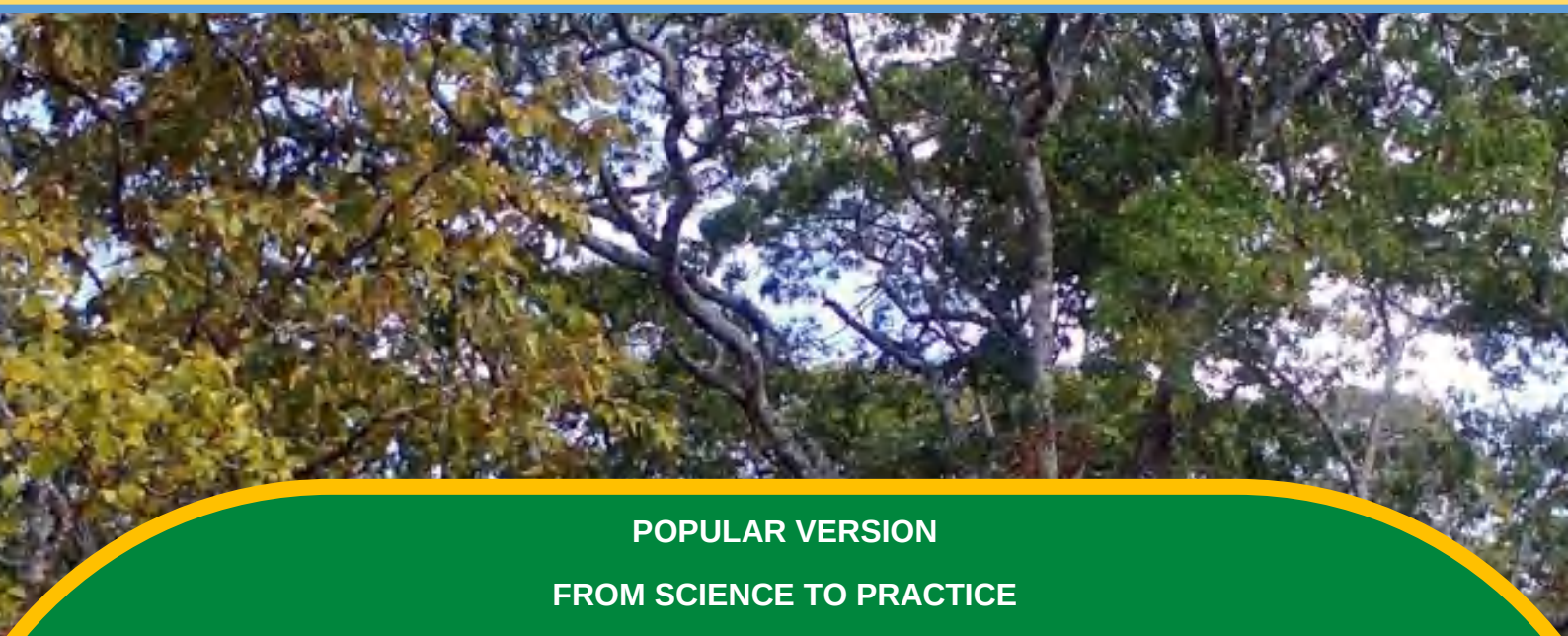
UNITED REPUBLIC OF TANZANIA

MINISTRY OF NATURAL RESOURCES AND TOURISM

TANZANIA FORESTRY RESEARCH INSTITUTE



POPULAR VERSION

FROM SCIENCE TO PRACTICE

SYNTHESIS OF PAPER PRESENTED AT THE INTERNATIONAL SCIENTIFIC CONFERENCE:

FOREST AND HONEYBEE PRODUCTS VALUE CHAINS FOR THE DEVELOPMENT OF SUSTAINABLE LIVELIHOODS AND INDUSTRIAL ECONOMY

HELD ON FEBRUARY, 2021 DAR ES SALAAM, TANZANIA

JUNE 2022

PREFACE

This popular version is a product of compilation and synthesis of selected papers presented at the International Scientific Conference on Forest and Honeybee Products Value Chains for the Development of Sustainable Livelihoods and Industrial Economy held on February 2021 at Mlimani City Conference Center, Dar es Salaam, Tanzania. The overall objective of the conference was to “unlock the potential of forest and beekeeping sector by providing a platform for sharing knowledge and promote discussions on how to develop forest and honey bee products value chains for transforming the nation into a middle-income country”.

The popular version is intended to provide an overview of empirical and practical experience on forest and beekeeping value chains. About 18 papers presented by forest and beekeeping researchers carried out within the past five years were rigorously reviewed and information was extracted for the development of this popular version. The practical use of this popular version can be easily understood and well implemented by stakeholders from community level to the decision makers level. The popular version is divided into two main sections, namely Forests and Beekeeping. The forests section highlights the timber and non-timber forest products value chains, while the beekeeping section provides insights on the honeybee products value chain.

The diversity of issues covered in this popular version will help the local communities, local government authorities, policymakers, decision-makers, planners, researchers and academicians to well-understand forest and beekeeping value chain issues. It is hoped that the forest and beekeeping value chain stakeholders will be able to put into practice the research results shared in this document to improve the forest and beekeeping value chains.

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SECTION ONE: FORESTS

Forest Status and Wood Demand and Supply Trends in Tanzania

Tanzania forest resources are estimated to cover 48.1 million ha (55%) of the total surface land area of Tanzania mainland (88.6 million ha). These forests apart from serving as biological diversity habitat, they provide a wide range of wood products and non-wood forest products. Most hardwoods come from natural forests while softwoods are produced and traded from plantations which account for 70% of the total annual volume production.

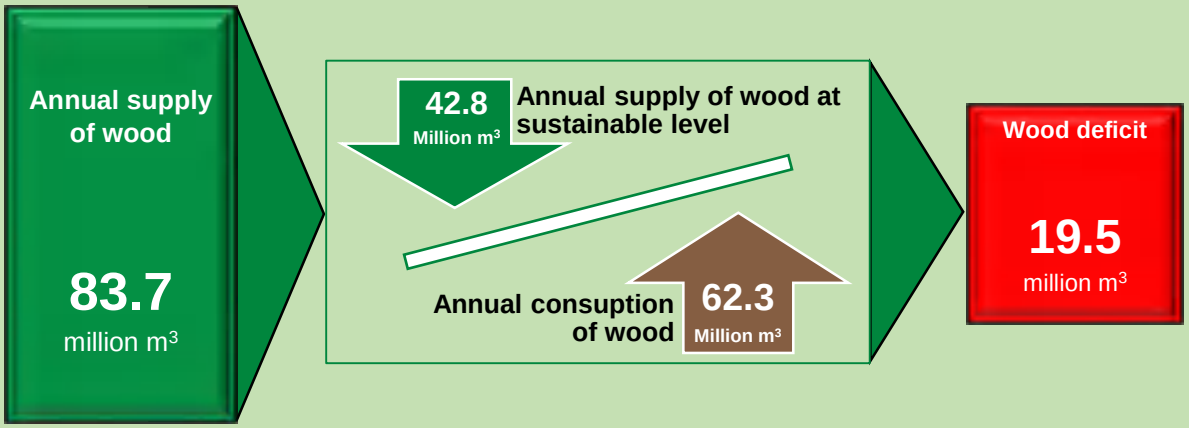
48.1 million ha of forests and woodlands in Tanzania

16.6 million ha (34.5%) are central government forest
3.1 million ha (6.5%) are local government forest
21.9 million ha (45.7%) are village land forest
3.5 million ha (7.3%) are private land forest
2.7 million ha (5.7%) are general land forest
0.098 million ha (0.2%) are unknown
0.049 million ha (0.1%) have no data

Forest products

Current estimates show a gap between available wood and demand. There is a large wood deficit of over 19 mil m^3 indicating that the forests supply more than they can potentially offer. There are efforts undertaken by the government and private sector in closing the demand and supply gap. These efforts include; improvement of planting and management capacity of state-owned forest plantations as well as private woodlots; support identification, promotion and use of lesser-known hardwood species; reduce export of timber from natural forests in raw form and support and encourage improved wood conversion technologies. Other efforts are geared towards improving the management of natural forests through Participatory Forest Management (PFM) under Community Based Forest Management (CBFM) approach on Village Land Forest Reserves (VLFRs). The PFM is a management strategy that embraces the need for involving communities adjacent to forests in the management and conservation of forests.

Annual total wood supply and consumption from natural and plantation forests in Tanzania



TIMBER PRODUCTS VALUE CHAIN

Exploring Ambiguities of Estimating Stocking and Harvesting Levels in Village Land Forest Reserves (VLFRs) in Tanzania

Introduction

In Tanzania, since the late 1990s, there has been an effort to enhance forest management and conservation through Participatory Forest Management (PFM) approach. The PFM is a management strategy that embraces the need for involving communities adjacent to forests in the management and conservation of forests through Community Based Forest Management (CBFM) under Village Land Forest Reserve (VLFR) and Joint Forest Management (JFM). In the CBFM approach a Forest Management Plan (FMP) is a pre-requisite for transferring forest management authority to community. The FMP has detailed information of a forest management prescription for a set period of at least five years. Also, if the forest is set aside for production need to have Harvesting Plan (HP) that entails forest size, a net harvestable area and quantity of the forest products to be harvested.

In the development of FMP, forest inventory must be undertaken. Forest inventory is the systematic collection of data and forest information for assessment or analysis. The forest inventory is very crucial because it gives significant information for forest management. The forest inventory provides the surveyed location, composition, and distribution of the forest resource and their relative amounts over a given area. Also, derive the information for resource evaluation enabling management decisions at a variety of levels including harvesting plans. At the strategic level, forest inventories provide data for longer-term forest management, analysis, and decision-making. Application of different stock estimation methodologies could lead to different harvesting strategies including selective harvesting of desired timber species (Plate 1) which necessities walking around the reserve to find suitable trees that meet minimum diameter for harvest.

Plate 1: Selective harvesting

There are several forest inventory methods among of them are; Participatory Forest Resource Assessment (PFRA); Partial Participatory Forest Inventory (PPFI) and Participatory Forest Inventory and Analysis (PFIA). Usually these methods use different sampling strategies and sample size during forest inventory. A question is, do these three methods, provide the same Annual Allowable Cut (AAC) or Total Allowable Cut (TAC)? To answer this question, the methods were applied in a Mindu Village Land Forest Reserve in Tunduru District, Southern Tanzania to explore ambiguities of estimating stocking and harvesting levels for *Brachystegia speciformis, Julbernadia globiflora*, *Brachystegia bussei*, *Brachystegia boehmii*, and *Pterocapus angolensis* in Tanzania (Plate 2). The forest reserve was declared in 2015 with a size of 3,713 ha of which 3,336 ha was set aside for production and 377 ha for protection.

