the bamboo resources are concentrated in the Amhara, Benishangul-Gumuz, Gambela, Oromia, SNNP and Tigray regional states. Despite bamboo being a versatile resource with existing, proven technologies available for higher value addition and a great potential to enhance socio-economic and environmental development, it remains underutilised in Ethiopia.

In general, Ethiopian bamboo sector development is in its infant stages. Bamboo in Ethiopia is used to produce low-quality products such as fences, traditional houses, low-quality furniture, mats and household utensils. The sector provides a low economic return for farmers and other actors along the bamboo value chain, and markets for bamboo and bamboo products are still underdeveloped (Embaye, 2003; Endalamaw et al, 2013; Mekonnen et al, 2014). Most of the MSEs are small-sized, informal and subsistence, with limited options to gain knowledge or innovate products. As a result, they are engaged in the production of traditional products using manual technologies in order to fulfil daily subsistence needs (Seyoum, 2007; Endalamaw et al, 2013). In addition, the bamboo and

product producers are unable to market high valued bamboo products, as it is still considered a poor-man's timber and the buyers or consumers hold negative perceptions about quality and durability. Thus, the bamboo sector in Ethiopia is largely unstructured and dominated by a lower standard quality, low-priced and informal market. Market linkages are also weak with a small number of intermediaries, and trade is largely restricted to local and national markets. The market landscape mainly consists of small household processors, small traders and middlemen, who are driven by profit margins and not by quality standards. Policy restrictions on harvesting and transport, and a lack of viable support in the form of centres of excellence where interested people could go for information or attend training programmes (Seyoum, 2007), combine to constrain value chain development and growth.

The government of Ethiopia has given a high priority to the bamboo sector. In its 2016-2020 growth and transformation plan (GTP II), bamboo was targeted as a strategic species for livelihood development and environmental rehabilitation. Under GTP II, the Ethiopian government set targets to afforest/ reforest 0.7 million ha of degraded land with bamboo and utilise 0.5 million m³ bamboo (Wondimu, 2017). The Government of Ethiopia pledged to rehabilitate 15 million ha of degraded landscapes by 2025 as part of the Bonn Challenge, a pledge that was increased to 22 million ha at the 2014 UN Climate Summit in New York. The Ministry of Environment, Forest and Climate Change (MoEFCC) and World Resources Institute (WRI) have since mapped 3 million ha of land suitable for bamboo restoration (Wondimu, 2017).

The International Bamboo and Rattan Organisation (INBAR) has been supporting activities for improved management and utilisation of bamboo resources in Ethiopia. Under the Dutch-Sino East Africa Bamboo Development Programme and Sustainable Land Management Programme (SLMP II), this market study was aimed at identifying existing bamboo products and the potential of bamboo products for upscaling to cater to domestic market demands, with the long-term view of supporting East African bamboo producers to export their products regionally as well as to the European Union (EU). This study aims to contribute to the design of suitable policies, strategies and action plans to up scale the bamboo value chains, in order to leverage the potential of bamboo to contribute to social, economic and environmental benefits in Ethiopia.

2. Objectives of the Assignment

The general objective of the study is to identify existing and potential bamboo value chains for upscaling. Specifically, this study was designed to:

- Assess the bamboo value chain in Ethiopia and identify key opportunities and bottlenecks.
- Map the existing bamboo products and explore new products that have potential in the domestic markets.
- Identify bamboo products (existing and new) that have potential for export to regional and international markets.
- Provide concrete recommendations for upscaling new and existing bamboo products.

3. Methodology

This study used both primary data and secondary data. Primary data was gathered through key informant interviews (KII) and focus group discussions (FGD), using a checklist prepared for this purpose (Annex 1). Secondary data was accessed from review of published and unpublished studies and reports of government and non-governmental organisations. Participants of KII and FGD included stakeholders involved in the raw material production, processing and marketing of bamboo products, as well as those supporting these activities. Other stakeholders consulted include producers (bamboo farmers), bamboo processors (Household enterprises, SME, and industry) and traders, experts from agriculture and natural resources, trade and industry, MSEs, saving and credit Institutions, Technical Vocational Education Training (TVET) institutes, exporters and consumers. A list of stakeholders consulted during field data collection is presented as Annex 2. In addition to the stakeholders directly interviewed (KII and FGD) during field visits, a number of KII were conducted via telephone, adopting the snowball sampling technique to access information on locations where the study team were unable to visit due to time and budget constraints.

During the field mission, the study team undertook visits to local bamboo markets to collect information on available bamboo products, their prices, specification and potential markets. In addition, the study team visited bamboo production sites and processing plants to triangulate information generated through interviews.

The consultant has analysed information generated during field data collection following standard methods of value chain analysis (Kaplinsky and Morris, 2000; Gereffi et al (2005) and Riisgaard et al, 2008). It describes actors and their functions such as production (raw material / bamboo pole supply), processing (value addition), and marketing (including transportation, storage and handling) from a value chain perspective. This study analysed bamboo growing areas using secondary literature, maps the existing bamboo value chain information. It also analysed the technical and market suitability for shortlisting potential bamboo value chains, developing SWOT analyses for each of the value chains and providing recommendations based on the identified bottlenecks currently restricting promotion of the value chain.

To prioritise existing bamboo products and identify new bamboo products that have domestic and export market potential, bamboo

value chains were shortlisted and prioritised through a scoring and ranking exercise based on the criteria and indicators presented in Table 1. The criteria and indicators cover bamboo products with both domestic and export market potential.

The five-point Likert scale was used to measure each indicator, where five was the highest score and one was the lowest. The score against each indicator was calculated based on the weight given to each criterion and indicator based on expert opinion. The weighted score was added and the total score was calculated. Finally, a ranking of each bamboo product was calculated based on its total weighted score. The products with the highest scores were considered potential products for assessment.

Table 1: Criteria and indicators for prioritisation of bamboo products

Criteria	Weight (%)	Indicators	Weight (%)
Livelihood / Job Creation Potential	25	Local / Rural employment creation potential	50
		% of poor household engagement	25
		% of Women engagement / Gender	25
Prospects of Success	30	Technology available / transfer	30
		Investment capacity	25
		Policy environment	20
		Resource availability and sustainability	25
Market and Trade potential	30	Availability / potential domestic market	60
		Availability / potential international market	40
Contribution to Government Agenda	15	Contribution to multi development agenda / cross sector linkages / targets	40
		Public – private investment	60

Source: Field study, 2017

Data on domestic trade value and volumes were not available due to the unorganised nature of the sector. International bamboo trade data (both imports and exports) were accessed via the United Nations Comtrade database (<https://comtrade.un.org/data/>) and compiled for analysis. Specifically, data for the three latest consecutive years (2014, 2015 and 2016) of bamboo with specific harmonised codes (HS codes) such as (1) HS 140110: Bamboo; (2) HS 200591: Preserved Bamboo Shoot; (3) HS 460121: Bamboo Mats / Screens; (4) HS 460192: Bamboo Plaits and plaiting material; (5) HS 460211: Bamboo Basket Work; (6) HS 440210: Bamboo charcoal; (7) HS 440921: Bamboo Flooring; (8) HS 441210: Bamboo plywood; (9) HS 470630: Bamboo pulp; (10) HS 482361: Bamboo Paper based articles; (11) HS 940151: Bamboo and Rattan seats and (12) HS 940381: Bamboo and rattan furniture were downloaded, compiled and analysed. Please note, HS Codes 940151 and 940381 are combinations of bamboo and rattan. All the other codes are unique to bamboo.

In addition, import and export data of products that could be alternated with bamboo were accessed from the UN Comtrade database (<https://comtrade.un.org/data/>). The details of the HS codes and their descriptions are shown below:

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

HS code 9403:	Furniture
HS code 47:	Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard
HS code 48:	Paper and paperboard; articles of paper pulp, of paper or of paperboard
HS code 4410:	Particle Board, Oriented Strand Board (OSB) and Wafer Board
HS code 4418:	Wood panels; Parquet Panels
HS code 4415:	Packaging cases – Wood
HS code 4411:	Fibre Board
HS code 380210:	Activated Carbon
HS code 330741:	Agarbatti and other odoriferous preparations which operate by burning

Data on relevant policy, strategy and institutions were extracted from the study titled “Comparative Analysis of Public Policies for bamboo development and assessment of opportunities for policy exchange between China, Kenya and Ethiopia”, conducted under INBAR’s Dutch-Sino East Africa Bamboo Development Programme (Saavedra, 2017).

4. The Study Area

The study team undertook field visits and collected data in Addis Ababa, Amhara, Benishangul Gumuz, Oromia, SNNP and Tigray regional states in specified locations, as listed in the table below (Table 2). Most of the physical field visits and data collection locations coincide with INBAR SLMP II and INBAR South-South Phase II project sites. These locations were mainly targeted taking into consideration the availability of manpower and other resources for data collection. In addition, data collection was undertaken through telephonic interviews of key informants from important bamboo growing and processing areas across Ethiopia (Table 2). An indicative map showing the field visit location and telephonic interviews are shown as Figure 1. The location details of the study are as follows

Table 2: Field visit location for data collection

Region	Specific Locations (Field Visit)	Telephonic interviews
Addis Ababa	Ureal, Piassa, Asko, Burayu, Sebeta and Gelan	
Amhara	Banja Woreda, Injibara Town Bahir Dar, Matema, Quara, Addis Kidam, Tilili (Awi), Bibugn	Dembecha, Finote Selam, Mankusa, Kessa, Kombolcha, Kemise, Alem Ketema, Debate, and Mambuk

Benishangul Gumuz	Bambasi Woreda, Assosa Zone	Komosha, Kemashi, Keburhamsa, Sherkole, Gizen, Guba, Metekel, Belo Jiganfoy, Gilgal Beles
Oromia	Wonchi Woreda, Dere Enchini Woreda	Shenen, Wolisso, Guder, Ambo, Addis Alem, Gimbi, Nejo, Dembi Dolo, Guten, Bedele, Agaro, Jimma, Shakiso, Adola, Gore, Guji, Bore, and Metu
SNNPRS	Arbegona, Masha and Butajira	Ula, Bule, Bonga, Bensa, Daye, Dilla, Wolkite, Sheka, Tepi, and Mizanteferi
Tigray	Wolqayt, Tsegede, Tselemt, Tahtaye Adeyabo, Shere, Adiarkaye, Adet, Mekele and Dansha.	Adwa, Axum and Temben

Source: Field study, 2017

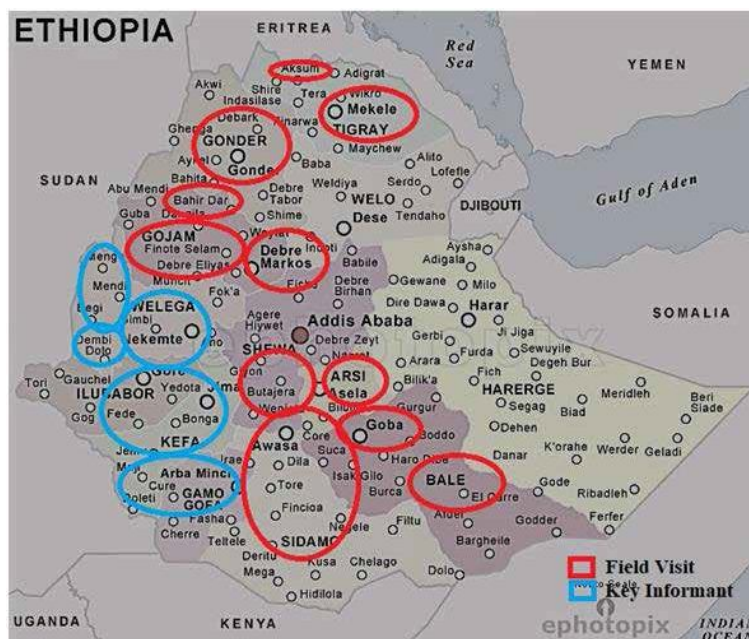


Figure 1: Map indicating field visit locations and locations of informants contacted via telephonic interview

5. Bamboo Resources

5.1 Status of Bamboo Resources in Ethiopia:

Ethiopia has one of the largest bamboo resources in Africa (Lobovikov et al, 2007). An INBAR production to consumption study (Kelbessa et al, 2000) estimates the availability of 1.1 million hectares of bamboo, out of which about 150,000 ha belongs to highland bamboo and 950,000 ha to lowland bamboo. A study conducted by a LUSO consultant (1997) estimated that there are 129, 626 ha of highland bamboo and about 700,000 to 850,000 ha of lowland bamboo in Ethiopia, while Lobovikov et al (2007) reported an overall 849,000 ha of bamboo resources in Ethiopia. In all cases, bamboo resources in Ethiopia represent one of the largest bamboo resources in Africa. Most of the bamboo resources are concentrated in six regions of Ethiopia namely Amhara, Benishangul Gumuz (BSG), Gambela, Oromia, Southern Nations Nationalities and Peoples' Regional State (SNNPRS) and Tigray region.

According to a recent remote sensing based inventory conducted by INBAR and Tsinghua University, Ethiopia has a total of 14744.63 km², or 1.47 million ha of bamboo. The study used Landsat imagery (30 m X 30 m resolution), limited to capturing bamboo cover of at least 900 m² and with a minimum canopy of 50 per cent. Therefore there is a chance that small bamboo patches (with an area less than 900 m² or with a width/length less than 30 m) were not identified in this study. In addition, due to the similarities of the spectral properties of bamboo to other land classes, such as agriculture (corn), grassland and shrub land, there may be a slight overestimation of bamboo areas, mainly in Western areas of Ethiopia.

Table 3 below shows the bamboo growing areas in respective regions and zones of Ethiopia.

Table 3: Bamboo area by zone and regions in Ethiopia

Region	Zone	Bamboo area in km ²	Predominant Species
Benishangul-Gumuz Region	Metekel	6797.40	<i>Oxytenanthera abyssinica</i>
	Kemashi	1548.42	<i>Oxytenanthera abyssinica</i>
	Assosa	1101.78	<i>Oxytenanthera abyssinica</i>
	Sub Total (Km²)	9447.59	
Amhara Region	North Gondar	2864.64	<i>Oxytenanthera abyssinica</i>
	Awi/Agew	202.25	<i>Oxytenanthera abyssinica</i>
	West Gojjam	54.61	<i>Oxytenanthera abyssinica</i>
	East Gojjam	0.79	<i>Yushania alpina</i>
	South Wollo	0.01	<i>Yushania alpina</i>
	Sub Total (Km²)	3122.29	

Oromia Region	West Wellega	856.53	<i>Oxytenanthera abyssinica</i>
	East Wellega	689.88	<i>Oxytenanthera abyssinica</i>
	Ilubabor	286.79	<i>Yushania alpina</i>
	Kelem Wellega	244.12	<i>Oxytenanthera abyssinica</i>
	Horo Guduru	31.46	<i>Yushania alpina</i>
	Jimma	6.86	<i>Yushania alpina</i>
	Bale	1.10	<i>Yushania alpina</i>
	West Shewa	0.30	<i>Yushania alpina</i>
	West Arsi	0.17	<i>Yushania alpina</i>
	Guji	0.02	<i>Yushania alpina</i>
	Sub Total (Km²)	2117.24	
Southern Nations, Nationalities, and Peoples' Region	Keffa	19.09	<i>Yushania alpina</i>
	Bench Maji	11.96	<i>Yushania alpina</i>
	Sheka	9.47	<i>Yushania alpina</i>
	Konta Special	4.39	<i>Yushania alpina</i>
	Dawro	1.86	<i>Yushania alpina</i>
	South Omo	1.04	<i>Yushania alpina</i>
	Gamo Gofa	0.66	<i>Yushania alpina</i>
	Gurage	0.02	<i>Yushania alpina</i>
	Gedeo	0.02	<i>Yushania alpina</i>
	Derashe Special	0.01	<i>Yushania alpina</i>
	Kembata Alaba and Tembaro (KAT)	0.01	<i>Yushania alpina</i>
	Sidama	0.01	<i>Yushania alpina</i>
	Yem Special	0.01	<i>Yushania alpina</i>
	Sub Total (Km²)	48.56	
Gambela Region	Agnuak	8.66	<i>Oxytenanthera abyssinica</i>
	Mezhenger	0.28	<i>Oxytenanthera abyssinica</i>
	Sub Total (Km²)	8.94	
	Total (Km²)	14744.63	

Source: INBAR-Tsinghua University (2017)

Synthesis of the bamboo growing areas, conducted by comparing the predominant bamboo species (key informants) in each of the zones with the remote sensing results, shows that *Oxytenanthera abyssinica* is the predominant species in Ethiopia, occupying about 14368.57 km², whilst *Yushania alpina* occupies 423.61 km². Please note, highland bamboo predominantly grows on smallholders farms or in small patches, which may not have been mapped during this remote sensing study. The top 25 woredas with highest concentration of bamboo resources are attached as Annex 3.

5.2 Bamboo Species: Characteristics and Uses

5.2.1 Lowland Bamboo:

O. abyssinica, commonly known as “lowland bamboo”, is a tufted, sympodial bamboo with a height ranging from 3-10 m and a diameter ranging from 4-10 cm (UNIDO, 2009). It is mainly found in the deciduous, savanna woodlands landscapes of western Ethiopia associated with grasslands. Ideally, it grows at an altitudinal range between 500-1600 m ASL, where the annual rainfall ranges from 700 – 1000 mm spread over three to four months. It is a hardy species that can grow on poor volcanic soils in areas with about 600 mm annual rainfall or in locations with higher rainfall (UNIDO, 2009).

In Ethiopia, under natural conditions, it produces 8000 culms/ha of semi-solid to solid bamboo poles, with a death rate of 4000 culms/ha and holding about 70 tons/ha of above ground biomass with a mean annual increment of about 10 tones/ha (LUSO, 1997). However, a plot level study by Mulatu et al (2016) indicates the possibility of at least 40,000 culms / ha, with an opportunity to harvest over 10,000 bamboo poles sustainably. The culms or poles are applied for a range of uses including for construction, fencing, furniture, basketry, mats, handicrafts, energy source, feed and fodder.

Lowland bamboo is dominantly found in natural forests or state forests. However, there is also sporadic adoption, planting or growing of *Oxytenanthera abyssinica* on farmland.

The technical specification / physical dimension of bamboo poles of *Oxytenanthera abyssinica* is shown in Annex 4A and 4B.

5.2.2 Highland Bamboo:

Y. alpina is a tufted, sympodial bamboo (long rhizome neck) with erect green culms ranging from 10-20 m in height (UNIDO, 2009a). The diameter of the culm ranges from 5-12.5 cm. It is mainly found in the south, south-west, central and north-west highlands of Ethiopia at altitudes ranging from 2200-4000 m ASL, with high rainfall ranging from 1500-2000 mm (LUSO, 1997; Kelbessa et al, 2000; UNIDO, 2009a; Mulatu et al, 2016). It requires well-drained, deep and humus-rich soil to allow rhizome spread and growth.

In planted bamboo forest the number of bamboo poles per hectare ranged from 11,000-20,000 poles, and the number of bamboo poles in natural forests ranged from 5869-8840 culms/ha (LUSO, 1997; Mulatu et al, 2016), with an annual increment of 6-26 tons in planted forests and 8.6 tons in the case of natural forests (Mulatu et al, 2016).

Although the proportion of *Yushania alpina* is comparatively small in relation to *Oxytenanthera abyssinica*, it is better utilised by local craftsmen owing to its high workability, and is also the type extensively domesticated by farmers. Highland bamboo is widely grown in the traditional agroforestry systems in many woredas of Amhara, Oromia and SNNPRS regions of Ethiopia. It is grown in backyards, on farm boundary, woodlots, and around the river banks. It is widely used for construction, fencing, basketry, furniture, beehives, mats, household and agriculture utensils. Currently, the industries operating in Ethiopia (in Addis Ababa and Injibara) use *Yushania alpina* for production of industrial products such as flooring tiles, stick-based product lines (curtains, table mats, incense sticks) and energy products. The location details of the highland bamboo growing areas in smallholder farms are attached as Annex 5.

Farmers as well as local communities have indigenous knowledge of the “variety” or “sub-types” of *Yushania alpina*. During field visits, in Arbegona (SNNPRS): farmers identified many varieties including (a) Gasalo, (b) Gato, (c) Chacho, (d) Ado, (e) Gadircho, (f) Abepenicho, and (g) Kiticho. As per local farmers, each of the “varieties” have specific applications. For instance, Chacho, Midhasho, and Gaticha are resistant to insect and pest attack, and thereby products produced are more durable. Ado is preferred for house construction due to its size, and is also suitable for producing edible shoots. In Bibugn Woreda (Amhara), farmers identified three varieties of highland bamboo: (a) Wolele, (b) Teffero and (c) Wonedye based on the difference in colour, diameter, inter-node length and nodal rings.

The technical specification or physical dimensions of *Yushania alpina* is shown as Annex 6A to 6E.



Highland Bamboo (*Yushania alpina*)



Lowland Bamboo (*Oxytenanthera abyssinica*)

5.2.3 Introduced Bamboo Species:

In addition to the two indigenous bamboo species mentioned above, Ethiopian Environment and Forest Research Institute (EEFRI) has introduced about 23 bamboo species from seven genera (Mulati et al, 2016a). The seven genera are (1) *Bambusa* (five species), (2) *Dendrocalamus* (six species), (3) *Guadua* (two species), (4) *Gigantochloa* (three species), (5) *Phyllostachys* (five species), (6) *Schizostachyum* (one species) and (7) *Thyrsostachys* (one species). Among these introduced species; *Dendrocalamus giganteus*, *Dendrocalamus hamiltonii*, *Bambusa balcooa*, *Bambusa tulda*, *Bambusa vulgaris* var. *green*, *Dendrocalamus asper*, *Dendrocalamus membranaceus* and *Guadua amplexifolia* showed best adaptability and growth performance under different field conditions (Mulatu et al, 2016; Personal Observation).

5.2.4 Bamboo Resources and Management Systems:

Bamboo resource production in Ethiopia can be categorised into four production systems: (a) state bamboo forest, (b) community bamboo forest, (3) institutional bamboo groves, and (4) “private” bamboo groves.

State Forest: The state bamboo forest refers to bamboo stands growing naturally in state-owned forests, usually under the government’s protection. Neither harvesting nor management activities are allowed in state bamboo forests.

In most locations, bamboo forest stands remain de facto open access resources, where local communities harvest bamboo poles for construction and other uses. Currently, the government has developed two institutional mechanisms for management of forests. These are (1) PFM, where the communities are assigned responsibility and allowed to benefit by sustainably managing the forests and the main extractable resources are NFTP’s including bamboo; and (2) forest concessions for private companies, where the companies can harvest bamboo in a sustainable manner (for example Bamboo Star).

In the case of bamboo harvesting for trade, local communities, traders, PFM actors and private companies need to obtain a “harvesting and transport permit”, known locally as a “Boleta”, accompanied by a “receipt” of royalty fees for transporting bamboo across “check points”. However, it is important to note that the enforcement mechanism remains weak.

Community Bamboo Forest: The community bamboo forest refers to bamboo growing in “designated areas” provided to communities for grazing or for communal use. They are managed by the “community”, or an “enterprise” or “association” of the local community. The community bamboo forests serve communities as a source of culms for construction as well as for value addition. In the case of bamboo trading or sale, the “association/enterprise/ cooperatives” need to obtain a harvesting permit and pay royalties for harvesting and transport of bamboo.

Institutional Bamboo: Institutional bamboo refers to bamboo grown on land owned or designated to organisations such as churches and schools. The practice of growing bamboo surrounding a “church” and “school” is mainly practiced in Amhara and SNNP regional states to generate “income”, as well as to “increase the forest cover and safeguarding of the indigenous resources”.

The predominant species grown is highland bamboo. In the case of local sale, the institutions sell the bamboo poles directly to local farmers and processors. However, for transporting to other locations which require crossing check points, a harvesting permit and “Royalty paid receipt” is required.

Private Bamboo: The “private” bamboo grove refers to bamboo groves grown on the homesteads or farmsteads of individual farmers, and which are owned by the farmer. Smallholder farmers grow bamboo in the form of block planting, farm boundaries, and as homestead planting.

Highland bamboo (*Yushania alpina*) is preferred and grown by the farmers on their farmland due to the ready market for bamboo poles, the potential application of highland bamboo for multiple uses, and for its ease in processing and management.

It is important to note that highland bamboo is mostly domesticated, and is a main source of raw material for value addition. This can be illustrated by the following data. The Arbegona Woreda Bureau of Agriculture and Natural Resources (BoANR) estimated that the Arbegona Woreda has about 4200 ha of bamboo resources, of which bamboo in state forests account for about 300 ha (235ha of Geremba forest and 68 ha of Yerke forest). the remaining 3865 ha of bamboo is grown on smallholder farmers’ land (Arbegona BoANR Staff; personal communication). Most of the highland bamboo is grown on smallholder farms, whilst lowland bamboo is grown mainly in state forests.

Region wide location details of domesticated highland bamboo is shown below (Table 4). The details of the Kebeles (villages) with domesticated highland bamboo are shown as Annex 5. Though the list of Kebeles is not complete, it provides clear information on the scale of highland bamboo domestication.

Table 4: Location details of highland bamboo in small holder farms

Region	Zone	Woreda / District	# Kebele
SNNPRS	Sidama	Hagare Selam, and Arbegona	46
	Sheka	Masha	2
	Kaffa	Adio and Bonga	4
Amhara	Awi	Banja, Guaguasa Shikudad, and Addis Kidam	18
	West Gojjam	Bure, Debub Achefer, Dembacha, Wemberma, Yilmana Densa, Aneded, Awabel, Baso Liben, and Bibugn	24
	East Gojjam	Senan, Kuye, Aneded, Awabel, Baso Liben, and Bibugn	18
Oromia	Bale	Gololcha Bale, Gore, Guradambole, Herena Buluk, Lege Hida, Mena, Rayitu, Seweyna and Sinan.	Information Not Available
	Arsi	Amigna, Aseko, Bele Gesgar, Chole, Degaluna Tijo, Diksis, Dodota, Gololcha Arsi, Guna, Hitosa, Inkolo Wabe, Jeju, Limu Bilbilo, Lude Hitosa, Merti, Munissa, Seru, Shirka, Sire, Sude, Tena, Tiyo and Ziway Dugda	Information Not Available
	South West Shewa	Dere Enchini, Shenen, Wolisso and Wonchi	Information Not Available
	Guji	Adola, Afele Kola, Ana Sora, Bore and Dara	Information Not Available
	SW Oromia	Haro Wonchi	9

Source: Field study, 2017

Recently, farmers have started planting *Oxytenanthera abyssinica* in the Benishangul Gumuz, Gambela and Tigray regions. However, the scale of planting is much smaller in comparison to highland bamboo. Lowland bamboo cultivated on farmland is mainly composed of bamboo clump regeneration after conversion of bamboo forest to agricultural land; and through the development interventions of government, and non-governmental organisations (NGO).

It was also noted that the demand for bamboo planting material and seedlings is growing in most of the regions, mainly to meet government plantation targets. Smallholder farmers currently raise bamboo plantations by using offsets or rhizomes as a planting material, sourced from neighbouring farmers. In addition, BoANR is providing bamboo planting material to farmers free of cost, though the availability of required species and quantity is a constraint. It is important to note that a cooperative operating in the Zengena lake area (Injibara, Amhara region) is producing bamboo plants (*Phyllostachys aurea*, *Yushania alpina*, and *Dendrocalamus hamiltonii*) for sale. The cost of bamboo planting material (ETB 30-40 per seedling) is relatively high, and for scaling up bamboo plantation a basic requirement will be enabling the availability of required planting material (species) at an affordable price.

5.3 Management and Utilisation of Bamboo Resources

Bamboo resources in state forest and communal bamboo forests are degraded owing to the lack of management and sustainable

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

harvesting practices. In addition, the recent gregarious flowering and die-back of *Oxytenanthera abyssinica* and *Yushania alpina* and lack of efforts to assist regeneration, coupled with anthropogenic forest fires, uncontrolled grazing and land conversion, has resulted in poor regeneration and thereby degradation or loss of bamboo forests. Other factors such as the government's resettlement programme, refugee influxes, and land concessions for alternative investments have also resulted in decline or loss of bamboo forests.

Table 5 below shows the management regime of bamboo under different land tenure systems.

Table 5: Land Tenure and Management of Bamboo

Land Tenure	Species	Management
State Bamboo Forest	<i>Oxytenanthera abyssinica</i> (major) and <i>Yushania alpina</i> (minor)	Open access in some cases: not managed: Over harvested or in natural state (degraded). Poor enforcement
Communal Bamboo Forest	<i>Oxytenanthera abyssinica</i> and <i>Yushania alpina</i>	Open access: poorly managed: Over harvested- highly degraded. Poor regulation and/or enforcement
Institutional Bamboo	<i>Yushania alpina</i>	Managed (Instances of over harvesting)
Private Bamboo	Predominantly <i>Yushania alpina</i>	Managed (Instances of over harvesting)

Source: Field Study, 2017

Bamboo in state-owned forests is not managed, and there are both instances of "over harvesting" and "no harvesting" depending on the accessibility and remoteness of the location. For instance, in the case of *Yushania alpina* bamboo forests, bamboo in Masha and Bale Mountains are mostly undisturbed, whilst bamboo in Bonga Forests is over-harvested. Similarly, in the case of *Oxytenanthera abyssinica*, bamboo forests in Kurmuk and Kibur Hamsa are over-harvested, and bamboo forests in Kemashi are mostly undisturbed. Bamboo is a "woody grass" which produces new bamboo shoots or bamboo poles every year, and old bamboo poles in a clump die out every year. Sustainable harvesting (harvesting of bamboo poles of 3+ years) improves the quality of bamboo forests as well as bamboo poles.



Unmanaged Bamboo Forests in Ethiopia

Communal bamboo forests are over-harvested and/or unsustainably managed, indicated by field visits to Buyema Kochere Kebele of Dere Enchini Woreda (Oromia region). Communal bamboo forest is unsustainably managed, with a higher number of older bamboo poles (3+ years) standing in the bamboo clump. Most of the young bamboo poles (~ 1-year-old) are harvested for value addition in the production of basketry, thereby jeopardising the emergence of new bamboo shoots and leading to a reduction in size of bamboo poles.

The bamboo grown in institutional areas is relatively “well managed”, with regular harvesting and management. However, in some cases instances of harvesting young bamboo poles (< 3 years) has been observed, mainly as a result of market forces.

Bamboo on private farms and smallholder farms is better managed in comparison to bamboo in state forests and on communal land. However, bamboo on private farms are not optimally managed: both the management of clump intensity (number of bamboo poles in a clump) and clump composition (proportion of different aged bamboo), as well as harvesting methods, are not practiced. Generally, standing bamboo poles in a clump belong to Year 1 and Year 2 categories, and the harvested bamboo poles belong to the same age category. With frequent and over-harvesting, bamboo clumps are not producing optimal successive generation poles in terms of diameter and the number of bamboo poles.

Overall, the management of the bamboo forests and bamboo in farmland is conducted based on traditional knowledge. There are very limited extension support services to communities for management of the bamboo resources. The main issues observed in management regimes of state-owned forest are (a) lack of a management plan; (b) lack of a strong, empowered community institution with clear incentive mechanisms; (c) lack of orientation of forest managers towards bamboo management (needs sustainable annual harvesting) for healthy and productive bamboo stands and (d) lack of enforcement. In the case of community owned bamboo forests, the main problems observed are over-harvesting due to lack of scientific knowledge of bamboo as well as lack of enforcement of sustainable management and harvesting practices. In the case of institutional bamboo and smallholder bamboo plantations, the main improvements that need to be made are (a) capacity building on sustainable management and harvesting practices (maintain right clump intensity and composition) and (b) adoption of sustainable management practices. In addition to the above, there are instances where insect and pest attacks impacted the quality of bamboo poles and ability to add further value. This could be addressed by adopting sustainable management and harvesting practices.

5.4 Assessment of the Existing Bamboo Value Chain in Ethiopia

5.4.1 Value Chain Actors and Products:

The bamboo production and consumption landscape consists of (1) bamboo resource producers, (b) bamboo processing enterprises, (c) traders or middlemen and (d) consumers. Bamboo resource production is dominated by smallholder farmers who supply bamboo to value addition enterprises. In most cases, smallholder farmers play the dual role of resource producers (bamboo poles), and as producers of bamboo basketry and mat-based products. A majority of the current bamboo processing activities are undertaken by household enterprises using manual technology for production of low value products for domestic and rural markets.

In towns and cities, semi-modern enterprises or micro and small-scale enterprises are functional, producing bamboo furniture and to some extent bamboo craft products. In addition, there are a few large industries (located in Addis Ababa and Injibara) producing industrial products such as bamboo flooring tiles, bamboo stick curtains, and bamboo stick-based and energy products. Therefore, the enterprises can be classified as (a) bamboo resource producers (small holder farmers producing bamboo poles), (b) household enterprises (producers of bamboo mats and basketry), (c) micro and small enterprises (furniture) and (d) organised industries (factories producing industrial products). In addition, bamboo is also used as a construction material, for feed and fodder, and as edible bamboo shoots. The most commonly used and widely available bamboo products in Ethiopia are shown in Table 6 below:

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Table 6: Most common bamboo products available in Ethiopia

Bamboo Poles	Mats and Basketry / Crafts	Furniture	Construction	Industrial Products	Energy	Others
Raw Bamboo Poles	Bamboo Mats for fencing, flooring, ceiling, partition / screens and drying. Granary Bee Hives Basketry (Akinbalo, Mosseb, Agelgel, Safed) Household and agriculture utility baskets (fruits and vegetables packaging, etc.). Life style products (Flower vase, Lamp shade, Fruit basket, Corner lamp, table mats, waste paper baskets, candle holder). Kitchen utensils (bread baskets, serving trays) Coffee box	Traditional products (3 seat stool, Single stools, Tables Shelves, Partition / screens, Beds, coffee table). Walking sticks Modern products (Dining chair and table), modern shelves, Coffee tables, Sofa sets Relaxing chairs / Rocking chairs, Bar shelves, Dressing table, TV Racks, Photo frames, Bamboo decorated door)	Rural House Construction: Entire House (Sidama), Wall Flooring, Roofing Partition, Wall cladding Designer mat for ceiling Decorations in Restaurants and coffee houses Eco-tourism resorts Animal shelter	Bamboo Flooring Tiles Bamboo Board Curtains Table Mats Incense sticks Briquettes and Pellets	Fuelwood Charcoal Briquettes and Pellets	Fodder Bamboo Shoot

The market for bamboo-related activities is not robust, with the majority of products confined to the household and agriculture subsistence markets. Market linkages and trading networks are weak, with a small number of intermediaries involved in the trade of bamboo poles as well as bamboo value added products, and with a majority of the trade confined to local or national markets (Endalamaw et al. 2013). An overall bamboo value chain map for Ethiopia is shown in Figure 2:

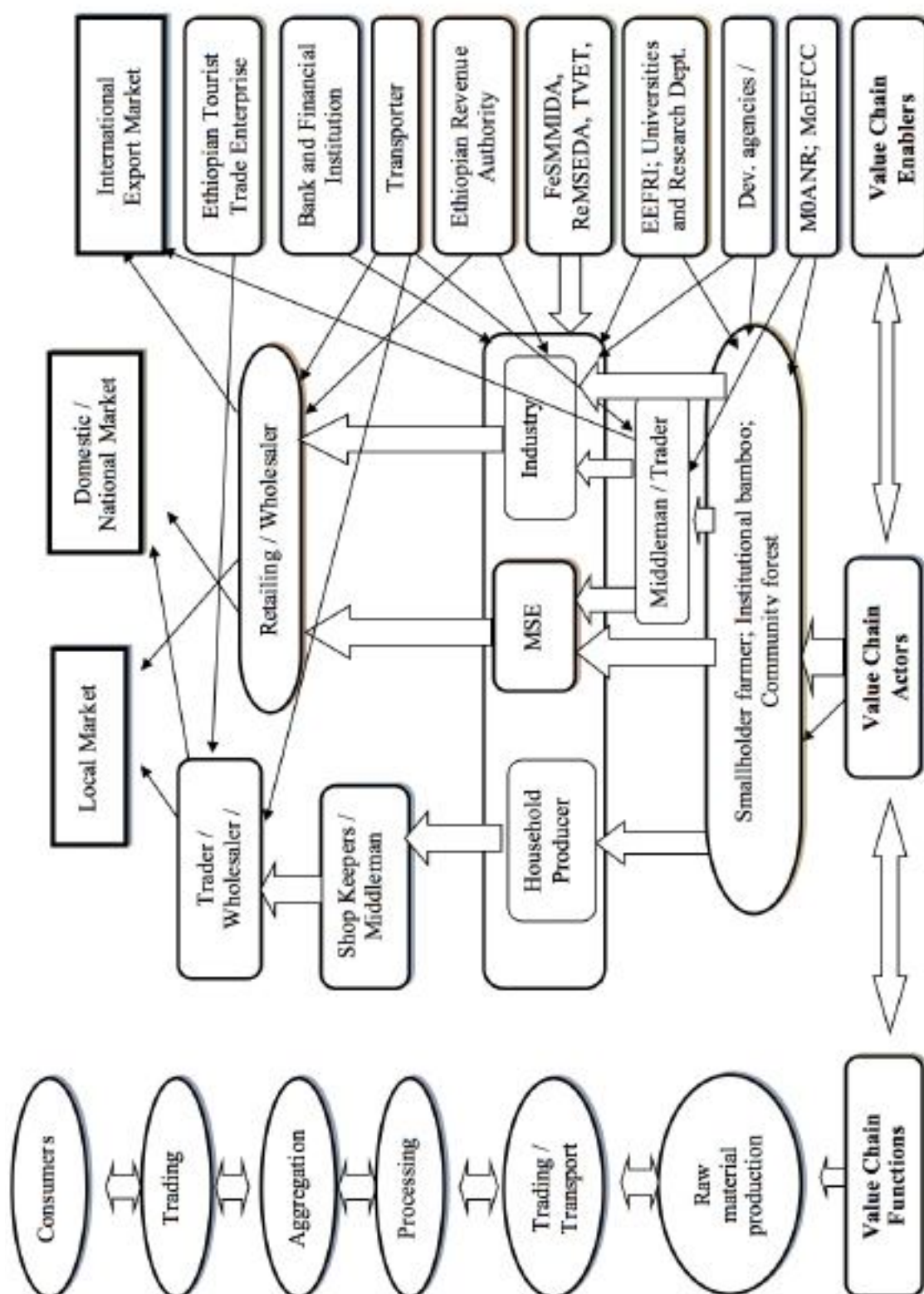


Figure 2: Overall bamboo value chain map

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

In the following sections, the roles of actors, value addition, techniques and technology, economic factors and consumers in the existing bamboo value chains of Ethiopia are analysed, including for (1) bamboo poles; (2) bamboo mats; (3) bamboo basketry; (4) bamboo construction; (5) bamboo furniture; (6) bamboo industrial products; (7) bamboo energy products, (8) bamboo fodder and (9) bamboo shoots.