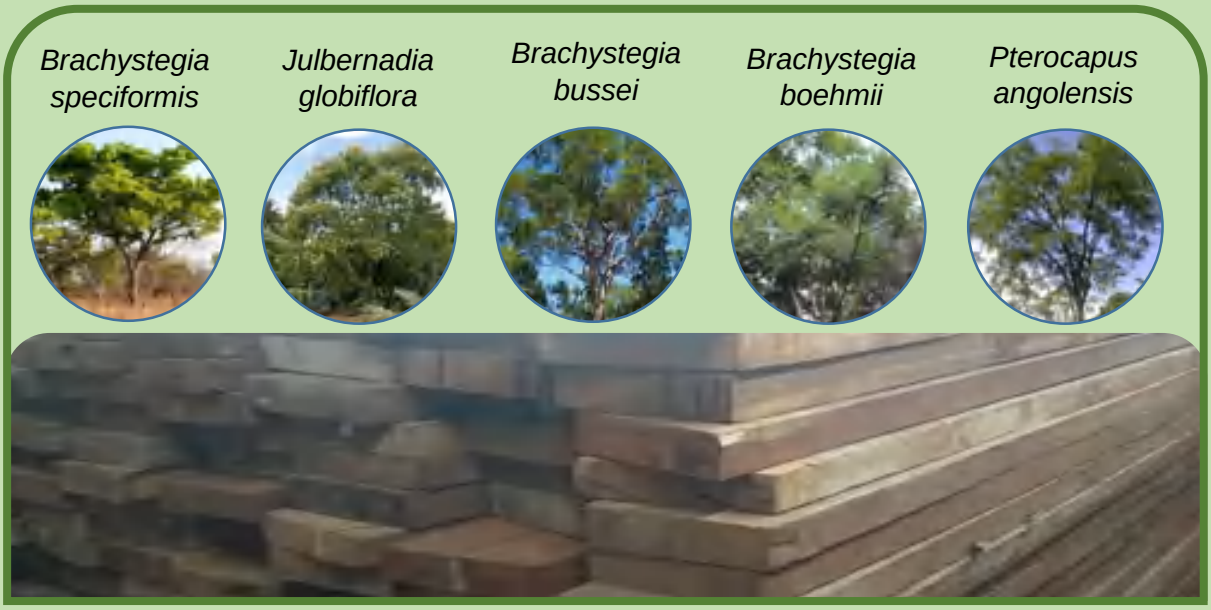


Plate 2: Preferred indigenous tree species and timber

Estimation of stocking and harvesting levels in VLFRs

Estimates for the number of stems* and *standing tree volume

In Plate 3, villagers are in the process of implementing the three named methods of PFIA, PPFI and PFRA. Also, the results in Table 1 show that each method resulted into different number of stems and standing across tree species. However, the PPFI method is recommended as it is easily manageable because it uses circular plots as compared to other methods.

Plate 3: Villagers participating in forest inventory

Table 1: Estimation of stocking and harvesting levels in Mindu Village Land Forest Reserve in Tunduru District

Botanical name	Total Allowable Cuts per 3,336 ha for 5 years (number of stems)			Total Allowable Cuts for 5 years (tree volume) (m^3 per 3,336 ha)		
	PFIA	PPFI	PFRA	PFIA	PPFI	PFRA
Brachystegia speciformis	346	3,196	7,784	607	177.10	57.24
Julbernadia globiflora	81	1,065	2,224	105	54.24	11.91
Brachystegia bussei	184	2,486	10,564	286	150.34	53.98
Brachystegia boehmii	470	3,551	0	663	178.92	0
Pterocapus angolensis	43	355	0	42	18.57	0
Total	1,124	10,653	20,572	1,703	579.17	123.13

According to the Government Notice No. 59 published on 28/1/2022 of the Forest Act, (cap. 323) regulations (made under section 106(1)) the forest (amendment) Regulations, 2022. Table 2, indicates tree classes and their respective price per each product.

Table 2: Tree classes and their respective prices per each product

No	Tree name	Class	Price in TZS					
			Logs per cubic metre	Poles in diameter size		Fire wood below 5cm diameter(per cubic metre)	Charcoal from natural trees (Kg)	Withies
				5cm≥10 cm	10cm≤20 cm			
1	*Brachystegia speciformis*	II	195,000	1,600	2,400	6,500	250	4,000
2	*Julbernadia globiflora*	II	195,000	1,600	2,400	6,500	250	4,000
3	*Brachystegia bussei*	IA	350,000	1,600	2,400	6,500	250	4,000
4	*Brachystegia boehmii*	II	195,000	1,600	2,400	6,500	250	4,000
5	*Pterocapus angolensis*	IB	290,000 .	1,600	2,400	6,500	250	4,000

Conclusion and recommendations

Estimation of stocking and harvesting levels in VLFRs using the three forest inventories methods, namely; PFRA, PPFI and PFIA demonstrate different number of stems and standing tree volume across the selected trees species (*Brachystegia speciformis* - Mtondolo, *Julbernadia globiflora* - Mchenga, and *Brachystegia bussei* - Mgelegele, *Brachystegia boehmii* - Mtundu, and *Pterocapus angolensis* - Mningajangwa). This implies that the methods have either positive or negative impact on forest condition, and can influence forest sustainability.

The use of PPFI method is recommended as compared to other methods. Also, in long run as a means of sustaining forest resources in VLFRs there is an urgent need to harmonize the forest inventory methods.

Understanding the Value Chain for Sawnwood from Ulanga District to Morogoro Municipality in Tanzania

Introduction

Tanzanian forests provide various products/goods and services which are of socio-cultural, environmental and economic values. For example, for many years these forests have been a source of sawnwood/timber for construction industry, infrastructure development and exports. Currently, there has been increased demand for sawnwood due to rapid population growth and some of these demands are met from sawnwood production and supply from natural forests and plantations through value adding activities among actors in the chain. Sawnwood production business contributes to the livelihood of communities living near the forests and the national economy. The contributions are obtained through participation in the sawnwood value chain as either producers, harvesters, sawyers, transporters, traders or furniture makers or other timber products producers.

Unlike other agricultural products, timber harvesting is not as simple as felling trees. It encompasses various interconnected activities to provide wood products to the market. This is represented by a value chain that includes every effort to produce and deliver a final product or service, from the supplier to customers. In this context, this article provides understanding of the value of sawnwood from Ulanga District to Morogoro Municipality. The Ulanga District is among the districts of Morogoro Region in Tanzania with substantial amount of forest cover of about 75% of its total land area and these forests are under pressure for forest product extraction particularly from natural forests and exotic forest plantations and are supplied to its distant markets such as Morogoro Municipality.

Sawnwood value chain

The sawnwood value chain from Ulanga District (supply side) to Ulanga District (demand side) involves various activities and actors along the chain (Figure 1). While the roles of sawnwood value chain are shown in Table 1, the value channels are as indicated in Figure 2.

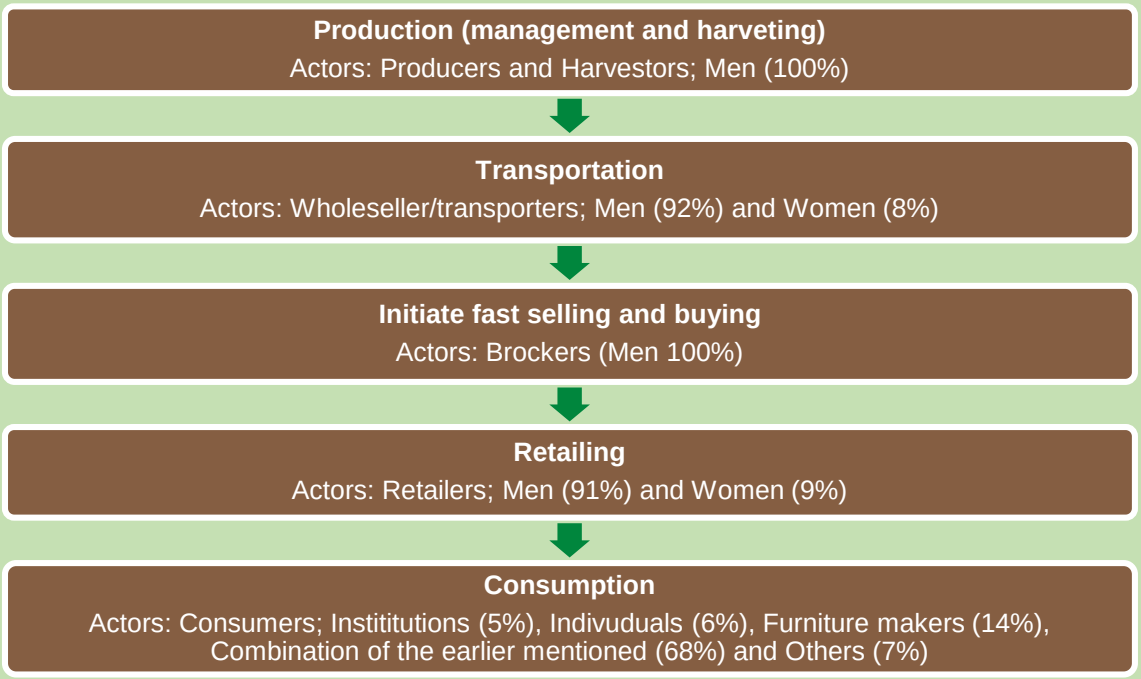


Figure 1: Sawnwood value chain from Ulanga District to Morogoro Municipality

Table 1: Roles of sawnwood value chain actors

Value chain actors	Roles
Sawnwood producers	Producers and harvesters of trees (76% from public forests while 24% from private and unreserved forest)
Sawnwood transporters	Transport sawnwood from production to different actors using either tractors, pickups or using 5-30 tons trucks
Sawnwood wholesalers	Purchase from producers and sell to retailers or to consumers
Sawnwood retailers	Majority of the retailers in the study area buy sawnwood from wholesalers/transporters, and sell directly to consumers who are individuals (14%), institutions or government contractors (5%), furniture makers (14%) and both individual and institutions (33%)
Sawnwood consumers	Purchase sawnwood from retailers

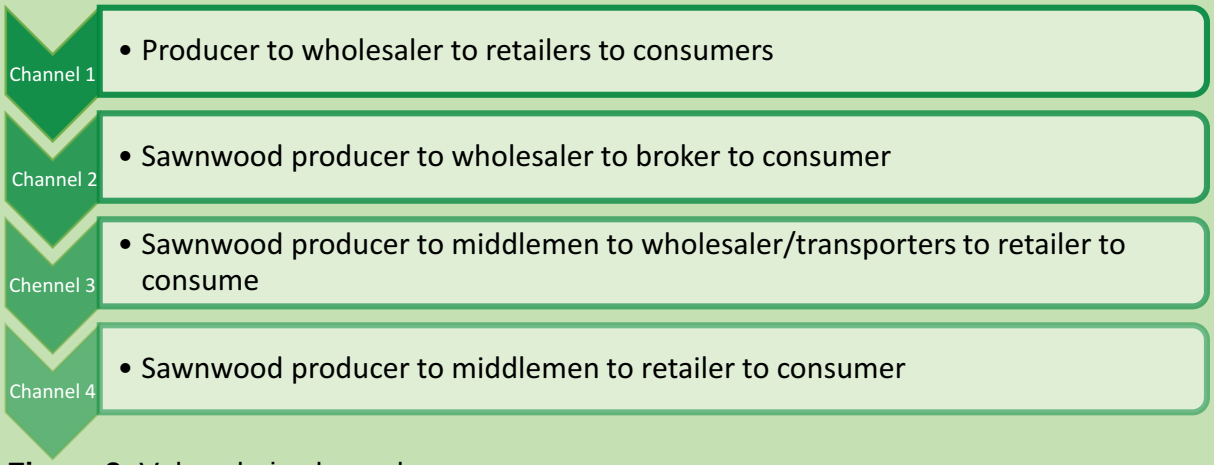


Figure 2: Value chain channels

Distribution of profit along the value chain

Profit margin refers to the amount by which revenue from sales exceeds costs in a business. It is calculated by finding the profit as a percentage of the revenue. In the study area, the profit margin accrued along the value chain was skewed. Retailers earned large share (46%) followed by wholesalers/ transporters (38%) while producers accrued only 15% of the total profit. This suggests that producers are less far benefiting compared to retailers and wholesalers. It also implies that the differences between prices at which they purchased/produced sawnwood and the price they sell were higher at producer compared to the other nodes.

Value adding activities along sawnwood value chain

- The value addition activities which were reported to be borne by producers are production, grading and skidding timber in the field as well as transporting sawnwood to the landing site ready to be transported by trucks to the markets; and
- Others are grading and transportation of sawnwood from the production area to the town has been reported to be the only value addition activity undertaken by wholesalers/transporters in the chain.

Preferred tree species used for timber production

Based on the survey conducted in the area, the most preferred tree species used for timber production are *Pterocarpus angolensis, Afzelia quanzensis and Khaya Anthotheca* while the least preferred species are *Breonardia scalicina, Julbernadia speciformis and Milicia exelsa* in their order of importance (Table 2).

Table 2: Preferred tree species used for timber production in study area

Botanical name	Swahili name	Preference rank	Class	Government royalty per cubic metre (TZS)
Pterocarpus angolensis	Mninga	1	IB	290,000
Afzelia quanzesis	Mkongo	2	IB	290,000
Khaya anthotheca	Mkangazi	3	IA	350,000
Milicia exelsa	Mvule	4	IA	350,000
Julbernardia speciformis	Mtondolo	5	III	195,000
Breonardia salicina	Mgwina	6	II	290,000

Conclusion and recommendations

- The sawnwood value chain in the study areas involved different actors which includes direct ones such as sawnwood producers, transporters, wholesalers, retailers and consumers;
- Direct actors in the chain perform different value adding activities;
- There are more men than women involved in the value chain, this means the value chain is dominated by men. Thus, need to encourage women involvement in the value chain; and
- *P. angolensis* (Mninga), *A. quanzensis* (Mkongo) and *K. anthotheca* (Mkangazi) are the main three tree species preferred for timber and efforts to conserve them by addressing the market demand to less utilised tree species are needed.

Forest Products Value Chain Development through Sustainable Timber Harvesting under Community Based Forest Management in Tanzania: Experience from Mpingo Conservation and Development Initiative

Introduction

In Tanzania, the development of sustainable value chains for forest based products is critical to ensure social, economic and environmental benefits. Sustainability of value chains is however threatened by many challenges including low access to modern pre-harvesting, harvesting and post-harvesting technologies. In this context, Mpingo Conservation and Development Initiative (MCDI) has been working with four Regions (Lindi, Ruvuma, Pwani and Arusha) involving nine Districts (Kilwa, Rufiji, Tunduru, Namtumbo, Liwale, Nachingwea, Songea, Ruangwa and Monduli) to support community forest enterprises under Community Based Forest Management (CBFM) for rural development and contribution to National economic growth through sustainable and socially equitable utilization of forest resources. MCDI considers that "Incentives from forest based products are key for communities to achieve conservation outcomes, financial and social sustainability".

Community based forest enterprise models: Recovery and Revenue

Practical experiences from MCDI, community based forest enterprises models from pilot sites show that, the High efficient community shared portable sawmill model is a proved working model. This is demonstrated by the 60% increase in revenues for the villages selling Forest Stewardship Council (FSC) - certified and kiln-dried sawn timber to the Eco Lodges and construction companies (Table 1). Thus, a need for transition from standing tree volume to sawn timber sales for value addition.

Table 1: General description of the model characteristic and their respective recovery rate and revenue

No	Model	Characteristics	Recovery rate (%)	Revenue (%)
1	Started by selling on stumpage (round logs)	Low demand and no value addition and lots of wastage	-	-
2	Ramp sawing and pit sawing	Faced with logistical challenges and poor recovery rate	27	3
3	Sawmill renting	Low recovery rate, primitive technology, not safe, power interruption, and challenges with logistics- unreliable hired trucks to transport logs to the sawmill	30	5
4	Log processing using Ding Dong	Not safe, limitation of log size and time consuming	35	18
5	High efficient community-shared portable sawmill	Value addition, create local employment, high recovery rate	60	63

Plate 1: Pit sawing

Plate 2: Sawmill

Plate 3: Ding dong

Plate 4: Mobile sawmill

Plate 5: Solar kiln

Value addition sawn timber and income generation experience from pilot three villages from Kilwa District

Table 2: Amount generated by villages by selling processed log versus unprocessed logs

No	Village	logs volume (m^3)	Amount generated in TZS		Operational cost	Profit gained from processed logs
			Processed logs	Unprocessed logs		
1	Ngea	100	34,279,300	26,000,000	5,903,800	2,375,500 (**9%**)
2	Liwiti	154	67,720,000	40,040,000	25,929,000	14,111,000 (**35%**)
3	Likawage	167	121,442,900	43,420,000	32,028,900	45,994,000 (**106%**)

Main benefits of employing the high efficient community-shared portable sawmill model

- **Increase recovery rate and achieve conservation impacts**

Much more significantly, on conservation impacts, due to high recovery of mobile sawmilling facilities, sawn timber produced from one tree are equal to number of sawn timber produced from two trees by using traditional technology. This means, the number of trees cut down are significantly reduced.

- **Rural employment**

An average of two youth per village benefit from direct employment as local sawmill operators and saw doctors and an average of 200 local communities benefit from indirect employment such as harvesting, supervision and transport operations.

- **Achieving high degree of financial autonomy**

The 60% increase in revenues for the villages selling FSC-certified and kiln-dried sawn timber to the eco lodges and construction companies has resulted to financial autonomy. Financial autonomy allows the rural communities to continue managing their forests and subsequent timber harvesting without external financing. This is the key aspect of the model.

Conclusion and recommendations

Under well guidance and supervision, community-based sawn timber production using high efficient mobile sawmills for value addition model is a viable and an effective way to:

- Increase recovery rate;
- Achieve conservation impacts;
- Increase revenues;
- Achieve a higher degree of financial autonomy;
- Stimulate rural employment and economic growth; and
- It is recommended that supporting and promoting community based sawn timber production using high efficient mobile sawmills is the profitable way for value addition in timber value chain.

Sustainable Charcoal Production Model for Supporting Forest-Based Charcoal Enterprise in Tanzania

Introduction

The sustainable charcoal production model being pioneered by the Community Forest Conservation Network of Tanzania (MJUMITA) with the aim of establishing a real-life, pro-poor, sustainable charcoal value chain that provides self-employment opportunities; contributes to investment in community development; and incentivizes more sustainable management of natural woodlands. The model has been deployed to 10 villages in Kilosa district, Morogoro. Charcoal as the main Forest Based enterprise is estimated to contribute 1.3% to Gross Domestic Product (GDP) – TZS 2 trillion. Charcoal is treated as informal business and Wood remains to be the main source of financial revenue for rural communities and forest biomass represents the biggest source of renewable energy in Tanzania. Promoting value chains for charcoal can be a powerful economic incentive for integrated forest management schemes, increasing forest multi-functionality, contributing to sustainable forest management and fostering rural development.

Plate 1: Charcoal

Challenges to sustainable charcoal production in Tanzania

- National energy policy focused on electricity and fossil fuels;
- No strategic plan or policy to guide the supply of charcoal, in the context of growing demand;
- Almost all charcoal in Tanzania is produced from natural woodlands that do not have charcoal production plans / forest management plans; and
- Many policy-makers perceive charcoal to be incompatible with a modernising agenda.