5.5 Bamboo Pole and Culms Marketing

The bamboo pole and culm market is not well-developed. However, there has been an incremental growth in bamboo pole trading and marketing over the years. According to the LUSO (1997), the bamboo culm market is confined to sale for production of mats and baskets, and the bamboo pole market is currently in its evolutionary phases, with emergence of MSEs producing furniture in towns, cities and the industrial sector.

The key actors involved in the bamboo pole value chain are smallholder farmers, community institutions (the producers of bamboo poles), middlemen, collectors and traders (who act as a link between the farmers and processors and consumers), and processors and consumers (who consume the bamboo for further value addition or for final use). Figure 3 below illustrates the bamboo pole value chain.

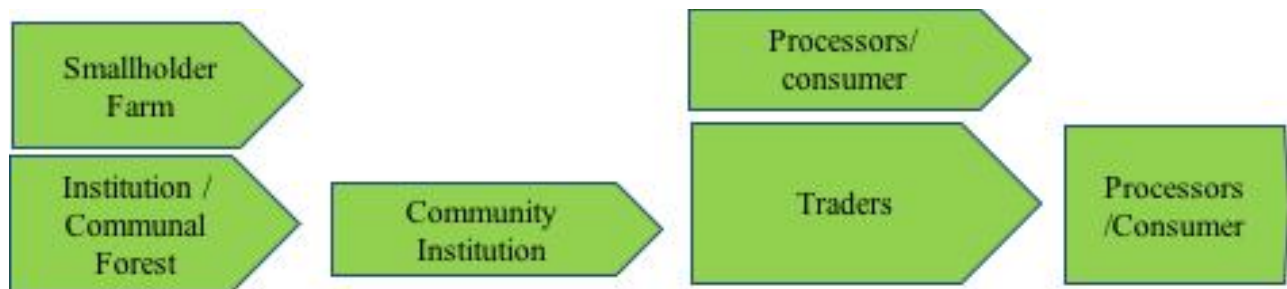


Figure 3: Bamboo culm/pole value chain map

Raw Material: Bamboo culms used for value-addition in the form of mats, basketry, furniture, and industrial products are mostly supplied by smallholder farmers, institutions and communal bamboo forests. However, in rare cases, bamboo from state-owned forests is also processed into value added products. For instance, “Bamboo Star” in BSG have special user rights on bamboo forests. In other cases, traders access bamboo in state forests through the regional or local Bureau of Agriculture, by obtaining harvesting and transport permits and through payment of royalties.

Market:

Highland Bamboo: Markets for highland bamboo are much better in comparison to lowland bamboo. The main bamboo locations where bamboo sales and marketing is observed are:

- (a) SNNPRS (Hula, Daye, Bursa, Bensa, Bore, Arbegona, Dilla, Agena, and Mojo Woreda).
- (b) Oromia region (Wonchi, Herero, Goba, Shedem, Shenen, and Dere Enchini Woreda).
- (c) Amhara (Injibara, Bibugn, Erogebeya, and Kesa Chawsa).

Smallholder farmers, community bamboo forests and institutional bamboo growers have two mechanisms for sale and marketing of bamboo poles. The first mechanism is direct sale of bamboo poles to local processors and traders. The price of the bamboo poles is mostly determined by their diameter, though the price-allocation process is highly informal in its nature. The price of bamboo poles

is not uniform across regions or locations. The price ranges from ETB 12 to 30 for large diameter bamboo poles at farmer's gate. For example, the price of large diameter bamboo pole is about ETB 12 in Dere Enchini (Oromia), and the same diameter bamboo pole is sold at Birr 30 in Agena (SNNPRS). Annex 7 shows the details of farm gate prices of different diameter bamboo at different locations across the country.



Local Bamboo Culms Market in Ethiopia

Traders / trading: Bamboo traders belong to two categories, (a) local traders who purchase bamboo from smallholder farmers to sell them in the nearby towns, and (b) big traders who source bamboo from growers and sell them in cities and towns. The number of traders, locational details of purchase and sale of bamboo poles are shown as Annex 8. Traders generally operate through middlemen, agents or collectors in the local Kebele. Firstly, they negotiate the price, specification, quantity and delivery schedule with the farmers, and pay a token fee in advance. In addition, traders also buy bamboo from weekly markets and on the roadside on market days.

Bamboo traders require a trading license issued by Ethiopia's Ministry of Agriculture, and they need to get a harvest and transport permit, locally called at "Boleta", and pay royalties for the transport of bamboo from one region to another.

Transport: Bamboo culms purchased from farmers are collected, pooled and temporarily stored at the nearest road head. Head loads, mule, horseback and cart are the common mechanisms of transport for collecting bamboo and for transport to the nearest market place. Purchased Bamboo is then transported to market locations using trucks, carts and other forms of transport. The cost of transportation varies across regions as well as according to the distance bamboo poles are transported. Below Table 7 illustrates the transportation cost of bamboo poles from different procurement locations to Addis Ababa.

Table 7: Transportation cost of bamboo pole from different parts of country to Addis Ababa

Culm source	Destination	Distance in km.	# poles / truck	Rent of Truck (ETB)	Cost/ culm (ETB)
Hula (SNNPRS)	Addis Ababa	350	600	3700	6
Arbegona (SNNPRS)	Addis Ababa	350	600	3700	6
Dere Enchini(Oromia)	Addis Ababa	160	600	3000	5
Injibara (Amhara)	Addis Ababa	445	600	5000	8

Note: Isuzu truck

Source: Field study, 2017

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Addis Ababa is the main market for bamboo poles due to the large number of bamboo furniture manufacture located in Shiromeda, Entoto, Urael, Nifas Silk and Kolfe areas, as well as the presence of industries processing bamboo poles into industrial bamboo products. The main sources of bamboo poles transported to Addis Ababa are Hula and Arbegona Woreda (SNNPRS), Dere Enchini (Oromia) and Injibara (Amhara). An analysis of bamboo cost increments from bamboo producers to consumers was undertaken to illustrate the profits and costs across different actors of the bamboo value chain. Table 8 below shows the farm gate prices, royalty, transportation, loading and unloading costs, market price and profits for each source location.

Table 8: Cost increment analysis of bamboo poles

Source	Market / Destination	Farm Gate Price (ETB)	Royalty fee/culm (ETB)	Transport cost / culm (ETB)	Loading / Unloading (ETB)	Total cost (ETB)	Market price (ETB)	Profit (ETB)
SNNPR, Hula	Addis Ababa	14.0	1.0	6.0	1.5	22.5	26.0	3.5
SNNPR, Arbegona	Addis Ababa	13.0	1.0	6.0	1.5	21.5	26.0	4.5
Oromia, Dere Enchini	Addis Ababa	10.0	1.3	5.0	1.5	17.8	26.0	8.3
Amhara, Injibara	Addis Ababa	14.0	1.0	8.0	1.5	24.5	26.0	1.5
Average		12.8	1.1	6.3	1.5	21.6	26.0	4.4

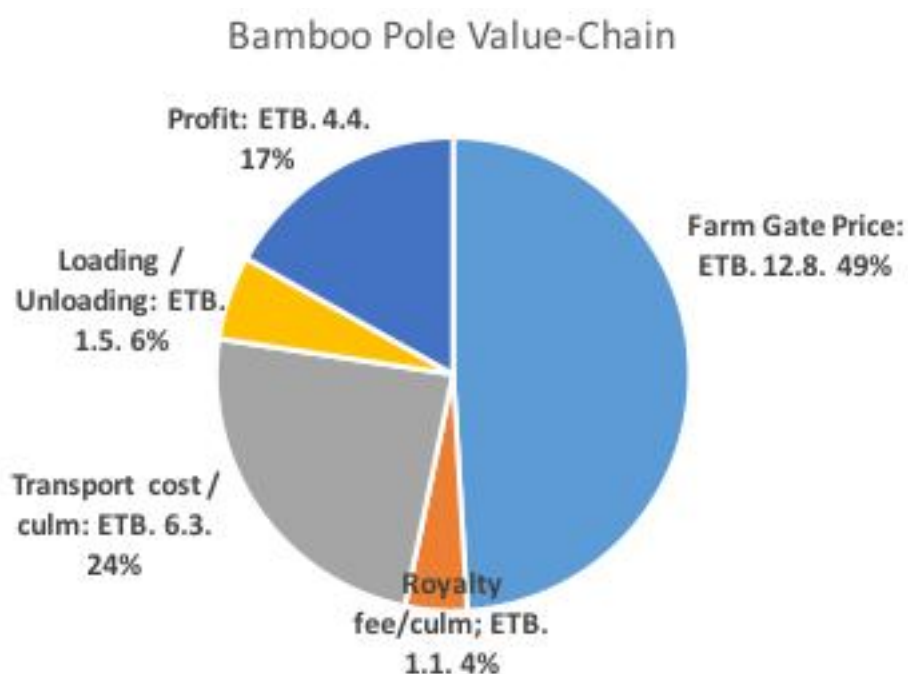


Figure 4: Pie chart showing the split up of cost and profit along the value chain

From Table 8 and Figure 4 above and Annex 7, it is evident that the cost of bamboo varies at different bamboo growing locations. This may be mainly due to distance factors and accessibility to market, the sub-variety of bamboo and its specification, level of bureaucracy and political situation of the bamboo growing areas. In addition, royalties for bamboo transportation varies across regions. For example, the royalty for transporting one bamboo culm is ETB 1 in the case of Amhara and SNNPRS and it is about ETB 1.3 in the case of Oromia.

Table 8 also shows the cost of bamboo at farm gate and at Addis Ababa, and the split up of costs involved in transportation, royalty, loading and unloading. The cost of sales outlets and shops, and manpower costs involved in sales are not included in the analysis. Based on Table 8 and Figure 4, about 50 per cent of the cost goes to the growers, and about 25, 6 and 4 per cent cost is incurred for transportation, loading/unloading and royalties respectively. The traders earn about 17 per cent of the cost of bamboo pole as profit.

Consumers: The consumers of the bamboo poles are households (construction and fencing), bamboo mat and basketry producers, furniture makers, and industries producing industrial products.

Others: Based on field observations, bamboo found in markets belongs to Year 1 and Year 2 age categories. There are high incidences of cracking, shrinking, insect and pest attack due primarily to harvesting of young age bamboo poles. There are no post-harvest management techniques involved, such as proper storage and treatment techniques or operational infrastructure available for treatment.

Lowland Bamboo:

Lowland bamboo used for utilisation and sale is mostly harvested from state forests. Bamboo trading and marketing activities are not well developed. Sales and marketing of lowland bamboo poles is confined to two regions, namely the Benishangul Gumuz and Gambella regions. Key local bamboo trading locations are as below:

- (a) Benishangul Gumuz region (Bambasi, Kurmuk, and Gizen)
- (b) Gambela (Gambela town)

The market or selling points of bamboo poles are on road sides and at bi-weekly markets in the Benishangul Gumuz region. In Tigray region, bamboo culms are not sold on the open market due to the bamboo harvesting ban issued by the regional government to enable regeneration of recently flowered bamboo forests. In Gambela town, there is a trader selling bamboo poles, the only organised trading system of lowland bamboo.

Local community members generally collect bamboo from forests and bring them to the marketing point. There is no trader involved in the entire system. The prices of bamboo poles in interior Kebeles of Bambasi Woreda is about ETB 2 (Example: Adi Arkai, Dansha and Tsegede Kebele). Due to inaccessibility and poor infrastructure, transportation of bamboo from bamboo growing Kebeles to main markets such as Assosa and Bambasi is mainly done on the back of mules or in mule carts. Transportation of bamboo poles by truck to market point is not a common phenomenon.

The most common uses of lowland bamboo poles are as fire wood, construction components, fencing material, low quality furniture, mats and basketry products. Refugee camps across BSG use lowland bamboo poles for construction and as a source of energy.

Table 9 below shows the price of bamboo poles at a bi-weekly market. The cost of bamboo poles ranges from ETB 8 – 15 for the whole bamboo pole (~ 5 cm Diameter; 6 m long), and cut pieces (2 m long, ~ 4 cm Diameter) are being sold at ETB 2 per piece. Most importantly, bamboo fire wood bundles (~ 40 pcs of bamboo poles; 90 cm long) are commonly traded across the BSG and Gambela region, with prices ranging from ETB 20 – 30 depending on the location.

Table 9: Cost of lowland bamboo poles of different specification at different locations

Region	Woreda	Harvester / Collector price (Birr)			Uses
		Size of bamboo pole			
		Whole Pole ~ 4 -5 cm Diameter; 6 m Length	Cut Pieces ~ 4 -5 cm Diameter; 2 m Length	Fire wood Bundle (~ 40 pcs/90 cm length)	
Benishangul Gumuz	Assosa	15		20 -30	Fire wood, Furniture; Construction
	Bambasi	9	2		Fire wood, Construction for Refugee camp
	Kurmuk	8	NA		
	Gizen	8	NA		
Gambela	Gambela town	15			

Source: Field Study, 2017

It was also reported that bamboo poles of *Oxytenanthera abyssinica* are illegally traded across the border (Sudan), mainly on mule backs.

5.6 Bamboo Mats

Bamboo mat production and sale is one of the important additional income source for farmers in bamboo growing regions (especially highland bamboo). Currently, bamboo mats are used for low-value high volume applications such as flooring and ceiling in rural households, fencing, toilet sheds, construction site screens, shade structures of nurseries, and drying mats for agriculture and horticultural application. In addition, a few contemporary bamboo mat producers, mainly in towns and cities, are producing good quality mats for partition, bamboo furniture and other applications.

Key actors involved in the bamboo mat value chain are smallholder farmers (who produce bamboo poles and in most cases also act as a mat producer or processor), processors (who value add or convert bamboo pole into bamboo mats), and traders who purchase bamboo mat from processors, transport and then store in their yard to sell to consumers.

Figure 5, below shows the indicative bamboo mat value chain map:

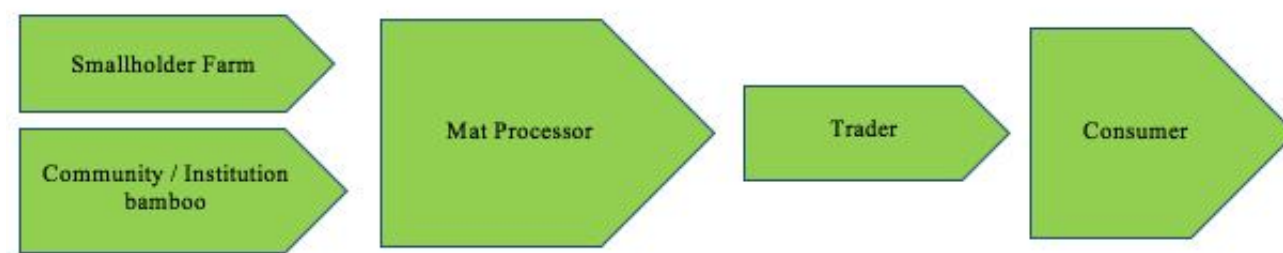


Figure 5: Bamboo Mat Value Chain Map

Raw Material: Bamboo culms with longer inter-node and young aged poles (~ 1-year-old) are currently used for mat production, due to ease in production of slivers. In a majority of cases, highland bamboo “*Yushania alpina*” is used for mat production. In BSG, lowland bamboo poles are also used for bamboo mat production. However, the scale of production is negligible. Since the fresh bamboo poles are required for bamboo mat processing, bamboo poles are procured from local farmers, and in most cases smallholder farmers who grow bamboo are also functioning as processors.

Processors: Based on the data collected from key informants, there are an estimated 1900 households involved in production of bamboo mats. Amhara (Addis Kidam, Tilili, Achefer, and Wonberma Woreda); SNNPPR (Andaracha, Masha, Hula, Bursa, Bule Woredas); and Oromia (Dere Enchini, Bale and Arsi Woredas) are the production hotspots. The regions with high concentration of mat producers are: (a) SNNPRS (44%); (b) Amhara (43%); (c) Oromia (8%); (4) BSG (2.65%); and Addis Ababa (2%). Kindly refer to the Annex 9 for the locational details of the bamboo mat producers in different regions of Ethiopia.

Figure 6, below is a histogram illustrating the number of bamboo mat processing households in different zones of Ethiopia. The pie charts on top show the distribution in different woredas of the particular region or zone.



Figure 6: Number of Households engaged in different regions / zones / Woredas

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Mat-making is a part time and seasonal employment or income generating option for most of the craftsmen engaged in the sector. The main mat producing seasons are from December to May, as well as from August to October (free time from farming activity). Mat-making is a family or household activity where every member contributes to production of mats. In many mat processing locations, households along the road side are mainly engaged in creating and selling mat products, mainly because of free space along road side for processing, storing and sales of produced mats to traders. Although a number of short-term skill development training sessions were provided to mat weavers, the impact of the training in product transformation has not been achieved due to the lack of business development services.

Skills, tools and techniques: Production Season

Bamboo mat production skills are passed on traditionally within families, but can also be learnt from neighbours. The weaving pattern mainly constitutes one-up and one-down / three up and three down simple parallel weaving. The dimensions of the mats produced varies according to region (Amhara (1.3m X 1 m); and SNNPRS (1.5 m X 1.5 m)). In addition, bamboo mats are custom-made depending on the customer needs. To upgrade and standardise the bamboo mat value chain, tools and equipments - such as radial splitter, manual slivering machine, width sizer and thickness sizer - will be required. This needs to be coupled with skill development training on mat weaving. The entire set of tools will cost around USD 150. These tools are not available in Ethiopia. They need to be introduced from abroad, and efforts to develop the capacities of local technical institutions and tool manufacturers need to be undertaken to produce it locally.



Bamboo Mat Processing

Currently, bamboo mat producers use simple knives for production, and no other special tools or equipment are used. The mats produced are of low quality, there is no uniformity of bamboo slivers (width and thickness used) and the dimensions of the finished mats are uneven. Since the current market and their application does not require standardisation, the current system of production is accepted. However, in cases where the bamboo mats produced are to be converted into Bamboo Mat Board (BMB) or other industrial products, standardisation of the mats produced becomes a pre-requisite.

Market and Trading: The bamboo mats produced are stacked and stored on the road side. In most cases sale of bamboo mats is commonly done through traders, but in some cases mats are sold directly to the customers. Traders purchase the bamboo mats in large quantities and transport the bamboo mats to their selling yards in towns and cities, where their sale is mainly carried out through retail. With the current lack of implementation of proper storage mechanisms by processors and traders, bamboo mats are prone to fungal, mould and insect attack, thereby affecting their durability. Unlike bamboo poles, trading and transport of bamboo mats is carried out without the need for a permit or trading license, and there is no royalty associated with the transport and sale of the mats.

Transporting: Bamboo mats are procured by traders are transported to their yards by trucks. In some cases, bamboo mats are transported as extra load on passing by trucks.

Consumers: Bamboo mat consumers are made up of rural and semi-urban households (for use on floors and ceilings), fencing, agriculture and horticulture sector (tea, coffee, agriculture, produce drying), and for use as screens for ongoing construction sites, nursery operators (shade nets).

Cost Increment Analysis: For the purpose of cost increment analysis, data for the most commonly produced bamboo mats (1.3 m X 1 m) at Tilili and Zengena Kebele (Injibara, Amhara) and bamboo mat of 1.5 m X 1.5 m at Hula location (SNNPRS) was analysed. Mats procured from Tilili and Hula locations are sold at Bahirdar and Hawasa respectively. Table 10 below shows the location of production and sale, purchase price of bamboo mats, dimension and quality, transportation and selling price of bamboo mats.

Table 10: Cost Increment and profit analysis of bamboo mat trade

S.No	Source	Destination	Specification (L X W)	Farm Gate (ETB)	Transport (ETB)	Load/ Unload (ETB)	Total Cost (ETB)	Selling cost (ETB)	Profit (ETB)
1	Injibara	Bahirdar	1.3 m X 1 m (Thick)	20	2	0.5	22.5	35	12.5
			1.3 m X 1 m (Thin)	15	2	0.5	17.5	30	12.5
2	Hula	Hawasa	1.5m X 1.5 m	18	1.5	0.5	20	30	10
		Average cost (ETB)		18	2	0.5	20	32	12

Source: Field study, 2017

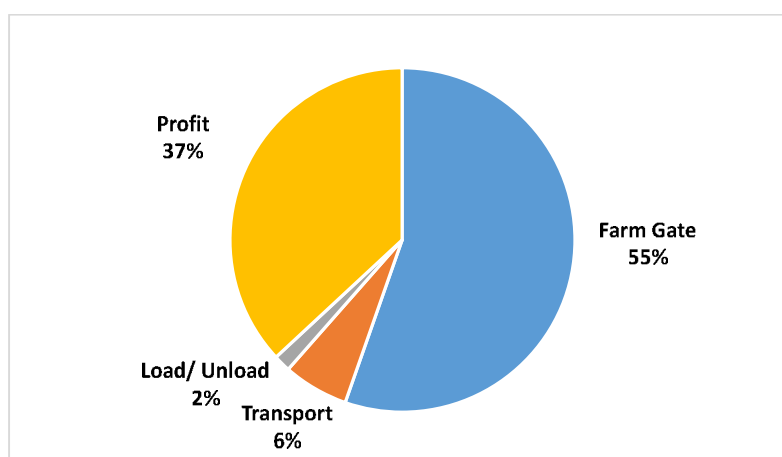


Figure 7: Pie Chart depicting the cost/ profit split up of bamboo mat value chain

From the above Table 10 and Figure 7 it is evident that the mat processors receive about 55 per cent of the selling cost of mats, traders incur about 6 per cent and 2 per cent of selling cost for transport, loading and unloading and earn a profit of about 37 per cent. The cost associated with renting of yards and the manpower costs involved in trading are not included in the analysis. The overall profit

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

margin seems to be high. Developing an association of producers and creating an open market for bamboo mats could enable producers to directly sell the bamboo mats to consumers, increasing their earnings.

5.7 Bamboo Basketry and Crafts

Bamboo basketry and crafts production is a part-time, seasonal activity for most of the craftsmen engaged in this sub-sector. A majority of the products produced and traded are traditional in nature (Basketry: Akinbalo, Mosseb, Agelgel and Safed; Granary, Bee-Hives; household, agriculture and horticulture sector utility baskets). In addition, there are few enterprises and entrepreneurs operating in urban centres that produce modern craft items and lifestyle products. These would include flower vases, lamp shades, fruit baskets, corner lamps, table mats, waste paper baskets, and candle holders.

Key actors involved in the bamboo basketry value chain are (a) smallholder farmers; (b) processors (value add / convert bamboo pole into bamboo basketry products), (c) collectors (collect and store baskets in their road side houses / shops); (d) traders and whole sellers (collect bamboo baskets directly from producers at their village, at bi-weekly markets or from village collectors, and either transport to market points or sell to consumers); (e) retailers (purchase from wholesale shops and sell to consumers) and (f) consumers. It is important to note that the same chain is not followed at all production locations of the country.

Figure 8 below shows the basketry value chain map.

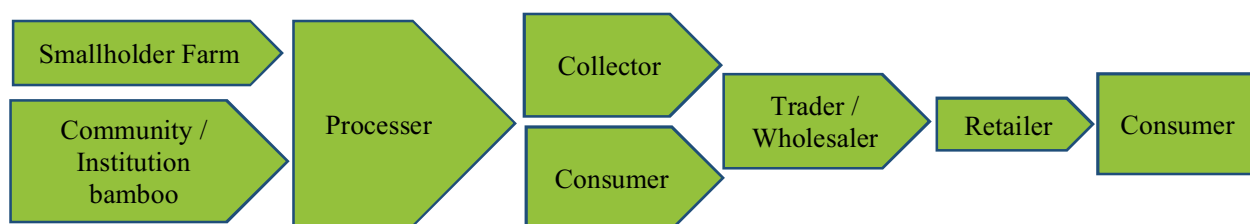


Figure 8: Bamboo basketry value chain map

Raw Materials: Bamboo required for basketry production (suitable for producing slivers and weaving) needs to be freshly harvested, selecting young aged poles (~ 1-year-old) that have long inter-nodal length. Considering the above-mentioned criteria, traditional bamboo basketry producers procure bamboo directly from local farmers (in most cases farmers are also basketry processors), and harvest or purchase from community forests and institutional bamboo grooves. In the case of bamboo craft product processors located in urban locations (in Addis Ababa, Hawasa, Bahir Dar), these processors procure bamboo from bamboo pole traders. However, the scale of modern crafts production is small.

Processors:

Data gathered from field visits, FGD and KII indicate that there are more than 2500 households involved in the production of bamboo basketry and crafts as shown in table 11 below. However, the exact number of households and craftsmen is difficult to determine.



Bamboo Basketry Production

Table 11: Number of households involved in bamboo basketry production

Region	Zone	Woreda / Location	# of HH	Percentage of Total
Addis Ababa	Addis Ababa	Urael, Abuare, Piassa	42	2
Amhara	Agew Awi	Fagta Lakoma, Banja, Chagni	480	34
	East Gojjam	Bure, Bibugn, Achefer, Dembecha, Yelmanadensa	370	
BSG	Metekel	Mambuk	100	4
	Assosa	Kamashi and Kibur Hamsa	6	
Oromia	East Showa	Wonchi	140	12
	West Showa	Dere Enchini	150	
SNNPRS	Sidama	Sidama, Bensa, Hula, Yirgalem	880	48
	Gedeo	Gedeo, Bule	250	
	Sheka	Sheka	50	
		Total	2468	100

Source: Field study, 2017

From the table above, it is evident that most of the bamboo basketry enterprises are concentrated in close clusters. SNNPRS have the highest concentration or number of bamboo basketry households (48%), followed by Amhara (34%), Oromia (12%) and Benishangul Gumuz (4%).

More than 95 per cent of the enterprises are unorganised, producing traditional bamboo products. Basketry is mainly processed by women and is a household activity. Unlike bamboo mat activity which is concentrated on the road sides, bamboo basketry works are found mainly in villages. Production of basketry products is a part-time and seasonal activity (September to April).

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

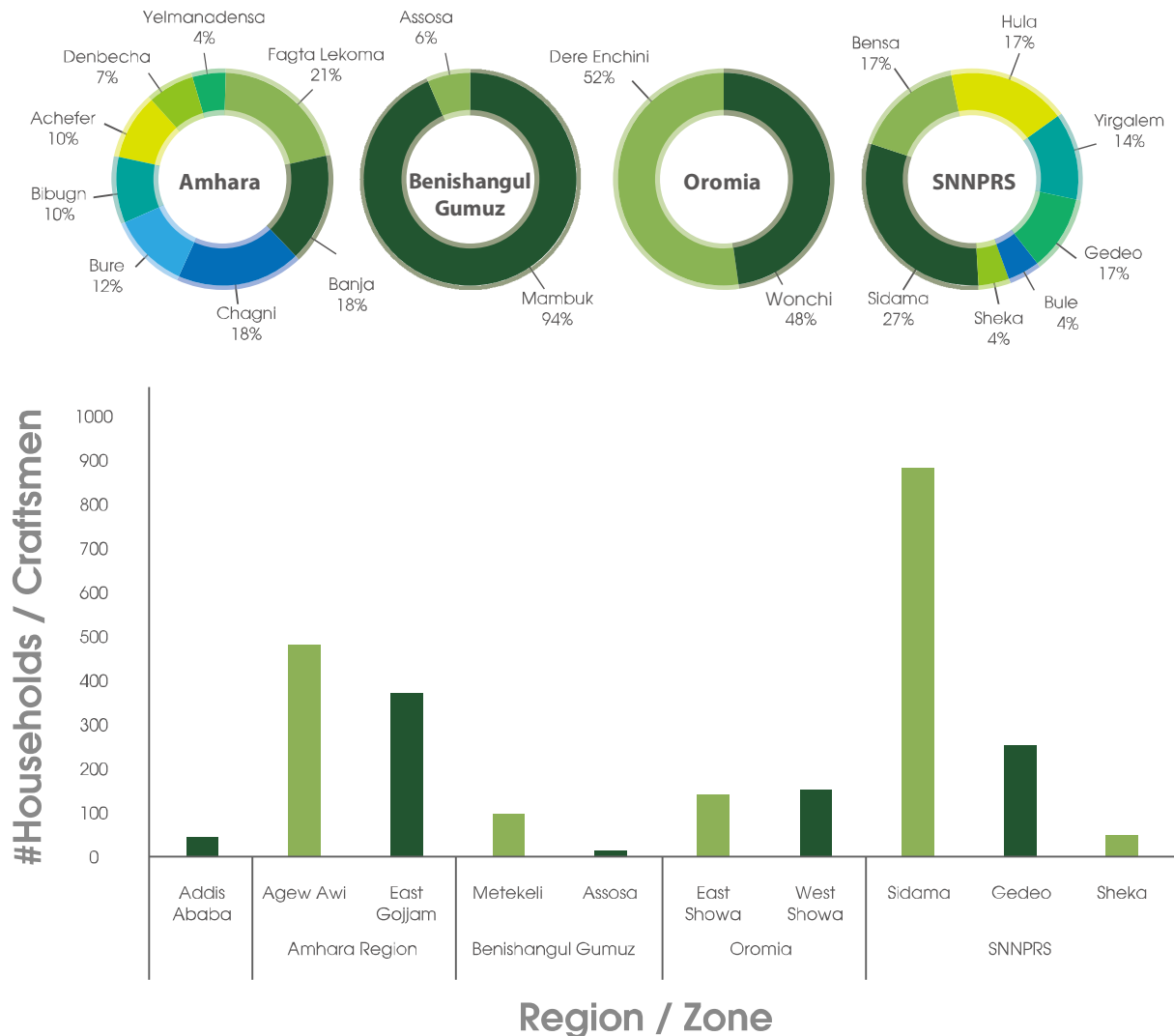


Figure 9: Chart showing the distribution of basketry producers in different regions/zones/woredas

The above histogram (Figure 9) shows the region or zone and number of households involved in basketry production, and the pie charts indicate the woreda and percentage of producers within each region and zone. The details of the region, zone, woreda and number of households involved in basketry are attached as Annex 10.

SNNPRS has the highest concentration of basketry making households (48%). Sidama Woreda has the highest number of households (27%), followed by Bensa, Hula and Gedeo (17% each); and Yirgalem Woreda (14%). Bule and Sheka Woreda too have households engaged in basketry production, though the numbers are low.

Amhara region accounts for about 34 per cent of the total households involved in basketry production. Fagta Lakoma Woreda has the highest number of households engaged in basketry production (21%), followed by Banja Woreda (18%) and Chagni (18%), Bure (12%), Bibugn (11%), Achefer (10%). Dembecha (7%) and Yelmanadensa (4%) Woreda have households engaged in basketry production, though the numbers are lower compared to other mentioned woreda.

Oromia region makes up about 12 per cent of the basketry producers. Wonchi and Dere Enchini are the two important woreda with basketry production households, with approximately 50 per cent each.

Benishangul Gumuz region accounts for about four per cent of the basketry producers. Mambuk and Assosa are the two woredas with the most households engaged in basketry production, accounting for 94 per cent and six per cent respectively. A few basketry producers are also based in Assosa Woreda.

Skills, Tools and Techniques: For a majority of the households (>95%) engaged in traditional basketry product production, the skill sets possessed are passed on through generations and learnt from neighbouring families. The tools used are rudimentary, using only a knife to both split and produce bamboo slivers.

Sales, Marketing and Trading: Traditional bamboo basketry products are sold directly to consumers as well as through intermediaries (collectors, traders, wholesalers and retailers). In the case of direct sales to consumers, bamboo baskets are mainly sold in bi-weekly markets at respective production locations. In the case of products sold to traders, there are several intermediaries through which the products can reach the consumers. There is no standard or uniform model of trading across regions and products. In some cases, bamboo products are first sold to a collector (who runs a coffee, grocery, or other type of shop) on the road head. The trader accumulates the products from collectors and then transports them to the marketing points, where they sell the products directly to consumers or to a retailer, before they are finally sold to a consumer. In other cases, the trader directly purchases from producers at their village or at weekly markets, transporting and selling them to consumers or retailers. Among all bamboo sub-sectors, the bamboo basketry sub-sector has the longest and complex production to consumption chain.

In the case of modern craft product producers (<5% of the total producers), mostly located in urban centres where they directly sell products to the consumers, there is no intermediary involved.

Trading is highly informal in nature, and there is no certification, license or regulation associated with the traders involved in the bamboo basketry trade. Bamboo basketry trading, wholesale and retail activity are additional activities for traders.

Transport: Bamboo basketry products purchased from producers and collectors are bundled together and loaded on top of public transport or in trucks as an extra load to minimise the cost of transportation.

Consumers: Consumers of traditional basketry products consist of rural and urban households, the agriculture, horticulture and floriculture sectors as well as shop keepers at market locations. In the case of modern craft products, the consumers are high income households, hotels and lodges, resorts, restaurants, and flower bouquet shop, mainly using the products for beautification.

Economic Analysis:

Cost Increment Analysis of a Traditional Product: For analysis, the most commonly produced and traded bamboo basketry product (Akinbalo or Injara baking plate cover) was analysed. The production source is Dere-Enchini and the selling point is Wolisso and Addis Ababa.

Table 12 below shows the cost increment of Akinbalo as it passes through each chain. The producer or basket maker on average sells the product to a collector or to a trader at ETB 12. The trader then sells to a consumer or to a retailer at a price of ETB 22 in Wolisso and ETB 26 at Addis Ababa (on average). It is important to note that the prices at the producer, trader, retailer and consumer level all fluctuate depending on the season.

Table 12: Cost increment and profit analysis of the bamboo mat trade

Source	Destination	Producer price	Collector	Transport	Total cost	Trader Margin	Retailer Cost	Retailer Margin	Selling price (ETB)
Dere Enchini	Wolisso	12	0.5	3	15.5	2.5	18	4	22
	Addis Ababa	12	0.5	3	15.5	3.5	19	7	26
Average(ETB)		12.0	0.5	3.0	15.5	3.0	18.5	5.5	24.0

Source: Field study, 2017.

Table 12, and Figure 10 (below) indicate that producers on average get 50 per cent of the selling cost of the product. Retailers get the highest percentage of profit (23%), followed by traders / wholesalers (13%). Transportation and collection or logistical support costs account for about 12 per cent and 2 per cent respectively.

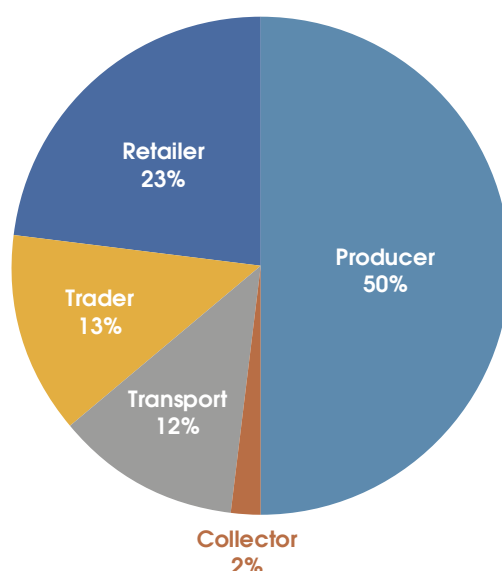


Figure 10: Pie-chart showing cost/ profit for different actors in the basketry value chain

Economic Analysis of Modern Products

Two of the most commonly produced and sold bamboo craft products in Addis Ababa, lamp shades and fruit bowls, were analysed to understand the profitability of enterprises. The separation of material costs, labour costs, overheads and profit of the products are shown in Table 13 below. The detailed split up of the costs involved in production is shown as Annex 11.

The profitability or profit margins of the modern craft enterprises are above 90 per cent. However, the scale of operation and business turnover is low, hence leading to high profit margins for production of only a few exclusive bamboo products.

Table 13: Profitability analysis of modern craft products

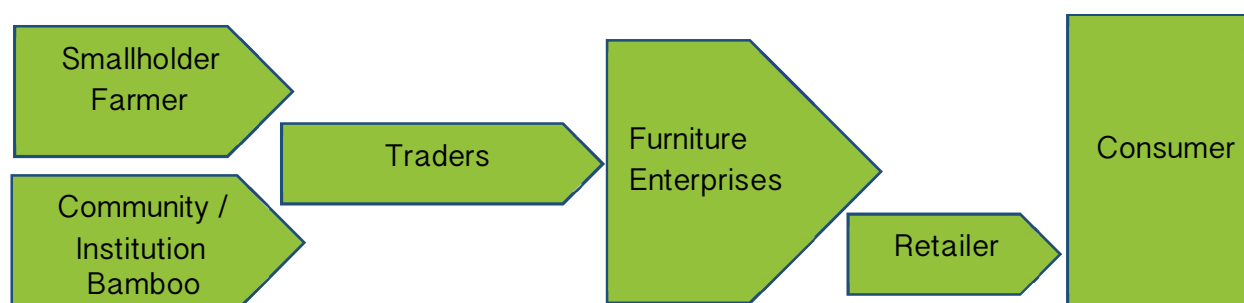
Products	Bamboo	Other Material	Labour	Sub Total	Overhead (20%)	Total Production Cost (ETB)	Selling Cost (ETB)	Gross Profit (ETB)	% Profit
Lamp Shade	7.92	10.7	15	33.62	6.724	40.344	90	49.656	123
Fruit Bowl	4.8	31.2	15	51	10.2	61.2	100	38.8	63
						Profit Margin (%)			93

Source: Field study, 2017

5.8 Bamboo Furniture:

Bamboo furniture is the most visible bamboo sub-sector in Ethiopia. The bamboo furniture value chain encompasses enterprises producing traditional as well as modern bamboo furniture. This value chain is semi-organised or more better organised in comparison to other value chains such as those of bamboo poles, mats and basketry.

Key actors involved in the bamboo furniture value chain are (a) smallholder farmers who produce bamboo poles, (b) traders who link between farmers and furniture makers mainly for supply of bamboo poles, (c) furniture makers and (d) consumers. Figure 12 below shows the indicative furniture value chain map.


Figure 11: Bamboo furniture value chain map

Raw Material: Traditional furniture makers, located in rural areas, procure bamboo poles directly from the farmers. Bamboo furniture enterprises located in urban locations commonly purchase bamboo poles from bamboo pole traders.

Processors:

Data gathered through field visits and key informants indicate that there are more than 100 enterprises (employing about 250 workers) producing bamboo furniture in Ethiopia. However, anecdotal evidence suggests that about 500 furniture producing workers could be found in Ethiopia.

Bamboo processors, based on the type and quality of bamboo products produced, can be categorised into two segments. The first segment is modern bamboo furniture which caters to urban market demand. A majority of bamboo furniture production enterprises are located in Addis Ababa (about 50 enterprises), producing and selling modern furniture. In addition to Addis Ababa, there are a few modern bamboo furniture enterprises in Bahirdar (four enterprises), Injibara (two enterprises), Hawasa (four enterprises) and Adet (one enterprise). All the other enterprises produce traditional bamboo furniture products to cater to rural market demand. Key hotspots for

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

traditional bamboo furniture production enterprises are Injibara / Tilili location (Amhara region), Assosa and Bambasi (BSG region), and Wonchi (Oromia region). It is important to note that more than 50 per cent of enterprises and 60 per cent of the workers are based in Addis Ababa, making it the biggest production and consumption centre. Details of the number of enterprises and workers and their locations are shown as Annex 12.