In recent years, the demand of charcoal has been observed to be increasing due to rapid rate of urbanization. The projection of increased demand is as shown in Figure 1:

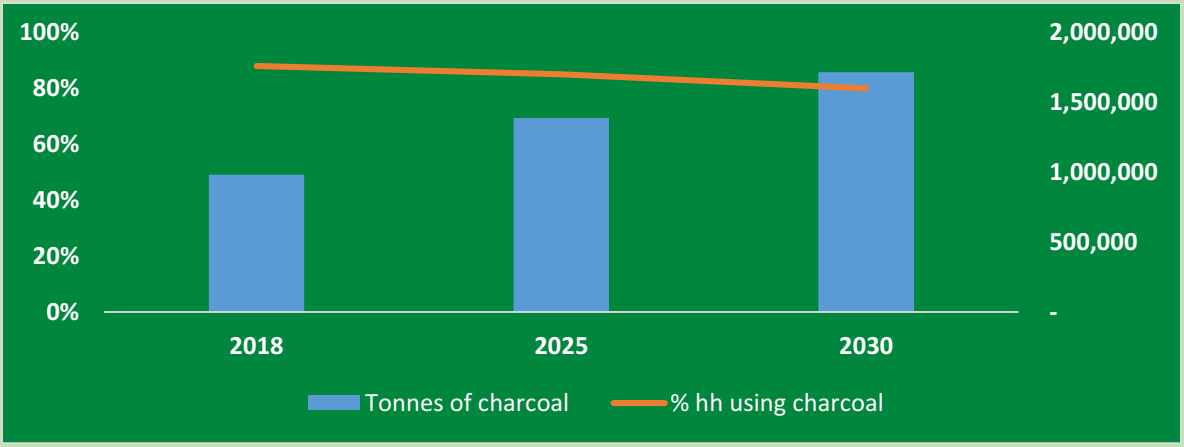


Figure 1: Projected charcoal demand and percent of households (hh) using charcoal in Tanzania. Source: URT, 2019

Plate 2: Communities participating in charcoal processes

Status of charcoal activities in Tanzania

i) **Charcoal Production**
Charcoal Production tends to be carried out in remote areas where would resources is abundant, however this has implication to transport cost.

ii) **Export**
Charcoal export is illegal. However, there is evidence that charcoal is exported illegally to Mombasa and Comoros through Zanzibar.

iii) **Transport**
Motorcycles often transport Charcoal do not go through check points because they lack the supporting documents.

iv) **Regulations**
- Various regulations control charcoal trade and transportation. For example, the Surface and Marine Transport Regulatory Authority (SUMATRA) prohibits transportation of charcoal bags using bicycles and motorcycles, in practice most trade is via motorcycles. The maximum weight of charcoal allowed in the trade is 50 kg per bag (regardless of species) and the trader is required to pay royalty of TZS 12,400.
- Regulation No. 59 of 2022: It guides the sale of charcoal per kilogram whereas 1kg is TZS 250.

Sustainable charcoal model and its mechanism

Sustainable charcoal model aims to establish a real-life, pro-poor sustainable charcoal value chain that provides self-employment opportunities. The following are the main steps to be followed in implementing sustainable charcoal model in a village.

Step 1: Villagers need to prepare and agree to a village land use plan that includes a village land forest reserve. The reserve needs to be at least a few hundred hectares and should have some areas of mature woodland in it.

Step 2: Community prepares the management plan and by laws for the village forest reserve. Procedures are well established in community based management system. The management plan designates “Forest Management Units (FMUs)” as areas for sustainable charcoal products. Number of FMUs may vary from one to three depending on the size and distribution of the reserve. In some areas, 10% of the area of village forest reserve is designated for charcoal products. The remaining 90% can be for protection, beekeeping, and timber harvesting.

Step 3: Determine the rotation period for harvesting. In this case, the rotation age is 24 years which means an area harvested in the first year, will only be harvested again after 23 years.

Step 4: Divide the FMU into 24 blocks or according to the number of age rotation.

Step 5: Harvest one block per year and make sure the yield for that block is calculated based on an assessment of available biomass. The boundaries of this block should be marked out by the Village Natural Resources Committee (VNRC) and producers are only permitted within a specific block. Importantly, other blocks need to be protected to allow woodland regeneration.

Recommendations

- Develop financing models to support communities to establish sustainable charcoal production and community-based forest management;
- Strengthen policies that support sustainable charcoal production and inter-sectoral coordination;
- Promote and strengthen the value chains e.g. digital product tracking systems; promoting the improved kiln and stove technologies;
- Professionalise production by promoting best practices; providing professional training; adopting standards; encourage use of eco-charcoal concept of certification; and increasing compliance; and
- Engage broad stakeholder dialogue and cooperation to move towards sustainable charcoal production and overcome barriers to scaling up.

Potentials and Strategies to Manage Patches of Natural Forests Retained around Homesteads and Farmlands in Tarangire - Manyara Ecosystem, Tanzania

Introduction
In Tanzania, natural forests are managed by government, community and individuals. Irrespective of ownership, these natural forests are faced with severe deforestation and degradation caused by human activities namely, shifting cultivation, over grazing, mining, wild fire and illegal tree cutting as sources of fuel wood, income and construction materials. As a means to reduce pressure on natural forests and increase availability of forest resources in the ecosystem, communities around Tarangire – Manyara ecosystem have undertaken deliberate efforts to retain natural forest patches around homestead and farmlands. Thus, this article highlights the extent of patches of natural forests retained in homestead and farmlands; the potential of natural forest patches on forest and beekeeping value chains; and recommendations on the strategies to enhance management of patches of natural forests.

Plate 1: Local community walking in the natural forest patches in Manyara

Why do we need forest patches and challenges hindering them?
Forest patches are forests which are widely dispersed through human-occupied landscapes and are owned and controlled by rural people. They are conserved by the people who own and use them. They provide products for sale and subsistence, protect watersheds, and have cultural and social benefits. They are managed to provide niches for the growing of forest products and crops. As a result, rural people maintain forest patches for their economic, environmental, social, and cultural benefits, thereby protecting the diversity of organisms that inhabit them.

Forest patches are changing, and in many cases disappearing, under the pressures of human population growth, increased integration of rural households into the world economy, the

breakdown of traditional patterns of forest use and conservation, and government policies that create incentives for conversion of forest patches into croplands and pastures. The loss of forest patches has a direct impact on the products including fodder, fuel wood, edible forest products, medicinal plants, and building materials and environmental services they provide; watershed protection; biological conservation; and guarding against adverse global environmental changes.

Size of forest patches

The research results showed that average size of patches of natural forests retained in homestead and farmlands ranged from 0.3 ha to 5.3 ha, with an average area of 1.2 ha. In the sample patches, the number of different tree species ranged from 3 to 30 (Table1). The most common species were *Brachystegia speciformis*, *Brachystegia microphylla* and *Combretum molle.*

Table 1: Size of forest patches

No	Village	Average size	No. of species	Stems/ ha	Basal area/ha	Volume/ ha	Biomass (tons/ha)
1	Gijedaboshka	1.5	30	753	6.5	43.3	67
2	Duru	1.5	6	745	1.8	3.9	10.9
3	Mswakini juu	4.8	8	548	3	8.3	24.5
4	Endamaghai	0.3	3	376	2.3	6.9	22.3
5	Maweni	1.5	12	124	8.48	121.15	88.7
6	Esilalei	5.3	10	345	4.2	35.7	40.3

Forest products from forest patches

A forest patch provides forest goods such as fodder, fuel wood (firewood and charcoal), edible forest products, medicinal plants, and building materials and services to households which includes provision of shade for livestock, protection of houses from strong winds and dusts, control soil erosion, hosting pollinators for agricultural crops.

Uses of forest products from forest patches

The most of the forest products harvested from forest patches are mainly for subsistence and trading purpose. For example, firewood is sold within the surveyed villages and price per headload (bandle) was estimated to be TZS 1,000. *Tamarindus indica* (Omasamburai), *Sclerocarya birrea* (Omangway), *Grewia similis* (Emangulai), and *Vangueria infausta* (Oromadonyi/Orgumi) are used as sources of fruits that are within and outside sampled villages and sold at an average price of TZS 500 to 1,000 for bowl of about 1.025 kg (Table 2).

Table 2: Forest products use and marketing

No	Products	Use	Market	Unit	Unit price (TZS)
1	Firewood	Subsistence and trade	Within the village	Headload	1,000
2	Fodder	Subsistence	-	-	-
3	Fruits	Subsistence and trade	Within and outside the village	Bowl	500
4	Medicinal plants	Subsistence and trade	Within and outside the village	Bundle	varies
5	Masanzu	Subsistence	-	-	-
6	Poles	Subsistence and trade	Within the village	Piece	500
7	Timber	Subsistence and trade	Within the village	Piece	varies
8	Vegetables	Subsistence and trade	Within the village	Bundle	200

Furthermore, forest patches' owners harvest poles after receiving an order from a buyer and sell them for TZS 500 per piece. At the same time, timber prices vary depending on the size and tree species yet range from TZS 3,000 to 10,000 per piece of timber. In addition, some of the trees are used as sources of medicine as per Table 3 below. Forest patches also provides environmental services including watershed protection, biological conservation, and guarding against adverse global environmental changes.

Table 3: Some medicinal plants in surveyed villages and parts used

No	Vernacular name	Botanical name	Part
1	Kiloriti	*Vachellia nilotica*	Roots, Barks
2	Omukutan	*Albizia anthelimintica*	Roots, Barks
3	Oremiti	*Salvadora persica*	Roots, Leaves
4	Oloisuki	*Zanthoxylum chalybeum*	Roots, Leaves
5	Enjaniembukeli	*Croton scheffleri*	Roots, Barks
6	Olesupen	*Ehretia cymosa*	Roots
7	Engamay	*Dovyalis macrocalyx*	Roots
8	Emangulay	*Grewia bicolor*	Roots
9	Orupande	*Lannea schweinfurthii*	Barks
10	Otimigomi	*Pappea capensis*	Barks
11	Olusayeti	*Withania somnifera*	Roots
12	Engibasikon	*Clerodendrum myricoides*	Roots
13	Endundulu	*Dichrostachys cinerea*	Roots
14	Engaimirori	*Lannea sp*	Barks
15	Endulelei	*Solanum incanum*	Roots
16	Osilalei	*Commiphora schimperi*	Roots, Barks
17	Endumelwa	-	Roots
18	Engilalangwa	*Oncocalyx ugogensis*	Leaves
19	Oimesera	*Adansonia digitata*	Roots
20	Ng`aboli	*Ficus cycomorus*	Barks
21	Orbukoi	*Terminalia brownii*	Barks
22	Eskilianjoe	*Ormocarpum kirkii*	Roots

Conclusion

The study has documented potentials and strategies to manage patches of Natural Forests retained around homesteads and farmlands in Tarangire - Manyara Ecosystem, Tanzania. The forest patches have potential in sustaining livelihood because they provide different forest products and services including fodder, fuel wood, edible forest products, medicinal plants, and building materials as well as source of natural and financial capitals. In terms of environment suitability, patches of natural forests provide ecosystem services such as climate amelioration and sequestration of carbon from atmosphere hence mitigating climate change.

Recommendations

- Formalizing the ownership and management of patches of natural forests as per Forest Act No. 14 of 2002;
- Promoting beekeeping in patches of natural forests to serve as a source of food and cash income for households; and
- Promoting of domestication of useful timber, fodder, fruit and medicines tree species for various forest products and services.

NON-TIMBER FOREST PRODUCTS VALUE CHAIN

Market System Analysis of Bamboo Products in Ruvuma

Introduction

Bamboo (Mwanzi in swahili) is an evergreen perennial flowering plants in the grass family Poaceae. In Tanzania, there are four major bamboo indigenous species namely; *Yushania alpina, Oreobambos buchewaldii, Hickelia africana* and *Oxytenanthera abyssinica* while exotic species are *Dendrocalamus strictus, Dendrocalamus nutans, Bambusa vulgaris, Bambusa multiplex, Bambusa nutans, Bambusa bamboos* and *Bambusa* spp. Some of bamboo species can grow as fastest as 910 mm (36 in) within a 24-hour period, at a rate of almost 40 mm (1½ in) an hour (equivalent to 1 mm every 90 seconds). Bamboo can also tolerate onto marginal lands.

Overview

Worldwide, bamboo is versatile and extensively planted. It is classified into running (monopodial) and clumping (sympodial) bamboos. The former is mostly found in tropical, subtropical and temperate regions, particularly in China and Japan while the latter bamboos in tropical and subtropical zones like Central and South America, Africa, Asia and Australia. Bamboos produce various products like food (culinary), kitchenware, musical instruments, fuelwood, writing pen, fabrics and building materials such as laminated boards and panels. In Tanzania, bamboos are used for making winnowers, baskets (Matenga and Jamanda), table, chairs and barbeque sticks. Despite the presence of bamboo in the country, its market is underperforming and hence the need to map the value chain and other factors which can assist in improving the market.

Plate 1: Bamboo and its products

Value chain and distribution channels in Ruvuma

The value chain and distribution channels for bamboo products in Ruvuma region is shown in the Figure 1 below.

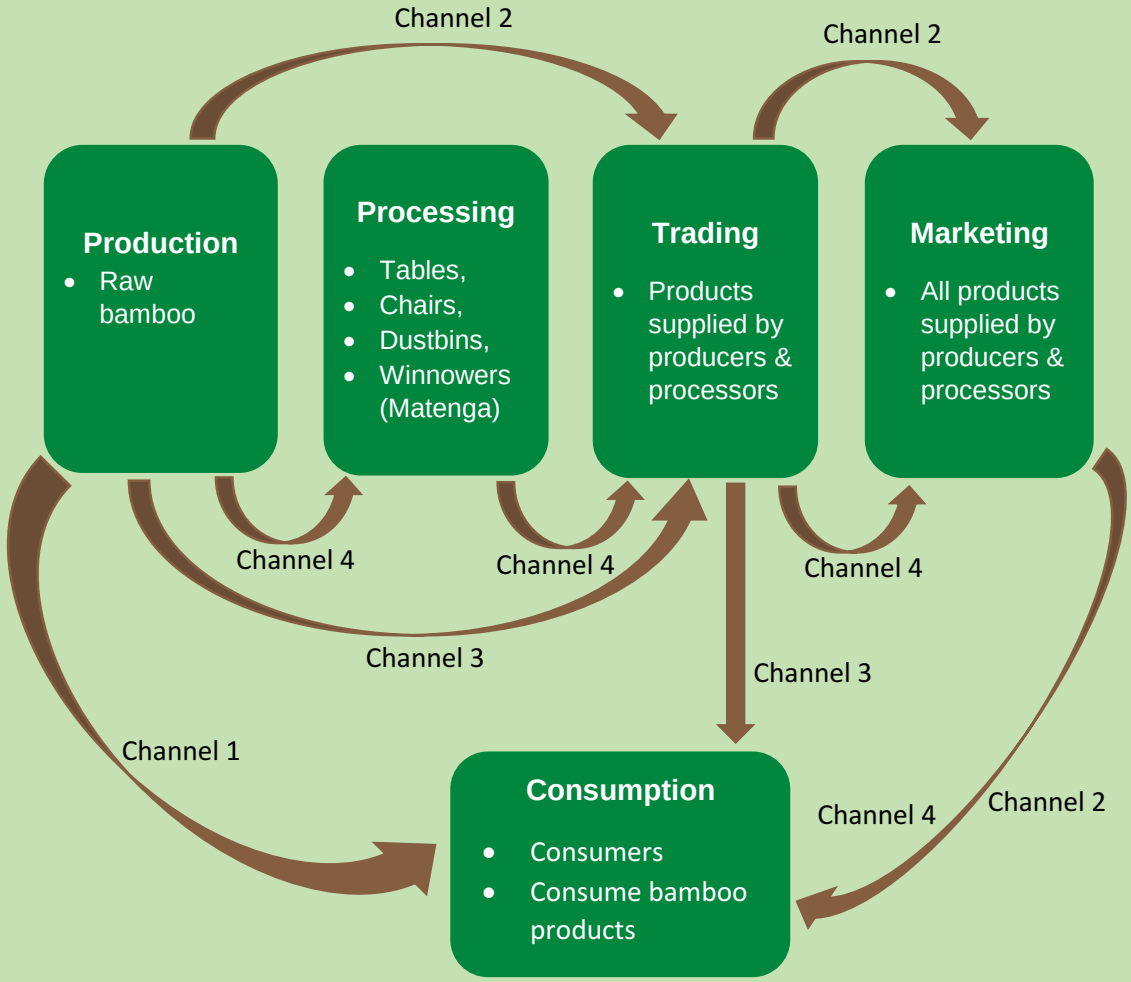


Figure 1: Bamboo value chain actors, products and distribution channels in Ruvuma

Value addition in bamboo value chain

The value addition activities in bamboo products include slicing of raw bamboo into strips that can be used to make different products, use of artificial colors for decoration and making of barbeque stick. Manufacture of bamboo furniture's and bamboo sticks.

Profitability analysis

The study of market system analysis of bamboo products in Ruvuma used gross margin to calculate profitability for each actor in the value chain. Gross margin is defined as the difference between revenue and cost over revenue. Producers' gross margins ranged from 22% to 47% depending on product dealt. However, when producers were in groups, gross margin was 78% which was higher than that of traders and processors (40% and 53% respectively). This implies that working in groups reduced costs and increased efficiency and productivity.

Price of each product within Ruvuma and other regions

Prices per bamboo products vary depending on the level of value chain, product type and market (Table 1).

Table 1: Average prices of bamboo products in Ruvuma region and other regions in Tanzania

Products	Price (TZS)	
	Ruvuma region	Other regions
Winnowers	2,100	3,400
Local cases (Jamanda)	4,600	12,000
Big basket (Tenga)	7,300	9,000
Furniture per set	-	150,000
Dustbin	-	18,000
Basket	1,900	6,000
Barbeque sticks per packet	550	900

Market types and model of selling

The market for bamboos in Ruvuma can be categorised into raw bamboo (inputs market) and final bamboo products (output market). The former is the producers supply raw bamboo for processors to produce intermediate/final bamboo products. The latter is the final bamboo products market supply to consumers. The final bamboo products market is further divided into local and export market. The local market comprises of Mbinga, Songea, Mbeya and Dar es Salaam. The export market includes neighbouring countries like Democratic Republic of Congo (DRC), Zambia, Malawi and Kenya.

Factors limiting bamboo value chain development in Ruvuma

The study on market system analysis of bamboo in Ruvuma realized the factors which cause the underperformance of bamboo value chain: -

- Poor means of transport;
- Lack of appropriate grading mechanisms;
- Transformation in culture and norms has minimized the consumption of bamboo products; and
- Use of poor technology prevailed among producers.

Conclusion

Notably there are different products of bamboo for households use and commercial purposes. Generally, the bamboo enterprise follows four main channels. Also, the products are both traded locally, regionally, nationally and internationally. The price of bamboo products is high at international markets compared to national, regional and local markets.

Recommendations

- For a broader commercialization of bamboo, more products should be added to the chain to attract both domestic and international market;
- Tanzania Forestry Research Institute (TAFORI), International Network for Bamboo and Rattan (INBAR) and Sokoine University of Agriculture (SUA) should conduct various researches on the suitability of bamboo species since it was not clear on whether species suitable for handicraft can also be used for making furniture and the comparison of bamboo products sourced from different areas to determine customers' preference; and
- The government is required to create a good environment to promote a competitive bamboo chain through strengthening policy and attention through reviewing it and communicating it to relevant stakeholders.

The Current Stocking of *Phoenix reclinata* (Mkindu) and Potential Market for its Products in the Coastal and Northern Areas of Tanzania

Introduction

Phoenix reclinata (Ukindu in Swahili) is one of the valuable Non-Timber Forest Products (NTFP). It is a wild date palm that grows to a height of 3 to 6 m, sometimes up to 10 m. It may grow as a stemless suckering bush, but usually several stems develop from the base. The leaves are pinnate, and compound with 30 - 50 leaflets on either side of the rachis and the lowermost leaflets are reduced to spines. In general, *P. reclinata* grows well along river or stream banks and in seasonally inundated low-lying, open grassland, typically in dispersed clumps. In Tanzania, Ukindu is present in swamp and river habitats, for example, in Pangani and Rufiji rivers.

The Ukindu is exploited commercially and many people both men and women at varying degrees and levels are engaged in the Ukindu value chain (especially harvesting, processing, and marketing). Whilst majority of women in rural and urban areas are involved in making Ukindu products such as floor mats or coiled and sewn to make fans, wall hangings, food covers, and baskets, their counterpart men are involved in harvesting, processing and selling of the dried leaves. It is recognised that involvement in Ukindu value chain provides important alternative source of income for rural and urban households.

In this context, as the population is growing and the country has entered into middle income countries, the demand for Ukindu is expected to grow. Thus, efforts to understand the current stocking of Ukindu and existing and potential markets of its products are a critical priority.

Availability, harvesting and processing of Ukindu

Availability

The study carried out in Mkinga, Same and Rufiji districts of Tanzania showed that the stocking levels of Ukindu in these districts were 316 stems/ha, 388 stems/ha, and 81 stems/ha respectively. This means that the large proportion of Ukindu was obtained in Mkinga and Same districts, as compared to Rufiji District.