Traditional and Modern Bamboo furniture production and marketing

Table 14 and Figure 13 below illustrate that about 75 per cent of the workers are involved in the production of modern furniture, and the remaining 25 per cent of the workers are involved in production of traditional furniture. However, the scale of production or number of products produced by traditional furniture makers outnumbers modern furniture. This is due to traditional furniture production requiring less processing than that of modern furniture.

Table 14: Number of bamboo furniture enterprises and their locations.

Region	Woreda	# Enterprises	Workers	Percentage
Addis Ababa	St. Urael Area, Abuare, Plassa, Beklobet, Asko, Mekanisa, Sebeta	55	140	56.0
Amhara	Bahir Dar	5	37	30.0
	Injibara/Tilili	25	35	
	Debra Marcos	2	2	
BSG	Assosa	5	9	4.5
	Bambasi	2	2	
Gambela	Gambela	1	1	0.4
Oromia	Wonchi	3	3	1.2
SNNPRS	Wolkite	1	1	6.7
	Sidama	1	1	
	Hawasa	6	14	
Tigray	Adet	2	2	0.8
Total (Nos)		108	247	

Source: Field Study, 2017

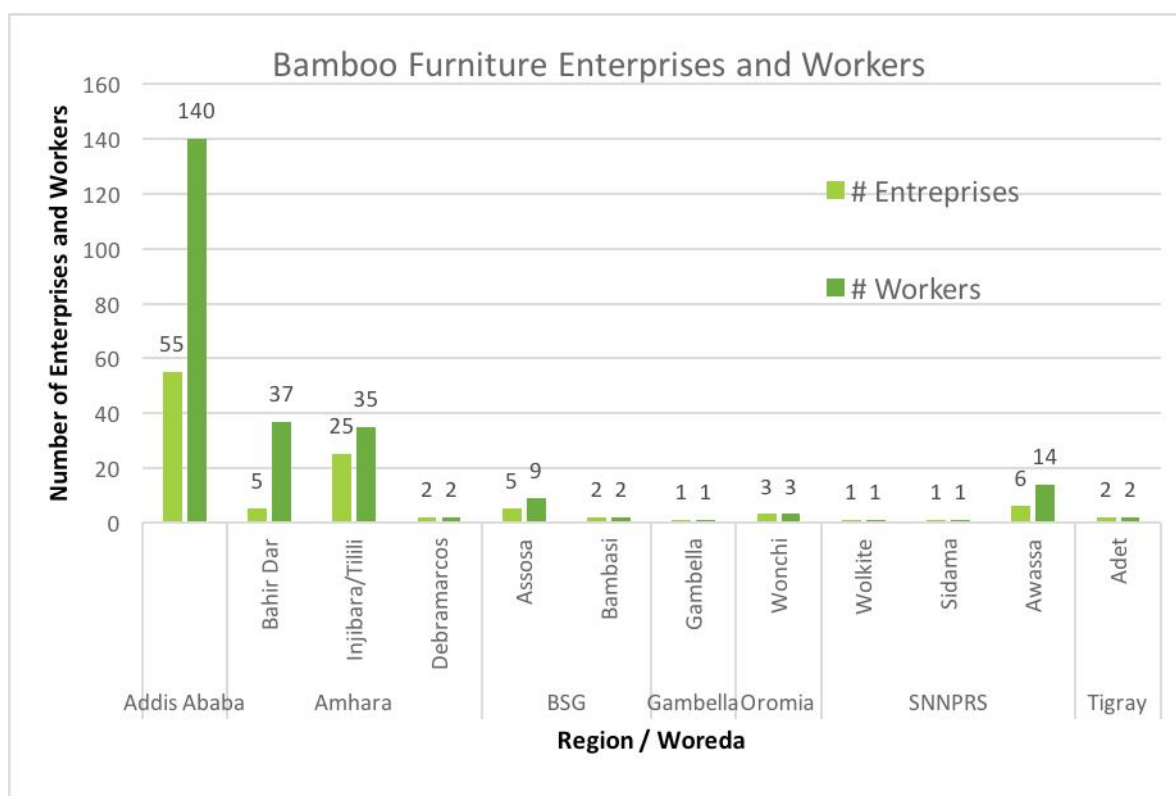


Figure 12: Bar chart showing number of enterprises and workers in each region/ woreda

Production, Tools and Techniques:

Modern furniture makers generally have work sheds, or in some cases work at their homes. Most of the traditional bamboo furniture makers work on the roadsides under temporary sheds.

Modern enterprises located in urban centres currently have access to electrical hand drills, portable electrical grinders, and hand tools (hand saws, knives, chisels, rough and smooth files, hammers, measuring tape and pliers). In a few enterprises, electrical bench drills have also been observed. Traditional furniture enterprises are not well-equipped, and the key tools used are hack saws, manual or hand drills, measuring tape and chisels. In both forms of enterprises, the current set of tools available is not sophisticated or modern enough to produce more high quality bamboo products.

Marketing / Trading: Modern furniture makers sell their products directly to consumers. In Addis Ababa, a few furniture makers have sales outlets in addition to their work shed. In the case of traditional furniture makers, bamboo furniture is produced on the road side, and the roads in front of their working place function as their sales outlet. Most of the bamboo products produced are sold directly to the consumers. However, there are few traders who purchase bamboo furniture from other producers and sell them to customers (a few traders from Tigray purchase bamboo furniture from Addis Ababa and Injibara and transport them to Shere, Endasilase and Axum for sales).

Consumers: Modern bamboo furniture products such as (a) sofa sets, (b) dining sets, (c) television (TV) racks, (d) dressing tables, (e) book shelves, (f) partitions and (g) stools are commonly targeted to cater to urban households, mostly consisting of foreigners and high-income households due to their interest in eco-friendly products. In addition, the new house owners tend to purchase bamboo furniture as an interim furniture until they can afford to purchase high quality wooden furniture. Bamboo furniture enterprises also cater to coffee shops, hotels, tourism and the recreational industry.

Traditional bamboo products such as (a) two-seater sofas, (b) tables, (c) shelves, (d) stools, and (e) coffee cup boxes are the most commonly produced products. These products are targeted towards rural households, local coffee shops, shoe polishers, rural restaurants, and shops in the open market area.

Consumers generally perceive bamboo furniture as low quality, less durable and cheap. The main problems observed by consumers are poor design, poor finish, loose joinery, and low durability due to insect, fungal and mould attack. This mainly arises due to the lack of selection of the right age bamboo poles for furniture making, lack of preservation and poor skill set.

Economic Analysis of Modern Products

An economic analysis of a few of the most common bamboo products produced in Addis Ababa such as sofa sets, stools, coffee tables, low sitting chairs and book shelves was carried out to understand the profitability of these enterprises. The costs of bamboo, other value addition materials, labour and overheads (such as electricity, water and rent of work shed) were calculated and shown in Table 15 below. Product wise detailed analysis is attached as Annex 13. However, the manpower costs of owners or managers and in some cases the rent costs of display and sales outlets were not included. The analysis shows that the modern furniture enterprises are making an average profit of about 40 per cent.

Table 15: Profitability analysis of modern bamboo furniture products

Products	Cost of Bamboo	Cost of Other Material	Labour Cost	Sub Total (ETB)	Overhead (20%)	Production Cost (ETB)	Selling Cost (ETB)	Profit (ETB)	% Profit
Sofa Set (4 Single Seat and 1 Double Seat)	589	2084	460	3133	623	3756	7000	3244	46
Stool	48	46	50	144	29	173	350	177	51
Coffee Table	108	108	75	291	58	349	500	151	30
Low Sitting Chair	84	139	60	283	57	340	500	160	32
Book Shelf - 3 rack	319	268	120	707	141	848	1200	352	29
						Profit Margin (%)			38

Source: Field study, 2017

5.9 Bamboo for Construction Sector

Bamboo-based construction material is traditionally extensively used for construction of entire houses (example Sidama house), and is widely used by other rural housing forms as a structural material for walls, floors, ceilings, and interior and exterior cladding. Bamboo usage in construction can be broadly split into three segments, (a) traditional housing, (b) refugee housing and (c) other construction.

Traditional Housing:

Actors involved in the traditional bamboo construction segment are limited. The main actors are the farmers and house builders. In most cases, both the farmers and house constructors are the same person.

Bamboo used for construction is predominantly sourced from the farmer's own farm, community bamboo forests and from state protected forests (with special permission for subsistence use). In some cases, there are instances of purchase or in-kind support from neighbouring farmers.

Distribution of Bamboo Housing:

Table 16 and Figure 14 show the number of housing units in different regions, constructed using bamboo or reed as an important material. Ethiopia had a total of 15,103,134 housing units in 2007 (CSA, 2007), out of which more than 500,000 (3.36%) used bamboo or reed for roofing. About 380,000 housing units (2.5%) used bamboo in form of walls. In addition, bamboo was also used as ceiling and as flooring.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Table 16: Number of housing units in Ethiopia with bamboo or reed as an important construction material.

Region	SNNPRS	Tigray	Amhara	Oromia	BSG	Gambela	Total Bamboo / Reed	Total Unit in Ethiopia	% of Units
Wall	237,162	333	14,070	77,280	41,995	236	378,379	15,103,134	2.50
Roof	322,555	3235	36,108	128,917	12,388	65	508,686		3.36
Ceiling	2854	916	752	848	35	42	6554		0.04
Floor	20,673	149	1197	14,957	15	10	37,692		0.25
Total	583244	4633	52127	222002	54433	353			

Source: CSA, 2007

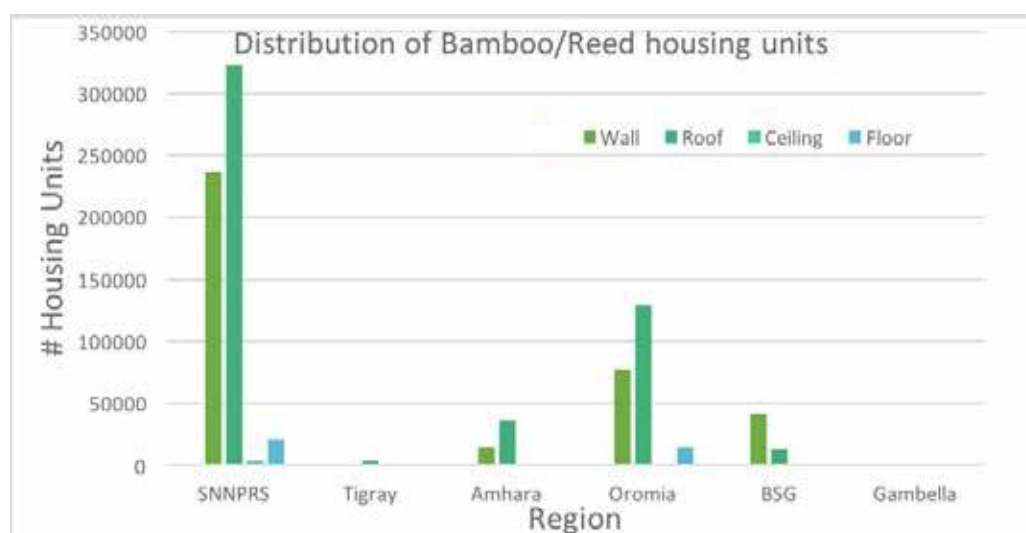


Figure 13: Regional distribution of bamboo or reed housing units

From Figure 14, it is evident that the intensity of usage varies according to region. In SNNPRS, bamboo as a construction material is mainly used for roofing and walls and to some extent as flooring. Bamboo is predominantly used for roofing, walls and flooring in Oromia region. In the case of Amhara region, bamboo is mainly used for roofing and walls. In BSG region, bamboo is mainly used for walls and to some extent for roofing.

Figure 15 below, shows the region wise distribution of total bamboo housing units in Ethiopia. Most of houses that use bamboo or reed as a construction material are located in SNNPRS region (64%), followed by Oromia (24%), Amhara and Benishangul Gumuz regions (6 % each). Though Gambela and Tigray regions have some use of bamboo in construction, the number of housing units is very low.

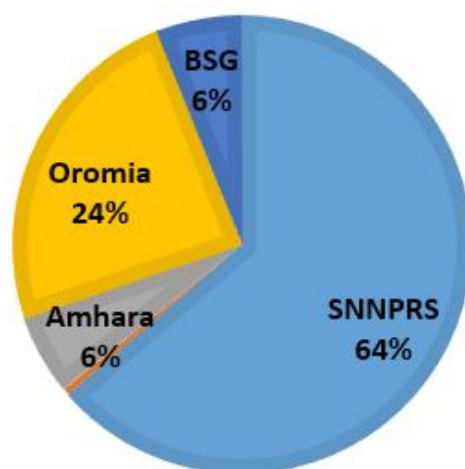


Figure 14: Region Wise distribution of bamboo/ reed housing units

Traditional Construction Techniques:

There is a wide diversity of bamboo housing and traditional construction techniques in Ethiopia. In some cases, the entire house is made of bamboo, and in other cases, different portions of the house, such as the wall, floor, ceiling and roof, are made of bamboo. Table 17 below shows the key housing models, bamboo usage, species used and predominant location of construction.

Table 17: Traditional bamboo housing type and location

House Type	Bamboo Usage	Location	Species
Traditional Dorze house	Majority of house	SNNPRS Region (Gamo Gofa Zone; Chench, Gamo Gofa, Dokko, Ezo, Zala Woredas)	<i>Yushania alpina</i>
Traditional Sidama house	Entire House	SNNPRS: Sidama Zone (Yirgalem, Wando, Hula, Arbegona Woreda)	<i>Yushania alpina</i>
Keffa / Sheka bamboo house	Roofs made of bamboo; walls made of hard wood and sometimes in combination with bamboo	SNNPRS: Sheka Zone (Masha, Andaracha, Yeski Woreda)	<i>Yushania alpina</i>
Guragie/ Siltie houses	Roof and walls (partially); doors and partitions.	SNNPRS: Siltie Zone (Kibet, Worabe, Alkaso Woreda)	<i>Yushania alpina</i>
Bertha/Gumuz and Awi houses	Walls and roof	BSG and Gambella: Metekel Zone (Abole, Etang, Gumuz, Shinasha Woredas) and Amhara.	<i>Oxytenanthera abyssinica</i>

Source: Endalamaw; Field study, 2017

Refugee Housing and Infrastructure:

Ethiopia is one of the largest refugee host nations, and hosts about 850,000 refugees in a total of 26 camps. According to Administration of Refugee and Returnee Affairs (ARRA) officials, bamboo was used as a main construction material in refugee camps located in Benishangul Gumuz and Gambella in the past (Personal Communication, 2017). In addition, Dolo Ado camp in the Somali region used bamboo extensively. The location details of the camps, main species of bamboo used for construction and bamboo source is shown in the Table 18 below:

Table 18: Location details of refugee camps using bamboo as construction material

Region	Camp	Species	Source
BSG	Sherkole, Bambasi and Menge	<i>Oxytenanthera abyssinica</i>	Local
Gambella	Fugnedo, Etang and Jawie	<i>Oxytenanthera abyssinica</i>	Local
Somali	Dolo Ado	<i>Yushania alpina</i>	Transported from Sidama Zone

However, ARRA stopped using bamboo in refugee shelter construction due to the poor durability of bamboo. It was mentioned that the bamboo houses constructed in the past collapsed within 1-2 years, and that the maintenance costs incurred were high compared to the cost of construction. ARRA and the United Nations Refugee Agency (UNHCR) therefore decided to stop using bamboo and started using mud blocks and hollow blocks as a main construction material. Based on the analysis, it is evident that the traders who supplied bamboo for construction harvested bamboo without age selection, and there was no preservation and treatment of the bamboo poles.

Bamboo has huge potential in refugee shelter construction, for improving livelihoods and as an energy source in refugee camps. For example, it was indicated by ARRA officials that there are more than 200 schools functioning in refugee camps, and that using bamboo for construction of schools, furniture and refugee shelters could create a large organised market opportunity for bamboo poles.

Other Construction:

In the past, few modern demonstration housing structures (whole-culm and/or panel-based) have been constructed by INBAR-EiABC-FeSMMIDA in Ethiopia to build the capacities of local institutions and to demonstrate its suitability as a construction material and to validate its durability.

Bamboo is also widely used as wall and ceiling decoration in hotels, restaurants, and in resorts located in tourism centres across Ethiopia (Bahir Dar (Amhara), Hawasa, Arba Minch and Dilla (SNNPRS), Mekele and Axum (Tigray) and Nazareth and Debrezeit (Oromia) and Assosa (BSG)).

5.10 Industrial Value Chains:

Bamboo industrial products are an important emerging node of the bamboo sub-sector in Ethiopia. There are a few private medium scale industries producing bamboo industrial products such as bamboo flooring tiles, bamboo boards and bamboo stick-based products (curtains, table mats, incense sticks, bamboo sticks and tooth picks). In addition, there are a number of government-owned or managed industrial set ups aimed at promoting training, business incubation and production.

Private Industry: There are about six established private industries in Ethiopia, namely (a) Adal Industries Private Limited Company (PLC), (b) African Bamboo PLC, (c) SA Industries PLC, (d) Abraham Mulatu PLC, (e) Bamboo Star PLC, and (f) Tebubu PLC. The details

of the private industries (Year of establishment, location and production lines and current status) are shown as Annex 14. The key industrial product lines are:

- 1) Bamboo parquet flooring and ceiling tiles
- 2) Bamboo curtains
- 3) Bamboo sticks including incense sticks
- 4) Bamboo timber (beams) from crushed bamboo
- 5) Energy products (Bamboo Charcoal briquettes and pellets)

Adal Industries PLC was established in 2006, and the entrepreneur has been involved in bamboo value addition for the past 30 years. It is one of the most promising industries in Ethiopia, producing fully functional bamboo flooring, roofing panels, blinds and curtains, table mats, incense sticks, tooth picks, briquettes and pellets.

SA Bamboo PLC based in Addis Ababa was established in 2017. Construction of work sheds, installation and commissioning of the machines is complete, but full-scale production has not yet started. This industry focuses on production of bamboo board, bamboo flooring, furniture, curtains, incense sticks and tooth picks.

Abraham Mulatu Bamboo PLC is based in Injibara (Amhara region) and was established in 2012. The production line and machines available with the industry are bamboo sticks, tooth picks and bamboo energy products (charcoal and biomass briquettes and pellets).

Bamboo Star PLC is the only bamboo industry based in Assosa, BSG region, and was established in 2012. This enterprise was operational in the past, producing bamboo flooring, curtains, and bamboo charcoal based products, but is currently not fully functional.

Tebebu PLC is a new bamboo industry currently in its development phase. The construction of the work shed is reported to be complete. This industry is aimed at production of bamboo boards, flooring, curtains and bamboo stick-based products. It is expected that this industry will become operational during 2018.

African Bamboo PLC is another important bamboo industry. Their first factory was established in Addis Ababa in 2010 aimed at production of bamboo timber (beams from crushed bamboo). However, the bamboo factory in Addis Ababa is non-functional. African Bamboo PLC is currently in development phases for establishment of another bamboo industry in Hawasa Industrial park (SNNPRS), aimed at production of bamboo flooring boards, curtains, stick based products, and bamboo timber from crushed bamboo. Currently, construction of the work shed has been completed, but production has not yet started.

Government/ Institutional Training and Production Centres: FeSMMIDA, along with the MoI, TVET, bamboo development projects and in cooperation with the Government of China have established a number of bamboo training, business incubation and production centres across the country (Addis Ababa, Amhara, SNNPRS and BSG). There are eight training and production centres and business incubation centres in the country. The details of the industry scale training, production and business incubation centres (year of establishment, location, production lines and current status) are shown as Annex 15.

The most important of these is the Production Improvement Centre (PIC), based in Addis Ababa, which is aimed at producing bamboo mats and plyboard (BMB), with linkages to three satellite bamboo mat production units based in Kosober (Injibara, Amhara); Dere Enchini (Oromia), and Hula (SNNPRS). However, the PIC and three bamboo mat production centres are non-functional. In addition, there are four training and business incubation centres which have machines and equipment for production of bamboo stick-based products (mainly bamboo curtain), namely (a) FeSMMIDA (Kirkos sub city, Addis Ababa), (b) Amhara BoTVED (Bahir Dar, Amhara), (c) Hawasa RTDT (Hawasa, SNNPRS), and (d) Rural Technology Promotion Centre (Assosa, BSG). FeSMMIDA, Amhara BoTVED, and Hawasa

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

RTDT. Assosa RTPC has machines and equipment for production of bamboo half cut boards. It is important to note that Amhara BoTVED and Assosa Rural Technology Promotion Centre (RTPC) have the most advanced bamboo vacuum pressure preservation and treatment plants. The above-mentioned centres are currently used mainly for capacity building and training activities, and there is no commercial production or sale of bamboo products.

Pulp and paper: Amhara Forestry Enterprise is in the planning and developmental stages for establishing a pulp and paper industry (bamboo is also considered as an important feedstock). However, the establishment of this industry and production of pulp and paper has not yet started.

Industrial Value Chain Analysis:

Two private industries that are functional in Ethiopia are (a) Adal Industries PLC, producing bamboo parquet flooring and ceilings, bamboo stick-based and energy products, and (b) Abraham Mulatu Bamboo PLC, which produces bamboo tooth picks, stick-based and energy products. Based on the analysis of the above, it is evident that the actors involved in the industrial value chain consist of bamboo raw material producers, traders, processors (industry), retailers and consumers. **Figure 16** below shows the most common value chain map in Ethiopia.



Figure 15: Industrial value chain map

Raw Material:

Bamboo poles for industrial processing are mainly sourced from smallholder farmers, community and institutional bamboo groves. There is no uniform procurement mechanism adopted by different industries, and even within the same industry. Bamboo pole (whole) is procured by the industry either directly or through a trader and transported to their factory location. The details of the cost of bamboo poles at different locations, and transportation costs are shown in Section 5.1 and Annex 7.

Bamboo industrial processing (timber substitute products) requires mature poles (3 years), uniform or standardised (age and size graded) poles to ensure the quality of final products. Currently, there is no mechanism adopted to assess and ensure the correct age of bamboo poles. Based on personal observation, bamboo poles used for processing belong to different age classes, and in most cases young and immature bamboo poles used in the process result in final products with less durability and lower quality.

Processing:

There is no value chain mechanism existing in the current system for industrial production, with industries operating in stand-alone mode. All of the industries procure entire bamboo poles and transport these to their factory locations, undertaking primary and secondary processing and undertaking final value addition to produce the industrial product. This results in inefficiency (low scale of production and optimisation of functions), and higher transportation costs.

Machinery, Technology and Skills:

The Ethiopian bamboo industrial sector has the machinery, technology and skill sets for production of bamboo boards, tiles (flooring

and roofing), bamboo lumber, bamboo stick-based products (curtains, table mats, bamboo round sticks, incense, tooth picks) and bamboo energy (charcoal, charcoal briquettes and pellets; biomass briquette). The details of machines and technology applied for production of bamboo boards, tiles, sticks based product line and energy products, and related training and business incubation facilities are illustrated as Annex 16.

However, there is large scope for improvement with addition of high precision finishing machines (bamboo boards and tiles); and standardisation of processes involved in production (age-grading, size-grading; slat production, drying, carbonisation, etc.) to improve the production efficiency and final quality of the product.

Marketing, Sales and Trade:

The functional bamboo industries have their own marketing or sales outlets, where all industrial bamboo products are sold directly to consumers. In the case of bamboo panels (parquet flooring tiles, and boards), the private industry may have an agreement with the construction company (for example, Adal Industries PLC). Bamboo flooring and panel products are not commonly available in other market outlets. In the case of bamboo curtains and mats, bamboo products, in addition to sale in their own outlet, are sold to retailers (mainly supermarkets) who further sell them to consumers. In the case of incense sticks, the only enterprise successfully producing and selling these products is Adal Industries, who have an established supply chain in the form of wholesalers and retailers (supermarket and shops) to get products to the consumer. Bamboo toothpicks are traded locally through whole sale and retailer chains. Bamboo sticks, both in raw form and coated in incense, are also exported. However, the scale of export is low. Bamboo energy products (briquettes and pellets) are sold mainly to supermarkets, who retail them to consumers.

Economics: It is difficult to analyse the economics or cost breakdown of the bamboo products associated with industrial production and trading. A detailed economic analysis of cost increments along the value chain, product costing and the economics of the industry could be pursued separately.

Considering the large domestic and international market, there is an enormous opportunity for scaling up industrial value chains in Ethiopia. However, since the sector is still in its emerging stages, there are numerous bottlenecks and problems associated with the industrial value chain. These are:

- 1) Sourcing of raw materials (size and age graded raw materials) and availability of a guaranteed raw supply source is limited (no formal agreements and linkages)
- 2) Inexistent supply-chain mechanisms (lack of primary processed and commoditised bamboo components at source, as well as differentiated production), leading to inefficiencies (high levels of waste) and quality issues
- 3) Limited technical capacity and innovation ability
- 4) Lack of market information and linkages
- 5) Financial constraints (lack of investment capacity)
- 6) Lack of standards and certification to reach high end markets
- 7) Weak policy framework and regulatory mechanisms

5.11 Bamboo Energy

Bamboo as an energy source can be separated into three categories: (a) fuelwood, (b) charcoal and (c) briquettes and pellets.

Bamboo as Fuelwood:

Bamboo is extensively used as fuelwood in Benishangul Gumuz, Gambella, Amhara (Chagni, Mambuk, Matema and Quara localities)

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

and Oromia (Dedessa locality). *Oxytenanthera abyssinica* or lowland bamboo is mainly used as fuelwood, considering its high wall thickness and the semi-solid nature of its bamboo culms. In addition, the cut pieces and processing waste of highland bamboo is also used as fuelwood.

Bamboo Charcoal and Briquettes:

Bamboo charcoal is not widely traded in Ethiopia, though a few micro enterprises in BSG, SNNPRS and Amhara are producing bamboo charcoal on a smaller scale for household consumption.

Bamboo processing industries especially Adal Industries PLC and Abraham Mulatu PLC are producing bamboo charcoal, briquettes derived from bamboo charcoal and pellets derived from bamboo powdered waste from industrial processing.

The actors involved in the bamboo fire wood chain are bamboo collectors or gatherers, who harvest and transport bamboo cut pieces to market locations, and consumers (households who purchase bamboo bundles for use as fire wood). In the case of bamboo briquetting, the actors involved are industries, which convert bamboo processing waste to charcoal and then to briquettes and pellets before selling them to consumers through retailers such as supermarkets.

Raw Material:

Bamboo used for fuelwood is sourced from state forests or communal forests. Waste derived from household enterprises (cut pieces, slivering waste) that process highland bamboo is also used as fire wood. In the case of private industries (briquettes), the raw material used for charcoal production and briquetting is industrial processing waste (cut pieces, splits, sliver waste, and powder waste).

Equipment, Tools and Techniques:

A number of development projects, including those run by the INBAR – EU Biomass project, GIZ, and the Ministry of Mines and Energy, have introduced equipment and technologies for promotion of bamboo (and other agricultural waste) charcoal, briquettes and energy products.

Equipment that has been introduced and validated in Ethiopia includes metal kilns and brick kilns for charcoal production, hand bee hive briquetting presses, electrical pulverisers, mixers and briquette and pellet machines.





Bamboo Firewood, Charcoal, Briquettes and Pellets production in Ethiopia

Sales and Marketing / Trade

Raw bamboo poles for use as fire wood are commonly traded in bi-weekly markets. A bamboo bundle (~ 30-40 pieces of about 90 cm length) is commonly purchased at a rate of ETB 20-30 depending on the location (Refer Table 9).

Briquettes and pellets are sold in supermarkets as well as the outlets of industries.

Key Constraints

Though bamboo as a biomass for charcoal and briquette production has tremendous proven potential, charcoal production and enterprises associated with it have not been scaled up. This is due to the lighter density of bamboo charcoal (high porosity), which thereby burns and releases energy faster than other wood charcoal. To mitigate this, there is a need for densification of charcoal into other contemporary energy products such as briquettes and pellets which behave similar or more effectively than other wood based briquettes and pellets. In addition, there is limited awareness of consumers of the suitability of bamboo as an energy source (charcoal, briquettes and pellets), as well as its eco-friendly nature and other environmental benefits.

5.12 Bamboo Feed and Fodder

Bamboo leaves are widely used by farmers and livestock owners as feed and fodder for livestock (mules, horses, cows, sheep and goat) in bamboo growing regions. A study by Mekuriaw et al, 2011 indicates that farmers in bamboo growing locations use bamboo leaves as feed and fodder for 7–10 months in a year (December to June) due to a lack of other green fodder and foliage. Farmers perceive that low land bamboo leaves are better than hay, and that the digestibility of organic matter, crude protein content, neutral and acid detergent fibres of bamboo are comparable to common available fodder. Most importantly, lowland bamboo leaves have a higher nutritional value compared to those of highland bamboo, making them a better selection for use as feed and fodder (Mekuriaw et al, 2011; Mekuriaw et al, 2012).

Farmers feed livestock with fresh foliage when bamboo poles are cut for sale and utilisation. Bamboo leaves are also collected via a “cut and carry” method by harvesting leaves from bamboo clumps. Bamboo poles are also “bent” by livestock herders to enable the cattle to eat green bamboo leaves during dry seasons. In addition, dried bamboo leaves and those that have fallen to the ground become palatable to cattle when they have been wetted by a light shower (Mekuriaw et al, 2011).

Bamboo feed and fodder is also a minor traded bamboo commodity in Ethiopia, especially in the BSG region. Figure 17 shows the value chain map of bamboo feed and fodder. The actors involved in the bamboo feed and fodder value chain are bamboo leaf collectors or gatherers and consumers (livestock owners, especially those who own mules.)

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

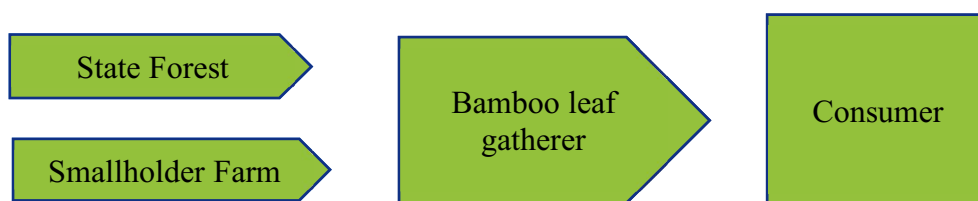


Figure 16: Bamboo fodder value chain map

During field visits and interviews with farmers, it was observed that bamboo is an imported feed and fodder source during dry seasons, and that it is also traded in local markets. For instance, a bundle of 2-3 kg of fresh bamboo leaves of *Oxytenanthera abyssinica* can be sold for about ETB 10. However, the number of people involved in trading is difficult to determine.



Bamboo Fodder Sales in Ethiopia

5.13 Bamboo Shoots:

Bamboo shoots, despite being the most important globally traded bamboo commodity, are not widely used as a source of food or traded as a commodity in Ethiopia. However, a few aboriginal communities in the Benishangul Gumuz region (Mandura) and Masha localities (SNNPRS) region consume both lowland and highland bamboo shoots as a source of food (Mekonnen et al, 2014; Mulatu et al, 2016).

Studies on the nutritional content of two Ethiopian indigenous species indicate that both bamboo shoots have a good nutritional value. However, highland bamboo species fare better in terms of nutritional value compared to lowland bamboo (Feleke et al, 2012). A study by Karanja et al (2015) of highland and lowland bamboo varieties in Kenya also indicates that the shoots of highland bamboo have higher levels of polyphenols and flavonoids, and that they exhibit higher antioxidant activity compared to lowland bamboo species.

Table 19: Nutrient content analysis of indigenous bamboo shoots

Species	N (%)	Fat (%)	Ash (%)	Ca (%)	Mg (PPM)	K (%)	Fe (%)
<i>Oxytenanthera abyssinica</i>	2.95 – 3.99	1.44%	NA	0.09 – 0.15	1903.33-1986.67	6.63 – 7.15	0.003-0.01
<i>Yushania alpina</i>	4.15 – 6.12	1.09%	14.2 – 17.1 %	NA	1386 – 1850	8.54-9.77	0.004 - 0.02

Source: Feleke et al, 2012

Although bamboo shoots are not widely consumed as food in Ethiopia, indigenous bamboo shoots with good nutritional qualities could contribute to the food security of communities living in bamboo-growing regions.

6. Trading Scenario for Bamboo Products

6.1 Domestic Market:

Bamboo is one of the most important NTFPs in Ethiopia. Its annual economic contribution to GDP is estimated at ETB 56,250,000, and close to 750,000 persons are dependent on bamboo for their livelihoods (MoEFCC, 2017). Data on the domestic traded volume of bamboo products is not available.

Currently, most bamboo products are traded locally and are consumed by the domestic market. Bamboo poles are consumed by farmers and producers for construction of houses, fencing, and the production of bamboo mats in addition to sale to other rural consumers, MSEs and private industries. Bamboo mats and bamboo basketry items are consumed by rural households, as well as by households located in towns and cities. Bamboo furniture belonging to the traditional category is consumed by rural and urban households whilst modern bamboo furniture is consumed mainly by urban households. For instance, bamboo furniture is often used by newly established households and businesses. The key informants noted that most consumers of bamboo furniture are those who need furniture for short-term use until they have the required budget to buy other kinds of more higher quality furniture. In this case, it was noted that consumers are less likely to pay a high price, which limits the potential of bamboo products under the current marketing system. Annex 17A, 17B and 17C shows the prices of bamboo products (basketry, mats and furniture) at important trading locations. Industrial bamboo products such as flooring tiles, curtains and blinds and incense sticks are consumed by urban households.

6.2 Global Scenario of Bamboo and Trade in its Products

Bamboo commodities are one of the most important globally traded commodities. Averaged data of global trade (both import and export of 12 bamboo communities) with specific HS codes for the Year 2014, 2015 and 2016 indicates that import and export of bamboo products totalled at about USD 2.82 billion. Average country-specific (Ethiopia) and major trading block (EU, USA, COMESA, Africa and China) import and export volumes are shown in Annex 18. Country and trading block percentages of traded volume are shown in Annex 19.

Globally, the most imported bamboo commodities are (a) preserved bamboo shoots (17.48%), (b) bamboo and rattan furniture (14.19%), (c) bamboo basketry (13.04%), (d) bamboo and rattan seats (12.91%), (e) bamboo ply board (12.24%), and (f) bamboo poles (10.16%). The most exported items are (a) preserved bamboo shoots (20.43%), (b) bamboo flooring (19.41%), (c) bamboo basketry (14.23%) and (d) bamboo and rattan furniture (10.30%).

The EU and USA are the two major importers of bamboo products. The EU on average imports USD 367 million worth of bamboo products and exports USD 142 million worth of bamboo products annually, accounting for about 28 per cent of imports and 10 per cent of exports globally. The most commonly imported bamboo products are bamboo poles, bamboo mats and screens, bamboo basketry, bamboo plywood, bamboo flooring tiles, bamboo paper-based products, bamboo furniture and seats. The USA accounts for about 25 per cent of global imports and about 1.5 per cent of global exports. The most commonly imported bamboo commodities are bamboo basketry products, bamboo ply board, bamboo furniture and seats, pulp and paper, and bamboo poles.

Africa as a whole accounts for about USD 21 million (1.61%) of global imports and USD 18 million (1.21%) of the global exports annually. The COMESA block as a whole imports and exports bamboo products worth USD 9.26 million and USD 2.12 million annually.

China is the world leader in bamboo commodity production and exports, accounting for about USD 1.09 billion (72.64% of the global total of exports). The major exported bamboo commodities from China are (a) preserved bamboo shoots (89% of the global total of exports), (b) bamboo mats and screens (89.44%), (c) bamboo plaits and plaiting material (93%), (d) bamboo flooring (92%), (e) bamboo ply board (76%), (f) bamboo basketry work (70%), (g) bamboo charcoal (55%) and (h) bamboo and rattan furniture (42%).

6.3 Ethiopia and International Trade:

Ethiopia is a negligible player in the global bamboo trade. Averaged annual imports and exports of bamboo products for the years 2014, 2015 and 2016 show that Ethiopia on average imports bamboo commodities worth USD 5.7 million, accounting for about 0.43 per cent of global imports. It exports bamboo products worth USD 0.23 million, accounting for about 0.02 per cent of the global exports. Important bamboo commodities imported are (a) bamboo plywood (USD 1.5 million), (b) bamboo pulp and paper (USD 1.07 million), (c) bamboo and rattan furniture (USD 2.66 million) and (d) bamboo flooring (0.18 million). The most commonly exported bamboo commodity is bamboo pole, at about USD 0.23 million.

7. Enabling Environment

7.1 Policy and Legal Framework

Currently, there is no national level bamboo policy, strategy or action plan. However, there are a number of laws, regulations, policies and programmes that have direct relevance to the bamboo sector which are shown in Table 20 below:

Table 20: Policy and legal framework for the bamboo sector in Ethiopia

Year	Laws and Regulations	Policies and Programmes
1975	Proclamation for the Public Ownership of Rural Lands	–
1982	Peasant Associations Consolidation Proclamation No. 223	–
1995	Federal Constitution of Ethiopia	–
2003	Forest Proclamation of Oromia Proclamation No. 72	–
2005	Rural Land Administration and Land Use Proclamation No 456.	–
2006	Plan for Accelerated and Sustainable Development to End Poverty.	–
2007	Development, Conservation and Utilisation of Wildlife Proclamation No.541, Forest Development, Conservation and Utilisation Proclamation No. 542.	The Environmental Policy of Ethiopia, Forest Management, Development and Utilisation Policy
2008	-	National Forest Policy

2009	-	National Employment Policy and Strategy of Ethiopia
2012	-	The Climate Resilient Green Economy (CRGE) Strategy, Ethiopia's Programme of Adaptation on Climate Change. Sustainable Development and Poverty Reduction Programme. National Strategy Plan for the Implementation of the Great Wall Initiative.
2016	-	The Growth Transformation Plan II, Sustainable Land Management Project-II. Ethiopian Environment and Forest Research Institute (EEFRI) Strategic Plan 2016-2025.

Source: Saavedra, 2017 (unpublished)

Based on synthesis of the above-mentioned policies, strategies, rules and regulations, the relevance of policy frameworks to the bamboo sector (value-addition, trade and industry) is shown below:

Bamboo in Policy Framework: The importance of Bamboo is highlighted in GTP II, National Forest Strategy and Forest Development, Conservation and Utilisation Proclamation. However there is insufficient support for second-level policies or strategies to make bamboo resources a part of the specific objectives, and for the allocation of resources.

Legal definition and classification: The Forest Development, Conservation and Utilisation Proclamation (2007) classifies bamboo as "trees". Therefore, bamboo is defined as a forest product: "any product obtained from a whole tree or part or any primary woody or non-woody product".

Land tenure and property rights: The "regional states" have the authority to administer land and natural resources according to their proclamations. Land tenure of bamboo can be classified as (a) state forest and (b) private land. It is important to note that the government is the owner of the land, and that user rights can be issued to individuals, associations or industries.

In the case of state forests: (1) individuals, associations, government and non-government organisation and business organisation or private players, can obtain rural or state forestland in areas designated for forest development through concessions; (2) the communities living in the state forests have the right to manage, harvest and commercialise forest products; and (3) any person who develops forests on his private land or in a state forest should be given assurance to his ownership of the forest.

In the case of private land owners, a "holding certificate" is the proof for land use rights.

Harvesting, Trade and Transport: A transport permit or "product movement permit" is mandated for both bamboos grown in both state forest and on private land. Additionally, in the case of state forest a "management plan" must be developed and followed. Currently, harvesting is regulated in terms of access to resources, but no specific regulations and guidelines have been developed in terms of management and harvesting limits.

Institutions: To enable communities to benefit from forests, a PFM mechanism was created. Under different proclamations, communities living within and nearby bamboo forests can access forest resources, and can have access to lands for forest

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

development, land, financial and technical support to promote forest-based enterprises. However, the policies do not specify bamboo, and this may create some difficulties or bureaucratic problems for the harvesting and transportation of bamboo.

Investment and Value Addition: The private sector can import machines for bamboo processing at 0 per cent import duty. In addition, a number of incentives such as land for enterprise, tax holidays and other incentives are in place. There is no specific investment promotion for bamboo. Bamboo and its products in particular do not have specific HS codes for import and export, and this creates a constraint for exporters looking to target green markets.

Markets: Market support and mechanisms for market development are mostly undefined in the policy framework. The support and incentives for enterprises are only partial, mainly for promoting skills development and provision of working space. Since the government is one of the largest institutional public procurers, it could be an important source of market during the initial phases.

Overall, the influence of policy and legal framework in the development of the bamboo sector is minimal in Ethiopia. It still lacks a defined pathway for the development of the sector. Despite the presence of bamboo in the core programmes of several national and local institutions, the allocation of financial resources is insufficient at all levels. It is important to note that international donor-led programmes are specifically project driven and time-bound, and therefore excessive dependence on international funding for bamboo sector development would not allow the government's ambitious targets to be met. The key to success is to develop a national policy, strategy and action plan with strong links between the key sectors and national objectives and targets.

7.2 Institutions and their Role

A number of government ministries, NGOs and private sector are involved in development of the bamboo sector. This includes government ministries such as the Ministry of Environment, Forest and Climate Change (MoEFCC), Ministry of Agriculture and Natural Resources (MoANR), Ministry of Industries (Mol), Federal Small, Medium Manufacturing Industries Development Agency (FeSMMIDA). In addition, it includes research and academic institutions such as the Ethiopian Environment and Forestry Research Institute (EEFRI), Ethiopian Institute of Architecture, Building Construction and City Development (EiABC), and TVET. NGOs and international organisations also involved include INBAR, GIZ, the Common Fund for Commodities (CFC), and the United Nations Industrial Development Organisation (UNIDO), among others. The details of the most important institutions and their roles are detailed in Table 21 below:

Table 21: Institutions and their key role in bamboo sector development

Institution	Role
Government Institutions	
Ministry of Environment, Forest and Climate Change (MoEFCC)	MoEFCC is a newly established ministry (2013). It is the current nodal ministry for the bamboo sector in Ethiopia. It has a mandate for sustainable management of environment and forest resources to contribute to poverty reduction and to coordinate climate resilient economic growth. MoEFCC is involved in developing policies, strategies and action plans related to development of the bamboo sector. In addition, it has a larger role in promotion of PFM for sustainable forest management.

Ministry of Agriculture and Natural Resources and their Regional Bureau's	Prior to establishment of MoEFCC, MoANR was the nodal ministry for bamboo in Ethiopia. It has a mandate for conservation, sustainable management and improvement of bamboo resources. Currently, under SLMP II programme, MoANR is supporting INBAR in implementation of bamboo development programme in five regions of Ethiopia. MoANR or their regional bureaus have strong presence in each of the Kebeles, providing support for any bamboo resource development activities in the country.
Ministry of Industry	The Ministry of Industry issues licenses to industries and MSEs. It has mandate to provide technical support, enable private businesses, develop the domestic and international market, as well as safeguard domestic industries. FeSMMIDA is placed under the administration of the Ministry of Industry.
Federal Small, Medium Manufacturing Industries Development Agency (FeSMMIDA)	FeSMMIDA is a federal level agency has the mandate of innovation, capacity building, and product promotion on different value chains including bamboo. It has industrial scale infrastructure for providing capacity building and trainings for targeted MSEs, and also has a mandate to support market development. FeSMMIDA is currently managing a bamboo training workshop and Productivity Improvement Centre (PIC).
Regional Micro and Small Enterprise Development Agency (ReMSEDA)	ReMSEDA regional level agencies have the mandate to provide business development services such as training and capacity building, providing working space, organising groups and arranging for micro-finance promotion and forward and backward linkages for success of enterprises.
TVET and RTTI / RTPC	TVET, RTTI and RTPC are regional level training and business incubation centres. They have a mandate to select appropriate technologies, tools and equipment; provide training for identified entrepreneurs on different technologies; provide technical support up until the graduation of enterprises; promote awareness raising and technology dissemination; and support students of different trades to establish enterprises. Currently, six well-equipped training and business incubation centres are under its control and management.
Ethiopian Environment and Forest Research Institute (EEFRI)	EEFRI has strong expertise in bamboo nursery and plantation research, trial and validation of bamboo species, bamboo fodder research, and conducting testing on physical, mechanical and chemical properties of wood as well as bamboo. In addition, it provides training and capacity building for farmers and women on bamboo nursery, plantation and sustainable management of bamboo resources. However, their efforts towards enterprise development and marketing are limited.
Ethiopian Institute of Architecture, Building Construction and City Development (EiABC)	EiABC has mandate to undertake research on development of alternative construction materials including bamboo. EiABC has constructed a few bamboo structures during training, and developed technical manual for bamboo construction.
Ethiopian Standards Agency (ESA)	ESA is a P-Member of the ISO 296 standard development committee for developing bamboo standards on terminology for bamboo products, bamboo charcoal and bamboo flooring. Currently, the capacity of the ESA for developing standards for bamboo and bamboo products is limited.
Ethiopian Tourist Trading Enterprise	Mandated to promote handicrafts and furniture (including bamboo). They run sales outlets for marketing products produced by MSEs.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Development Agencies	
International Bamboo and Rattan Organisation (INBAR)	Ethiopia is a member country of INBAR. INBAR, through its different projects funded by IFAD, CFC, UNIDO, EU, World Bank and others have raised the profile of bamboo in Ethiopia. Through action research and project implementation they have demonstrated and validated different pro-poor technologies on bamboo nursery and plantation, bamboo products and SME, bamboo energy, bamboo construction and industries. Critical capacity building has been deployed for communities, line department officials, policy makers, and infrastructure .
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Through Public Private Partnership (PPP) on industry development, GIZ has supported African Bamboo PLC. In addition, GIZ supported capacity building of EiABC in construction and in support of FeSMMIDA staff and entrepreneurs in bamboo furniture and crafts.
International Centre for Bamboo and Rattan (ICBR)	ICBR, in collaboration with INBAR and local government implementing agencies (mainly FeSMMIDA) have supported South-South Knowledge transfer training and capacity building in Ethiopia and China. ICBR has supported in setting up of model production units and demonstration construction units in Ethiopia.
NGO's	A number of local and international NGOs are working on capacity building, awareness raising and start-up equipment for household enterprises.
Private Sector and Communities	
Private Sector	Six private industries were established in Ethiopia, though a number of them are non-functional. The details of the industries and their status is attached as Annex 14.
Smallholder Farmers, Bamboo Mat and Furniture producers	There are many smallholder farmers involved in the sector, producing bamboo poles, household-based bamboo mats, basketry and traditional furniture. The details are attached as Annex 9, 10 and 12.
Traders	A number of traders are involved in bamboo pole trading (registered), bamboo basketry, and mat trading (un-registered). Details and number of traders involved in bamboo pole trading are attached as Annex 8.
Participatory Forest management (PFM)	MoEFCC (2017) indicate that about 1 million hectares are under PFM agreement. However, the activities of PFM have not been realised on the ground

Source: Field study, 2017

7.3 Value Chain Governance

Kaplinsky and Morris (2000) define value chain governance as a mechanism which ensures that interactions and transactions between actors of the value chain are organised rather than simply being random, enabling producers to meet the requirements of product, processes, logistics and market. Governance of the value chain implies a set of rules and regulations set by the actors involved in the value chain, or by those who are outside the value chain (government, NGOs, domestic and international trade bodies, standard agencies, and others). The governance mechanisms of the bamboo value chain can be categorised into (a) private sector governance and (b) public sector governance:

Gereffi et al (2005) defines five governance types, namely market, modular, relational, captive and hierarchy, based on the power and dependency relationship between actors of the value chain.

- 1) **Market-based governance:** A typical spot market, either with or without repeated transactions. In this model, there is little or

no formal cooperation between actors and the cost involved in switching to new partner is low.

- 2) **Modular value chain:** Similar to turn-key services, producers or suppliers take full responsibility, using generic machines and making capital outlays on behalf of customer.
- 3) **Relational value chain:** It is marked by strong interaction between suppliers and the lead firm. There is a strong linkage, trust and reputation where the relationship is built over time.
- 4) **Captive value chain:** Smallholder farmers and producers are largely dependent on large firms or buyers, marked by high degree of monitoring and control of lead firms.
- 5) **Hierarchy value chain:** There is a vertical integration between the suppliers and lead firms. For example, from lead firms to secondary processing units, primary processing units and smallholder farmers.

Analysis of the each of the bamboo value chains in Ethiopia was carried out, using the above mentioned theoretical framework to understand and identify the bottlenecks.

Bamboo Pole:

Public Sector Governance: In the case of the bamboo pole value chain, public sector governance and regulations are strong. Bamboo state forests (both land and bamboo) and communal bamboo forests (land) are owned by government. In the case of communal bamboo forests, local communities are provided the opportunity to use the bamboo resources. According to MoEFCC (2017), about 1 million hectares of forests, which includes bamboo and NTFP, are under PFM agreement, though the majority of them are not in operation. In the case of “private” smallholder farms and “institutional” bamboo groves the ownership and land tenure of the bamboo lies with the farmers or with community institutions. It is important to note that PFMs are currently not actively involved in any sustainable management, harvesting or value addition of bamboo. Large tracts of bamboo in state forests are not available for utilisation and trading.

Bamboo is classified as “tree” in the forest statute, and it mandates the same regulations for harvesting and transport as those for wood, timber or trees. Bamboo pole transportation across check-points or across regions requires obtaining a “harvesting and transport” permit, commonly called as “Boleta”, and a “Payment of Royalty”. Bamboo trading or transport requires a “trading license”. Firstly, a trader is required to get a letter from the “Bureau of Agriculture and Natural Resources” office of the relevant Woreda indicating that they hold abundant bamboo resources, and based on that letter the “Office of Trade and Industry” will issue a “trading license” to the trader. Different regions have different royalty fees. For example, in the case of Amhara royalty fees are about ETB 1.3, SNNPRS is about Birr 1 and in Oromia it is about ETB 1.3. Key informants noted that obtaining a trading license is becoming difficult in many bamboo growing areas due to the growing sentiment towards conservation of natural resources. For instance, in Arbegona Woreda (SNNPRS region) it is not possible to get a license to trade bamboo culms as a circular was issued to prohibit issuance of trade licenses. In addition, the Woreda office has revoked licenses of traders who were in business before 2016.

Private Sector Governance: Bamboo traders procure bamboo poles from smallholder farmers, community or institutional bamboo producers. The price of bamboo, specification and volume of the bamboo poles are determined by the traders. There are no long-term agreements between the farmers and traders and the traders move from one location to another, causing instability of the bamboo market price as well as of opportunities for the smallholder farmers. Currently, there is no community institution, such as an association or cooperative of bamboo farmers, and bamboo farmers sell their poles individually.

The current mechanism of bamboo pole governance falls under the “market-based governance model” where the degree of explicit coordination and degree of power with the farmers or suppliers of bamboo poles is low, and the traders therefore exert a higher degree of power.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Bamboo Mat and Bamboo Basketry

Public Sector Governance: The influence of governments rules and regulations on bamboo mats and bamboo basketry value chains is minimal or non-existent. The influence is restricted only to the purchase of bamboo poles in some cases (mostly bamboo mats, basketry and traditional furniture makers, who are farmers themselves or personnel living in the villages who have direct access to bamboo). There are no trading licenses or royalties associated with the transport and trade of bamboo mats and basketry.

Private Sector Governance: Bamboo mats and bamboo basketry households and small-scale producers sell their produce directly to consumers as well as to traders. In the case of direct sale to customers, the customers define the product and prices are fixed mutually between the customers and producers. In most cases, the small-scale producers sell their produce to traders, who they are in direct network with. Traders commonly decide the price and specification of the product, and the final market information is not available to the producers. Traders can move from one location to another. Commonly traders exert greater control on small-scale producers as they are the main link between the producers and consumers.

The current mechanism for bamboo mats and basketry value chain governance falls under the “market-based governance model”, where the degree of explicit coordination and degree of power with the producers or suppliers of bamboo mats and baskets is low and the traders exert a high degree of power.

Bamboo Furniture:

Public Sector Governance: Bamboo furniture-making enterprises categorised as MSE require a license or working permit to establish an enterprise for bamboo furniture production. However, there is no specific trade licensing for bamboo furniture. It is commonly licensed as a metal and wood work furniture enterprise. The license is issued by the Kebele's Trade office, and the trader is required to obtain a competency certificate (any training organisation) and will need to register for TIN. Government training institutions such as ReMSEDA, FeSMMIDA, EEFRI and development agencies are providing training and capacity building activities for entrepreneurs. However, many respondents informed that the trainings and support provided are insufficient (only covering skills development aspects), and that they lack support for tools, business development services, financial management, quality control, and for establishing forward and backward linkages.

Private Sector Governance: There is no horizontal or vertical integration within the sector. All the entrepreneurs work in a stand-alone mode, where all of the production processes, starting from procurement of the bamboo poles to the sale of bamboo products, are carried out independently. Most of the enterprises are located on roadside clusters for easy transport and on the spot sales of products.

This falls under the “market-based governance model”, where the degree of explicit coordination and degree of power with the farmers or suppliers of bamboo poles is low, and a higher degree of power is exerted by the consumer and traders.

Bamboo Construction:

Bamboo construction is traditional in nature. There is no public sector or private sector influence in regulating the sector. However, it can be stated that some of the bamboo houses are constructed with bamboo poles extracted from state forests with “Community User Right” and permission from a Woreda Office.

Bamboo Industry including Energy:

Public Sector Governance:

The Government of Ethiopia provides incentives for investors and entrepreneurs in the form of (a) access to land (free of cost), (b) tax incentives (import and export; corporate tax holidays), and in some cases (c) providing “user rights” for managing and sustainably

harvesting bamboo from state forest (example “Bamboo star” Benishangul Gumuz).

There is no private industry – research institution – consumer forum linkage or innovation platform to support the industry in upgrading value chains. There are no standards and certification mechanisms to confirm compliance with quality standards.

Private Sector Governance:

There is no horizontal or vertical integration among the players of the bamboo industrial value chain. There is also no direction or guidelines with regards to (a) what is to be produced? (b) how it should be produced? (c) when it should be produced? (d) how much should be produced and (e) pricing. Bamboo poles supplied to industries are procured from small-scale farmers individually, either by the industries themselves or through the traders who supply to the industries. There is no organised horizontal integration of smallholder farmers that could enable them to supply bamboo of a particular age and specification, within a regular time frame. This leads to system inefficiency and quality problems. With regards to the lack of vertical integration, procured bamboo poles are transported in their original form, with no primary processing activities carried out in bamboo growing areas. Therefore the industry is required to carry out these processing activities, as well as incur exorbitant transportation costs.

The current mechanism of bamboo pole governance falls under the “modular value chain governance model”, where the level of explicit coordination and degree of power with the farmers or suppliers of bamboo poles is low, whilst the private industries exert higher degree of power.

There is no product differentiation in industries. All of the industries have multiple product lines, and there is no specialisation in the processing any one particular product. There are also no horizontal linkages among the industries, and they process similar products – boards, stick-based products and charcoal. No system exists for differentiation of products across industries, and for creating horizontal linkages among industries where a particular industry will produce a specialised product. This would improve work efficiency and minimise wastage.

According to study by Endalamaw (2015), bamboo enterprises do not confirm to the three pillars of the value chain. These pillars are (a) increased system efficiency, (b) improved quality and (c) development of differentiated products. The study opined that production of good quality and differentiated products can: (1) minimise the competition, and (2) enable them to produce higher quality products, increasing market penetration and price. In addition, the cost of production could be lowered through integration of the value chain, improving efficiency.

However, there is a larger scope for improvement of the value chain and for enabling pro-poor growth by improving value chain governance from the public and private sector, and by moving from the existing “market-based value chain” governance model towards a “hierarchy governance” model. With this model there would be higher integration of the sector to reach the global markets.

7.4 Innovation: Research and Development:

Innovation entails continuous upgradation of products, technology, markets, organisation and institutions. These could be broadly classified as product innovation (product diversification), process innovation (changes in interorganisational practices for driving improvements in the quality and scale of production), new and improved processing techniques, supply chain development and functional innovation (value chain governance, new market development, and institutional innovation).

Innovation and research and development activities under each component of the value chain are illustrated and analysed below:

Bamboo Pole and Bamboo Resource Development:

Bamboo pole value chain development entails implementing nursery, plantation, sustainable management and harvesting practices. Government institutions such as EEFRI and its regional agencies and universities are involved in research and development. A number of packages consisting of practices or technologies to promote propagation and sustainable management were developed. In addition, a number of training and capacity building activities were conducted by EEFRI, INBAR and others. Bamboo in forests as well as on farmland is not sustainably managed, which could be mainly due to poor governance of the value chain and a lack of incentive mechanisms for sales of bamboo poles – which are age-graded or not. The dissemination of technologies to grassroots organisations through government line departments is far from being effective.

Bamboo Mats, Basketry, Construction and Traditional Furniture:

In the case of bamboo basketry, mats, construction and traditional furniture product segments, the main source of technology is traditional knowledge, which is passed on from generations and by learning from neighbours. Household enterprises producing mats, baskets and furniture are survivalist in nature, producing low quality products and selling bamboo products at a cheap price. There have been efforts from FeSMMIDA to develop a bamboo mat value chain through implementation of satellite bamboo processing centres, aimed at supplying bamboo for production of bamboo mats / ply board (BMB). However, the bamboo mat production centre and Production Improvement Centre in Addis Ababa are not functional. In the case of construction, a number of innovations on “bamboo construction design” and “technology” for construction were transferred to EiABC and FeSMMIDA by INBAR and ICBR through construction of a few demonstration units. However, modern bamboo construction has only focused on “product innovation”, and not on “process innovation” or “functional innovation” to develop new markets and enterprises as well as supply chain linkages.

Modern Bamboo Basketry and Furniture Enterprises:

In the case of modern basketry and furniture enterprises, the main source of innovation is training and capacity building of entrepreneurs. FeSMMIDA, ReMSEDA, EEFRI, ETTE, TVET and development agencies (INBAR, NGOs) are the main sources of technology, mainly in the form of technology transfer from other countries, primarily China. A study by Endalamaw (2015) indicates that there has been an increase in the number of products and that the main reason for increases in product innovation are (1) to improve sales, (2) as a result of customer preference, and (3) to improve competitiveness. In addition, internet and customer preferences and choices are another source for driving innovation. Apart from training and capacity building, there is no innovation and technology transfer or handholding support from government and non-government organisations.

The level of innovation by craft enterprises is low due to limited internal capacity and technological support. Poor market response, limited consumer awareness, lack of finance, technology and state support are the factors hindering innovation and product upgradation (Endalamaw, 2015).

From the above, it can be stated that there is limited innovation confined to “product diversification”, and that no innovation or support is focused on “process and functional” development.

Industries:

In comparison to the past, a number of new products are being produced as a result of innovation. Technology transfer in form of machines and processes associated with the industrial value chain are the main sources of innovation. MoI, FeSMMIDA, TVET and non-government agencies are the main actors driving technology exchange through South-South Knowledge transfers, especially for transfer of knowledge from China. A number of industries and mechanised training cum production centres are non-functional, and some of the reasons could be attributed to poor selection of technology and machines, as well as a lack of local capacity related to technology absorption and promotion of innovation. Industries do not currently carry out any research and development activities, and do not have the personnel or budget dedicated to this purpose.

Support of research and development agencies and private industries for innovation is very limited. The research and development capacity of institutions is still weak, and both the number and quality of related publications is low, not sufficient to meet high-level industrial demands. It is important to note that there are fewer numbers of dedicated researchers on bamboo, and no formal education institutions have courses specific to bamboo.

Inter-firm and intra-firm networks could be a source of innovation, providing an interface for exchange of knowledge and information (Endalamaw, 2015). Private industries and modern enterprises are not networked as there is a trust deficit among enterprise players, and there is no formal structure or relationship among private industries, enterprises, research institutions and the government.

Innovations related to private industries only focus on “product innovation” or industry/ firm-level practices. There have been no efforts invested by private industries or research agencies in “process or functional innovation”, and there have been few efforts on development of local technology and processes. There is a need to complement technology transfer from the outside with rigorous support from local research agencies, but currently this is completely missing.

Need for Innovation:

Innovation in the bamboo sector is more important than for other agricultural commodities due to the need for substantial value addition to convert raw materials to the final product, as well as the diversity of product ranges. Innovation currently only focuses on “product innovation”. However, to upgrade the value chain, compete with alternative products and enter into global markets, there is a need for continuous innovation in product, technology, market, organisation and institutional innovation, which would result in “product upgradation”, “process upgradation” and “functional upgradation” of the value chain. Innovation and upgradation is required for both the traditional value chain sectors and in industrial sectors.

7.5 Constraint and Bottlenecks:

A number of constraints and bottlenecks arise due to the lack of policy and strategy frameworks specific to bamboo. The limited role of relevant institutions in bamboo sector governance, research and development and innovation mainly stems from a lack of policy direction, elaborated below:

Lack of Policy, Planning and Integration

There is currently no bamboo policy or enabling frameworks for the bamboo sector within other relevant policies or strategies. Prior efforts have not assessed bamboo resources, prevailing market conditions or the capacities of implementing agencies to carry out interventions in the field. All activities have been target-based, with or without the required budgetary support. Under the present implementation mechanism, changes in the level of support or project components cannot be made regardless of whether the interventions are successful or not. In addition, there is a need for inclusion or changes in other policy frameworks which could have an impact on the bamboo sector. Cross-sector linkages of bamboo with other sectors such as construction, energy and timber need to be pursued to support creation of market demand.

Communication and Linkages: There are weak linkages between different institutions (Research- Extension- Academia- Governmental and Non-Governmental Organisations-Farmers-Industries). In addition, there is limited communication among the implementers, researchers, policy makers, and institutions involved, resulting in a lack of coordinated development. Although there is a considerable amount of technical and research-based information available, interviews with different actors indicate that technical information has not been efficiently disseminated across the bamboo sector.

Manpower and Support

Numerous problems regarding the workforce exist. For example, there are no dedicated personnel at the national, regional and local

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

levels in the nodal agencies for bamboo to coordinate the development of bamboo specific activities. This also applies to the training and research institutions. Bamboo sector development is one of the many activities under their portfolio, but is of lower priority with less time and resources allocated. With multiple tasks at hand, the implementers are not specialised to address the complexities associated with bamboo sector development.

Lack of Coordination

The bamboo sector is promoted simultaneously by different ministries and organisations at the national level and regional level. There is lack of coordination between the ministries as well as among other bamboo development projects and industries. Bamboo plantation programmes have been carried out all over the country (mostly in bamboo growing regions), whereas enterprise and industrial development activities are concentrated in certain locations. Plantations are intended to cater to the future needs of value addition. Due to a lack of coordination, problems associated with raw materials and enterprise development are not being solved.

Budget and Resource Allocation:

With bamboo being a lower priority sector, resources such as budget, staff, and other required facilities are insufficiently allocated across all levels of the bamboo sector.

7.6 Other Enabling Business and Environmental Factors

According to the World Bank's 2018 "Doing Business Report", Ethiopia ranks 161 out of 190 countries for ease of doing business. Starting a business in Ethiopia involves 11 steps carried out over a 35-day period, whilst clearance of construction procedures involves 13 steps requiring about 130 days. In addition, electricity connection involves 4 steps and takes about 95 days, and registering a property involves seven steps and takes 52 days. The strength of legal rights is 3 on a scale of 0-12 (World Bank, 2018).

Investment Promotion Agency: One-Stop Centre

Ethiopia is one of the fastest growing economies in the world, growing at an average of over 10 per cent per annum (EIC, 2017; Shiferaw, 2017). The country is vigorously engaged in promotion of domestic and foreign investment across various sectors including agri-business.

Ethiopia Investment Commission (EIC) is a dedicated agency for promoting and facilitating investment and providing after care (<http://www.investethiopia.gov.et/>). EIC functions as a one-stop centre for providing investment permits, permitting customs duty exemptions, issuing construction permits, notarisation of documents, registration of enterprises and trade, business licenses and Value Added Tax (VAT). Key information required for the investors has been extracted from the above website.

According to Proclamation No 769/2012, investments can be in form of sole ownership, joint ownership, or cooperatives. The company can be registered in Ethiopia or abroad. An investor, whether domestic or foreign investor, needs to obtain an "investment permit". The minimum capital required for a foreign sole ownership firm or for a joint ownership with a domestic investor is USD 200,000 and USD 150,000 respectively. Investment permits need to be renewed until the enterprise commences production and marketing of goods and services. It is important to note, remittance of funds is possible on profit and dividend, principal and interest paid on external loans, technology transfer payment, transfer of shares, and liquidation of enterprises. No investment shall be expropriated or nationalised except for in the public interest and in conformity with the law, and adequate compensation shall be paid (ECRA, 2012).

Ownership on Investment and Land

According to EIC (2014), land in Ethiopia is the sole property of the state. Both urban and rural land is available for lease and on a rental basis. According to Urban Lands Lease Holding Proclamation No. 721/2011, for industrial purposes, the land lease in Addis Ababa is 70 years, and lease holding in other urban centres is 80 years with possibility of further extension and transfer of lease holding (EIC, 2014).

The lease price is reasonable, and the lease rent per annum depends on the purpose and activity. In the case of manufacturing, the lease rent ranges from ETB 4 – 6.53 per m² per annum for manufacturing and from ETB 4.3 – 7 per m² per annum for agro-industries.

With regards to ownership, foreign investors are treated in the same way as a domestic investor, and have the right to own dwelling units and other immovable property (ECRA, 2012).

Exit and Transfer of Property

Exit or transfer of property and investments is possible.

Electricity and its Tariff

Ethiopia annually produces about 9.5 billion kWh of electricity, with 95 per cent of the production coming from hydropower (UCS, 2016). Electricity costs in Ethiopia are some of the lowest in the world. Table 22 below shows the categories of industrial power connection and tariff/flat rates for power connection. In addition, service charges and minimum load charges are also applicable (EIC, 2014).

Table 22: Electricity Tariff rates for industries

Category	Equivalent Flat Rate ETB / kWh	Service Charge (ETB)	Minimum Charge (ETB/ kw connected load)
Low Voltage Industry	0.5778	53.57	First 20KW: ETB 41.97
			Next 200 KW:ETB20.20
			Balance: ETB 10.10
High voltage industry – 15 KV	0.4086	54.01	First 20KW: ETB 34.20
			Next 400 KW:ETB17.70
			Balance: ETB 8.55
High Voltage industry	0.3805	54.01	First 20KW: ETB 31.09
			Next 400 KW:ETB 15.54
			Balance: ETB 7.77

Source: ECRA, 2014

Potential Human Resources, Labour Rates and Conditions

Ethiopia has a large labour pool of about 50 million working age people. According to the 2013 National Labour Force Survey (NLFS) survey, 73 per cent of the employed population was engaged in the agriculture sector. The service sector employs about 15 per cent of the working population followed by manufacturing and trade, which employ 7 per cent and 5 per cent respectively. The survey indicates that about 1.98 million, or 5 per cent, of the active labour force is unemployed (urban (16.5%); Rural (2%)) (CSA, 2014).

Normal working hours are a maximum of eight hours per day, six days a week. Premium wage for over time is 25 per cent higher than the hourly pay. There are no restrictions for overtime during nights and weekly holidays. Employees are entitled to 14, 18 and 23 days of annual leave for personnel with 1 year, 5 years and 10 years of service respectively. The average notice period for redundancy dismissal is about 8.7 weeks. Employees are allowed five days of sick leave with full pay, and the minimum length of maternity leave is 90 days (World Bank, 2018).

There is no legislation for setting a minimum wage in Ethiopia. Minimum wages are only set for the public-sector employees. Table 23

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

below shows the prevailing wage rate of public sector enterprises, giving an indication of prevailing wage rates in Ethiopia.

Table 23: Prevailing public-sector wage rates in Ethiopia

Public sector organisation / enterprise	Skill / Wage Grade	Monthly Minimum / maximum wage (ETB)
Ministry of Urban Development and Construction – Technical Jobs	Grade 1 -18	800 – 12,013
Leather Industry Development Institute	Grade 1 – 15	550 – 12,933
Information Technology Project Professionals	Grade 1 -10	2240 – 10,034
Metal Industry Development Institute	Grade 1-15	550 – 12,933
TVET	Grade 1-9	1718 – 9604
Textile Industry Development Institute	Grade 1 – 15	550 – 12,933

Source: Mywage (2017)

According to EIC (2017), Ethiopia has one of the lowest average wages in Africa. A university graduate salary ranges from USD 150 – 200, and construction worker salaries range from USD 60 for a worker to USD 300 for a foreman.

Markets

Ethiopia has a population of over 100 million and is rapidly growing. Ethiopia is also a member of COMESA, which have a total combined population of over 400 million and where the Ethiopian products have unrestricted access. Ethiopia has duty free and quota free access to the EU and USA under the Everything But Arms (EBA) and African Growth and Opportunities Act (AGOA) respectively.

There are a number of bilateral and unilateral agreements such as (a) Ethiopia-Sudan Free Trade Agreement; (b) General Systems of Preferences (GSP) with EU, Switzerland, Norway, Belarus, Canada, USA, Japan, Australia, New Zealand, Turkey and Russian Federation; (C) Special Preferential Tariff Treatment (SPTT) with China; (d) Duty Free Tariff Preference (DFTP) with India; (e) South Korean Duty Free Preference and (f) Morocco Duty Free Tariff Preference (ERCA, 2017).

Taxation

Both direct and indirect taxes are applicable in Ethiopia. Direct tax includes personal income tax, rental tax, withholding tax, and corporate tax. Indirect tax includes VAT, customs duty, excise and turnover tax. The key taxes are detailed below.

Business Income Tax Exemption:

According to the Council of Ministers Regulations No. 84/2003 (ECRA, 2003; ECRA, 2012a), an investor exporting at least 50 per cent of their produce or supplies, at least 75 per cent of produce to an exporting unit is eligible for income tax exemption for six years, and this can be extended for another two years. An investor exporting less than 50 per cent of produce, or mainly supplying goods to domestic market, is eligible for two years tax exemption. Investors setting up factories in less developed regions are eligible for additional benefits.

In addition, an investor has the option to carry forward losses to the other half of the income tax exemption period.

Customs Duty:

Imports: An investor is permitted to import capital goods, equipment and machines duty free. This also applies to spare parts if the value of spare parts is less than 15 per cent of the capital goods.

Export and Incentives: Any products exported to countries with preferential trade agreements attract 0 per cent export duty (ECRA, 2002). Export Trade Duty Incentive Schemes Proclamation No768/2012 explains different schemes and incentives for exporters, namely (a) Duty Draw Back Scheme; (b) Voucher Scheme; (c) Bonded Export Factory Scheme; and (d) Industrial Zone Scheme (ECRA, 2012a)

Turnover tax: According to Proclamation No. 308/2002 (ECRA, 2002a), when annual taxable transaction value exceeds ETB 500, 000, 2 per cent turnover tax is applicable for goods and services sold or rendered locally, and 10 per cent for other categories.

Personal income tax: Income tax for domestic employees ranges from 0- 35 per cent depending on income from business, employment, rent, dividends, interest and pensions, among others. Expatriate personnel can have an income tax exemption of up to five years if the factory or enterprise is located within an industrial park.

Corporate tax: The rate of corporate tax is 30 per cent.

Value added tax: Normal rate of VAT is 15 per cent.

Intellectual Property Rights

Ethiopia has a dedicated office established to protect intellectual property rights (<http://www.eipo.gov.et/>). Trademarks, patents, copyrights and neighbouring rights protection mechanisms are developed (EIPO, 2003; EIPO, 2015). Ethiopia is a member of the Multilateral Investment Guarantee Agency (MIGA) and World Intellectual Property Organisation (WIPO),

Transport and Shipping

Ethiopia is a landlocked country, and about 95 per cent of the imported and exported goods pass through Djibouti port (UNDP, 2017). In addition to Djibouti port, Ethiopia uses Port Sudan, Port Mombassa and Port Berbera. The most substantial cost incurred for exports and imports is for road transport from Ethiopia to Djibouti, representing over 60 per cent of the overall cost (UNDP, 2017).

Road Transport: Ethiopia has over 110,000 km of road network and this is expanding rapidly. The cost of transporting raw bamboo poles from the location of harvesting to a processing centre is about ETB 5-8 for a distance ranging from 160 – 450 km (Refer to Table 8).

The cost of transporting a 20ft container from Addis Ababa to Djibouti ranges from USD 1200 to 1500, at an average of about USD 1.74 per km (Challa, 2015; Ethiotrack, 2016). A study by Challa (2015) which studied the sea freight cost from Tianjin (China) to Djibouti and inland transport costs from Djibouti to Addis Ababa concluded that the cost of sea freight (China to Djibouti) and inland transport costs are the same. The same study indicates that the cost of importing a 20ft container of goods is between USD 3000 and USD 3350, and that the shipment takes an average of 40 – 50 days to reach its destination.

Rail Transport:

Ethiopia has an operational railway line running from Addis Ababa to Djibouti (~ 800 km). With 95 per cent of Ethiopia's imports and exports passing through Djibouti port, this railway network is critical for reducing shipment costs (EIC, 2017). The rail authority announced the rate of rail cargo charges in January 2018, at USD 0.051 per ton/km (Reporter, 2018). This network has the capacity to carry about 4000 tons per day or about 6-7 million MT per annum (Export, 2017). In addition, Ethiopia has plans for the construction of about 5000 km of railway line to connect different ports and interior locations of the country.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Export and Import Logistics Cost Analysis:

Table 24 below (data compiled from Doing Business report (World Bank, 2018)) shows the cost involved in Ethiopia of documentary compliance for export and imports in comparison with other Sub-Saharan African countries, Organisation of Economic Co-operation and Development (OECD) countries and best performers. Analysis shows that documentary compliance costs for exports is low in Ethiopia compared to Sub-Saharan Africa, but is 1.87 times higher compared to OECD countries. In the case of imports, the cost is higher compared to Sub-Saharan Africa and exorbitantly high compared to OECD countries (11 times). The cost of documentary and border compliance for imports is about 4.3 times higher than exports in the case of Ethiopia.

Table 24: Imports and exports documentary compliance costs comparison

Indicator	Ethiopia	Sub Saharan Africa	OECD	Overall best performer	Ethiopia Vs OECD
Export					
Cost documentary compliance (USD)	175	215.1	35.4	0	1.87
Cost Border compliance (USD)	172	592.1	149.9	0	
Total Cost (USD)	347	807.2	185.3	0	
Import					
Cost Documentary compliance (USD)	750	300.1	25.6	0	10.85
Cost Border compliance (USD)	738	685.8	111.6	0	
Total Cost (USD)	1488	985.9	137.2	0	
Export VS Import	4.29	1.22	0.74		

Source: World Bank, 2018

Table 25 below shows the time involved in documentary compliance (World Bank, 2018). Time involved in export documentation and border compliance in Ethiopia is about 127 hours which is lower compared to Sub-Saharan Africa (188 hours). However, it is 8.4 times higher compared to OECD countries. In the case of imports, documentary and border compliance takes about 360 hours, which is higher compared to both Sub-Saharan Africa (240 Hours) and OECD countries (12.2 Hours).

Table 25: Time involved in import and export documentary compliance

Indicator	Ethiopia	Sub Saharan Africa	OECD	Overall best performer	Ethiopia Vs OECD
Export					
Documentary compliance: Time (in hours)	76	87.8	2.4	1	8.41
Export Border compliance (hours)	51	100.1	12.7	0	
Total time (Hrs)	127	187.9	15.1		
Import					
Import documentary compliance: Time (in hours)	194	103	3.5	1	29.51
Import Border compliance (hours)	166	136.4	8.7	0	
Total time (Hrs)	360	239.4	12.2		
Export Vs Import	2.83	1.27	0.81		

Source: World Bank, 2018

Sea Freight Cost Analysis:

Table 26 and Table 27 below show the costs in Ethiopia of exports and imports, along with data for other key countries. Please note that cost breakdown includes (a) fees levied, (b) cost involved in procedural compliances to export or import the goods, (c) costs for documents, (d) administrative fees for customs clearance and technical control, (e) customs broker fees, (f) terminal handling charges and (g) inland transport. The cost measure does not include tariffs or trade taxes. Only official costs are recorded.

Table 26: Average cost of exports: 20ft container

Country Name	Country Code	Cost (USD)				
		2010	2011	2012	2013	2014
China	CHN	275	275	319	823	823
Ethiopia	ETH	2180	2180	2180	2180	2380
European Union	EUU	1034	1045	1039	1035	1042
Kenya	KEN	2055	2055	2255	2255	2255
North America	NAC	1145	1145	1157	1422	1452
Netherlands	NLD	925	925	925	925	915
Uganda	UGA	2780	2880	3050	2800	2800
United States	USA	630	630	654	1164	1224
World	WLD	1369	1389	1461	1530	1560

Source: World Bank, 2017a

Table 27: Average cost of imports: 20 feet container

Country Name	2010	2011	2012	2013	2014
China	300	300	338	800	800
Ethiopia	2660	2660	2660	2760	2960
European Union	1076	1095	1083	1070	1080
Kenya	2190	2190	2350	2350	2350
Netherlands	942	975	975	975	975
Uganda	2940	3015	3215	3375	3375
United States	789	789	789	1289	1289
World	1632	1658	1755	1839	1877

Source: World Bank, 2017a

The above table shows that the costs involved in export and import are much higher in Ethiopia compared to the world average, as well as in comparison with key importing and exporting countries.