Harvesting

Although Ukindu can be harvested both from reserved and unreserved forests, a large proportion of Ukindu was harvested in unreserved forests. The harvesting part of Ukindu is a juvenile frond, which is an immature leaf with unexpanded leaflets. Harvesting tools are; a bush knife (Panga) and a stick (Fimbo). Stick is used to press mature leaves aside to allow clear visibility at the center of the clump or stem. Ukindu harvesting involves two techniques:

1. Pulling from a center of the stem. This technique is rarely used due to time consuming, laborious and hurting arms.

2. Cutting using bush knife (Panga). This is a common harvesting technique for Ukindu. The use of a bush knife involves skilfully cut of juvenile frond by pushing it against the leaflet base. One juvenile frond is harvested at the time per stem while the number of fronds harvested in clump depends on the clump size and quality. Many fronds might be harvested in bigger and well-established clumps as compared to small and weak clumps.

Processing

After harvesting Ukindu from the forest, they are processed and dried before weaving into various products. Drying is mainly done via;

1. Bisecting and tying up compound leaves, then sun drying for 5 to 6 days.
2. Spreading of the leaves on the ground for sun drying for 5 to 6 days.

Following each step, when leaves are dried, the greenish colour turns to whitish. Then, dried leaflets are ripped off from rachis and then graded to make sure that only quality dried leaflets are taken. Grading is based on colour and length. The first grade is white leaflets which are sorted manually. The second grade is the one which is left after sorting the first grade. Graded leaflets are tied in bundles locally known as Vichanga. Average dried leaflets in a bundle range between 375 and 440 making an average of 400 dried leaflets per bundle. Preparation of Ukindu products involves the splitting off dried leaflets into thin strips locally called Chane.

Sometimes, Chane is dyed by boiling in mixture of water and dye before drying and plaiting to make narrow strips called Ukili. Ukili are then joined together using nylon thread in various shapes and sizes to make a product. A product can be decorated or undecorated with colours.

Plate 1: Woman weaving a mat

Products made from Ukindu and their uses

Ukindu are used to make different products which include prayer mats, baskets, mats, wall hangings, handbags, hats, dish/food cover, hand fan and pouch with various uses (Plate 2). For example, mats are laid on the ground or bed, dish cover for covering cooked food, wall hangings for indoor decorations.

A number of "Vichanga" used to make a product depends on the number of leaflets per bundle. The average dried leaflet per bundle is 400 and the number of leaflets per frond ranges between 46 and 67 with an average of 56 leaflets. The estimated number of bundles, leaflets, and fronds required to make "Ukili" that is sufficient for each product. Of all products, mat requires an average of 80 bundles bundles due to its size as compared to other products. The prayer mat is the second for using many bundles, which requires an average of 30 bundles. The average number of items/products that a household can produce per month depends on the type of product being made as well as on market forces as summarised in Table 1.

Plate 2: Mkindu products

Table 1: Average bundles, fronds and leaflets required to make a product

Product	Bundles	Fronds	Leaflets	Average number of products produced per month per household?
Basket	5	40	2,000	19
Mat	80	640	32,000	2
Prayer mat	30	240	12,000	3
Wall handing	10	80	4,000	8
Hand bag	5	40	2,000	6
Hat	3	24	1,200	14
Dish cover	5	40	2,000	5
Pouch	1	8	400	Nil
Hand fan	3	24	1,200	Nil

Note: One bundle = 8 fronds; one frond (leaflet) is estimated to have 50 preferred leaves

Marketing of Ukindu and its products

Ukindu can be sold as a raw material (leaflet) or its products at home or village markets. The products sold at home or village markets are of low quality compared to those found in the potential markets in towns and cities which are imported. The difference is attributed to the level of technology used to make final products (finishing process). For example, weavers in the villages do not decorate their product, while imported products are decorated using artificial materials such as synthetic fibers, beads, varnish and colours.

There are other potential markets for Ukindu products including curio shops in towns and cities which are popular for tourism such as Dar es Salaam, Arusha, Moshi, Iringa, Tanga, Zanzibar and Bagamoyo. With regards to international market, Ukindu products were reported to be exported to Mombasa Kenya which is also a hub for Tourist in East Africa. However, marketing of Ukindu products is influenced by the availability of tourist and quality of products. The availability of tourists is seasonal thus when the number of tourists is higher, the demand for weaving products in the market also increased and vice versa. The quality of products further determines the prices. For example, the price of well-decorated handbags imported from abroad ranged between TZS 115,000 and 172,500 (USD 50 and 75) in Zanzibar, Arusha and Dar es salaam while those locally made were sold between TZS 23,000 and 69,000 (USD 10 and 30).

When there is a high demand for products, households mobilize more resources to make many products. This involves time spend slitting leaflets, weaving narrow strips (Ukili), and sewing strips to make the product. When there is a higher demand for the product, there is increase in production to meet the demand.

This studied site can produce 1099 bundles which require average number of bundles per month is 526, hence under current scenario projection of two months (Table 2).

Table 2: Projected sustainability of the available Ukindu stock

Product	Bundles	Fronds	Leaflets	Average number of products produced per month	Number of products in Mkinga	Number of products in Same	Number of products in Mkinga	Number of bundles per month
Basket	5	40	2,000	19	8.85	10.86	2.27	95
Mat	80	640	32,000	2	0.55	0.68	0.14	160
Prayer mat	30	240	12,000	3	1.47	1.81	0.38	90
Wall handing	10	80	4,000	8	4.42	5.43	1.13	80
Hand bag	5	40	2,000	6	8.85	10.86	2.27	30
Hat	3	24	1,200	14	14.75	18.11	3.78	42
Dish cover	5	40	2,000	5	8.85	10.86	2.27	25
Pouch	1	8	400	1	44.24	54.32	11.34	1
Hand fan	3	24	1,200	1	14.75	18.11	3.78	3
	142	-	-	-	106.73	131.05	27.36	526

Note: Aggregated total number of bundles is 1,099 and average number of bundles per month is 526, hence projection of two months

Recommendations

- Identification and demarcation of all areas with Ukindu within village lands and other land uses. This can be done by the village government in collaboration with other actors such as district councils;
- Promoting the production of weaving materials by searching the market of the products, disseminating of market information and improving quality. This will not only improve the income of rural households but also will conserve natural resources especially forests by reducing human pressure on forests with Ukindu;
- Providing training and extension to farmers/weavers about the date palm production and processing by using seminars, workshops and tours;
- Research should be conducted to develop production and processing technologies;
- Empowering by strengthening funding sources such as credit facilities. This will enable economic groups or individuals to access soft loans in respective areas and investing in weaving. In the formation of groups, the focus should be on marginalized and excluded groups such as women, elders and people with disabilities; and
- Establish community forest based enterprise model on Ukindu to make stronger links between sustainable harvesting, forest management and market opportunities for Ukindu products including development of digital platforms.

Local Made Soap from *Lantana camara* and other Local Available Resources

Introduction

Lantana camara is a species of flowering plant native to American tropics. *L. camara* is an invasive, small, perennial shrub growing around 2 m tall forming dense thickets. It grows in a wide variety of habitats in the tropical and subtropical zones. *L. camara* can grow in sand, loam and clay soils, though it prefers well drained soils and can also grow in nutritional poor soil. It grows in semi-shade (light woodland) or no shade.

Due to its versatility, it has naturalized Europe, Asia, Ocenia and Africa. It is found in many African countries including some arid regions and is widespread in Kenya, Uganda and Tanzania.

L. camara has multiple uses including medicinal, edible, agroforestry uses and other uses like pulp for paper production. Despite all these uses, medicinal is the prime use of *L. camara*. Medicinally, the plant has antimicrobial, fungicidal, insecticidal, and nematocidal properties. Essential oil obtained from the plant is used for the treatment of skin itches, wounds, leprosy, and scabies (see Plate 1 below).

Plate 1: One of skin diseases which *L. camara* can cure

Other parts of the plant like root is used for influenza, cough, mumps, fever, malaria, toothache, headache, etc. The flowers are used for hemoptysis and pulmonary tuberculosis. Conditions like constipation, high blood pressure, dermatitis, eczema, measles, urethral inflammation, colds, and bronchitis among others can also be treated using plant parts of *L. camara.*

Propagation and harvesting

L. camara can be propagated using seeds or cuttings. A single plant can produce 12,000 seed per year. The cutting of *L. camara* can respond well to cutting back, able to resprout even from severe and repeated cutting back.

Local *L. camara* soap value chain and value addition

Two key actors are found this value chain is farmers of private owned farm and soap manufacturers. Value addition processing of leaves and flowers into rectangle and cylindrical soap and use of artificial colours to decorate soap to attract customers.

Process for creating *Lantana Camara* soap

In case of medicated soap (see Plate 2 bellow) making the leaves and flowers are the main components. Leaves and flowers are collected using simple tools and local skilled labour and then dried under the room temperature between 5 to 7 days. The active ingredients of Lantana camara leaves are volatile oil 0.2%, triterpenoids, betulonic acid, oleanolic acid, lantadene A, lantadene B and lantanilic acid while flowers contain; volatile oil, 0.07% - Caryophyllene - like bicyclic terpene, 80% and a-phellandrene, 10-12%.

Plate 2: *L. camara* products on a marchandise

New economic opportunity through utilization of forest resources

Tanzania is now destined to becoming the industrial and middle-income country. The innovation of new medicated *L. camara* soap is paving a way to achieve the goal of establishing new industries which will increase the government revenues through levied tax and reduce unemployment particularly for the youth. It also increases the possibility of utilization of forest resources through value chain. The innovation will help the country to reduce import of medicated soap which reduces the country's foreign currency reserves.

Conclusion

This idea-based research has verified the use of *Lantana camara* leaves and flowers on treatment of skin diseases specifically skin itches, skin rashes and Tinea capitis as described by previous studies. Despite of Local based technology adoption on making soap but, it shows

possibility of utilization of forest resources into economic opportunities through value chain. The perception of majority in the local community is still at low level, because the product is newly at the market and also products from local industries not much trusted. Quality of the product not yet tested so far but, the efforts have done and initial stages of quality assurance process go on at Tanzania Bureau of Standards (TBS).