8. Bamboo Products Prioritised for Scaling up:

Prioritisation of key bamboo value chains with strong potential was carried out based on the methodology and indicators shown in Section 3 and Table 1. Based on the prioritisation activity, the key value chains that were identified are (a) industry, (b) bamboo energy products, (c) bamboo poles, (d) furniture, (e) construction, (f) mats, and (g) basketry / crafts. Considering the low scale of existing operations, bamboo feed and fodder and bamboo shoots were eliminated. Table 28 shows the final score and rank for prioritised value chains. The calculations involved in arriving at the final score/ mark and rank are attached as Annex 20.

Table 28: Prioritised bamboo value chains

Bamboo Sub Sector	Score / Mark	Rank
Industry	3.75	1
Energy	3.64	2
Bamboo Pole	3.53	3
Furniture	3.52	4
Construction	3.35	5
Mat	3.32	6
Basketry	3.29	7

Source: Field study, 2017

In addition to the scoring and ranking process of different value chains, the market potential of shortlisted bamboo value chains has been analysed from the perspective of the market potential (existing and future) and technical suitability of the predominant indigenous bamboo species, based on a literature review.

8.1 Existing Industrial Products

8.1.1 Bamboo Flooring Board (Parquet):

Ethiopia currently has industries equipped with machines, equipment and technology for production of bamboo flooring tiles. *Yushania alpina*, or highland bamboo, is highly suitable for the production of bamboo flooring, ceiling materials and bamboo boards. Currently, Adal Industry PLC is producing bamboo flooring boards, mainly to cater to the domestic market. In addition, “Bamboo Star PLC”, based in Assosa (BSG region), has validated the production of bamboo flooring boards and tiles from lowland bamboo. However, the quality and scale of production is relatively low due to the lack of supply chains in supplying age-graded and size-graded bamboo culms, and the production and technical capacities of industries. Bamboo flooring materials have a large international market, and the average global annual export value of bamboo flooring board is about USD 292 million (Refer **Annex 18 and 19**). The EU and USA are the major importing countries. In addition, with Ethiopia’s rapid economic growth, and with bamboo being a green material, both the market for the bamboo flooring materials and consumer awareness of this market are likely to grow.

Table 29 below shows Ethiopia’s import and export value of wood panel and flooring materials from 2014-2016 that could be alternated with bamboo. On average, Ethiopia imported flooring tiles and panels worth USD 12.7 million whilst export value was about USD 24,704. The export value is negligible in comparison to imports, and indicates the market potential for bamboo flooring materials in Ethiopia.

Table 29: Import and Export of Wood Panels and Parquet Panels in Ethiopia

HS Code	Description	Value in USD			Average value (USD)
		2014	2015	2016	
4418	Wood panels, Parquet Panels	Import			
		9,119,799	15,890,203	13,144,191	12,718,064
		Export and Re-Export			
		17,245	3348	53,520	24,704

Source: Compiled from UN Comtrade Database, 2017

8.1.2 Bamboo Stick-Based Products:

Ethiopia already has a validated bamboo stick-based products production line. The product line encompasses production of round bamboo sticks of different diameter, followed by further conversion into incense, agarbatti sticks, tooth picks, skewers and barbeque sticks, curtains, table mats, and match sticks. Currently, Adal Industries PLC, SA Bamboo PLC and Abraham Mulatu PLC (Injibara) are producing bamboo sticks and have added further value by converting them to curtains, table mats, incense sticks and tooth picks. It was also indicated that Adal Industries PLC and SA Bamboo PLC are currently exporting bamboo sticks to India and other countries.

In addition, the Ethiopian government is running training centres such as FeSMMIDA and the Production Improvement Centre (Addis Ababa). The Rural Technology Transfer Institute (Hawasa), and TVET (Bahir Dar) have machinery and infrastructure for production of round bamboo sticks and curtains. However, no production or sale of bamboo sticks and curtains is currently taking place.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Based on the UN Comtrade data under HS Code 460,121 (mats and screens), Ethiopia on average imports bamboo screens and mats valued at USD 25,236 and exports about USD 1876 per annum. Globally, the traded value of bamboo mats and screens is about USD 91 million per annum. The EU is a major importer, and imported about USD 23 million worth of products annually between 2014 and 2016 (Refer Annex 18). Bamboo curtains and table mats have an established domestic market (already produced and sold) and huge export potential.

8.1.2.1 Other Stick-Based Products

Incense Sticks: During 2016, Ethiopia imported incense and agarbatti weighing 1340 tons and valued at USD 4 million, and during the same period exported 2 tons of agarbatti sticks valued at USD 6077 (HS Code 330741). Global exports under this HS code during 2016 are reported at USD 294 million, demonstrating huge potential. According to INBAR, the domestic and export market value of incense and agarbatti in India is estimated at USD 900 million, and this sector consumes about 45,000 MT of bamboo sticks annually (INBAR 2009).

Match Sticks: According to Precise Ethiopia (2012), match stick and splints demand is met entirely through imports. Annually, Ethiopia imports about 1600 tons of match sticks and splits (2012 estimate) and it is projected that this will increase to about 2000 tons by 2022. INBAR and Indian Plywood Industries Research and Training Institute (IPIRTI) have developed technology for production of bamboo sticks. Production of bamboo splints and further research on development of protocol for local bamboo species is needed to develop a new sub-sector for bamboo.



Bamboo flooring, and stick based product line production in Ethiopia

8.1.3 New Industrial Product Lines:

Bamboo could play a vital role as a “timber or wood substitute” in various forms. A large number of panel based products which are currently produced from wood such as Laminated Lumber Boards, flooring boards, parquet flooring, ply boards, Medium Density Fibre Boards (MDF), Oriented Strand Boards (OSB), veneer panels, flake boards, shave boards, corrugated roofing sheets, pulp and paper, plastic composites and a variety of other forms can be produced using bamboo (Yuming and Chaomao, 2010).

8.1.3.1 Bamboo Pulp and Paper:

Bamboo is extensively used for pulping and paper-making in many countries around the world, mostly in India, China, Bangladesh, Argentina, Sri Lanka and Japan. India and China produce about 2 million MT and 1.06 million MT of bamboo pulp per annum respectively (Zehui et al, 2007).

A study conducted by Dr. Seyoum Kelemwork on the physical and mechanical properties of two indigenous bamboo species shows that (a) *Oxytenanthera abyssinica* (from the Dedessa location of BSG) and (b) *Yushania alpina* (from Hula and Injibara) are highly suitable for pulp and paper production due to their long fibre length and low fibre wall thickness. However, due to the scale of resource availability and high biomass productivity, lowland bamboo (*Oxytenanthera abyssinica*) is more highly suitable for production of pulp and paper (UNIDO, 2007). In addition, a study by Tolessa and Feleke (2017) indicates suitability of *Oxytenanthera abyssinica* for pulp and paper production using an environmentally friendly chemical-pulping process.

Ethiopia on average imports USD 17 million worth of pulp made up of wood or other fibrous cellulosic materials, and USD 349 million worth of paper and paper boards (Refer Table 30). Wood pulp is entirely imported. There are an estimated 19 companies in Ethiopia engaged in pulp and paper production where the main activities are related to recycling pulp and processing of pre-produced imported products (MOEFCC, 2017). There is a large outflow of funds for the purchase of pulp, paper and paper based articles.

Table 30: Import and export of pulp and paper

HS Code	Description	Value in USD			Average value (USD)
		2014	2015	2016	
47	Pulp made of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard	Import			
		12,788,751	30,314,863	8,029,715	17,044,443
		Export and Re-Export			
		0	0	12	12
48	Paper and paperboard; articles of paper pulp, of paper or of paperboard	Import and Re-Import			
		396,549,633	439,448,753	211,433,512	349,143,966
		Export and Re-Export			
		80,046	116,341	110,412	102,266

Source: Compiled from UN Comtrade Database, 2017

With the suitability of bamboo for pulping and paper-making, and with enormous domestic market potential, bamboo could be a suitable alternative for production of domestic pulp and paper, reducing the dependence on imports.

8.1.3.2 Bamboo Boards, Lumber and Panels:

Suitability of Indigenous Bamboo Species:

A study (UNIDO, 2007) conducted by Dr. Seyoum Kelemwork concluded that both highland and lowland bamboo species have suitable physical and mechanical properties for production of bamboo flooring, bamboo ply board, Laminated Bamboo Lumber, Oriented strand board (OSB), and Medium Density Fiber Board (MDF). The study was conducted with bamboo samples of two indigenous bamboo species collected from three predominant bamboo growing locations, shown below:

- 1) *Yushania alpina*: Hula or Hagare Selam (SNNPRS), Injibara (Amhara), and Ambo (Oromia).
- 2) *Oxytenanthera abyssinica*: Assosa (BSG), Dedessa (Oromia) and Chagni (Amhara).

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

8.1.3.2.1 Bamboo Mat / Ply Board

Table 31 below shows the mechanical and physical properties of bamboo ply board, including Modulus of Rupture (MoR), Modulus of Elasticity (MoE), density and thickness swelling properties. In addition, a comparison between the properties of the boards produced from two indigenous species and those of the most common bamboo-based ply board, produced from *Phyllostachys pubescens*, was carried out.

Table 31: Mechanical and physical properties of bamboo mat/ plyboard

Species	Mechanical and physical properties of bamboo plyboard				
	MoR (N/mm ²)	MoE GPa	Density (g/cm ³)	Thickness swelling	Source
Bamboo PlyBoard					
<i>Oxytenanthera abyssinica</i>	123.47	17.24	0.777	4	UNIDO, 2007
<i>Yushania alpina</i>	101.45	12.86	0.648	5	UNIDO, 2007
<i>Phyllostachys pubescens</i>	135.78	10.50	1.00	2.5	Zehui, 2007

From Table 31, it can be noted that *Oxytenanthera abyssinica* has comparatively higher MoR and MoE and a higher density compared to *Yushania alpina*. Also, lowland bamboo has less thickness swelling compared to *Yushania alpina* (UNIDO, 2007). Comparing the parameters of bamboo ply board produced from two indigenous Ethiopian bamboos with *Phyllostachys pubescens* (Chinese bamboo) shows that MoE is higher in the case of plywood produced from Ethiopian bamboos, and that density and MoR is higher in case of plywood produced from Moso bamboo. UNIDO (2007) indicate that the mechanical properties of the ply board produced from lowland bamboo are superior compared to highland bamboo of Ethiopia. However, it can be concluded that bamboo mat board can be produced using both bamboo species in Ethiopia, as it meets the standard requirements stipulated in the Forestry Trade Standard of the People's Republic of China: LY 1055-91.

Market: Ethiopia imports a large quantity of wood-based plywood to meet with domestic demand. On average, Ethiopia imports about USD 32 million worth of wood-based ply board and exports USD 36,456. According to MoEFCC (2017), the domestic market for panel-based products, including wood-based products, is set to increase due to a combination of economic and population growth. Table 32 below shows the value of imports and exports of ply board for the years 2014, 2015 and 2016.

Table 32: Imports and exports of ply board in Ethiopia

HS Code	Description	Value in USD			Average value (USD)
		2014	2015	2016	
4412	Ply board	Import			
		33,693,760	43,790,114	21,190,305	32,891,393
		Export and Re-Export			
		91,874	12,160	5,336	36,456

Source: Compiled from UN Comtrade Database, 2017

Ethiopia imports bamboo plywood worth USD 0.15 million annually (Refer Annex 18). In addition to domestic demand, there is a huge export market for bamboo plywood. About USD 161 million worth of bamboo ply boards are imported by different countries around the world annually. The EU and the USA import about USD 37 million and USD 46 million worth of bamboo ply boards annually.

There is a large production base of bamboo mat producers in Ethiopia. Bamboo resources (especially *Yushania alpina*) with long internodes are highly suitable for production of bamboo mats. However, the currently available bamboo mat quality does not match the requirements for production of BMB. The main problems associated with bamboo mat production include non-uniform sliver production (no two slivers are uniform in width and thickness) and unsuitable weaving pattern. The current weaving pattern is one up and one down – parallel weaving, whilst the face mats (top and bottom mats) used for production of BMB require bamboo mats produced using a herringbone weaving pattern.

Ethiopia has the machines, equipment and technology to produce Bamboo Mat Board. FeSMMIDA has established bamboo mat production centres in Injibara, Hawasa, and Dere Enchini, and has established a centralised mat processing unit at the PIC, Addis Ababa under the Ministry of Industry / FeSMMIDA (Refer Annex 15). However, the enterprises are not operational.

8.1.3.2.2 Bamboo Laminated Lumber:

Physical and mechanical test results for Bamboo Laminated Lumber (UNIDO, 2007) indicate that both bamboo species are suitable for production of Bamboo Laminated Timber/ Lumber. Specifically, test results show that the parameters of Modulus of Rupture, Modulus of Elasticity, density and thickness swelling for *Oxytenanthera abyssinica* are better compared to *Yushania alpina*. Comparing test results of the laminated lumber produced from Ethiopian species with test results for *Phyllostachys pubescens* (the most commonly used bamboo variety) indicate that Ethiopian bamboo is comparable or even better under certain parameters. Table 33 (below) shows the mechanical and physical properties of Bamboo Laminated Lumber.

Table 33: Mechanical and Physical Properties of Bamboo Laminated Lumber

Species	Mechanical and Physical properties of Laminated Bamboo Lumber				
	MoR (N/mm ²)	MoE GPa	Density (g/cm ³)	Thickness swelling	Source
Bamboo Laminated Lumber					
<i>Oxytenanthera abyssinica</i>	157.97	18.10	0.776	3	UNIDO, 2007
<i>Yushania alpina</i>	130.22	14.67	0.662	6	UNIDO, 2007
<i>Phyllostachys pubescens</i>	102.7	10.7	0.686	NA	Madhavi et al, 2011; Zehui, 2007

Considering the technical suitability, process for production (machine-based), and the scale of resource availability, *Oxytenanthera abyssinica* presents a good option for production of Bamboo Laminated Lumber, although production from highland bamboo is also technically possible.

Market: A huge domestic market exists for bamboo panels (Refer Table 29- Import of wood panels and parquet panels) and packaging materials (Refer Table 34 - Import of packaging cases and materials). Data for wood panels and packaging materials has been considered due to the lack of a unique HS code for Bamboo Laminated Lumber and since these products can also be derived from Bamboo Laminated Lumber. In total, Ethiopia imports about USD 18 million worth of bamboo panel and packaging materials. Of particular note, Ethiopia imports about USD 6 million worth of packaging materials which could be easily produced using bamboo (Refer Table 34).

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Table 34: Import and export of packaging materials

HS Code	Description	Value in USD			Average value (USD)
		2014	2015	2016	
4415	Packaging cases – Wood	Import			5,833,512
		8,850,568	7,289,086	1,360,882	
		Export and Re-Export			11,836
		18,622	12,763	4122	

Source: Compiled from UN Comtrade database, 2017

8.1.3.2.3 Oriented Strand Board (OSB)

UNIDO (2007) test results on the mechanical and dimensional stability properties of OSB, (MoR, MoE, Internal bonding, Ts WA), show the mechanical properties of OSB prepared from both Ethiopian bamboo species (Refer to Table 35 below)

Table 35: Mechanical and dimensional stability of Oriental Strand Board

Species	Location	Mechanical and dimensional stability properties					Source
		MOR (N/mm ²) N=10	MOE (N/mm ²) N=10	Internal bond (N/mm ²) N=10	Ts (%) N=10	WA (%) N=10	
<i>O. abyssinica</i>	Assosa	36.90	7530.52	0.39	15.51	41.66	UNIDO, 2007
	Chagni	17.68	8488.17	0.09	47.59	59.80	
	Dedessa	31.19	8121.11	0.45	37.49	55.97	
	Injibara	27.55	6589.13	0.29	24.67	50.68	
<i>Yushania alpina</i>	Hagare Selam	50.97	9152.72	0.64	13.03	48.11	
	Ambo	24.50	9454.16	0.14	32.42	56.15	
ISO Standard		17	2100	0.35	18	NA	

The study observed that the internal bond and dimensional stability is relatively lower for bamboo species, mainly due to lower use of resin (10 per cent resin used during study). The study recommends usage of 12 per cent resin, and application of higher temperatures (>180 °C) and high pressure and density (750 Kg/m³) during pressing, combined with a longer pressing time.

From Table 35 (above), it is evident that the OSB made from bamboo samples collected from Chagni (lowland bamboo) and Ambo (highland bamboo) have a high MoE. Boards prepared with bamboo samples from Assosa (lowland bamboo) and Hula (highland bamboo) have a high MoR. Overall, the study concludes that the mechanical properties of the boards made from both highland and lowland bamboo are suitable for manufacture of OSB.

With the availability of enormous quantities of underutilised lowland bamboo, and considering the process involved in production of OSB (particle or flaking), *Oxytenanthera abyssinica* is a suitable candidate. A study by Shimels and Woldeesenbet (2016) illustrates that the lowland bamboo is a good candidate for production of particleboard, and that its strength capacity is similar to that of Eucalyptus, which is commonly used to make particle board.

Market: The domestic market for OSB and particle board is huge. On average, Ethiopia imports about USD 8.5 million worth of OSB and particle board. With rapid economic growth and huge demand in the construction sector, the market demand for OSB is set to increase. Table 36 below shows the import and export values of OSB and particle board from 2014-2016.

Table 36: Import and export of OSB from 2014-2016, Ethiopia

HS Code	Description	Value in USD			Average value (USD)
		2014	2015	2016	
4410	Particle Board, Oriented Strand Board (OSB) and Wafer Board	Import			8,451,124
		8,869,651	7,294,989	9,188,731	
		Export and Re-Export			
		2220	1046	1063	1443

Source: Compiled from UN Comtrade Database

8.1.3.2.4 Medium Density Fiber Board (MDF)

Table 37 below shows the test results for mechanical and dimensional stability properties of MDF board developed with two bamboo species indigenous to Ethiopia. It is evident that highland bamboo, in comparison to lowland bamboo, is more suitable for production of MDF Boards. Particularly, highland bamboo from the Injibara location is more suitable than bamboo from the Hula and Ambo locations. In the case of lowland bamboo, bamboo from Dedessa is more suitable compared to bamboo from Assosa and Chagni.

It is important to note that the mechanical and dimensional properties of MDF boards prepared from both indigenous species are lower when compared to ISO standards. However, the parameters fall within the range of MDF boards produced in China (Zehui et al., 2007). The main problems observed are (a) spring back or wrapping, (b) internal bonding and (c) thickness swelling by absorption (UNIDO, 2007). This could be mitigated by increasing the resin content, temperature of press, pressure and pressing time. The study suggested to undertake further research and work towards optimising the percentage of binder/ glue, pressure, heat and pressing time.

Table 37: Mechanical and dimensional stability properties of MDF Board made from two bamboo species indigenous to Ethiopia.

Species	Site	Mechanical and dimensional stability properties					Source
		MOR (N/mm ²)	MOE (N/mm ²)	Internal bond (N/mm ²)	Ts (%)	WA (%)	
<i>O. abyssinica</i>	Assosa	16.28	2237.35	0.68	21.77	66.97	UNIDO, 2007
	Chagni	15.21	2004.47	0.32	24.26	84.76	
	Dedessa	17.45	2327.97	0.60	22.41	73.73	
<i>Y. alpina</i>	Injibara	19.95	2809.16	0.61	22.15	64.5	
	Hula	15.93	2085.87	0.69	25.53	72.7	
	Ambo	17.55	2213.68	0.38	26.78	80.95	
<i>ISO standard</i>		22	2500	0.60	15	NA	
MDF Boards made in China		17 – 27	NA	0.50 – 0.65	NA	NA	Zehui et al, 2007

MoEFCC (2017) indicate that Ethiopia currently has three large companies (including one state owned company: Ethiopian Chip wood and Furniture company (ECAFCO)), producing a total volume of particle boards of about 10,000 m³ annually. This highlights the availability of technology associated with the production of MDF boards.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Market: Ethiopia's import and export data (Table 38) during the period from 2014-2016 indicates that Ethiopia is a net importer of fibre boards. On average Ethiopia imported fibre boards worth USD 32 million, and during the same period its exports of fibre boards were on average worth USD 217 annually. There is a huge domestic demand that could be met with the production of bamboo-based MDF boards.

Table 38: Import and export of fibre boards in Ethiopia, 2014-2016

HS Code	Description	Value in USD			Average value (USD)
		2014	2015	2016	
4411	Fibre Board	Import			
		29,243,725	42,189,478	24,046,061	31,826,421
		Export and Re-Export			
		81	146	424	217

Source: Compiled from UN Comtrade Database, 2017

8.1.3.2.5 Bamboo Fibreglass/ Plastic Composite:

A study by Redda and Alene (2016) that investigated the suitability of highland bamboo for producing E-glass fiber reinforced epoxy hybrid composites (BEGRC) found that an E-glass and bamboo fibre ratio of 50:50 has the highest elastic modulus and compressive strength. This makes it a particularly suitable composite alternative for glass, carbon and other man-made fibre. Application of bamboo in production of composites has many advantages, including its large scale availability, low production cost, suitable mechanical properties, eco-friendliness and bio-degradability.



Possible products: Bamboo Mat / Ply Board; Bamboo Laminated Lumber; MDF and OSB; Paper and Charcoal based products

8.2 Bamboo Energy:

Results from an INBAR and Nanjing University (2010) test of bamboo charcoalisation showed that both Ethiopian lowland and highland bamboo species have desirable fuel characteristics. The study illustrates that in the case of highland bamboo, the fixed carbon and calorific value of charcoal is positively correlated with the age of the bamboo pole, and that the charcoal yield rate also increases with age of the bamboo pole. Highest charcoal recovery is achieved in the bottom portion, followed by middle and top portions of the bamboo pole. In the case of lowland bamboo, ash content increases with age, fixed carbon and calorific values decreases with age, and yield rate of charcoal increases with the age of culm. The recovery rate is highest in the bottom portion followed by middle and top. Charcoalisation test results for two Ethiopian indigenous species are attached as Annex 21. A carbonisation study was also conducted according to the optimal process (final carbonisation temperature of 600°C , heating rate of 5 °C / min and holding time of 1 hour).

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

More than 90 per cent of the households in Ethiopia use biomass and charcoal as their primary energy source. According to MoEFCC (2017), Ethiopia consumes about 116 million m³ of wood fuel annually, with a per capita consumption of about 1.2 m³ per annum. It is estimated that following economic development, economically advanced households will switch to other sources of conventional fuel. However, with projected increases in population, it is estimated that Ethiopia's wood demand for fuelwood will increase, estimated to reach 142 million m³ by 2033 with a demand–supply gap of about 80 million m³ (MoEFCC, 2017).

Bamboo can fill the gap if sustainably managed, and lowland bamboo is especially suitable for energy application. A study by Mulatu et al (2016) indicates that sustainably managed lowland bamboo plantations can hold about 40000 culms/ha, providing an opportunity to harvest about 10,000 bamboo poles annually. With an average dry weight of about 2.5 kg/bamboo pole (LUSO, 1997), a hectare of lowland bamboo forest can yield about 25 MT/ha/annum. With an average estimate of lowland bamboo resources at about 800,000 to 1 million ha (INBAR-Tsinghua, 2017; LUSO, 1997), sustainably managed *Oxytenanthera abyssinica* bamboo forests could sustainably supply about 25 million MT of biomass per annum.

In addition to the traditional uses of fuelwood and charcoal, bamboo is suitable for conversion to briquettes, pellets, active carbon, and is also suitable for electricity generation. For example, only 500 ha of bamboo plantations would be required to produce 1 MW of electricity on a sustainable basis. In addition, about 1.2 kg of bamboo biomass could produce 1 kWh of electricity (NMBA, 2007). In addition, bamboo biomass could be used for thermal gasification to produce thermal energy, as well as having traditional boiler and heating uses.

Active Carbon: Bamboo charcoal could also be further value added into active carbon. Bamboo activated carbon has a large surface area, good absorption ability, high selectivity and stable physical and mechanical properties (Zehui, 2007). It is widely used in water purification, waste water disposal treatment, refining and discolouring (sugar industry, pharmaceutical industry) and electrical application. Ethiopia is a net importer of activated carbon, and on average imports active carbon worth USD 445,237 annually, as shown in Table 39 below:

Table 39: Imports of active carbon in Ethiopia for years 2014, 2015 and 2016

HS Code	Description	Import Value (USD)			Average (USD)
		2014	2015	2016	
380210	Activated Carbon	414,997	487,018	433,696	445,237

Source: Compiled from UN Comtrade Database, 2017

8.3 Bamboo Pole

Bamboo yields a higher biomass per unit of land than most wood timber trees, has a minimal ecological footprint and can contribute to reducing pressure on the environment. Unlike trees, which take decades to mature, bamboo plantations or forests reach maturity in a short period of four to six years (Banik, 2000). Being a grass with multiple stems or culms in a clump, bamboo provides an opportunity to selectively harvest bamboo poles annually without consuming all of the bamboo clumps at once. With a lifespan of about 40 years (flowering cycle), bamboo can provide biomass on a continuous basis without the need for replanting (Lobovikov et al., 2007).

Bamboo pole production involves increasing the bamboo resource base as well as sustainable management of existing bamboo resources. The bamboo pole value chain is the foundation for all the other bamboo sub-sectors, such as the industrial, construction and energy sectors, MSEs and household enterprises that produce bamboo furniture, mats, bamboo handicrafts and basketry products. Industrial and high-end value addition requires age-grading, size grading and implementation of post-harvesting management

practices, which are currently non-existent. Highland bamboo resources are currently widely used whilst lowland bamboo resources are underutilised.

About one million ha of bamboo forests are under PFM agreement, but a majority of them are not under sustainable forest management (MoEFCC, 2017). Bamboo is one of the important NTFPs in forests managed under PFM agreements. Capacity building with PFM members to promote sustainable management and harvesting of bamboo forest, enterprise development and market linkages could bring a large span of bamboo under sustainable management, with triple bottom line benefits (social, economic and environmental).

Bamboo has enormous potential to contribute to filling the gaps in current shortages of timber resources and in meeting growing demand. It also has the potential to propel green growth as part of CRGE strategy and to contribute to achievement of targets outlined under GTP II. Particularly, GTP II aims to promote value addition of 0.5 million m³ of bamboo product for domestic and international markets, at the same time aiming to create about one million forest based jobs. Ethiopia has set an ambitious target of about 15 million ha under the Bonn Challenge, INDC and AFR 100, providing a huge opportunity for bamboo. Recent MoEFCC and World Resources Institute (WRI) Forest and Landscape Restoration (FLR) potential mapping has identified about three million ha of land suitable for bamboo forest and land restoration in Ethiopia (~2.5 million ha for lowland bamboo and ~0.6 million hectares for highland bamboo) (Wondimu, 2017).

Various studies in Ethiopia have shown that bamboo is an important economic crop for farmers (especially highland bamboo), and it is widely domesticated as a result (Mekonnen et al., 2014; Endalamaw, 2015). In addition to economic benefits, indigenous bamboo provides a sustainable, day-to-day resource for growers. Bamboo could be easily integrated into farming, various mosaic land restoration and agroforestry practices, with smallholders planting bamboo as farm boundaries, shelter belts and via block planting. The most important interventions required are to develop a market pull and extension services, promote capacity building of the farmers and develop sustainable markets for bamboo produce through farmer – industry/ association linkages.

A cost-benefit analysis of establishing one hectare of bamboo plantation (*Yushania alpina*) shows that by year 7 farmers would break even, and could earn more than Ethiopian Birr (ETB) 40,000 per year 8-9 years after establishing the plantation. This provides an excellent opportunity for farmers to earn a handsome revenue with little effort, at the same time contributing to environmental sustainability, climate change and green economy targets of the government. Please refer to Annex 22 for an outline of the assumptions, inputs and outputs of the cost-benefit analysis.

In conclusion, promotion of a bamboo pole value chain requires integration of bamboo planting into forest (PFM) and land restoration (small holder farmer planting) approaches, supported by strong industry-farmer linkages and development of market networks. These can be facilitated by government interventions in the form of capacity building, provision of extension services and development of suitable policy and governance frameworks.

8.4 Bamboo Furniture:

There is a long tradition and culture of using bamboo furniture, and there are a number of trained bamboo furniture makers (both traditional and modern furniture) in Ethiopia. The bamboo furniture subsector faces a number of constraints limiting the widespread application of bamboo furniture. These are (a) common perceptions of bamboo being a less durable and poor-quality material; (b) furniture designs which are mostly traditional and lack of diversity or contemporary design; (c) the technology used in production; (d) a lack of treatment and preservation to improve the durability of the products and (e) a lack of consumer awareness on the diversity, durability and suitability of bamboo furniture. However, these gaps could be addressed through (a) selective harvesting, bamboo

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

preservation and treatment to improve the durability; (b) skills and technology development and transfer; (c) design development, (d) improved awareness and sensitisation and (e) market development.

Market Potential: Ethiopia imports furniture in large quantities. On average, from 2014 to 2016 Ethiopia imported furniture made from metal, wood, plastic, bamboo and other materials worth USD 125 million. Wood, metal, plastic, other materials and bamboo/rattan-based furniture imports were valued at USD 74, 14.4, 2.27, 24 and 2.66 million respectively. During the same period, Ethiopia exported negligible amounts of furniture, valued at USD 1.80 million. The details of furniture import and export for the period 2014 – 2016 and its average under each of the HS Code 9403 is shown in Table 40 below:

Table 40: Ethiopia: Imports and exports of furniture from 2014-2016

HS Code	Heading Description	2014	2015	2016	Average (USD)
		Value (USD)	Value (USD)	Value (USD)	
Import					
9403	Furniture and parts	136,634,246	188,840,976	50,394,183	125,289,802
940310	Metal furniture for office use	4,247,601	6,412,305	2,186,810	4,282,239
940320	Other metal furniture	10,844,065	14,597,720	5,074,316	10,172,034
940330	Wooden furniture for office	26,961,867	29,673,605	8,441,271	21,692,248
940340	Wooden furniture for kitchen	5,445,103	6,208,549	1,712,165	4,455,272
940350	Wood furniture for bed room	15,572,577	16,313,501	4,336,103	12,074,060
940360	Other wooden furniture	32,569,757	50,944,778	23,480,048	35,664,861
940370	Plastic furniture	2,682,522	3,410,552	731,521	2,274,865
940381	Bamboo or rattan furniture	6,822,635	1,163,922	14,733	2,667,097
940389	Other	21,917,331	45,788,391	3,929,882	23,878,535
Export					
9403	Furniture and parts	1,727,443	1,545,197	2,103,869	1,792,170
940310	Metal furniture for office use	14,050	8995	25,763	16,269
940320	Other metal furniture	30,994	4857	31,320	22,390
940330	Wooden furniture for office	145,184	125,776	4420	91,793
940340	Wooden furniture for kitchen	339,976	119,843	59,630	173,150
940350	Wood furniture for bed room	84,604	82,804	136,626	101,345
940360	Other wooden furniture	799,455	765,050	1,221,200	928,568
940370	Plastic furniture	298	5824	16,602	7575
940381	Bamboo or rattan furniture	0	980	256	618
940389	Other	302, 670	427,872	607,291	445, 944

Source: Compiled from UN Comtrade Database, 2017

According to the MoEFCC (2017) study, the furniture sub-sector is projected to grow by an estimated 400 per cent over the next 20 years, and wood demand for furniture is expected to grow from 0.8 million m³ (2013) to about 1.8 million m³ in 2033. Bamboo is a suitable material for the production of various categories of furniture such as (a) whole culm furniture; (b) slat based furniture; (c) sliver based furniture; (d) bamboo board based furniture and (e) composite furniture, all products which can cater to households, offices and enterprises.

8.5 Bamboo Construction:

Currently, bamboo used as a construction material in Ethiopia mainly relates to the construction of traditional and rural housing segments, relying on traditional construction techniques and methods. For traditional construction bamboo usage ranges from construction of the entire house (for example Sidama houses) to use in its original form for different components of construction such as roofing, walls, floors, interior and exterior decoration. It is important to note that about 2.5 per cent of the total housing units in Ethiopia are made from bamboo and reed, and Ethiopia does not have an adequate resource base to meet the future demand of housing (CSA, 2007; MoEFCC, 2017).

Around one billion people around the world live in bamboo houses (Scurlock et al., 2000; Banik, 2000; Lobovikov et al., 2007). The dual characteristics of being lightweight with high tensile strength make bamboo a suitable material for construction, especially in disaster-prone areas (Banik, 2000; Widenoja, 2007; INBAR, 2010). Recently, bamboo has gained popularity for use in the construction of modern social houses, hotels, churches, schools, and bridges in Columbia, Peru, and Ecuador (Takahashi, 2006), and for building of low cost, pre-fabricated, disaster housing and eco-tourism complexes in India (Durai, 2010).

Bamboo housing can meet a wide range of housing needs from rural low-cost housing to urban and modern construction, covering household, office and tourism segments. Housing is one of the priority areas for the government of Ethiopia. According to the MoEFCC (2017), about 95 per cent of the Ethiopians live in traditional houses (wood/mud housing). Annually, an average of 400,000 new housing units are built and an additional 450,000 housing units are repaired in Ethiopia, and in 2013 this consumed about 6.6 million m³ of wood. Wood demand for construction is projected to increase from the current level of 6.6 million m³ to about 11.3 million m³ by 2033, valued at USD 384 million (MoEFCC, 2017).

Bamboo can be used as a suitable alternative for construction of rural housing units, urban housing units, eco-tourism resorts and for interior and exterior decoration. In addition, construction requires panels, boards and composite materials for flooring, roofing, kitchen cabinets, interior decoration, doors windows and partitions. A number of bamboo panels, flooring tiles, roofing tiles, lumber for doors and windows could be made from bamboo. This would not only reduce dependence on wood timber and lower the import/ foreign exchange burden, but would also create income and employment opportunities for smallholder farmers, semi-processors and other industries.

Products which could be alternated immediately for production with bamboo include (a) flooring tiles; (b) boards; (c) ceiling panels (currently plastic and wood false ceiling panels are used); (d) door panels (currently aluminium and wood are used); and (e) door and window frames (currently aluminium and wood are used).

8.6 Bamboo Mats

Production of bamboo mats is an important bamboo sub-sector in Ethiopia. Currently the bamboo mats produced are used as fencing material, flooring (rural households), ceilings and as screens on construction sites. They are also used as drying mats for coffee bean and tea leaves and as shade nets in nursery.

It is evident that the majority of the bamboo mats produced are of low-value and are used for low-value applications. There is a huge market demand for bamboo mats for traditional application. However, domestic market value and demand is hard to estimate due to lack of data.

Bamboo mats produced could be converted into bamboo mats / ply board (BMB) by gluing and pressing multiple layers of bamboo mats together. There is a huge domestic demand and market for the plywood. The technical details and market potential of BMB are

shown in section 8.1.3.2.1.

8.7 Bamboo Handicrafts

Traditionally, communities across Ethiopia (bamboo growing regions) produce various types of bamboo basketry for (a) household use (Mosseb, Agelgel, Sefed, Akinbalo, fire wood collection baskets and granary); (b) agriculture use (grain baskets, fruit and vegetables collection and transport and manure collection); (c) horticulture (coffee bean collection and tea leaf collection) and (d) other uses (sand mining baskets, sieves, chicken transport cages).

Domestic market and trade value is difficult to determine due to the unorganised nature of the sector. At the global scale, bamboo basketry is one of the most important traded commodities, representing 14.3 per cent of total export of bamboo products. On average, USD 215 million worth of basketry or plaited products are exported annually. The EU and the USA import about USD 46 million and USD 54 million worth of bamboo basketry respectively (refer to Annex 18). Ethiopia is a minor player on the global scale, importing bamboo basketry products worth USD 23,274, and its export contribution is NIL. It is assumed that the main basketry products imported are coasters, lamp shades and fruit vases (commonly found in supermarkets).

Considering the availability of (a) traditional skill sets, (b) suitable bamboo species (mainly *Yushania alpina*), and (c) promising domestic and international markets, bamboo basketry is a promising value chain for Ethiopia. Currently, there is a good demand for bamboo basketry in rural areas to meet the needs of agriculture and horticultural applications. In addition, there is a thriving horticulture (coffee and tea) and floriculture sector (investments) in Ethiopia, which uses imported friendly plastic crates which are not environmentally friendly.. Bamboo basketry could provide a sustainable alternative for supply of basketry and packaging material to meet the growing demand of agriculture, horticulture and floriculture sub sector.

Tourism and high-end packaging (coffee packaging) is another subsector where bamboo basketry or woven products could be introduced and upscaled. There is also a growing demand for household lifestyle products such as lamp shades, flower vases, fruit vases, jewellery boxes, wall hanging decoration materials, all areas where the bamboo basketry sector could penetrate. The above-mentioned are already validated in Ethiopia, with a few enterprises in Addis Ababa already producing high-end bamboo handicrafts products.

In order to develop markets for these products, linkages will need to be developed and markets opened up in the horticultural, floriculture and tourism subsectors. In addition, efforts focussed on design diversification, skills and capacity building, tools and technique upgradation, cluster development, handholding and provision of business development services are necessary. With continuous focussed support and dedicated agency to promoting the handicraft subsector, it will be possible to cater not only to domestic market demand but also to the export market, which is significant and growing.

8.8 Strengths, Weaknesses, Opportunities and Threats

Based on analysis of the existing bamboo value chain in Ethiopia (Section 5) and products prioritised for scaling up (Section 8), there are a number of advantages for upgrading the value chains in the bamboo sector. However, there are also weaknesses and threats that could act as bottlenecks for effective promotion of the bamboo sector.

Table 41 below illustrates the Strengths, Weaknesses, Opportunities and Threats of each of the prioritised bamboo value chains.