Recommendations

- The government and development partners should assist in promoting innovations for application countrywide;
- The government should allocate adequate financial resources for innovations and technologies development;
- The government should create smooth environment for small scale soap producers to penetrate in the markets and make them able to compete with large soap producers;
- The government should promote technologies which aim at sustainable utilization of forest resources as primary raw materials;
- *Lantana camara* woodlots should be established to ensure sustainable supply of leaves and flowers for soap making;
- Collaboration should be enhanced between research institutions like Tanzania Forestry Research Institute (TAFORI), National Institute of Medical Research (NIMR), Tanzania Industry Research Development Organization (TIRDO), Commission for Science and Technology (COSTECH), universities, training institutions and technology development institution like Small Industry Development Organization (SIDO) to develop technologies, which will assist Small and Medium Enterprises (SMEs) to produce quality products and improve value chain in utilization of forest resources;
- The government should intervene by lowering loan interest from financial institutions so as to favour SMEs countrywide; and
- Fees and procedures for quality assurance should be moderate to SMEs so as to promote their interventions.

The Potential of Nature-Based Enterprises in the Arid and Semi-Arid Lands of Kenya: Case Studies in Loima and Turkana West sub-Counties, Turkana County

Introduction

Nature-based enterprises (NBEs) refers to as an enterprise or engagement in economic activity that use nature sustainably as a core element of product/service offered. Nature may be used directly by growing, harnessing, harvesting or sustainably restoring natural ecosystems, and/or indirectly by contributing to the planning, delivery or stewardship of nature-based solutions (NBS). NBS encompasses different approaches that work with and enhance nature to help address several societal challenges, including climate change, deforestation and biodiversity loss. NBEs are ventures that can be exploited to support people's livelihoods, biodiversity utilization, conservation and equitable benefit sharing from derived resources. Thus, expanding NBEs can improve community livelihoods and also develop their resilience to social, economic and environmental threats such as climate change. NBEs have recently emerged as important actions in the delivery of NBS to societal challenges and are increasingly integrated into national and local government planning and strategies in developing countries including Kenya.

Recently, three bio-enterprises including beekeeping production, pasture production and Aloe turkanensis enterprises as part of NBE initiatives were established in the Arid and Semi-arid lands (ASALs) of Loima and Turkana west sub-counties in Turkana County in Kenya. The sites selected for the nature based interventions were Naipa, Lochor-angikalalio, Namoni-angkaala and Nalapatui. The communities in these sites are mainly pastoralists and graze their livestock along the cross-border region of Kenya and Uganda. These pastoralists solely depend on livestock and livestock products for their livelihood. In this context, this article aims to document the potential of these NBEs interventions in the aforementioned sites of ASALs of Kenya.

Beekeeping Production Nature-Based Enterprise

Description on the beekeeping intervention

The beekeeping intervention were carried out in three sites namely; Naipa, Lochor-angikalalio, Namoni-angkaala and involved a series of activities according to their order;

i. Training of the target communities on all aspects of Apiculture namely: Bee products, types of bees, types of hives, hive installation, beekeeping equipment and how to use them, hive management, bee forage, processing of honey and marketing;
ii. Provision of bee hives equal to the group me mbers in each site so that each member of the group possessed a bee hive as follows: Lochor-angikalalio (24 hives), Namoni-Ankaala (22 hives) and Naipa (20 hives);
iii. Training on the conservation of biodiversity, concept of sustainable livelihoods and sensitization on the role's trees play in the beekeeping enterprise; and
iv. Provision of fruit and high value native tree seedlings to the members who were also trained on tree planting and water harvesting techniques to ensure survival of the seedlings.

Participation in beekeeping production

Gender representation for the groups involved in beekeeping showed that women had the highest representation in all three sites namely; Lochor angikalaio, Namoni-Ankaala and Naipa. Namoni-Ankaala representing the highest (> 50%) involvement (Figure 1). This implies that labour, especially women, are more engaged in beekeeping.

Hive occupancy by bees

Regarding hive occupancy by bees, in three sites, namely; Lochor angikalaio, Namoni-Ankaala and Naipa installed with beehives showed different hive occupancy in 30 days. Lochor angikalio registered the highest (88%) of hive occupancy (Figure 2). This partly indicates that the area is potential for beekeeping.

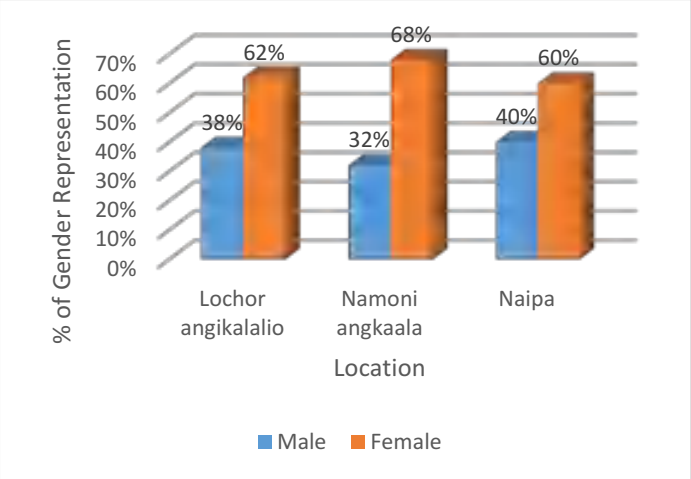


Figure 1: Number of males and females in each of the beekeeping groups

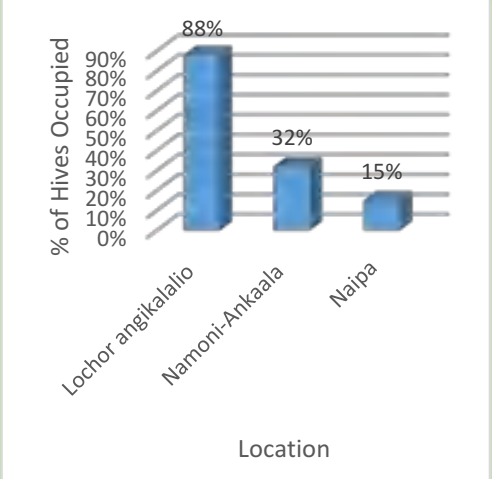


Figure 2: Shows the percentage of the hives occupied by bees one month after installation

Pasture Production Nature-Based Enterprise

Description of pasture production intervention

Four sites namely; Naipa, Lochor angikalalio, and Namoni angkaala were selected for pasture production intervention. The community group members were trained on pasture establishment, management, harvesting, bailing and storage following a Farmer Field School (FFS) training model to enhance community's understanding of practices involved. The pasture seeds planted were *Cenchrus ciliaris*. Planting, seed harvesting and hay baling was done manually and the grass planted depended purely on rainfall for establishment. The experiment was monitored for a period of six (6) months.

Pasture seed, grass and hay production per acre

Pasture production encompasses grass seed and hay production. For grass seeds production, Lochor angikalalio produced the highest amount of grass seeds under rain-fed regime with 46 kgs of *Cenchrus ciliaris* seeds per acre, Namoni angkaala 36 kgs per acre while Naremioto produced 15 kgs of *Cenchrus ciliaris* seeds per acre. The grass planted at Naipa did not establish to maturity, hence no results were recorded (Figure 3). With regards to hay production, Lochor angikalalio produced 48 bales of *Cenchrus ciliaris* grass per acre, Namoni angkaala 41 bales, while Naremioto produced 32 bales of harvested *Cenchrus ciliaris* grass (Figure 4). These results imply that Lochor angikalalio is more potential for grass seed and bales production.

Plate 1: Hay

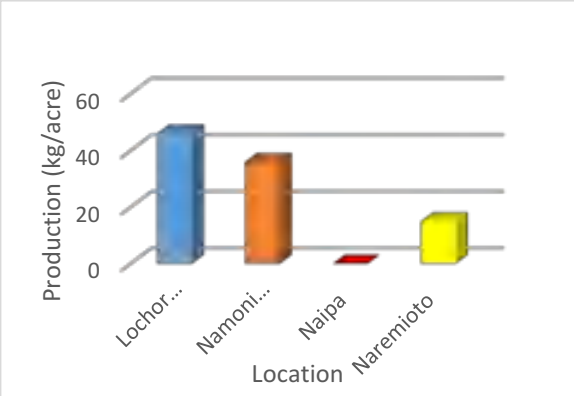


Figure 3: Grass seed production per acre at Lochor angikalalio, Namoni angkaala, Naipa and Naremioto

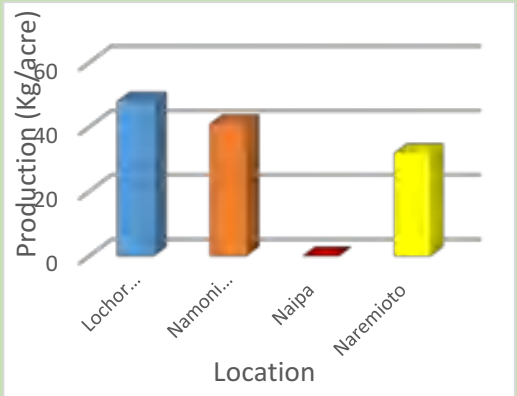


Figure 4: Grass bales production per acre at Lochor angikalalio, Namoni angkaala, Naipa and Naremioto

Aloe turkanensis Nature-Based Enterprise

Description of *Aloe turkanensis* enterprise intervention

The activity of *Aloe turkanensis* production was conducted in two sites: Lochor-angikalalio (Loima sub-county) and Nalapatui (Turkana west sub-county). The community groups were trained on the importance of Aloe species, different types of aloe species, nursery establishment, aloe propagation and management, Aloe sap harvesting, aloe bitter gum processing and development of Aloe products. The two community groups established their own aloe farm with Lochor-angikalalio having 5 acres and Nalapatui 2 acre of *Aloe turkanensis* suckers. Further, the group members were trained on development of products such as aloe bar soap, aloe shampoo and soap liquid detergent.

Products and income

Aloe was used to produce soap, shampoo and detergent. The estimated gross profit of these products based on the cost of production and the prevailing market prices for the Aloe value addition enterprises are as shown in Table 1. The soap detergent had a highest gross profit margin of 79%. Aloe soap had the least gross profit margin of 37% while Aloe shampoo had a gross profit margin of 78%. The average gross profit margin of all the products was 65%. This means that Aloe detergent and Aloe shampoo had far most higher gross profit than Aloe soap.