Table 41: SWOT Analysis of Prioritised Value Chains

Value Chain	Strengths	Weaknesses	Opportunities	Threats
Bamboo Pole / Bamboo Resource Development	Indigenous bamboo resources available. Indigenous knowledge on propagation, harvest and management exists. Bamboo growing areas are naturally clustered in close geography. Important additional income option for smallholder farmers. Market is available, with additional potential uses and a shortage of wood. Low labour cost and low price of bamboo compared to other countries.	Poor silvicultural practices / unsustainable management and harvesting leading to degradation of farm bamboo and forest bamboo. Lack of supply chain (operated mainly through market intermediary) Transportation cost is high (hollowness of bamboo). No intermediary processing; no availability of age graded and size graded poles (no support from government) Lack of clarity and coordination among players for permits and regulation. No post harvesting management practices. Poor infrastructure in case of state forest.	Potential to diversify utilities. Industrial uses (Boards, flooring, stick based product line, energy, panel, timber textiles, pulp and paper etc.) Possible to integrate with intended national determined goals (INDC) Climate resilient green economy (CRGE), and GTP II, soil and water conservation, and Bonn challenge. Integration with refugee housing and enterprise development; other cross sectors such as horticulture, floriculture and energy.	Unsustainable management leading to degradation of bamboo forest and farm bamboo. Bamboo flowering (lack of data on flowering). Land use conversation and forest fires. Eucalyptus (alternatively used for bamboo)
Bamboo Mats	Traditional skill set and culture of using bamboo mats. Additional income option for households during off seasons. Raw materials locally available at household or within reach. Requires limited skills, tools and little/ no investment. Traditional /local market and supply chain exist. Easy logistics and transportation.	Labour intensive work (could be a future constraint). Poor tools and limited skills leading to poor quality mats and low prices. Not durable / prone to fungal insects and borer attack. Lack of storage (open air). Absence of institutional support.	Possibility of industry development (Bamboo Mat Board). Availability of pre-processing and bamboo matting machinery in three locations (SNNPRS, Oromia and Amhara). Linkage with coffee, tea and agricultural subsector for drying and packaging. Substitute for plastic in cases of urban gardening (tree guards etc.).	Processing requires young age culm (impacting sustainability of clumps if over harvested). Competition for plastic materials and composites. Low species diversity (highland bamboo highly suitable for mat production. Lowland bamboo not ideal though used).

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Value Chain	Strengths	Weaknesses	Opportunities	Threats
Bamboo Basketry	Traditional skill sets and a culture of using bamboo baskets. Additional income-generating options, mainly for women and youth. Suitable raw material readily available to farmers. Requires limited tools and investment (Household activity). Good market available for low cost products to cater to the household and agriculture sectors. Most products easily transportable by stacking. Customisation possible (size and form) as per requirements.	Time consuming due to manual processing. Lack of contemporary product design and market penetration. Poor quality (size and form) and durability (insect and fungal attacks). Limited tools and skill sets. No organised supply chain or marketing channels (operate mainly through part time traders / weekly markets)	Develop contemporary lifestyle products. Packaging material for agricultural, horticultural fishery, and floriculture including coffee and tea. High-end packaging cases (coffee, honey tea wines and flower) Possibility of creating rural (local employment for women and youth) by penetrating the large export market.	Production (silvering) require young age bamboo poles (~1 years); overharvesting may lead to degradation of bamboo clumps. Attractive cheap plastic products (imported and local) provide alternative choice. Alternative products from materials such as grass, Rafia, palms. Lack of data on mass-flowering. Low specious diversity.
Bamboo Construction	Traditional skill sets and culture of using of bamboo in construction of rural houses. Government and research agencies focused on developing alternative construction materials. Bamboo is already being used in hotels, resorts and tourism location for aesthetics. Technology transfer/ bamboo construction technology available within research agencies.	Poor durability of traditional bamboo houses (prone to insect attack, borer, termite attack and fungal attack due to lack of treatment and treatment). Perception as a poor man's house. Poor workmanship and lack of technical knowhow for modern bamboo construction. Unequal distribution of bamboo in different regions of the country. Lack of a building code for bamboo and lack of standardisation for access to permits and loans. No bamboo-specific construction policies or guidelines.	Production of bamboo panel, boards and composites for condominium and modern houses. Construction of eco-tourism, mid and high-end recreational structures. Reintroduction for refugee camp construction (ARRA and UNHCR stopped using bamboo). Building of semi-permanent to permanent rural houses to replace timber demand.	Gregarious flowering of bamboo. Perception of bamboo as a poor man's timber and less durable product. Lack of preservation and treatment. Poor infrastructure network.

Value Chain	Strengths	Weaknesses	Opportunities	Threats
Bamboo Furniture	Existing value chain and deep-rooted culture of using bamboo furniture. Growing population, economy and construction creating furniture demand. More economical than wood and metal products. Availability of suitable bamboo. Establishment of enterprises possible due to low investment and working space requirements.	Poor quality (rudimentary tools, skill sets and poor joinery and finishing) and less durability (insect and fungal attack). Common perception as a poor man's furniture. Lack of modern design. Lack of age-graded, size-graded, commoditised and treated bamboo. Bulking (not suitable for long distance transport). Lack of organised markets and outlets. Absence of active training and business incubation centres (lack of curriculum).	Link up with government procurement system (schools, office, hospital and furniture etc.). Markets are increasing (Ethiopia imports large quantities of wood, steel and plastic furniture). Consumer awareness and interest in using eco-friendly or green material is increasing. Possible for linkup with MSE cluster initiative of the government to access infrastructure space, including credit facility. Possible to integrate with large scale condominium construction. Link-up with youth job creation targets and government budgets.	Cheaper imported furniture products (wood, steel and plastic). Lack of bamboo-specific guidelines for licensing, trading and taxation. Lack of standards and certification mechanisms.
Bamboo Energy	Bamboo (especially lowland bamboo) is traditionally used as fire wood. High calorific value (bamboo fire wood, briquette, charcoal or palette). Bamboo is crop that provides annual yields (requiring annual harvesting), does not result in deforestation. Large energy market (90% of households in Ethiopia still use biomass + charcoal as primary energy source). Demonstrated and validated technology and machinery available for production of charcoal and pellets (including stoves).	Highland bamboo (hollow) is a less durable fire wood energy source compared to lowland bamboo wood. Bamboo charcoal burns faster – (highly porous), and is less dense compared to wood charcoal. Common perceptions of bamboo as a low-quality fire wood (outside BSG region). No specific World Customs Organisation (WCO) HS code in the Ethiopia customs agency for charcoal. Processing is labour intensive.	Convert bamboo wastage generated from value addition and industrial processing into energy products. Bamboo can be a source of energy for industrial processing (thermal and electrical gasifier) to produce thermal and electrical power; contributing to CRGE strategy. An alternative to timber, as sources diminish, demand and price of timber also increasing. Bamboo charcoal can be exported internationally (based on world customs organisation HS Code).	Charcoal and biomass from Eucalyptus and Acacia. Largely unregulated charcoal industry leading to availability of charcoal at cheaper price. Unsustainable (unregulated harvesting can lead to degradation of bamboo forest).

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Value Chain	Strengths	Weaknesses	Opportunities	Threats
Industry	Large raw material resource base exists in Ethiopia. Cheap power and labour costs. Government is encouraging investment and providing support in the form of land, loans, and tax exemptions. Import of machinery is duty free (0% tax). Special user rights / concessions for bamboo forests. Growing economy and local market (access to COMESA, EU and USA market reformation purchase).	High capital and advanced technology requirements. Poor quality of raw material (no age graded, size graded material). Lack of value chain approach (no horizontal and vertical integration). Currently, industry functions in a standalone mode). No machine development or supply of spare parts (leading to breakdown). Quality of final product not meeting export standards. Lack of quality control standards and certification. Dependent on imports (input materials include glues and treatment chemicals). Products are expensive compared to imported products.	Industry can offset imports and can be an export revenue earner. Caters to growing demand (construction and lifestyle products etc.) Substitute for timber in the form of boards, timber, lumber, furniture, flooring, roofing doors. Caters to large energy markets (Briquettes, pallets etc). A substitute for imported pulp and paper. Harmonise with government strategic plan of industrialisation and economic development (CRGE, GTP II, etc). Cater to large and growing green market in developing countries (Export).	Imported industrial bamboo products high quality and comparatively cheap. Shortage of hard currency to import machinery and input materials. Bamboo flowering (low specious diversity and lack of data on flowering).

Source: Field Study, 2017

9. Recommendations:

Recommendations are proposed below for the each of the potential value chains, based on the synthesis of the existing bamboo resources (Section 5.1), value chains and products (Section 5.5-5.13), enabling environment (Section 7) and prioritised bamboo products: technical suitability and market potential (Section 8).

Recommendations are further split into two categories:

- 9.1. Location, species and product matrix (Table 43): A matrix showing the location (region, Zone and Woreda), species available in the particular location and value chain suitability based on technical feasibility and market potential.
- 9.2. A specific set of recommendations for promoting each of the value chains.

For the purpose of developing recommendations (due to the similar nature of the activities and constraints, and level of value addition), the prioritised value chains are separated into the following categories shown in the Table 42 below.

Table 42: Value chain categorisation for development of recommendations.

Level of value addition	Value Chain
Bamboo resource development / bamboo pole	Bamboo pole for MSEs, industries and construction
Household enterprise	Bamboo mats and basketry
Micro and small-scale enterprise	Bamboo furniture
Bamboo Construction	Traditional and modern construction
Industrial product lines	Bamboo parquet flooring and ceiling, Bamboo stick based products, Bamboo Pulp and Paper, Bamboo Laminated Lumber, OSB, MDF, and bamboo energy

Source: Field study, 2017

9.1 Location, Species and Product Matrix

Table 43: Location and Product Matrix

Region	Zone	Woreda	Species	Bamboo pole		Bamboo Mat		Bamboo Basketry		Bamboo furniture		Bamboo Housing		Bamboo Industry		Bamboo Energy		
				Existing	Potential	Existing	Potential	Existing	Potential	Existing	Potential	Existing	Potential	Existing	Potential			
Addis Ababa		Addis Ababa	<i>Y alpina</i>												FRT, SBP, LBL		Waste	
	Awi	Fagjita Lekoma Addis Kidam / Banja	<i>Y. alpina</i>															
		Injlbara, Kesa chawsa, Tilili	<i>Y. alpina</i>													FRT, SBP, MDF, LBL		
		Guangua shikudad	<i>Y. alpina</i>															
		Bahirdar	<i>Y. alpina</i>															
	East Gojjam	Bibugn, Erogegebeya	<i>Y. alpina</i>															
		Senan	<i>Y. alpina</i>															
	Mirab Gojjam	Bure	<i>Y. alpina</i>															
		Debub Achefer	<i>Y. alpina</i>															
Dembecha		<i>Y. alpina</i>																
Wemberma		<i>Y. alpina</i>																
North Gondar	Debra tabor	<i>Y. alpina</i>																
North Gondar	Quara, and Matema.	<i>O abyssinica</i>	3000 Sq. Km												PP, LBL, MDF, OSB		Bamboo charcoal, pellets and briquettes	
Benishangul Gumuz	Assosa	Biidigjitu, Assosa, Homasha, Bambasi, and Maokomo Special	<i>O abyssinica</i>												Non functional	SBP, LBL, OSB		Bamboo charcoal, briquettes, pellets, chips
	Kamashi	Kamashi, Yaso, Agalometi, Bilo Jiganfoy, Gizen, Kurmuk and Sirbabay	<i>O. abyssinica</i>	8500 Sq. Km of bamboo forest												PP, LBL, MDF, OSB		
	Metekel	Guba, Dangur, Wenbera, Bulen, Dibate, and Mandura.	<i>O. abyssinica</i>													PP, LBL, MDF, OSB		

9.2 Specific Recommendations for Prioritised Value Chains

9.2.1 Bamboo Pole/ Bamboo Resource Development:

Developing a strong resource base, both in terms of quantity and quality, would provide a backbone for overall bamboo sector development. Current bamboo resources, both on farms and in state forests, lack appropriate management, and in some cases the quantity of bamboo resources at a particular location lack critical mass to support large industries. To develop sufficient bamboo resources and produce bamboo poles of required quantity and quality, there is a need for participation of local communities, primarily smallholders in the case of farm plantations and community institutions (PFMs) in the case of state forests. Bamboo is an annually yielding crop, and therefore requires annual selective harvesting to keep the bamboo clumps and forests healthy, as well as to ensure the supply of bamboo poles of the appropriate age and size. This requires maintenance and management similar to that of any other agricultural or horticultural crop.

Creation of demand and market generation for the bamboo poles is the most critical element to propel smallholder bamboo planting (examples can be seen in the case of *Eucalyptus* and *Acacia*), with farmers currently planting them at a large scale with/without government support or intervention. During the initial phases of bamboo development, the support of government, non-government agencies and the private sector is critical to ignite and drive growth. Bamboo resource development and bamboo pole improvement entails (a) development of quality planting material, (b) establishment of new plantations in both smallholder farms and forest areas and (c) sustainable management and harvesting of the bamboo on smallholder farms including community forests, institutions and bamboo in state forests.

Produce and Distribute High Quality Planting Material:

1. Involve local research agencies (EEFRI) in undertaking research on agro-climatic and end-use suitability of a few selected species (both indigenous and exotic bamboo species). Problems related to the compatibility of raw materials with machines and process standardisation can be addressed by undertaking the planting of a few selected species in an orderly fashion, rather than planting multiple species of bamboo.
2. Identify plus clumps or superior clones of shortlisted bamboo species, and mass produce for distribution to smallholder farmers and for state forest planting.
3. The current system for bamboo planting material production involves large government-owned nurseries, where the benefits to communities are minimal. Support and develop the role of women and youth nurseries in a decentralised fashion to enable Availability of bamboo planting materials at the local level, and to reduce the transportation cost and mortality of plants. This will enable communities to gain access to additional employment and income opportunities.
4. Provide training and capacity building to local line department officials and to communities working on bamboo nurseries and in planting material production.

Support the establishment of new plantations, both on smallholder farms and in forest areas:

1. Leverage the budgets and plantation targets of INDCs, The Bonn Challenge, AFR 100, CRGE, SLMP and others to support establishment of bamboo plantations in state forests, community forests and smallholder farms. In addition to supporting large-scale or block plantations, promote bamboo planting in the form of farm boundaries, shelter belts, and stream or river bank protection, creating potential additional income for farmers and growers without competing with their food crops.
2. Develop plantations by adopting a cluster-based approach (concentrate activities in a limited geographical area) for effective value chain development. Linkages between farmers and value addition enterprises can be easily forged. Farmers can be assured of a market for their products, and the clustering of plantations will ensure a strong resource base for the enterprises and industries.
3. Develop clear guidelines on the species to be planted based on the proposed applications. By using only a few species of bamboo, it will be much easier to develop specialised machinery, production processes, technology, and final products.

4. Provide training and capacity building to local line department officials, smallholder farmers and community institution members on bamboo plantation establishment and maintenance.

Sustainable Management of Bamboo Forests and Farms:

Sourcing and the availability of bamboo poles or raw materials (for example of a specific diameter, wall thickness, internode length, and correct age) is a pre-requisite for production of quality products, and therefore industrial development is currently a major constraint. In addition, guaranteed raw material sources are scarce.

With a major portion of Ethiopia's bamboo resources located in natural or state-owned forests, and bamboo resources currently in use originating mainly from smallholder farms, it is necessary to bring both the smallholders farms and bamboo forests under a sustainable management regime. This can be achieved through the following actions:

1. **Smallholder farmers:** Conduct trainings and build the capacities of farmers on bamboo plantation establishment, inter-cropping, maintenance, sustainable harvesting and management of bamboo clumps, as well as on post-harvest management.
2. **State forests:** Strengthen PFM groups and other community institutions by allocating bamboo forests (delineated and compartmentalised) with proper management plans, harvesting guidelines and schedules to enable sustainable management of bamboo forests. This will provide income and employment benefits to youth and poor households, provide bamboo supplies to enterprises, and ensure the good health of bamboo forests. In addition, training on sustainable harvesting management and handholding is critical for line departments implementing staff members, PFM and community institutions.

Market Development and Intermediary Processing:

1. Establish horizontal integration (organising small holder farmers as cooperatives or association) and vertical integration (linking farmers to HH processors, MSEs and industries) to develop sustained market linkages, improve bargaining capacity and improve reliability of the supply chain.
2. Establish and promote participation of youth groups in PFMs, associations and cooperatives, where they will engage in primary processing and commoditisation of bamboo to improve the efficiency of the value chain.
3. Build the capacities of the primary processors for conducting age and size grading and commoditisation (appropriate specification requirement of industry, MSEs or HH enterprises).
4. Develop a **"bamboo market"** at strategic locations (similar to Eucalyptus logs), which could encompass bamboo poles, bamboo mats, bamboo basketry, furniture and other products.
5. In addition to the above actions, conduct demonstrations and sensitisation training with farmers and local communities on the suitability of bamboo as a multi-utility product in addition to its trade potential. For example, the usage of bamboo as a biomass, for food and fodder and agricultural props.

9.2.2 Household Enterprise Products:

A large number of rural households in bamboo growing regions are involved in processing of bamboo products at the household level. The advantage of household enterprises is that they can operate in their free time and with no or minimal investment. Household bamboo activity provides additional income and employment options for women and young people, and could also be a mechanism for promoting adaption to climate change and mitigating migration to urban centres.

The most important household based bamboo products under production are (a) bamboo mats and (b) bamboo basketry products. In addition to the traditional bamboo products segments, a few modern bamboo mat and bamboo craft enterprises are operational in most towns and cities in Ethiopia. Currently, there are a number of bottlenecks that these sectors are facing, as explained in the SWOT analysis (Table 41). The following recommendations are suggested to upgrade the bamboo mat and bamboo basketry value chains.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Raw Materials:

1. Undertake capacity building with entrepreneurs on selective harvesting methods (age grading of bamboo poles; and season of harvesting), post-harvest management and sustainable management of bamboo clumps.
2. Facilitate supply of commoditised bamboo components (slivers) by developing linkages with primary processors.

Processing:

1. Develop bamboo clusters specific to bamboo mats and bamboo basketry in small geographic areas for ease of logistics, technology transfer and innovation.
2. Target existing bamboo mat and bamboo basketry household entrepreneurs for training and capacity building, rather than identifying new ones.
3. **Bamboo Mats:** Conduct targeted capacity building to produce uniform mats (sliver width and thickness with introduction of appropriate jigs and fixtures) and weaving patterns, to suit the production of industrial bamboo mat board (BMB).
4. **Bamboo Basketry:** In the short-term focus on domestic demand, diversify products and build capacity to cater to the immediate agricultural and horticultural sector and urban households. In the long run, conduct assessment of the most commonly traded basketry products globally, diversifying the production line to cater to the export market. In addition, introduce appropriate tools, jigs and fixtures to maintain and improve quality.

Innovation, Research and Development

1. **Process Upgradation:** To improve production efficiency, establish or link producers in the identified clusters to an existing “Common Production and Training Centre (CPTC)”, providing the necessary forward and backward linkages.
2. **Product Upgradation:** Regularly develop new designs on contemporary life style products. Existing TVET and design schools can be leveraged to provide design development, capacity building, enterprise building and handholding training.
3. **Functional upgradation:** Develop horizontal (association of processors) and vertical linkages (links with primary processors, industry in case of bamboo mats; wholesaler and retailers in the case of the bamboo basketry value chain).
4. In the long term, build capacity of the Ethiopian Standards Agency (ESA) to develop standards and certification mechanisms for bamboo basketry products.
5. Introduce, build capacity and enable inputs of material supplies for bamboo preservation and treatment.

Market Development:

1. **Diversity usage, utility and design:** Develop cross-sector linkages with the agriculture, horticulture, and floriculture sectors to develop markets for low-end packaging and transportation. In addition, develop linkages with tourism and retail commodity sectors such as coffee, honey, flower, tea and wine for producing high end packaging products.
2. Develop links with the existing and new government-run sales outlets targeting the domestic and tourism markets.
3. Facilitate participation of producer associations or groups in local, regional and national level trade fairs and exhibitions.
4. Run an awareness and marketing campaign targeting common consumers to illustrate the social, economic and environmental benefits of bamboo.
5. Support establishment of storage and market centres at prominent locations (road heads) for marketing and sales of bamboo products at a centralised location.
6. Enable preferential public-sector procurement of bamboo basketry products.

9.2.3 Bamboo Furniture:

The bamboo furniture sub-sector (both traditional and modern) is one of the most promising and prominent value chains in Ethiopia. Bamboo furniture enterprises can be categorised as micro and small enterprises (MSE), located mostly in urban centres and at road

heads close to the urban centres. The advantages of MSEs is that they can generate high levels of employment set up with minimal investment, and the return on investment is high compared to large scale industries. There are a number of key constraints facing the furniture sub-sector, such as (a) durability (insect and fungal attack), (b) quality (traditional design, poor joinery and finishing) and, due to the above, (c) perception of bamboo furniture as a “cheap/non-durable” product. With an enormous market opportunity, as described in Section 8.4, and with Ethiopia importing huge quantities of wood, metal and plastic furniture, the bamboo furniture value chain could be a suitable option not only for curtailing currency drain, but also for creating local income and employment opportunities for young people, women and people living in poverty, all the goals the government is striving for under its CRGE strategy to create a “green economy”.

The following recommendations are proposed to upgrade the bamboo furniture value chain.

Raw Materials:

1. As most of the enterprises are based in urban and semi-urban centres, access to raw materials (most importantly quality raw materials) is the most significant constraint. Development of vertical integration of the supply chain could mitigate this, developing linkages with primary processors and farmers’ associations to source age-graded, commoditised bamboo components and poles as required.
2. Conduct training and capacity building with furniture entrepreneurs and associated farmers on selective harvesting (3-year-old bamboo poles) and sustainable management of bamboo clumps.

Processing:

1. Build capacity of bamboo furniture processors and primary processors on bamboo preservation and treatment, and enable access to preservation and treatment chemicals or sourcing of preserved and treated bamboo pole through primary processors. It is important to note that two Vacuum pressure treatment preservation units are available in Ethiopia (BoTVED: Bahir Dar; and RTPC: Assosa).
2. Develop new contemporary designs to suit market requirements, and conduct “tailor made” capacity building or skill building trainings for furniture producers on improved “processing techniques” (grading, cross cutting, scrapping, measurement, component preparation, joinery, assembly, finishing and storage) and “new product designs”.

Innovation, Research and Development

1. Work with local research agencies (EEFRI) to develop cost-effective preservation and treatment methods using locally available materials.
2. Develop enterprise-service provider linkages for regular development and diversification of product designs and techniques. Local institutions such as TVET, design schools and universities could be leveraged to provide design and product innovation support.
3. Develop bamboo furniture specific course curriculums in TVET, similar to metal and wood works, to create a pool of professionally trained entrepreneurs.
4. Support and strengthen Ethiopia Standards Agency (ESA) to develop and adopt standards and certification mechanisms for bamboo furniture products.
5. Develop “horizontal integration” of bamboo furniture producers to enable exchange of product designs and techniques, improve advocacy and enhance innovation through joint efforts.

Market Development:

1. Introduce preferential public-sector purchase policies for bamboo furniture, mainly to cater to school, hospital, public enterprise and office procurement to create initial guaranteed market demand, increase public awareness and build customer confidence.

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

2. Facilitate establishment of a common “**market centre**” for bamboo furniture products in prominent locations in cities and towns.
3. Support marketing and sales of bamboo furniture products through government-run sales, and facilitate participation in international trade fairs and exhibitions.
4. Implement public awareness campaigns to dispel the myths of bamboo furniture being poor quality and less durable.

9.2.4 Bamboo Construction:

Bamboo use in the construction sector involves building (a) traditional and rural houses, (b) modern structures and (c) use of bamboo industrial products. Currently, usage of bamboo is confined to construction of traditional or rural structures. About 2.5 per cent of the dwelling units in Ethiopia are constructed predominantly using bamboo (~ 380,000 units), and another 4 per cent of the rural housing units use bamboo in their construction (Refer to **Section 5.6 and 8.5**). However, there is a common perception that bamboo houses have poor durability and quality, and there is a common trend to switch to cement and concrete structures. Considering the enormous potential of bamboo in construction, a number of recommendations are proposed below:

Raw Materials:

1. Undertake capacity building of farmers, primary processors and construction workers on selective harvesting and usage of matured bamboo pole in construction.
2. Develop and link a “common preservation and treatment unit” in location central to bamboo construction (example SNNPRS), enabling availability of treated bamboo poles for construction.

Processing and Techniques

1. Coordinate technology transfer and build the capacities of the local carpenters, masons and line department officials on durable, disaster proof construction techniques (foundation, walling, truss, joinery, etc.).
2. Develop a pool of professionals trained in bamboo construction.

Research and Development:

1. Work with EiABC to develop and adopt best practices of bamboo construction techniques to local situations.
2. Develop standards and certification mechanisms for bamboo construction, both traditional and modern construction, and include bamboo building codes and construction codes to enable access to finance/ loans and to enable receiving of construction permits.

Market Development:

1. Target market development of both “rural low-cost construction” and “modern high-end structures” by constructing demonstration housing structures, both “traditional and modern”, in strategic locations to raise awareness and customer confidence. Rural bamboo housing promotion should target existing locations and modern bamboo structures should target urban centres and tourist locations (hotels, resorts, eco-tourism).
2. Develop linkages and enable the Availability of bamboo poles in wood depots, similar to *Eucalyptus* or *Acacia* poles.
3. Develop linkages with ARRA and UNHCR and advocate for usage of bamboo for construction of refugee dwelling units and other infrastructure.
4. Develop linkages with the Ministry of Construction to develop markets for bamboo industrial products (panels, boards, doors and windows, interiors).

9.2.5 Industrial Product Lines:

Ethiopia has one of the more advanced bamboo industries in Africa. Industries (machines, technology and production) producing bamboo panels (parquet flooring, ceiling tiles), bamboo stick based products (bamboo sticks, curtains, table mats, incense sticks,

and tooth picks and Bamboo Lumber Board) are deployed in Ethiopia. A few industries are operational and a few are dysfunctional. However, a number of bottlenecks, including the availability of right quality raw material for processing, high cost of processing, lack of supply chain, low quality products (panels) and undeveloped domestic markets constrain the development of bamboo industries.

Promote Bamboo as a Timber Substitute:

Technically, a number of industrial products can be produced using indigenous bamboo resources such as (a) bamboo panels (parquet flooring and ceiling), (b) stick based products (curtains, table mats, incense sticks, tooth picks, barbeque sticks, match sticks, etc), (c) bamboo lumber and boards (bamboo ply board, bamboo laminated lumber, Oriented Strand Board, Medium Density Fibre board and bamboo fibre composite boards) and (d) bamboo pulp and paper. In addition, there is huge domestic market demand for the above mentioned products (Refer Section 8.1).

It is recommended to develop and strengthen new and existing industrial product lines in a phased manner.

Short-term:

Private sector: Support strengthening of the existing private sector to improve the scale of production and quality of existing products (bamboo parquet flooring and roofing, bamboo stick based products (curtains, mats, incense stick and tooth pick), and Bamboo Laminated Lumber. Support could include facilitating industry-focused scientific research and technology transfer, developing standards and certification mechanisms for bamboo products, issuing special user rights for sustainable management of bamboo forests coupled with development of forest roads and infrastructure, eliminating royalty and transport permits for bamboo poles, developing market locations for enterprises, and providing subsidies for upgrading machines as well as technology for improving production efficiency and quality.

Public Sector: Operationalise non-functioning government-managed production and training centres by developing “Public Private Partnerships (PPP)” for production of (a) Bamboo Mat Boards and (b) bamboo stick-based products. Support could include facilitating industry-focused scientific research and technology transfer, developing standards and certification mechanisms for bamboo products, issuing special user rights for sustainable management of bamboo forests coupled with development of forest roads and infrastructure, eliminating royalty and transport permits for bamboo poles, developing market locations for enterprises, and providing subsidies for upgrading machines as well as technology for improving production efficiency and quality.

Medium-Term:

Focus on development of the “bamboo pulp and paper” industry, which requires huge capital, high end technology and a large bamboo resource base. Since Amhara forestry enterprise is already in process of establishing a pulp and paper industry, advocate for inclusion of bamboo as a primary feed stock.

Long-term:

Focus on development of industry for Oriented Strand Board, Medium Density Fiber Board, bamboo composite panels and other high end industrial products.

Bamboo Energy:

Biomass is the primary energy source in Ethiopia, and with huge market demand and shortage of timber (Refer Section 8.2) bamboo biomass energy could fill the gap. Bamboo biomass energy production could follow two models:

1. **Decentralise charcoal and briquette production** at the local level by organising farmer associations, PFMs, and youth participation in production of charcoal and briquetting. This would entail supporting establishment of infrastructure (charcoal

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

kilns, and mechanised briquetting units), delivering capacity building on charcoal production, briquetting, quality control and entrepreneurship development.

2. **Large scale production:** Promote charcoal, briquette and pellet and wood chip production by industries (energy-based as well as those involved in conversion of waste into energy). There are huge existing domestic and international energy markets for briquettes, pellets and chips, and a large, currently underutilised bamboo resource (lowland bamboo) highly suitable for energy production.

A common set of interventions are proposed for development of the bamboo industry in Ethiopia with regards to development of raw material, supply chains, research and development and market development.

Raw Materials:

Industries require a huge quantity of bamboo biomass (bamboo poles) of consistent quality (managed bamboo forests and farms) to optimise the production process and produce high quality industrial products.

1. Allocate or issue special harvesting and usage rights for currently unmanaged bamboo forests to industries with clear sustainable management, harvesting and transport guidelines.
2. Allocate bamboo forests to PFM groups with clear guidelines on sustainable management, harvesting and transport with market linkages to industries.
3. Provide intensive training on sustainable management and harvesting practices to forest managers, PFM groups, harvesters, and industries.

Intermediary Processing and Supply Chain:

1. Facilitate development of horizontal and vertical linkages to develop a multi-product value chain with different parts or components of bamboo being supplied to different industrial segments. Develop primary processing units (at the source of raw material) to componentise bamboo and utilise the complete biomass of bamboo, as well as to minimise logistics and processing costs.
2. Develop formal agreements between the bamboo pole producers (both small holder and forest bamboo), primary processors and final value addition industries.

Research and Development:

1. Undertake research on diversification of bamboo species for industrial purposes to mitigate the uncertainty associated with bamboo flowering cycles, validating proven species for higher value addition (example *Guadua* spp; *Dendrocalamus* spp). In addition, undertake research on the physical, chemical and mechanical property testing of introduced species.
2. Facilitate South-South technology transfer and involve local research agencies in the development of suitable technologies, processes, low-cost machinery and equipment.

Market Development:

1. **Bamboo Timber Substitutes:** Develop domestic market linkages with the construction sector (condominium and government office construction) to create demand for bamboo timber substitutes.
2. Conduct product specific surveys of international market demand, quality and the price of products in the international market, and develop mechanisms to penetrate the international market.
3. **Bamboo Energy:** Develop linkages with government procurement (schools and universities) to use bamboo biomass briquettes and pellets instead of biomass from unsustainable sources.
4. Demonstrate and facilitate usage of bamboo bioenergy products for large consumers: (a) industries for process heating, (b) tea and coffee processing factories, and (c) restaurants.
5. Develop licensing mechanisms and enable international trade of bamboo charcoal (create separate WCO HS Code for bamboo

charcoal, briquettes and chips).

6. Design and undertake awareness and sensitisation campaigns in the form of public demonstrations, radio and video programmes.

Investment Promotion and Incentives:

1. Develop bamboo industry specific “business models” and link with the EIC for inclusion of the bamboo sector as a preferential sub-sector to attract domestic and foreign investment.
2. Organise investment platforms and Business-to-Business (B2B) meetings of industries and potential investors at the national and international level.
3. Introduce fiscal and pricing frameworks (higher rates of taxes produced from unsustainable or imported sources) to encourage domestic production.
4. Support the ESA to develop or adopt existing standards and certification of industrial processes and products.

9.2.6 Institutions and Governance:

Governance of the value chain (organising of interactions between the value chain actors) involves government, non-government agencies and the private sector. The key constraints identified for governance and institutions are (a) lack of policy and planning, (b) lack of inter-sectoral coordination, communication and linkages, (c) lack of manpower and support and (d) limited budget and resource allocation.

The recommendations proposed to improve the institutional framework and governance are as follows:

1. **Bamboo policy/programme integration:** Develop national and regional level bamboo policies, strategies and action plans with clear links to complimentary policies or programmes of sustainable development agenda such as landscape restoration, MSE, industry, construction, CRGE, bioenergy, and employment, and poverty reduction, with the objective of leveraging increased investment in bamboo development. The Ministry of Environment, Forest and Climate Change should be the lead ministry considering the mandate provided by statute.
2. **Develop multi-stakeholder innovation platforms** to enhance cross-ministry and multi-stakeholder coordination at national and regional levels. The platform can include relevant line departments, farmer’s groups, processing groups, industries, research agencies, financial institutions and consumer forum representatives to discuss investment priorities, implementation, product innovation, process innovation, functional innovation, tracking of progress and sharing of learning.
3. **Develop a “multi-product value chain”:** Key interventions involve “process and functional upgradation” of value chain governance to increase the conversion rate of bamboo from current rate of 20-30 per cent to 80 per cent, and to develop product differentiated industry (specialised products rather than producing a general set of products).
4. **Integrate the bamboo sector:** Develop horizontal linkages at different levels, “farmers”, “primary processors” and “industry”, to formalise the value chains, in order to ensure product differentiation, increase the bargaining power of actors in each of the layers and reduce the wastage and transaction costs. In addition, joint marketing and joint use of production facilities could be envisaged to spread the cost of infrastructure. Develop vertical integration or functional upgradation of processes involved in the value chain and distribute processing functions among different value chain actors (primary processing and secondary processing) with technical support, formal contracts and market information flow mechanisms. This will also enable product differentiation and specialisation.
5. **Facilitate innovation:** Develop industry clusters with product differentiation and private-public-business-research agency collaboration for continuous innovation.
6. **Develop inter-sectoral collaboration:** Develop bamboo sector linkages with other sectors (energy, construction, tourism, agriculture, horticulture, floriculture) to develop markets.

10. Conclusion

Ethiopia has one of the largest bamboo resources and bamboo value chains in Africa. A large proportion of bamboo resources both in state forests and in farm lands are not sustainably managed or are underutilised. A large number of bamboo mat and bamboo basketry producers in bamboo growing regions derive additional income and employment benefits from bamboo. The existing bamboo products are predominantly traditional in nature, catering to rural and traditional market segments. A number of MSEs are successfully operating in Ethiopia, producing modern bamboo furniture and bamboo basketry mainly in urban centres. In addition, a few bamboo industries producing industrial products such as bamboo parquet flooring, bamboo stick based products and bamboo energy are functional. Overall, bamboo value chains are largely informal in nature, dominated by low cost, quality incentive and unstructured market mechanisms.

Many institutions (government, research agencies, non-governmental agencies) have a mandate to promote the bamboo sector. However, there is a general lack of coordination, overlap of roles and responsibilities, a lack of policy and planning, and limited dedicated manpower and resources to effectively promote the bamboo sector. Policy and institutional influence on the bamboo sector is limited, except in regulating the transport of bamboo poles. Public and private sector governance mechanisms of the value chain are poor, and there is also a lack of vertical and horizontal integration of the bamboo sector. The intervention of government and non-government agencies is confined to “product innovation” in the MSE sector (developing new designs and providing training to MSEs on new products and skills). There is also a lack of “process upgradation” (inter-organisational practices for quality and production improvement) and “functional innovation” (value chain governance, new market development, and institutional innovation). This has resulted in underdevelopment of the sector.

There are no reliable formal or structured supply chains. MSEs and industries mostly operate in “standalone mode”, processing entire bamboo poles into the final product. There is no intermediary processing involved, resulting in wastage, logistical and production inefficiencies, reduced quality of production, and a general lack of innovation. Bamboo resource producers (smallholder farmers) face problems associated with the sale of bamboo poles, and at the same time MSEs and industries face challenges related to accessing supply of quality bamboo poles. Establishment of multi-product value chains with reliable supply chains (organised and functional intermediaries) could integrate all actors and reduce inefficiencies observed in the existing value chains.

Bamboo has over 10,000 uses and utilities, and is one of the most important traded commodities in the world offering enormous export potential. Ethiopia imports large quantities of timber, steel and plastic products that could easily be alternated with bamboo, and technical and market potential analysis of the shortlisted bamboo products shows that industrial products (bamboo parquet flooring and ceiling tiles), bamboo mat boards, bamboo lumber boards; Oriented Strand Board, Medium Density Fibre Board, bamboo pulp and paper, and bamboo composites could be used as a substitute for timber. Bamboo stick-based products (curtains, blinds, incense sticks, tooth picks, and match sticks) can be produced from the existing indigenous bamboo species. These products have tremendous potential in domestic markets, in addition to possibility for export. MSE products such as modern bamboo furniture, craft products and household products including bamboo basketry, crafts and bamboo mats also have good market potential. This study also identified bamboo construction as an important value chain (traditional housing and modern construction) for upgradation. Most importantly, with a large resource of lowland bamboo available, bamboo-based bioenergy and pulp and paper also have huge potential.

It is important to note that the government of Ethiopia has given a high priority to the bamboo sector. In its 2016-2020 growth and

transformation plan (GTP II), bamboo has been targeted as a strategic species for livelihood development and for environmental rehabilitation. Under GTP II, the Ethiopian government has targeted 0.7 million ha of degraded land for afforestation or reforestation with bamboo, and will utilise 0.5 million m³. However, these targets are not backed up by robust policy and institutional frameworks and resources are insufficient. There is a larger scope to develop the bamboo sector by implementing a suitable policy and institutional framework, and for integrating bamboo development into the strategic policies and programme priorities of government and non-government development objectives.

To conclude, this study is not without its limitations. Key limitations include limited exact quantitative data on the number of actors in each of the value chain (number of producers, number of traders, number of wholesalers and retailers) in different regions and locations of the country. This study used snowballing techniques in data collection related to on-farm bamboo resource locations, and processor details among other, and has used key informants and focus group discussions as a main mechanism for data collection. Limitations also arose due to the lack of sufficient resources and time available to complete the study. It is recommended to include bamboo growing and processing activities as separate items during household and enterprise censuses, which will provide a more exact number of the beneficiaries and actors of bamboo sector.

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Annexes

Annex 1: Checklist used in data collection

The checklist for primary data collection has separate sections to gather information on 1) bamboo production systems and products; 2) bamboo resource endowment and property rights issues, and 3) bamboo products development and marketing. Each section may have subsection as necessary.

1. Bamboo resource and production systems

- Describe the condition/management of the bamboo resource in your area?
- What does the access to the resource looks like, property right issues (managed, forest and plantation bamboo)?
- Is there transportation access to the area?
- Constraints and opportunities

2. Bamboo products

- What are the marketable bamboo products in your area? (Can you rank them by current market, potential market?)
- What do you think about application fitting to species (pulp, textile, charcoal, lumber, etc.)
- What are the current and potential uses and applications of bamboo.
- Could you please list the possibilities for adding values to full bamboo resources, from top to bottom, from inside to outside (e.g. outer skin, core tissue, fibre, inner skin)
- Could you suggest some (domestic) markets?
- How feasible are those markets, and will it feasible to export those products? (This is specifically for processors and middleman)

3. Assessing marketing chains

- Are there any issues related to supply and demand of bamboo products?
- Is it possible to map the marketing chains for the major bamboo products(identified)?
- Can you describe the market actors along the market chains, for instance by gender and age?
- Price information at different markets along the market chains?
- Understand the estimated costs of the market actors?
- How are the market facilities?
- What is the share of marketing margins of various actors along the marketing chain? (Producers, processor, etc.)
- Does access to market information marketing legislation, rules and regulation (e.g. export band) affect the sectors?
- Constraint and opportunities

4. Transportation and storage

- Describe the various modes of transport and access to them? Are there any other alternatives you could suggest?
- How do you assess the cost of transportation?
- How do you see the role of middlemen in the marketing system?
- Describe the storage facilities at different stages along the marketing chain?
- Are there any capacity or quality issues related to transportation and storage?
- Explain any transportation and storage related constraint and opportunities?

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

5. Processing

- What are the processing methods?
- How do you see today's bamboo product processing industry?
- Tell us about processed bamboo products, in terms of quality, quantity, and variety?
- How is the value addition process?
- Is there existing capacity (technical as well as financial) for investment in good machinery and operation and maintenance?
- How about technological know-how – access to knowledge (technology transfer, e.g. from China)?
- How do you see the competitiveness of wages and working culture in the processing sectors?
- Is there a reliable energy supply?
- Can you comment on the availability and affordability of inputs for processing i.e. glues, lacquers, stains?
- Any suggestions how to improve the processing stage of the value chain?
- What are the constraints and opportunities related to bamboo product processing?

6. Possibilities for product development

- Can you please list bamboo products you believe are underutilised, where they can be promoted and how to create a better domestic or export market?
- Are there any research and development activities in progress to develop new bamboo products?
- Are there any companies working on innovation of bamboo products?
- Are there testing facilities or laboratories?
- Is there a research and development budget?
- What efforts are in place to ensure sustainability (improving environmental footprint)?
- What about partnership - trust in safeguarding intellectual property (e.g. bio based glue)?

7. Secondary information

- Collect data on the total area of bamboo under different level of management (managed, wild forest, plantations, etc.), measured in hectares.
- How much bamboo can be harvested from each managed, wild forest reserve and plantation, per hectare?
- Data on total production levels and marketing of various bamboo products at the district or regional level. Does this include pricing of the different products?
- Data on sales of bamboo products both on domestic and international (export) markets.
- Data on bamboo product processing companies.
- Data on the various value addition activities in your area.

Annex 2: List of Stakeholder consulted

No	Name	Details / Organisation	Position / Occupation
1	Tegene Tesfaye	Furniture producer	MSE Entrepreneur
2	Sisay Zegeye	Furniture producer	MSE Entrepreneur
3	Sisay Shiberu	Furniture producer	MSE Entrepreneur
4	Biruk G/hawariat	Furniture producer	MSE Entrepreneur
5	Debrework	Furniture producer	MSE Entrepreneur
6	Zelege H/yesus	Furniture producer	MSE Entrepreneur
7	Aberash Ayano	Furniture producer	MSE Entrepreneur
8	Loul	Furniture producer	Artisan
9	Genetwork Teshome	Furniture producer	Artisan
10	Abebaw	Furniture producer	Artisan
11	Beletu Teferi	Furniture producer	MSE Entrepreneur
12	Abraham	Furniture producer	Artisan
13	Fikerte Gebre	Furniture producer	Artisan
14	Tsehay hassen	Furniture producer	Artisan
15	Emebet Dereje	Furniture producer	Artisan
16	Sisay Shiberu	Furniture producer	Artisan
17	Tadele Assefa	Furniture producer	Artisan
18	Mengistu Debebe	Furniture producer	Artisan
19	Woinsshet Achramtew	Furniture producer	Artisan
20	Wubye Tesfaye	Furniture producer	Artisan

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

21	Meseret Tesfaye	Furniture producer	Artisan
22	Fitsume legesse	Furniture producer	Artisan
23	Wondwossen Fekadu	Furniture producer	Artisan
24	Abdu Geremew	Furniture producer	Artisan
25	Abiy Berehanu	Furniture producer	Artisan
26	Derje	Private bamboo handcraft, owner	MSE Entrepreneur
27	BedruOumer	Craft worker	MSE Entrepreneur
28	Sisaye Zegeye	Workshop owner	MSE Entrepreneur
29	GUNET Sahle	Workshop owner	MSE Entrepreneur
30	Solomon Ayele	Now out of business	MSE Entrepreneur
31	Demmwoz	Furniture producer	MSE Entrepreneur
32	Abezash Haile	Entrepreneur, Debora Small and Micro Enterprise	MSE Entrepreneur
33	Demoze Dejene	Member of Small and Micro Enterprises	Artisan
34	Berhanu Yetwal	Hosana Bamboo Furniture	Artisan
35	Muluken Kassie	Handcraft Entrepreneur in Injibara	Artisan
36	Asaye Bizuneh	Handcraft Entrepreneur in Bahirdar	Artisan
37	Abdu Geremew	Craft worker	Artisan
38	Abush Bogale	Craft worker	Artisan
39	Ababau Amare	Craft worker	Artisan
40	Loulsegged Lemma	Craft worker	Artisan
41	TegeneTsfaye	Craft worker	Artisan
42	Kidest Alemayehu	Craft worker	Artisan

43	WondwosenYohanes	Craft worker	Artisan
44	Abdu Geremew	Craft worker	Artisan
45	AbushBogale	Craft worker	Artisan
46	AbabauAmare	Craft worker	Artisan
47	Loulsegged Lemma	Craft worker	Artisan
48	TegeneTesfaye	Craft worker	Artisan
49	Kidest Alemayehu	Craft worker	Artisan
50	WondwosenYohanes	Craft worker	Artisan
51	Abiy Berhanu	Craft worker	Artisan
52	Seid Abdu	Bamboo craft	Artisan
53	JemalHusen	Bamboo craft	Artisan
54	Abdu Endris	Bamboo craft	Artisan
55	Tenawe Alamerew	Private bamboo handcraft owner, Roubu Gebya Bamboo market dealer	MSE Entrepreneur
56	Tefera Tadesse	Sidama Zone Forest Protection and Environment	Expert
57	Gossaye Godana	Sidama Zone Forest Protection and Environment , Forest Resource Development and Protection Expert	Expert
58	Mulugeta Gonfa	Wood and Bamboo Technologist, RTTI	Workshop Head
59	Amanuel Endale	Arbegona Woreda Agricultural Inputs Marketing	Coordinator
60	Gossaye Egata	Arbegona Woreda Agricultural Inputs and Marketing	Coordinator
61	Tewabech Tefera	Arbegona Woreda Agriculture and Natural Resources	Office head
62	Mestawot Mengist	Manufacturing Industry Development Enterprise	Expert
63	Tajudin Indris	Manufacturing Industry Development Enterprise	Expert

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

64	Wube Belam	Hawasa City Enterprise Development Core Work Process, Coordinator	Coordinator
65	Fantanesh Anmawu	Awi Zone Agriculture and Natural Resource Office, Agroforestry	Expert
66	Dagnewu Amsalu	Awi Zone Agriculture and Natural Resource Office, Agroforestry	Expert
67	Ayele Asres	Awi Zone Trade and Industry, Trade registration and licensing	Coordinator
68	Alemayehu Gebeyehu	Awi Zone Cooperative Promotion Office	Office head
69	Bogale Ayele	Awi Zone Small Micro Enterprises, Job Creation	Expert
70	Alemayehu Wassie	Tana Pulp and Paper Project Office, Manager	Manager
71	Tilahun Workneh	Awi Zone Small and Micro Enterprise, head	Office head
72	Abatneh Destaw	Amhara Credit and Saving Association, Awi Zone Office	Expert
73	Nesanet	East Gojjam Zone Agricultural office, Process Owner of the NRM department	Division head
74	Agengheu Gashe	Amhara region Agriculture office, Head of NRM department	HRM head
75	Yeshane Biresawu	Banja Woreda Cooperative Promotion Office	Coordinator
76	MulatuTeshale	Addis Ababa Officer in food security	Expert
77	GetachewTesfaye	Addis Ababa Division head at FeSMMIDA	Division Head
78	Tsehaynesh Aweka	Assosa ReMSEDA	Officer
79	AbiyAbebe	Bambasi Micro and small Enterprise Agency.	Technician
80	Ketema Bajiga	Banja Woreda natural resource department	Dep. Head
81	Daniel Belay	Ethiopia, MoEFCC	Expert
82	Ashebir Wondimu	Ethiopia, MoEFCC	Senior Expert
83	Wogane Mosisa	Haro-Wonchi Woreda natural resource department	Expert
84	Qanna Ararsa	Haro-Wonchi Woreda natural resource department	Officer
85	Wakuma Ango	Kebele official /community leaders	Kebele office manager

86	Tashome Dasalegn	official /community leaders	Community Leader/Consumer
87	Kahlid Duri	African bamboo plc	G. manager
88	Tesfaye Haile	Ethiopia tourist trading Enterprise	Production Department Head
89	Michael Gebru	Bamboo star plc	Owner/manager
90	Chirstopher Cleur	African bamboo	Director/Consumer
91	Shitaye Molla	Basket making trainer in OFWE	Trainer
92	Negestat	Abreham Geletu Bamboo Factory Plc.	Expert
93	Masresh Armede	Basket making trainer in OFWE	Trainer
94	TebebuTamene	Tebebu wood and bamboo plc	Owner Manager
95	Tarekegn Bogale	Bamboo grower / Farmer	Farmer
96	Abtewu Amsalu	Bamboo grower / Farmer	Farmer
97	Shite Lule	Bamboo grower / Farmer	Farmer
98	Tadessa Megersa	Bamboo grower / Farmer	Farmer
99	Abeba Lema	Bamboo grower / Farmer	Farmer
100	Abye Agegnehu	Bamboo grower / Farmer	Farmer
101	Getachew Engdayehu	East Gojjam Zone Poly technique Institute	Vice Dean
102	Embale Merkebu	Injibara Poly-Technique College	Dean
103	Assamenew	East Gojjam Zone small and Medium development office	Representative officer
104	Yegardu Mengistu	Environment and forest research institute	Researcher
105	Denamo Adisse	Ethiopia institute of Architecture, building construction and city planning	Chair holder/Lecturer
106	AlemAfework	Engineer in rural technology development	Department Head
107	AshadeliOumer	Rural tech. technician	Technician

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

108	Wubalem Tadesse	Environment and forest research institute	Director General
109	Abiy Assefa	Jimma University	Researcher/Lecturer
110	Getachew Enigedawe	Bibugn Woreda INBAR-SLMP-II site, INBAR	Coordinator
111	Hymanote	INBAR-EARO, SLMP-II, INBAR-EARO technical Officer	Coordinator
112	Zerihun Adenew	INBAR EARO	Technical Officer
113	Wondimagegn Bekele	INBAR, EARO	Technical Officer
114	Tesfaye Hunde	INBAR, EARO	Training Coordinator
115	Selim Raza	INBAR EARO	Project Manager
116	Bedilu Kifle	INBAR EARO	Project Coordinator
117	Yohanes Adane	Shere resident	Teacher/Consumer
118	Girma Deriba	FeSMMIDA	Division Head/Consumer
119	Yonas Kassa	Addis Ababa resident	Consumer
120	Selam Lemma	Ethiopia institute of Architecture, building construction and city planning	Lecturer/Consumer
121	Dawit Girma	Ethiopia institute of Architecture, building construction and city planning	Lecturer/Consumer
122	Murad Zeleke	Productivity improvement centre	Director/Consumer
123	Dereje Kebede	Addis Ababa resident	Consumer
124	Assefa/bamboo paradise	Assosa Resident	Hotel Manager/owner Consumer
125	Shewa Watango	Hawasa resident	Retired civil servant/Consumer
126	Seme dessie	Dere Enchini bamboo culm trader	Trader
127	Mahammed kedir	Addis Ababa bamboo culm trader	Trader
128	Haimanot s/michael	Structural engineer	Lecturer/Consumer

Annex 3: Top 25 bamboo growing Woredas in Ethiopia

Woreda	Zone	Region	Bamboo area in Km ²	Species
Quara	North Gondar	Amhara	2662.75	<i>Oxytenanthera abyssinica</i>
Guba	Metekel	BSG	2575.12	<i>Oxytenanthera abyssinica</i>
Dangura	Metekel	BSG	1295.37	<i>Oxytenanthera abyssinica</i>
Wenbera	Metekel	BSG	1137.85	<i>Oxytenanthera abyssinica</i>
Bulen	Metekel	BSG	846.41	<i>Oxytenanthera abyssinica</i>
Dibate	Metekel	BSG	524.37	<i>Oxytenanthera abyssinica</i>
Kamashi	Kemashi	BSG	470.66	<i>Oxytenanthera abyssinica</i>
Yaso	Kemashi	BSG	380.38	<i>Oxytenanthera abyssinica</i>
Mandura	Metekel	BSG	360.29	<i>Oxytenanthera abyssinica</i>
Agalometi	Kemashi	BSG	315.69	<i>Oxytenanthera abyssinica</i>
Bilidigilu	Assosa	BSG	296.32	<i>Oxytenanthera abyssinica</i>
Assosa	Assosa	BSG	236.98	<i>Oxytenanthera abyssinica</i>
Belo Jiganfoy	Kamashi	BSG	213.46	<i>Oxytenanthera abyssinica</i>
Manusibu	West Wellega	Oromia	198.85	<i>Oxytenanthera abyssinica</i>
Matema	North Gondar	Amhara	197.02	<i>Oxytenanthera abyssinica</i>
Haro Limu	East Wellega	Oromia	189.20	<i>Oxytenanthera abyssinica</i>
Homosha	Assosa	BSG	174.04	<i>Oxytenanthera abyssinica</i>
Sirbabay	Kemashi	BSG	168.27	<i>Oxytenanthera abyssinica</i>
Guangua	Awi/Agew	Amhara	147.42	<i>Oxytenanthera abyssinica</i>
Gimbi	West Wellega	Oromia	147.01	<i>Yushania alpina</i>
Bambasi	Assosa	BSG	137.10	<i>Oxytenanthera abyssinica</i>
Gida Kiremu	East Wellega	Oromia	114.33	<i>Oxytenanthera abyssinica</i>
Gudetu Kondole	West Wellega	Oromia	109.00	<i>Oxytenanthera abyssinica</i>
Chwaka	Ilubabor	Oromia	98.19	<i>Yushania alpina</i>
Maokomo Special	Assosa	BSG	95.56	<i>Oxytenanthera abyssinica</i>

Source: INBAR-Tsinghua University (2017)

Annex 4 A: Technical specification: *Oxytenanthera abyssinica* (Bambasi, BSG)

Size	Portion	Diameter	Thickness	Inter-nodal length
Large (Total Height 7 m)	Bottom	7 cm	3.5 cm	10 cm
	+1.5 m	4 cm	1.5 cm	13 cm
	+ 3 m	3 cm	0.8 cm	27 cm
	+ 4.5 m	2.5 cm	0.7 cm	30 cm
	+ 6 m	1.8 cm	0.3 cm	25 cm
Medium (Total height 6 m)	Bottom	6 cm	3 cm	10 cm
	+1.5 m	4.8 cm	2.2 cm	18 cm
	+ 3 m	2.5 cm	1.8 cm	27 cm
	+4.5 m	2.1 cm	1 cm	21 cm
	+ 6 m	1.5 cm	0.6 cm	17.5 cm
Small (total height 5 m)	Bottom	2 cm	1 cm	10cm
	+ 1.5 m	1.4 cm	0.7 cm	15cm
	+3 m	1 cm	0.5 cm	17cm
	+4.5 m	0.7 cm	0.3 cm	15cm

Availability of bamboo as per the size

Large	38 per cent
Medium	40 per cent
Small size	22 per cent

Annex 4 B: Technical specification: *Oxytenanthera abyssinica* (Dansha, Tigray)

Size	Portion	Diameter	Thickness	Inter-nodal length
Large (Total Height 8 m)	Bottom	4 cm	2 cm	15 cm
	+1.5 m	3.4 cm	1.5 cm	
	+ 3 m	2.6 cm	1.1 cm	24 cm
	+ 4.5 m	2 cm	0.8 cm	
	+ 6 m	1.3 cm	0.4 cm	
	+7.5 m	0.9 cm	0.3 cm	18 cm
Medium (Total height 6.6 m)	Bottom	3.2 cm	1.1.4 cm	14 cm
	+1.5 m	2.8 cm	1.2 cm	21 cm
	+ 3 m	2.2 cm	0.8 cm	27 cm
	+4.5 m	1.8cm	0.6 cm	23 cm
	+ 6 m	1.3 cm	0.5 cm	17.5 cm
Small (total height 5.4 m)	Bottom	2.5 cm	1.2 cm	9 cm
	+ 1.5 m	2 cm	0.8 cm	12 cm
	+3 m	1.6 cm	0.5 cm	19.5 cm
	+4.5 m	1.1 cm	0.3 cm	13 cm

Availability of bamboo as per the size

Large	20 per cent
Medium	35 per cent
Small size	45 per cent

Annex 5: List of *Yushania alpina* bamboo growing villages (Small holder Farms)

Region	Zone	Woreda / District	Kebele / Village	Bamboo species
SNNPRS	Sidama	Hagare Selam	Kenkicha	<i>Yushania alpina</i>
			Bursa	<i>Yushania alpina</i>
			Abela	<i>Yushania alpina</i>
			Gerbicho	<i>Yushania alpina</i>
			Olonso	<i>Yushania alpina</i>
			Bongado	<i>Yushania alpina</i>
			Chelbesa	<i>Yushania alpina</i>
			Luda	<i>Yushania alpina</i>
			Janjire	<i>Yushania alpina</i>
			Teticha	<i>Yushania alpina</i>
			Gasie	<i>Yushania alpina</i>
			Hangie	<i>Yushania alpina</i>
			Babicha	<i>Yushania alpina</i>
			Bochesa	<i>Yushania alpina</i>
			Ankubaya	<i>Yushania alpina</i>
			Sororo	<i>Yushania alpina</i>
			Udesa	<i>Yushania alpina</i>
			Shako	<i>Yushania alpina</i>
			Finchowa	<i>Yushania alpina</i>
			Kersa	<i>Yushania alpina</i>
			Faficho	<i>Yushania alpina</i>
			Chirone	<i>Yushania alpina</i>
			Godayo	<i>Yushania alpina</i>
		Arbegona	Sidefolish	<i>Yushania alpina</i>
			Chucho	<i>Yushania alpina</i>
			Gutie	<i>Yushania alpina</i>
			Shedamo	<i>Yushania alpina</i>
			Toga	<i>Yushania alpina</i>
			Goba	<i>Yushania alpina</i>
			Toshine	<i>Yushania alpina</i>
			Wala	<i>Yushania alpina</i>
			Dinto darara	<i>Yushania alpina</i>
			Afursanameto	<i>Yushania alpina</i>
			Shasho	<i>Yushania alpina</i>
			Kero chancho	<i>Yushania alpina</i>
			Mayu tolicha	<i>Yushania alpina</i>
			Sambura	<i>Yushania alpina</i>
			Beto	<i>Yushania alpina</i>
			Hure	<i>Yushania alpina</i>
			Danducho	<i>Yushania alpina</i>

SNNPRS	Sidama	Arbegona	Shafamo	<i>Yushania alpina</i>
			Jaldo	<i>Yushania alpina</i>
			Chiko	<i>Yushania alpina</i>
			Muchacho	<i>Yushania alpina</i>
			Katana	<i>Yushania alpina</i>
			Akile	<i>Yushania alpina</i>
	Sheka	Masha	Getipa	<i>Yushania alpina</i>
			Selenono	<i>Yushania alpina</i>
	Keffa	Adio	Modio	<i>Yushania alpina</i>
			Mera	<i>Yushania alpina</i>
			Boka	<i>Yushania alpina</i>
		Bonga	Ameya	<i>Yushania alpina</i>
Amhara	Awi	Banja	Kessa	<i>Yushania alpina</i>
			Gashena	<i>Yushania alpina</i>
			Musla	<i>Yushania alpina</i>
			Danguta	<i>Yushania alpina</i>
			Basanagana	<i>Yushania alpina</i>
			Akenajity	<i>Yushania alpina</i>
			Asera	<i>Yushania alpina</i>
			Asem	<i>Yushania alpina</i>
			Minlakyte	<i>Yushania alpina</i>
			Chabanagita	<i>Yushania alpina</i>
			Lidjigola	<i>Yushania alpina</i>
			Kalu	<i>Yushania alpina</i>
			Chankit lideta	<i>Yushania alpina</i>
		Guangua shikudad	Tilili	<i>Yushania alpina</i>
			Jibayata	<i>Yushania alpina</i>
			Ageza	<i>Yushania alpina</i>
			Ashefa	<i>Yushania alpina</i>
	Mirab Gojjam	Bure	Wumbri	<i>Yushania alpina</i>
			Skekudad	<i>Yushania alpina</i>
			Agnis Fereda	<i>Yushania alpina</i>
			Jib Gedel	<i>Yushania alpina</i>
		Debub Achefer	Boko Tabo	<i>Yushania alpina</i>
			Anbesa	<i>Yushania alpina</i>
			Belel	<i>Yushania alpina</i>
			Ankasa	<i>Yushania alpina</i>
			Zebeset	<i>Yushania alpina</i>
			Hanfa	<i>Yushania alpina</i>
		Dembecha	Yecherekatsion	<i>Yushania alpina</i>
			Kuresa	<i>Yushania alpina</i>
			Anejene	<i>Yushania alpina</i>
			Wadan	<i>Yushania alpina</i>
			Gelela	<i>Yushania alpina</i>

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Amhara	Mirab Gojjam	Addis Kidam		<i>Yushania alpina</i>
		Wemberma	Koli	<i>Yushania alpina</i>
			Jawambi	<i>Yushania alpina</i>
			Woinema	<i>Yushania alpina</i>
		Yilmana Densa	Semareja	<i>Yushania alpina</i>
			Ayebat	<i>Yushania alpina</i>
			Chinkulit	<i>Yushania alpina</i>
			Yezora	<i>Yushania alpina</i>
			Dabal	<i>Yushania alpina</i>
			Zagei	<i>Yushania alpina</i>
			Anbesit	<i>Yushania alpina</i>
		Aneded	NA	<i>Yushania alpina</i>
		Awabel	NA	<i>Yushania alpina</i>
		Baso Liben	NA	<i>Yushania alpina</i>
		Bibugn	NA	<i>Yushania alpina</i>
	East Gojjam	Bibugn	Wonber K.yohanes	<i>Yushania alpina</i>
			Debretsion	<i>Yushania alpina</i>
			Arusi mesebsebia	<i>Yushania alpina</i>
			Molsa	<i>Yushania alpina</i>
			Dedeyesus abo	<i>Yushania alpina</i>
			Gunetemariam	<i>Yushania alpina</i>
			Debrezeitkuchit	<i>Yushania alpina</i>
			Kebesy	<i>Yushania alpina</i>
			Dungo kanta	<i>Yushania alpina</i>
		Senan	Gedanait	<i>Yushania alpina</i>
			Tachlaby	<i>Yushania alpina</i>
			Tlazamo	<i>Yushania alpina</i>
			Alziish	<i>Yushania alpina</i>
			Sinan	<i>Yushania alpina</i>
		Kuye	Ankote	<i>Yushania alpina</i>
			Sheme	<i>Yushania alpina</i>
			Nazret	<i>Yushania alpina</i>
			Debreyesus	<i>Yushania alpina</i>
Oromia	Bale	Gololcha Bale	NA	<i>Yushania alpina</i>
		Goro	NA	<i>Yushania alpina</i>
		Gura Damole	NA	<i>Yushania alpina</i>
		Herena Buluk	NA	<i>Yushania alpina</i>
		Lege Hida	NA	<i>Yushania alpina</i>
		Mena	NA	<i>Yushania alpina</i>
		Rayitu	NA	<i>Yushania alpina</i>

Oromia	Bale	Seweyna	NA	<i>Yushania alpina</i>
		Sinan	NA	<i>Yushania alpina</i>
	Arsi	Amigna	NA	<i>Yushania alpina</i>
		Aseko	NA	<i>Yushania alpina</i>
		Bele Gesgar	NA	<i>Yushania alpina</i>
		Chole	NA	<i>Yushania alpina</i>
		Degaluna Tijo	NA	<i>Yushania alpina</i>
		Diksis	NA	<i>Yushania alpina</i>
		Dodolo	NA	<i>Yushania alpina</i>
		Gololcha Arsi	NA	<i>Yushania alpina</i>
		Guna	NA	<i>Yushania alpina</i>
		Hitosa	NA	<i>Yushania alpina</i>
		Inkolo Wabe	NA	<i>Yushania alpina</i>
		Jeju	NA	<i>Yushania alpina</i>
		Limu Bilbilo	NA	<i>Yushania alpina</i>
		Lude Hitosa	NA	<i>Yushania alpina</i>
		Merti	NA	<i>Yushania alpina</i>
		Munessa	NA	<i>Yushania alpina</i>
		Seru	NA	<i>Yushania alpina</i>
		Shirka	NA	<i>Yushania alpina</i>
		Sire	NA	<i>Yushania alpina</i>
		Sude	NA	<i>Yushania alpina</i>
		Tena	NA	<i>Yushania alpina</i>
		Tiyo	NA	<i>Yushania alpina</i>
		Ziway Dugda	NA	<i>Yushania alpina</i>
	Debub Mirab Shewa	Wolisso	NA	<i>Yushania alpina</i>
		Wonchi	NA	<i>Yushania alpina</i>
	Guji	Adola	NA	<i>Yushania alpina</i>
		Afele Kola	NA	<i>Yushania alpina</i>
		Ana Sora	NA	<i>Yushania alpina</i>
		Bore	NA	<i>Yushania alpina</i>
	SW Showa	Wonchi	Haro Wonchi	<i>Yushania alpina</i>
			Azerkerensa	<i>Yushania alpina</i>
			Shegeg	<i>Yushania alpina</i>
			Woldotelsem	<i>Yushania alpina</i>
			Shitewato	<i>Yushania alpina</i>
			Marega	<i>Yushania alpina</i>
			Chebo senselet	<i>Yushania alpina</i>
			Worab	<i>Yushania alpina</i>
			Edofura	<i>Yushania alpina</i>

Annex 6A: Technical specification of *Yushania alpina* (Hula, SNNPRS)

Size	Portion	Diameter	Thickness	Inter-nodal length
Large (Total Height 12 m)	Bottom	8 cm	1.7 cm	40 cm
	+1.5 m	6.5 cm	1.3 cm	
	+ 3 m	4.7 cm	1 cm	50 cm
	+ 4.5 m	3.2 cm	0.7 cm	
	+ 6 m	2.8 cm	0.5 cm	
	+7.5 m	2.3 cm	0.4 cm	42 cm
	+ 8 m	2 cm	0.4 cm	
	+ 9.5 m – 11 m	1.5 cm	0.3 cm	
Medium (Total height 10 m)	Bottom	7 cm	2.5 cm	28 cm
	+1.5 m	6.3 cm	1.8 cm	30 cm
	+ 3 m	5.2 cm	1.2 cm	38 cm
	+4.5 m	5 cm	0.8 cm	38 cm
	+ 6 m	3.8 cm	0.6 cm	32 cm
	+ 7.5 m	2.9 cm	0.2 cm	25 cm
	+ 9 m	1.5 cm	0.2 cm	25 cm
Small (total height 8 m)	Bottom	3 cm	0.8 cm	30 cm
	+ 1.5 m	2.8 cm	0.6 cm	26 cm
	+3 m	2.8 cm	0.4 cm	23 cm
	+4.5 m	1.8 cm	0.4 cm	20 cm
	+6 m	1.3 cm	0.3 cm	18 cm
	+7.5 m	0.5 cm	0.3cm	20 cm

Availability of bamboo as per the size

Large	15 per cent
Medium	55 per cent
Small size	30 per cent

Annex 6B: Technical specification of *Yushania alpina* (Gurage, SNNPRS)

Size	Portion	Diameter	Thickness	Inter-nodal length
Large (Total Height 12 m)	Bottom	8 cm	1.5 cm	45 cm
	+1.5 m	7 cm	1.3 cm	
	+ 3 m	5.6 cm	1.1 cm	60 cm
	+ 4.5 m	4.8 cm	0.7 cm	
	+ 6 m	3.7 cm	0.5 cm	
	+7.5 m	3 cm	0.5 cm	50 cm
	+ 8 m	2 cm	0.4 cm	
	+ 9.5 m – 11 m	1.6 cm	0.2 cm	
Medium (Total height 10 m)	Bottom	7 cm	2.5 cm	28 cm
	+1.5 m	6 cm	1.8 cm	32 cm
	+ 3 m	5.2 cm	1.2 cm	38 cm
	+4.5 m	4 cm	0.8 cm	35 cm
	+ 6 m	3.1 cm	0.6 cm	32 cm
	+ 7.5 m	2.7 cm	0.2 cm	25 cm
	+ 9 m	1.9 cm	0.2 cm	27 cm
Small (total height 8 m)	Bottom	5 cm	0.8 cm	30 cm
	+ 1.5 m	4.2 cm	0.6 cm	26 cm
	+3 m	3.8 cm	0.4 cm	23 cm
	+4.5 m	3.2 cm	0.4 cm	20 cm
	+6 m	2.6 cm	0.3 cm	18 cm
	+7.5 m	1.5 cm	0.3cm	20 cm

Availability of bamboo as per the size

Large	30 per cent
Medium	55 per cent
Small size	15 per cent

Annex 6C: Technical specification of *Yushania alpina* (Sheka, SNNPRS)

Size	Portion	Diameter	Thickness	Inter-nodal length
Large (Total Height 12 m)	Bottom	9 cm	1.5 cm	50 cm
	+1.5 m	7 cm	1.3 cm	
	+ 3 m	5.6 cm	1.1 cm	
	+ 4.5 m	4.8 cm	0.7 cm	65 cm
	+ 6 m	3.7 cm	0.3 cm	
	+7.5 m	3 cm	0.3 cm	45 cm
	+ 8 m	2 cm	0.2 cm	
	+ 9.5 m – 11 m	1.6 cm	0.2 cm	
Medium (Total height 10 m)	Bottom	7 cm	1.5 cm	45 cm
	+1.5 m	6 cm	1.2 cm	38 cm
	+ 3 m	5.2 cm	0.9 cm	29 cm
	+4.5 m	4 cm	0.6 cm	21 cm
	+ 6 m	2.9 cm	0.6 cm	20.5 cm
	+ 7.5 m	1.8 cm	0.23 cm	20 cm
	+ 9 m	1.3 cm	0.2 cm	21.5 cm
Small (total height 8 m)	Bottom	5 cm	1 cm	33 cm
	+ 1.5 m	4.2 cm	0.8 cm	26 cm
	+3 m	3.8 cm	0.5 cm	21.5 cm
	+4.5 m	3.2 cm	0.3 cm	17.5 cm
	+6 m	2.6 cm	0.2 cm	15 cm
	+7.5 m	1.5 cm	0.2cm	15.5 cm

Availability of bamboo as per the size

Large	50 per cent
Medium	35 per cent
Small size	15 per cent

Annex 6D: Technical specification of *Yushania alpina* (Dere Enchini, Oromia)

Size	Portion	Diameter	Thickness	Inter-nodal length
Large (Total Height 12 m)	Bottom	9 cm	2.3 cm	22 cm
	+1.5 m	7.5 cm	2 cm	
	+ 3 m	6.4 cm	1.6 cm	
	+ 4.5 m	5.5 cm	1 cm	54 cm
	+ 6 m	4.8 cm	0.7 cm	
	+7.5 m	3.4 cm	0.4 cm	
	+ 8 m	2.9 cm	0.4 cm	60 cm
	+ 9.5 m – 11 m	1.9 cm	0.2 cm	
Medium (Total height 10 m)	Bottom	7.5 cm	2. cm	45 cm
	+1.5 m	6.8 cm	1.8 cm	42 cm
	+ 3 m	5.2 cm	1.3 cm	38 cm
	+4.5 m	4 cm	0.8 cm	35 cm
	+ 6 m	3. cm	0.6 cm	35 cm
	+ 7.5 m	2.4 cm	0.3 cm	32 cm
	+ 9 m	1.9 cm	0.2 cm	32 cm
Small (total height 8 m)	Bottom	5 cm	0.8 cm	30 cm
	+ 1.5 m	4.2 cm	0.6 cm	26 cm
	+3 m	3.6 cm	0.45 cm	23 cm
	+4.5 m	3.2 cm	0.4 cm	20 cm
	+6 m	2.5 cm	0.3 cm	18 cm
	+7.5 m	1.8 cm	0.3cm	20 cm

Availability of bamboo as per the size

Large	20 per cent
Medium	65 per cent
Small size	15 per cent

Annex 6E: Technical specification of *Yushania alpina* (Addis Kidam, Amhara)

Size	Portion	Diameter	Thickness	Inter-nodal length
Large (Total Height 12)	Bottom	8 cm	2 cm	40 cm
	+1.5 m	7.5 cm	1 cm	
	+ 3 m	7 cm	0.7 mm	65 cm
	+ 4.5 m	6.5 cm	0.6 cm	
	+ 6 m	5.7 cm	0.5 cm	
	+7.5 m	5.3 cm	0.4 cm	55 cm
	+ 8 m	4.5 cm	0.4 cm	
	+ 9.5 m – 11 m	3.3 cm	0.3 cm	
Medium (Total height 10 m)	Bottom	7 cm	1.5 cm	31 cm
	+1.5 m	6.3 cm	0.8 cm	46 cm
	+ 3 m	5.5 cm	0.6 cm	53 cm
	+4.5 m	5 cm	0.6 cm	55 cm
	+ 6 m	4.3 cm	0.5 cm	57 cm
	+ 7.5 m	3.5 cm	0.5 cm	52 cm
	+ 9 m	2.5 cm	0.4 cm	42 cm
Small (total height 8,5 m)	Bottom	5.4 cm	1.4 cm	34 cm
	+ 1.5 m	4.3 cm	0.5 cm	56 cm
	+3 m	4 cm	0.4 cm	61 cm
	+4.5 m	3.7 cm	0.4 cm	53 cm
	+6 m	2.9 cm	0.35 cm	46 cm
	+7.5 m	1.8 cm	0.3 cm	31 cm

Availability of bamboo as per the size

Large	30 per cent
Medium	50 per cent
Small size	20 per cent

Annex 7: Yushania alpina: Bamboo Pole Price at Farm Gate and Trading Point

S.No	Species	Region	Woreda	Farm Gate Price (Birr)								Traders Selling Price (Birr)															
				Size in Diameter (in cm)								Size in Diameter (in cm)															
				> 8 cmø				3 - 7 cmø				< 3cmø				> 8 cmø				3 - 7 cmø				< 3cmø			
				WS	RE	WS	RE	WS	RE	Average (WS)	Average (RE)	WS	RE	WS	RE	Average (WS)	Average (RE)	WS	RE	WS	RE	Average (WS)	Average (RE)				
1		SNNPR	Hula	16.0	18.0	15.0	13.0	10.0	12.0	14	14	22.0	22.0	18.0	15.0	14.0	12.0	18.0	16								
2			Daye	NA	18.0	NA	15.0	NA	7.0	NA	13	NA	22.0	NA	18.0	NA	11.0	NA	17								
3			Bursa	NA	18.0	NA	10.0	NA	NA	NA	14	21.0	18.0	22.0	20.0	10.0	8.0	17.7	15								
4			Bensa	NA	18.0	NA	10.0	NA	NA	NA	14	NA	20.0	NA	17.0	NA	NA	NA	19								
5			Bore	NA	18.0	NA	15.0	NA	7.0	NA	13	NA	21.0	NA	17.0	NA	9.0	NA	16								
6			Arbegona	NA	21.0	NA	12.0	NA	7.0	NA	13	NA	23.0	NA	15.0	NA	12.0	NA	17								
7			Dilla	NA	18.0	NA	15.0	NA	7.0	NA	13	NA	20.0	NA	18.0	NA	11.0	NA	16								
8			Agena	30.0	30.0	24.0	24.0	12.0	12.0	22	22	33.0	32.0	30.0	30.0	15.0	15.0	26.0	26								
9			Mojo	NA	23.0	NA	19.0	NA	11.0	NA	18	NA	27.0	NA	23.0	NA	11.0	NA	20								
10	Yushania Alpina	Oromia	Wonchi	NA	25.0	NA	12.5	NA	7.5	NA	15	NA	29.0	NA	16.0	NA	9.0	NA	18								
11				Herero	18.0	18.0	11.0	11.0	7.0	7.0	12	22.0	20.0	18.0	17.0	9.0	12.0	16.3	16								
12				Goba	NA	9.0	NA	6.0	NA	5.0	NA	7	NA	NA+A.1	NA	NA	NA	NA	NA								
13				Shedem	NA	15.0	NA	10.0	NA	6.0	NA	10	NA	21.0	NA	17.0	NA	10.0	NA	16							
14				Shenen	18.0	20.0	14.0	15.0	7.0	7.0	13	14	22.0	23.0	15.0	19.0	9.0	9.0	15.3	17							
15				Dere Enchini	12.0	13.0	10.0	11.0	7.0	9.0	10	11	18.0	22.0	16.0	18.0	9.0	11.0	14.3	17							
16		Amhara	Injibara	20.0	23.0	13.0	17.0	9.0	12.0	14	17	25.0	26.0	20.0	22.0	13.0	14.0	19.3	21								
17			Bibugn	NA	25.0	NA	17.0	NA	8.0	NA	17	NA	29.0	NA	22.0	NA	13.0	NA	21								
18			Eraebebeyea	15.0	16.0	12.0	11.0	8.0	7.0	12	11	21.0	22.0	17.0	18.0	12.0	13.0	16.7	18								
19			Kesa chawsa	22.0	24.0	18.0	15.0	12.0	12.0	17	17	23.0	24.0	17.0	20.0	15.0	15.0	18.3	20								
20			Debratabar	NA	12.0	NA	10.0	NA	5.0	NA	9	NA	18.0	NA	15.0	NA	8.0	NA	14								
21			Gassegne	NA	12.0	NA	10.0	NA	5.0	NA	9	NA	19.0	NA	18.0	NA	12.0	NA	16								
22			Addis Ababa									30.0	32.0	26.0	27.0	16.0	18.0	24.0	26								
23			Bahirdar									35.0	35.0	35.0	35.0	0.0	0.0	35.0	35								

Note: WS (Wholesale); RE (Retail)

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Annex 8: Details of Bamboo Pole Traders

No	Region	Specific area	Location: Bamboo Sourcing	Location: Sale	No. of traders
1	Addis Ababa	Markato	SNNPR, (Gurage)	Addis Ababa	5
		Urael	SNNPR, (Gurage); Oromia(Dere Enchini)	Addis Ababa	1
				Sub total	6
2	Amhara	Injibara	Amhara (Banja, Guagusa and Jawi)	Addis Ababa, Bahirdar	12
				Sub total	12
3	BSG	Assosa	BSG (Kurmuk and Gizen)	Bambasi, Assosa	5
		Bambasi	BSG (Anbessa and Chaka)	Assosa, Bambasi	3
				Sub total	8
4	Oromia/West Shewa	Dere Enchini	Dere Enchini and Shenen	Addis Ababa	6
				Sub total	6
5	SNNPRS	Hula	Arbegona, Hula, Bursa, Bore	Addis Ababa, Hawasa and local sales	3
		Arbegona	Arbegona, Hula, Bursa, Bore	Addis Ababa, Hawasa, Mojo and local sales	2
		Bule	Bula	Local Sales	3
		Masha	Masha	Local Sales	6
				Sub total	14
				Total	46

Annex 9: Locational Details of Bamboo Mat Processors

S.No	Region	Zone	Woreda	Kebele / location	#Households	Organisation
1	Addis Ababa	Addis Ababa	Urael area		1	Kidest Alemayehu
2			Urael area		40	Association for rehabilitation of Girls
3			Saris		2	Oromia Forest Research Enterprise
				Sub Total	43	
4	Amhara Region	East Gojjam	Addis Kidam; Fagta Lekoma	Quara, Degiabola, Gezhar	200	Community
			Achefer	Anbesa, Bebel, Zebest	60	Community
6			Yelmanadensa	Semarga, Ayebar, Yezora, Chinkulit	40	Community
7			Dembecha	Kursa, Anjeni, Gelila, Wadan	50	Community
8			Wonberma	Koli, Jawambi, Woynema	70	Community
9		Awi	Tilili; Guagusa Shikudad	Jibayta, Atkuna, Agza, Asifa	350	Community
10			Injibara; Banja	Ageza, Ashefa, Banja Guagusa, Jawi	40	Community
				Sub Total	810	
11	Benishangul Gumuz	Metekel	Mambuk	Mambuk	10	Community
12		Pawe Special	Guba	Guza, Alwad, Rasa, Yarenja	40	Community
				Sub Total	50	
13	Oromia Region	West Showa	Dere Enchini	Buyema kochore, Dalfo	60	Community
14		Bale	Bale	Rira, Delo, Kecha	50	Community
15			Arsi	Kokosa, Adaba, Herero, Kofelele	40	Community
				Sub Total	150	
16	SNNPR	Keficho	Andaracha	Getiba, Yena, Duena	200	Community
17			Masha	Gada, Gatimo, Aeso, Atle	80	Community
18		Sidama	Yirgalem	Dale, Hansho, Aleta	75	Community
19			Hula	Teticha, kenkicha, Abela	210	Community
20			Arbegona	Daye, Sidofolish, Toga	50	Community
21			Daye	Sidofolish, Toga	50	Community
22		Gedeo	Bursa	Shafamo, Sororo, Bulancho, Bakala	80	Community
23			Bule	Soberi, Haro, Loke	90	Community
				Sub Total	835	
				Total	1888	

Annex 10: Locational Details of Bamboo Mat Processors

No	Region	Zone	Woreda	Kebele / Location	# of HH / craftsmen	(%) per region
1	Addis Ababa		Addis Ababa	St.Urael, Abuar, Piassa	42	
				Sub Total	42	2
2	Amhara Region	Agew Awi	Fagta Lekoma	Quara, Degiabola, Gezhara	180	
3			Banja	Agiza, Ashifa, Banja Guagusa, Jawi	150	
4			Chagni	Chagni	150	
5		East Gojjam	Bure	Bakotabo, Jibgedel, Shikudad	100	
6			Bibugn	Bahataye, Kuchit, Ajora	90	
7			Achefer	Anbessa, Belel, Zebest	85	
8			Dembecha	Kursa, Anjeni, Gelila, Wadan	60	
9			Yelmanadensa	Semarga, Ayebar, Yezora, Chinkulit	35	
				Sub total	850	34
10	Benishangul Gumuz	Metekel	Mambuk	Kutameda, Kurmuk	100	
11		Assosa	Assosa	Komosha, Kibur Hamsa	6	
				Sub total	106	4
12	Oromia	East Showa	Wonchi	Shegege, Shitawato, Azerkerensa	140	
13		West Showa	Dere Enchini	Buyema lochore, Buyema dalfo	150	
				Sub total	290	12
14	SNNPRS	Sidama	Sidama	Dale, Honsho	320	
15			Bensa	Daye, Sidofolish, Toga	200	
16			Hula	Teticha, kenkicha, Abela	200	
17			Yirgalem	Yirgalem	160	
18		Gedeo	Gedeo	Dilla zuria, Elalcha	200	
19			Bule	Shobery, Haro	50	
20		Sheka	Sheka	Amaya	50	
				Sub Total	1180	48
				Total	2468	

Annex 11: Economic analysis of modern craft products Lampshade

No	Inputs	Unit	Quantity	Unit cost	Cost (ETB)
1	Bamboo	pole	0.33	24	7.92
2	Dye	Kg	0.03	300	9
3	Glue	Kg	0.02	85	1.7
4	Labour	MD	0.25	60	15
			Sub total (ETB)		33.62
			Overhead (20%)		6.724
			Total production cost (ETB)		40.344
			Selling Price (ETB)		90

Fruit service

No	Inputs	Unit	Quantity	Unit cost	Cost (ETB)
1	Bamboo	Pole	0.2	24	4.8
2	Steel wire - 2 mm	kg	0.1	32	3.2
3	Beads	Role	0.5	42	21
4	Sand paper	Pieces	0.5	5	2.5
5	Varnish	kg	0.05	90	4.5
6	labour	MD	0.25	60	15
			Sub total (ETB)		51
			Overhead (20%)		10.2
			Total production cost (ETB)		61.2
			Selling Price (ETB)		100

Annex 12: Details of bamboo furniture enterprises

S.No	Region	Zone	Woreda / Location	Organisation name	No of craftsmen engaged	Phone No
1	Addis Ababa	Addis Ababa	St. Urael area	Kidest Alemayehu	2	
2				Tegene Tesfaye	4	911678791
3				Sisay Debebe	3	911637609
4				Sisay Shiberu	3	115538016
5				Biruk W/hawariat	1	929438580
6				Debrework Kebede	7	911121816
7				Mengistu	1	115511122
8				Abebaw	3	
9				Loul	1	910532162
10				Genet	5	
11				Abebaw	1	
12				Abebe delnese	1	912918998
13				Abraham	4	
14				Fikerte Gebre	1	929338056
15				Tsehaye hassen	1	920194705
16				Emebet Dereje	1	929181086
17				Sisay Shiberu	2	911426995
18				Tadele Assefa	3	977421466
19				Mengistu Debebe	1	911133471
20				Woinsshet Achramtew	1	913569681
21				Wubye Tesfaye	1	913864859
22				Meseret Tesfaye	1	911864859
23				Fitsume Legese	1	911220856
24				Wondwossen Yohanes	3	911836552
25				Abdu Geremew	1	909676877
26				Bedru Oumer	6	911753953
27				ARG	1	913569914
28				Abush Bogale	1	941146408
29				ETTE workshop	5	918057535
30				ETTE (piece rate 1)	1	911656325
31				ETTE (Piece rate 2)	1	911573208
32				Abiy Berehanu	1	911924354
				Sub Total	69	
33			Mexico square	FeSMMIDA	5	115511122
34				Tadess Birega	1	945962649
35				Damtow	1	920183347
36				Lemma	1	923731839
37				Tadess Birega	1	945962649
				Sub Total	9	

38	Addis Ababa	Addis Ababa	Abuare	Abebe	1	
39				Tages	1	
40				Habte hailu	1	912023592
				Sub total	3	
41			Piassa	Zerihun	6	913734147
42				Wondwossen Yohanes	5	911098127
				Sub Total	11	
43			Beklo bet	Federal TVET Institute	3	912055058
44				Nuru	1	912096165
45				Abege	1	911546373
46				Getenet Endale	1	910156432
				Sub Total	6	
47			Asko	Gumabas Biratu	1	910005254
48				Adugna Bayesa	1	913205145
				Sub Total	2	
49			Mekanisa	Gezahagne	5	911089151
50				Bamboo enterprise	5	
51				Nazrawe Demese	1	933818276
52				Mustefa Abdurkadir	1	953818280
				Sub Total	12	
53			Sebeta	Kiber Temesgen	1	942829751
54				Teb Plc	4	983742711
55				Mesud Aminu Mussa	23	937911626
				Sub Total	28	
				Sub Total (Addis Ababa)	140	
56	Amhara	Bahir Dar	Bahirdar	Berhanu Yetwale	1	910696354
57				Bam. Enterprise	25	
58				ReMSEDA	9	924314260
59				Alemante Beruye	1	910609976
60				Melash Worku	1	932945608
				Sub Total	37	
61		Awi	Injibara	Road Side Enterprises	20	
62			Tilili / Banja Woreda	Ayanaw	15	
				Sub Total	35	
63		Misraq Gojjam	Debramarkos	Anemaw Andualem	1	922211699
64			Bibugn	Margia Ashenefe	1	985359792
				Sub Total	2	

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

				Sub Total (Amhara)	74	
65	BSG	Assosa	Bambasi	Yemam Muhe	1	979280769
66				Abdu Geremew	1	909676877
				Sub Total	2	
67			Assosa	Amrach Berhei	1	966002556
68				ReMSEDA	5	
69				Rural tech dev.	1	946537189
70				Michael Mengistu	1	906184414
71				Fiseha Mohammed	1	918306985
				Sub Total	9	
				Sub Total (BSG)	11	
72	Gambela	Agnauk	Gambela	ReMSEDA	1	913398325
				Sub Total (Gambella)	1	
73	Oromia	East Showa	Wonchi	Susi Teshome	1	941982547
74				Amare G/michael	1	921423375
75				Torba Tona Bokana	1	942473535
				Sub Total (Oromia)	3	
76	SNNPR	Wolkait Tegede	Wolkite	ReMSEDA	1	
77		Sidama	Arbegona	Lemma Narie	1	925676227
78			Hawasa	Government	3	
79				ReMSEDA	1	913180075
80				Shimeles Shiberu	5	916052470
81				Yared Zemedkun	2	
82				Demwoz Dejene	2	
83				Habtam Tesfaye	1	
				Sub Total (SNNPRS)	16	
84	Tigray	Mehakelegnaw zone	Adet	Mamu Seifu K/ Mariam	1	972139179
85			Adet	Alemayehu Legese	1	945484659
				Sub Total (Tigray)	2	
				Total	247	

Annex 13: Economic analysis of selected modern bamboo furniture

Sofa set

Single Seat

No.	Material	Unit	Quantity	Cost/piece (ETB)	Cost (ETB)
1	Bamboo 7 mmø	pieces	2.0	24	48
2	Bamboo 6 mmø	pieces	1.0	22	22
3	Bamboo 3 mmø	pieces	3.0	12	36
4	Varnish	1 kg/5 product	0.20	90	18
5	Glue	1 Kg / 6 product	0.17	85.00	14.17
6	Sponge 12 cm thick (Seat)	2 Sq.m for 8 chair	0.13	700.00	87.50
7	Sponge 8 cm (Back rest)	2 Sq.m for 8 chair	0.13	500.00	62.50
8	Fabric for seat	1.75X 1 m	0.71	120.00	85.71
9	Fabric for back rest	1.75 X 1 m	0.66	120.00	78.86
10	Sand Paper	Running meter	0.25	40.00	10.00
10	Nail	kg	0.10	35.00	3.50
11	Kerosene / thinner	Liter	0.25	18.00	4.50
				Material Cost	466
				Labour cost	80.00
				Sub total	546
				Overhead 20%	109.20
				Total cost	655.20

Sofa set	# Units	Unit Cost	Total Cost
4 Single Seat	4	655.20	2620.8
1 Double seat	1	1114.44	1114.44
Total production cost			3735.24
Selling Price			7000

Double seat

No.	Material	Unit	Quantity	Cost/piece (ETB)	Cost (ETB)
1	Bamboo 7 mmø	pieces	3	24	72
2	Bamboo 6 mmø	pieces	1.5	22	33
3	Bamboo 3 mmø	pieces	5	12	60
4	Varnish	1 kg/3 product	0.33	90	30
5	Glue	1 kg / 4 product	0.25	85	21.25
6	Sponge 12 cm	1X2 m / 4 product	0.25	700	175
7	sponge 8 cm	1 X 2 m/ 4 product	0.25	500	125
8	Fabric for seat	1.75 X 1 m	1	120	120
9	Fabric for back rest	1.75 X 1 m	1	120	120
10	sand paper	R meter	0.5	40	20
10	Nail	kg	0.15	35	5.25
11	Kerosene	Liter	0.4	18	7.2
				Material cost	788.7
				Labour cost	140
				Sub total	928.7
				Overhead 20%	185.74
				Total cost	1114.44

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Stool cost

No	Raw-material	Unit	Quantity	Cost/piece	Cost (ETB)
1	Culm 6cm Ø	Piece	2	24	48
2	Glue	kg	0.05	85	4.25
3	Varnish	kg	0.066	90	5.94
4	Sand paper	Piece	0.25	40	10
5	Nail	kg	0.033	35	1.155
6	Sponge	1 m X 2 m	0.05	500	25
			Material cost		94.345
			Labour cost		50
			Sub total		144.345
			Overhead 20%		28.869
			Total Cost		173.214
			Selling Price		350

Coffee table

No	Raw-material	Unit	Quantity	Cost/piece	Cost (ETB)
1	Culm 8cm Ø	Piece	3.5	24	84
2	Culm 2-3cm Ø	Piece	2	12	24
2	Glue	kg	0.2	85	17
3	Varnish	kg	0.2	90	18
4	Sand paper	Piece	0.25	40	10
5	Nail	kg	0.5	35	17.5
6	Glass	Sq.m	0.5	90	45
			Material cost		215.5
			Labour cost		75
			Sub total		290.5
			Overhead 20%		58.1
			Total cost		348.6
			Selling Price		500

Low Sitting Chair with backrest

No	Raw-material	Unit	Quantity	Cost/piece	Cost (Birr)
1	Culm 6cm Ø	Piece	2	24	48
2	Culm 2-3 cm	Piece	3	12	36
3	Glue	kg	0.142	85	12.07
4	Varnish	kg	0.125	90	11.25
5	Sand paper	Piece	0.25	40	10
6	Nail	kg	0.033	35	1.155
7	Sponge	1 m X 2 m	0.08	500	40
8	Bamboo Mat	Metre	1	25	25
9	Fabric	Metre	0.1	150	15
10	Ply wood	Piece	0.1	160	16
11	Plastic sheet	Metre	0.25	35	8.75
			Material cost		223.225
			Labour cost		60
			Sub total		283.225
			Overhead 20%		56.645
			Total cost		339.87
			Selling cost		500

Book Shelf - 3 rack

No	Raw-material	Unit	Quantity	Cost/piece	Cost (ETB)
1	Culm 8cm Ø	Piece	4	24	96
2	Culm 2-3cm Ø	Piece	4	12	48
3	Glue	kg	2	85	170
4	Varnish	kg	0.5	90	45
5	Sand paper	Piece	0.5	40	20
6	Nail	kg	0.5	35	17.5
7	Bamboo mat	Sq. M	7	25	175
8	Colour Stain	Liter	0.05	300	15
			Material cost		586.5
			Labour cost		120
			Sub total		706.5
			Overhead 20%		141.3
			Total cost		847.8
			Selling Price		1200

Annex 14: Details of private sector industries in Ethiopia

No	Name of Organisation	Establishment Year	Region	Specific Location	Product Lines	# employees	Owners name	Status
1	Adal Industries PLC	2006	Addis Ababa	Gelan	Bamboo flooring, roofing panel, Blinds, table mats, incense sticks, briquettes and pellets	140	Adane Berehe	Functional
2	SA Industries PLC	2017	Addis Ababa	Burayu	Bamboo board, bamboo flooring, furniture, curtains, incense sticks and tooth picks	23	Addisu	Installation and commissioning of machines
3	Abraham Mulatu Bamboo PLC	2012	Amhara	Kosober, Injibara town	Tooth picks + Bamboo energy products	28	Abraham	Functional
3	Bamboo Star PLC	2012	Benishangul Gumuz	Assosa	Bamboo flooring, curtains, charcoal	27	Michael Gebru	Not Functional
4	Tebubu PLC	2017	Addis Ababa	Sebeta	Bamboo flooring and curtains	5	Tebebu Teklu	Construction of work shed complete
6	African bamboo PLC	2010	Addis Ababa	Mekanisa	Bamboo timber (beams) from crushed bamboo	25	Kalid	Not functional
		2017	SNINPRS	Hawasa Industrial park	Bamboo flooring, curtain, tooth picks and timber (beams)		Kalid	Working shed secured

Annex 15: Details of public sector training and production centres

No	Name of Organisation	Establishment Year	Region	Specific Location	Product Lines	#employees	Owners name	Status
1	FeSMIMIDA / Mol Productivity Improvement Centre (PIC)	2012	Addis Ababa	Lideta	Bamboo Mat Board, curtains and bamboo stick making	0	Government	Not functional
1 A	Injilbara TVET	2012	Amhara	Kosober	Bamboo mat production	0	Government	Not functional
1 B	Hula TVET	2012	SNNPR	Hula	Bamboo mat production	0	Government	Not functional
1 C	M & S Enterprise Office	2012	Oromia	Dere Enchini	Bamboo mat production	0	Government	Not functional
2	FeSMIMIDA	2005	Addis Ababa	Kirkos Sub City	Bamboo furniture, floor and curtains	3	Government	Functional
3	Amhara BoTVEDB	2014	Amhara	Bahir Dar	Bamboo curtains and treatment	5	Government	Semi-functional
4	Hawasa RTDT	2009	Hawasa	SNINPRS	Bamboo curtains	4	Government	Semi-functional
5	Assosa RTPC	2014	BSG	Assosa	Bamboo half cut board, charcoal and treatment	0	Government	Non-functional

Annex 16: Pictures showing the industrial scale machines and technologies



Cross cutting



Splitting



Planning



Fine Planning



Carbonising and treatment



Glue application



Hot Press



Flooring tile planning



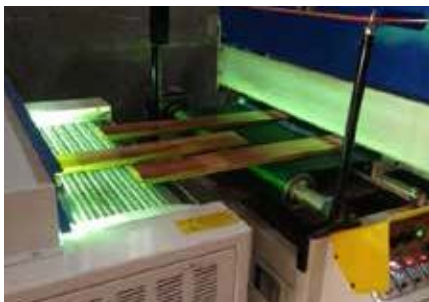
Board Planning



Ceiling tile machine



Board Sizer



Finishing

Bamboo sticks Based Product



Cross cutter



Radial Splitter



Knot remover and planer



Round stick-making machine



Stick-sizing machine



Toothpick sizer



Polishing machine



Toothpick stick arranger



Toothpick-sharpening machine

Curtains / Blinds



Bamboo stick polishing



Bamboo Blinds



Bamboo Curtains / table mats, etc

Value Chain Analysis and
Market Assessment of Bamboo Products in Ethiopia

Incense Sticks



Incense coating



Incense



Incense drying

Bamboo Energy



Bamboo Charcoal Kilns



Bamboo Charcoal production



Bamboo Charcoal Pellets – pillow block



Honey comb Briquetting machine



Drying of pellets



Packaged pellets



RAM-type saw dust briquetting machine



RAM-type and Screw-type briquetting machines



Sawdust Briquettes

Government-owned TVET centres:

The machinery available in TVET are (a) cross cutter, (b) radial splitter, (c) two-sided planner; (d) four-sided planner (in some cases); (e) rough slivering machine; (f) fine slivering machine; (g) mat weaving machine; and (h) blind weaving machine (only in FeSMMIDA, Bahir Dar and Hawasa)



Bahir Dar TVET



Injibara TVET

Annex 17A: Bamboo basketry products, trading locations and prices

No		Basketry type	Price in ETB											
			Addis Ababa	Hawasa	Debramarkos	Bahirdar	Ambo	Bambasi	Bibugn	Haro Wonchi	Injibara	Tsegede	Wolisso	
Traditional														
1		Mosseb		360							150	180		22
2		Agelgel							110		65			
3		Sefed									30	27		
4		Akinbalo		28				17		14	25	80		80
5		Granary									170	275		
6		Bee hives						250			180	160		240
7		Basket (different shape and size)	250	165			80	50	30	25	50			
Modern														
1		Flower vase	150	120	175	30								
2		Lamp shade	300	120	200									
3		Fruit service	80	250	200	75								
4		Corner light		120	300									

Traditional products

Modern Products

Annex 17B: Bamboo mats, trading locations and prices

No	Bamboo Mat	Specification	Price in ETB									
			Addis Ababa	Ambo	Arbegona	Bahirdar	Bambasi	Bibugn	Haro Wonchi	Injibara	Tsegede	Woliso
1	Mat (Thick)	1.3 X 1 m				35	35	18	35	20	25	23
2	Mat	1.5 X 1.5 m	60 - 70	23	18							

Annex 17C: Bamboo furniture, trading locations and prices

No		Furniture Type	Price in ETB														
			Modern					Traditional									
			Addis Ababa	Bahir dar	Hawasa	Debra-markos	Aksum	Ambo	Arbegona	Shere	Bambasi	Bibugn	Dansha	Haro Wonchi	Injibara	Tsegede	Woliso
1	Bed	3500	2000	2350	3500			260		150		105		180	150		
2	Chair	600	150	135	900	350	120	80	250	150			100	85		130	
3	Dinning chair	150	480	350	900	350											
4	Stool	70 - 150	100	150	150			70	325		80	60		100			
5	Coffee table	900	500	360	600			60	800	70							
6	Shelf	250	150	1600	650			70		75							
7	Dressing mirror	2500		1400													
8	Screen/ partition	1700	1600	1400													
9	Sofa set	7000		4850		7000			6500					6000			

Modern Products
Traditional Products

Annex 18: Average value of import and export - country / region wise between 2014 - 16

Product Code	Product	Trade Value (USD)							
		Ethiopia		COMESA		Total Africa		Total EU	
		Import	Export	Import	Export	Import	Export	Import	Export
140110	Bamboo	96,748	236,272	274,196	295,724	503,559	309,374	52,982,330	12,311,210
200591	Preserved Bamboo Shoot	9278	0	163,796	58	261,908	89441	3,6276,330	18,601,725
460121	Bamboo Mats / Screens	25,236	1878	119,370	549,399	348,834	593,133	22,740,742	5,880,534
460192	Bamboo Plaits and Plaiting material	0	0	48,707	6609	297,887	23,610	7,714,951	1,929,503
460211	Bamboo Basket Work	23,274	0	221,668	15,136	1,126,872	197,967	463,47,637	13,691,972
440210	Bamboo charcoal	98,356	740	115,237	1,171,608	872,286	11,741,910	9,585,305	5,056,054
440921	Bamboo Flooring	186,047	0	476,257	42,221	2,369,534	2,245,681	24,237,144	7,475,305
441210	Bamboo plywood	1,508,065	0	2,886,041	35,232	5,485,052	555,286	37,005,125	10,527,382
470630	Bamboo pulp	0	0	12,727	164	24813	1,783,986	1,573,715	1,318,873
482361	Bamboo Paper based articles	1,071,824	213	1,149,320	69,992	1,466,245	259,896	14,195,668	6,218,069
940151	Bamboo and Rattan seats	21,972	0	247,928	10,372	2,876,853	215,676	51,230,523	16,311,612
940381	Bamboo and rattan furniture	2,667,097	0	357,650	18,112	5,594,062	290,191	62,772,934	43,092,511
Total (USD)		5707896	239,102	9,262,898	2,214,628	21,227,906	18,306,151	366,662,405	142,414,751
Per cent (%)		0.43	0.02	0.70	0.15	1.61	1.21	27.79	9.44

Source: Compiled from UN Comtrade Database, 2017

Trade Value (USD) - Continued from previous page							
USA		China		Global		Global	
Import	Export	Import	Export	Import	Export	Import (%)	Export (%)
20,117,378	427,327	1,663,015	67,611,593	134,075,491	95,074,389	10.16	6.31
29,621,677	221,648	131,979	274,725,989	230,630,792	308,001,800	17.48	20.43
4,237,098	454,586	52,937	81,525,800	61,308,259	91,153,174	4.65	6.05
4,199,688	309,650	105,516	54,100,125	32,341,004	58,161,394	2.45	3.86
53,920,248	1,815,118	576,919	149,036,258	171990202	214618781	13.04	14.23
2,975,879	349,901	314,134	31,974,073	38762065	58,416,320	2.94	3.87
3,164,373	6,389,588	60,894	271,484,623	88,491,293	292,741,064	6.71	19.41
46,079,657	6,503,300	223,281	75,739,897	161,450,208	99,733,636	12.24	6.61
86,1692	61248	396,999	2,760,426	5,388,638	6,562,809	0.41	0.44
4,627,576	1,264,255	20,530	9,430,144	37,321,707	31,072,976	2.83	2.06
52,184,363	2,371,787	1,954,507	10,928,384	170,351,824	96,967,163	12.91	6.43
4,741,1598	4,036,911	687,185	66,010,375	187,254,968	155,347,652	14.19	10.30
26,940,1226	24,205,318	6,187,895	1,095,327,687	1,319,366,451	1,507,851,158	100.00	100.00
20.42	1.61	0.47	72.64				

Annex 19: Percentage of traded value of bamboo commodities between 2014 - 2016

Product Code	Product	Percentage of Trade Value (%)					
		Ethiopia		COMESA		Total Africa	
		Import	Export	IMPORT	EXPORT	IMPORT	EXPORT
140110	Bamboo	0.07	0.25	0.20	0.31	0.38	0.33
200591	Preserved Bamboo Shoot	0.00	0.00	0.12	0.00	0.11	0.03
460121	Bamboo Mats / Screens	0.04	0.00	0.09	0.58	0.57	0.65
460192	Bamboo Plaits and Plaiting material	0.00	0.00	0.04	0.01	0.92	0.04
460211	Bamboo Basket Work	0.01	0.00	0.17	0.02	0.66	0.09
440210	Bamboo charcoal	0.25	0.00	0.09	1.23	2.25	20.10
440921	Bamboo Flooring	0.21	0.00	0.36	0.04	2.68	0.77
441210	Bamboo plywood	0.93	0.00	2.15	0.04	3.40	0.56
470630	Bamboo pulp	0.00	0.00	0.01	0.00	0.46	27.18
482361	Bamboo Paper based articles	2.87	0.00	0.86	0.07	3.93	0.84
940151	Bamboo and Rattan seats	0.01	0.00	0.18	0.01	1.69	0.22
940381	Bamboo and rattan furniture	1.42	0.00	2.65	0.02	2.99	0.19

Source: Compiled from UN Comtrade Database, 2017

Percentage of Trade Value (%)					
Total EU		USA		China	
IMPORT	EXPORT	IMPORT	EXPORT	IMPORT	EXPORT
39.52	12.95	15.00	0.45	1.24	21.95
15.73	6.04	12.84	0.07	0.06	89.20
37.09	6.45	6.91	0.50	0.09	89.44
23.86	3.32	12.99	0.53	0.33	93.02
26.95	6.38	31.35	0.85	0.34	69.44
24.73	8.66	7.68	0.60	0.81	54.73
27.39	2.55	3.58	2.18	0.07	92.74
22.92	10.56	28.54	6.52	0.14	75.94
29.20	20.10	15.99	0.93	7.37	42.06
38.04	20.01	12.40	4.07	0.06	30.35
30.07	16.82	30.63	2.45	1.15	11.27
33.52	27.74	25.32	2.60	0.37	42.49

/ 141

Note: R = Respondent

Construction														
Cate- gory	Criteria / Indicators	Weightage (Criteria)	Weightage (Indicators)	R1	R2	R3	R4	R5	R6	R7	R8	Aver- age	Mark (Indi- cator)	Mark (Criteria)
1	Livelihood / Job Creation Potential	25												
1.1	Local / rural employment creation potential		50	5	4	3	5	4	5	5	5	4.50	2.25	
1.2	% rural household engagement		25	3	5	2	3	4	3	4	3	3.38	0.84	
1.3	% of women		25	1	1	2	2	2	2	3	2	1.88	0.47	
													3.56	0.89
2	Prospects of success	30												
2.1	Technology available / transfer		30	5	3	3	5	3	4	4	3	3.75	1.13	
2.2	Investment capacity		25	5	3	3	4	3	4	4	5	3.88	0.97	
2.3	Policy environment		20	2	2	2	5	3	4	4	5	3.38	0.68	
2.4	Resource availability and sustainability		25	2	5	3	5	3	3	3	5	3.63	0.91	
													3.68	1.10
3	Market and Trade Potential	30												
3.1	Availability / potential domestic market		60	5	2	3	5	3	4	3	5	3.75	2.25	
3.2	Availability / potential international market		40	1	2	2	2	1	2	1	3	1.75	0.70	
													2.95	0.89
4	Contribution to government agenda	15												
4.1	Contribution to multi development agenda / cross sector linkages / targets		40	3	3	3	3	5	4	5	5	3.88	1.55	
4.2	Public – private investment		60	4	2	3	4	2	2	2	2	2.63	1.58	
													3.13	0.47
Note: R = Respondent														3.35

/ 143

/ 143

Mat														
Category	Criteria / Indicators	Weightage (Criteria)	Weightage (Indicators)	R1	R2	R3	R4	R5	R6	R7	R8	Average	Mark (Indicator)	Mark (Criteria)
1	Livelihood / Job Creation Potential	25												
1.1	Local / rural employment creation potential		50	4	4	5	4	4	4	4	4	4.13	2.06	
1.2	% rural household engagement		25	2	4	4	4	4	3	5	4	3.75	0.94	
1.3	% of women		25	4	4	5	4	3	3	3	3	3.63	0.91	
													3.91	0.98
2	Prospects of success	30												
2.1	Technology available / transfer		30	2	2	3	4	3	4	4	3	3.13	0.94	
2.2	Investment capacity		25	3	3	5	5	4	3	3	2	3.50	0.88	
2.3	Policy environment		20	2	2	2	3	2	2	2	4	2.38	0.48	
2.4	Resource availability and sustainability		25	2	2	4	5	3	3	4	5	3.50	0.88	
													3.16	0.95
3	Market and Trade Potential	30												
3.1	Availability / potential domestic market		60	5	3	4	4	4	4	4	4	4.00	2.40	
3.2	Availability / potential international market		40	1	2	2	1	2	3	2	1	1.75	0.70	
													3.10	0.93
4	Contribution to government agenda	15												
4.1	Contribution to multi development agenda / cross sector linkages / targets		40	2	3	3	1	4	4	3	4	3.00	1.20	
4.2	Public – private investment		60	5	3	2	4	2	4	3	2	3.13	1.88	
													3.08	0.46
Note: R = Respondent														3.32

Note: R = Respondent

Industry													
Category	Criteria / Indicators	Weightage (Criteria)	Weightage (Indicators)	R1	R2	R3	R4	R5	R6	R7	R8	Average	Mark (Indicator)
1	Livelihood / Job Creation Potential	25											
1.1	Local / rural employment creation potential		50	4	4	3	3	2	3	4	3	3.25	1.63
1.2	% rural household engagement		25	2	1	3	3	4	2	3	3	2.63	0.66
1.3	% of women		25	2	3	3	2	4	4	5	1	3.00	0.75
2	Prospects of success	30											3.03
2.1	Technology available / transfer		30	5	5	3	3	4	3	5	5	4.13	1.24
2.2	Investment capacity		25	5	5	2	3	4	4	4	5	4.00	1.00
2.3	Policy environment		20	2	5	3	4	5	4	5	5	4.13	0.83
2.4	Resource availability and sustainability		25	5	3	2	2	3	4	5	5	3.63	0.91
3	Market and Trade Potential	30											3.97
3.1	Availability / potential domestic market		60	5	4	4	3	4	5	5		4.29	2.57
3.2	Availability / potential international market		40	3	5	4	4	4	3	2		3.57	1.43
4	Contribution to government agenda	15											4.00
4.1	Contribution to multi development agenda / cross sector linkages / targets		40	3	4	4	5	4	3	1		3.43	1.37
4.2	Public – private investment		60	5	5	5	4	4	3	5		4.43	2.66
													4.03
													0.60
													3.75

Note: R = Respondent

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Energy														
Category	Criteria / Indicators	Weightage (Criteria)	Weightage (Indicators)	R1	R2	R3	R4	R5	R6	R7	R8	Average	Mark (Indicator)	Mark (Criteria)
1	Livelihood / Job Creation Potential	25												
1.1	Local / rural employment creation potential		50	3	2	5	4	3	4	5	5	3.88	1.94	
1.2	% rural household engagement		25	2	4	2	4	3	4	5	5	3.63	0.91	
1.3	% of women		25	3	3	2	3	2	4	5	5	3.38	0.84	
													3.69	0.92
2	Prospects of success	30												
2.1	Technology available / transfer		30	5	4	4	5	4	5	5	4	4.50	1.35	
2.2	Investment capacity		25	5	4	4	4	4	3	5	2	3.88	0.97	
2.3	Policy environment		20	2	4	2	3	3	4	5	4	3.38	0.68	
2.4	Resource availability and sustainability		25	4	3	3	3	2	3	5	5	3.50	0.88	
													3.87	1.16
3	Market and Trade Potential	30												
3.1	Availability / potential domestic market		60	5	2	5	5	3	4	4	4	4.00	2.40	
3.2	Availability / potential international market		40	3	4	4	3	4	3	3	2	3.25	1.30	
													3.70	1.11
4	Contribution to government agenda	15												
4.1	Contribution to multi development agenda / cross sector linkages / targets		40	4	2	4	4	4	3	2	4	3.38	1.35	
4.2	Public – private investment		60	2	4	2	3	2	4	2	3	2.75	1.65	
													3.00	0.45
														3.64
	Note: R = Respondent													

Note: R = Respondent

Feed and fodder													
Category	Criteria / Indicators	Weightage (Criteria)	Weightage (Indicators)	R1	R2	R3	R4	R5	R6	R7	R8	Average	Mark (Indicator)
1	Livelihood / Job Creation Potential	25											
1.1	Local / rural employment creation potential		50	2	1	5	3	3	1	5	1	2.63	1.31
1.2	% rural household engagement		25	2	5	5	4	5	4	5	1	3.88	0.97
1.3	% of women		25	3	4	5	4	3	4	5	1	3.63	0.91
													3.19
2	Prospects of success	30											0.80
2.1	Technology available / transfer		30	4	1	3	2	1	3	5	3	2.75	0.83
2.2	Investment capacity		25	3	1	2	2	3	4	4	5	3.00	0.75
2.3	Policy environment		20	2	3	1	1	2	1	5	5	2.50	0.50
2.4	Resource availability and sustainability		25	4	2	4	2	3	2	5	3	3.13	0.78
													2.86
3	Market and Trade Potential	30											0.86
3.1	Availability / potential domestic market		60	5	1	3	2	1	1	4	5	2.75	1.65
3.2	Availability / potential international market		40	1	1	1	1	1	1	1	2	1.13	0.45
													2.10
4	Contribution to government agenda	15											0.63
4.1	Contribution to multi development agenda / cross sector linkages / targets		40	2	1	3	2	2	3	3	3	2.38	0.95
4.2	Public – private investment		60	3	1	1	1	2	1	4	2	1.88	1.13
													2.08
Note: R = Respondent													0.31
													2.60

Annex 21: Bamboo carbonisation results

Samples	Ash content%	Volatile content%	Fixed carbon %	Calorific value kJ/kg	Yield rate%
Highland Bamboo (<i>Yushania alpina</i>)					
H-1T	5.380	6.472	88.148	28273.8	26.13
H-2T	3.508	7.079	89.413	29215.4	26.78
H-3T	3.360	7.438	89.202	30036.5	27.14
H-1M	6.768	6.727	86.505	28757.3	26.63
H-2M	3.850	7.618	88.532	29597.2	27.32
H-3M	3.790	7.764	88.446	30723.4	28.01
H-1B	7.353	4.531	88.116	28949.3	27.93
H-2B	5.612	4.836	89.552	29918.5	27.72
H-3B	4.559	5.232	90.209	30912.7	28.79
Lowland Bamboo (<i>Oxytenanthera abyssinica</i>)					
L-1T	10.634	5.367	83.999	27196.7	27.13
L-2T	16.523	6.733	76.744	26065.3	28.26
L-3T	23.235	5.498	71.267	23346.2	30.02
L-1M	9.820	7.271	82.909	27676.3	27.39
L-2M	14.532	6.445	79.023	26876.7	28.75
L-3M	21.820	5.703	72.477	23723.4	29.69
L-1B	7.371	6.763	85.866	27984.6	27.94
L-2B	13.043	6.368	80.589	26346.3	28.87
L-3B	20.489	5.607	73.904	24278.5	29.92

Note: 1,2,3 indicate age of bamboo pole; T, M, B mean top, middle and bottom respectively.

H indicate highland bamboo; L indicate lowland bamboo.

Example: H-1T mean High land bamboo 1-year old Top; L-1T mean lowland bamboo 1-year old Top

Annex 22: Bamboo plantation profitability analysis

Species: *Yushania alpina*

Basic Assumption for Calculation

Description	Quantity	Assumption / Source
Spacing (m)	4 X 4 M	SLMP II
No. of plants/ha	625	SLMP II
Mortality replacement (%)	20	SLMP II
Manure required (kg/plant/year)	10	SLMP II
Seedling price (ETB/seedling)	20	SLMP II
Labour wages (ETB/man day)	32	SLMP II
No. of harvestable plants per ha (%)		
	10	10 % of standing culms
	20	20 % of standing culms
	30	30 % of standing culms (9+years)
Average sale price per bamboo pole/culm (ETB)	14	Current study
Average yield (culms/ ha)	3000	10000 standing culms / ha An average of 10000 - 20000 standing culms per ha (Mulatu, 2012)
Harvesting cost (birr/culm)	0.50 cent	

Value Chain Analysis and Market Assessment of Bamboo Products in Ethiopia

Input cost for raising Bamboo Plantation

Items	Cost in ETB							
	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	Total
Material								
Planting material including 20 per cent mortality replacement in second and third year	12500	2500	2500					17500
Manure and fertiliser (50g/plant)	3125	625	625					4375
Sub total	15625	3125	3125					21875
Labour (person day)								0
Land preparation (LS)	2500	0	0	0	0	0	0	2500
Pitting work (PD/15 pits)	1344	0	0	0	0	0	0	1344
Planting (PD/50 plants)	312	96	96	0	0	0	0	504
Soil working/weeding (LS)	0	2500	1000	1000	1000	1000	1000	7500
Harvesting 5th year onwards	0	0	0		500	500	1000	2000
Sub total	4156	2596	1096	1000	1500	1500	2000	13848
Contingency (5%)	207.8	129.8	54.8	50	75	75	100	692.4
Grand Total (ETB)	19988.8	5850.8	4275.8	1050	1575	1575	2100	36415.4

Income calculation of bamboo plantation (1 Hectare)

Production Year	Optimum yield (Culms)	Price/pole (ETB)	Income (ETB)
Year 5 (10% harvest)	1,000.00	14.00	14,000.00
Year 6 (10% harvest)	1,000.00	14.00	14,000.00
Year 7 (20% harvest)	2,000.00	14.00	28,000.00
Year 8 (20 % harvest)	2,000.00	14.00	28,000.00
Year 9 (33 % harvest)	3,000.00	14.00	42,000.00
Year 10 (33 % harvest)	3,000.00	14.00	42,000.00
Total			1,68,000.00