Table 1: Gross profit of *Aloe turkanensis* products

No	Product	Quantity	Cost of production	Unit cost	Total sales	Gross profit	Remarks
1	Aloe soap	11 Pieces (1 kg)	347	50	550	203	37% gross profit
2	Aloe shampoo	10 litres	439	200	2,000	1,561	78% gross profit
3	Aloe detergent	10 litres	211	100	1,000	789	79% gross profit

Conclusion and recommendations

It is clear from the three-case studies that Turkana County has a significant potential for the three bio-enterprises appraised. However, all the sites registered varying degrees of success in different enterprises. Based on the study results, Lochor-angikalalio is the best suited site for beekeeping, based on the high percentage of beehives colonized within a month. This site also has more potential for grass seed and bales production compared to the other sites. Aloe products enterprises also showed good performance at Lochor-angikalalio and Nalapatui for Aloe shampoo and Aloe detergent. Thus, Lochor-angikalalio clearly demonstrate that bio-enterprise approach can be adopted as tool for sustainable livelihoods improvement strategy and wealth creation if well designed and organized to enable proper skills transfer to the target communities.

It is recommended that the Beekeeping, Pasture, and *Aloe turkanensis* nature-based enterprises to be tested in the context of Tanzania especially in the arid and semi-arid area of the country.

SECTION TWO: BEEKEEPING

Beekeeping Status and Honeybee Products and Services Potential in Tanzania

Beekeeping is a traditional economic activity that involves stinging and stingless bees among the communities living in the vicinity of forests and woodlands. Estimates show that about 90% of beekeeping in the country is a forest-based activity using traditional methods. The other 10% is carried outside the forest. Beekeeping produces different products such as honey, beeswax, pollen, propolis, royal jelly, brood and venom. The beekeeping sector has a great potential to contribute to the development of the national economy and livelihoods of the people including employment creation; income generation; health issues of human and livestock; food security; wild ecosystem sustainability resulting from pollination; provision of aesthetical value through api-tourism and revenue collection through beekeeping enterprises.

Types of bees

Stinging bees

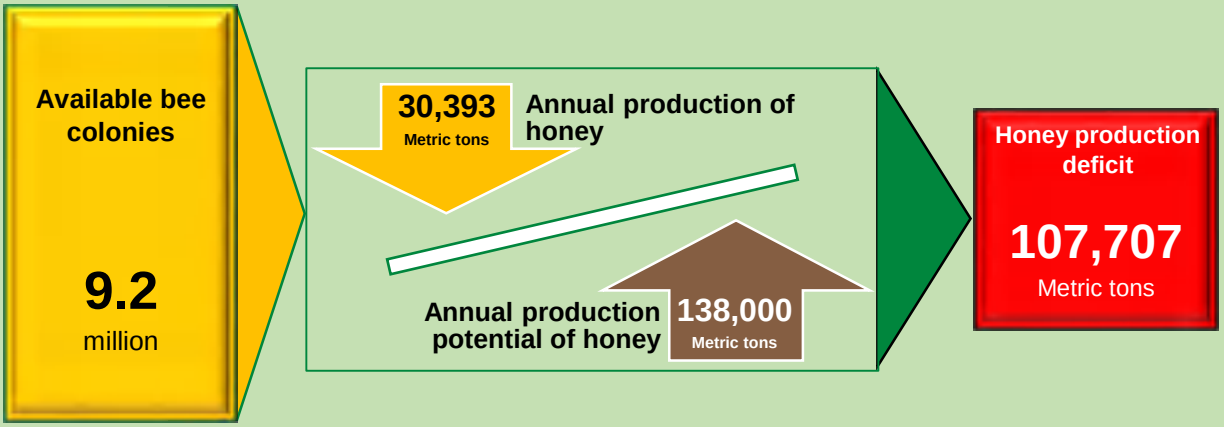
Stingless bees

Bee products

© Tanzania Honey Sector Synthesis Report and Development Rood Map, 2014

Tanzania is estimated to have 9.2 million honey bee colonies. The production potential of bee products is about 138,000 MT of honey and 9,200 MT of bee wax per annum. However, current production stands at 30,393 (22%) MT and 1,843 (20%) MT of honey and beeswax respectively, which is if far below the country's production potential.

Total annual honey production and production potential in Tanzania



HONEYBEE PRODUCTS VALUE CHAIN

Beekeeping Cluster Initiative: A New Approach to Honey and Beeswax Value Chain Process in Manyoni District, Singida Region, Tanzania

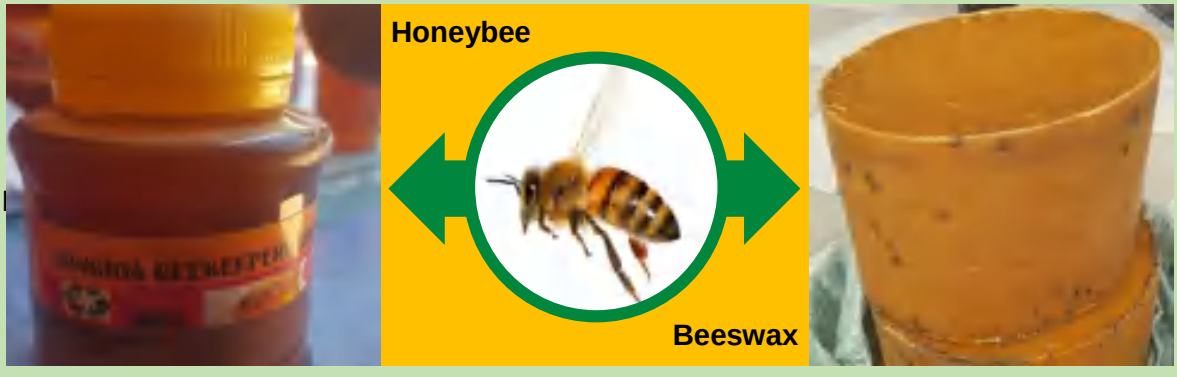
Introduction

Cluster initiative is an organised effort aimed at fostering the development of the cluster either by strengthening the potential of cluster actors or shaping relationships between them. Clusters entail groups of companies/firms, mainly Small and medium-sized enterprises (SMEs) and other actors (government, research and academic community, institutions for collaborations, for example, financial institutions) co-locating within one geographical area, cooperating around a specialised niche and establishing close linkages and working alliances to improve their competitiveness. Clusters are characterized as multi-dimensional due to strong linkages between competing firms, and often with a geographic focus. As of their proximity be it geographically and in activities, clusters can take advantage of the economic benefits of being located in the same place. Such benefits include access to specialized human resources and suppliers, access to and sharing of information and expertise, increased productivity in head-to-head competition.

Cluster initiative started way back in 2003 under Innovation Systems and Clusters Program (ISCP – EA) in Tanzania, Uganda and Mozambique under financial support of Sida/SAREC. In April 2008, African Union (AU) found Pan African Competitiveness Forum (PACF) in Addis Ababa in April 2008 with the mission to stimulate, catalyze and promote the development of innovation and cluster based competitiveness for poverty reduction, wealth creation and sustainable development in Africa. In Tanzania, Manyoni beekeeping cluster is one example of a cluster initiative based in Manyoni District in Singida Region.

About the Manyoni beekeeping cluster initiative

The Manyoni beekeeping cluster was officially launched in 2013 and involved identifying potential beekeeping groups, individuals, companies involved in beekeeping value chain and reputable academic institution competent to avail modern technologies and technical backstopping to the Cluster. The beekeeping groups identified were trained to form cluster and selected their leadership. The Cluster comprised of 10 beekeeping groups both with 149 members having 369 and 490 traditional and modern beehives respectively. The cluster is engaged in beekeeping honey processing, packaging and trading. In addition to honey, beeswax is another product and they have started to process Wine as a value addition innovation from honey (Figure 1).



Why cluster initiative in Manyoni District

- Potential resources in beekeeping, e.g presence of Itigi thickets ecosystem and wide range of Miombo woodland;
- Existing beekeeping groups;
- An opportunity to harness big market of bee products; and
- Improving quality and quantity of bee products.

Cluster initiative success stories as experienced in Manyoni District

- Increased quality and quantity of produce (for example honey has increased from 8 to 12 tons and beeswax from 1 to 3 tons per year);
- Price of honey and beeswax has improved (for example price of honey has increased from 5,000 to 10,000 TZS per kilogram and bees wax from 4,000 to 7,000 TZS per kilogram;
- More groups motivated to join cluster initiative after realizing benefits;
- Increased market information and linkages;
- Increased collaboration beekeeping and the entire value chain; and
- More individuals motivated in beekeeping.

Challenges of the cluster initiative

- High cost of new commercial beehives;
- Prolonged droughts which affected production;
- Forests degradation due agricultural practices;
- Lack of clear policy to support these new initiatives;
- Lack of cluster initiative knowledge to most employees in beekeeping sector;
- Cluster Initiative members initially hesitated to share information among themselves fearing losing their markets; and
- Very little is known about the functioning of innovation systems and innovative clusters in Tanzania. This creates knowledge gap both in cluster initiative concepts, theories, policy and empirical.

Conclusion and recommendations

- Clusters are proven tools to address social and economic challenges through business development and innovation support programs;
- Excellent cluster management is crucial for maximizing the benefits that can be achieved through cluster initiatives in effort to support industry, research and education;
- Mainstreaming cluster initiative to government policies and plans;
- Documentation of cluster initiative approaches working in various parts of the country;
- More awareness be created to both politicians and economists on this new approach towards economic prosperity; and
- Higher learning institutions to mainstream cluster knowledge to their curriculums.

Meliponiculture (Stingless Bees Domestication) and Pot-honey Value Chain: Challenges and Opportunities to Uncover the Potential of Beekeeping in Tanzania

Introduction

Meliponiculture is an activity that involves Stingless bees keeping. Stingless bees belong to the tribe Meliponini (Hymenoptera: Apidae, Melipolinae). These bees have vestigial stingers and lack venom apparatus and therefore cannot sting. They occur primarily in the tropical and subtropical regions including Tanzania. In Tanzania, these bees can be found in various specific habitats (land-uses) such as grasslands, natural forests, wetlands, marshlands, protected areas, farmlands, woodlands, woodlots and forest plantations. Stingless bees vary in morphology and behaviour (Plate 1).

Plate 1: Stingless bees' morphology and their nests

Pot-honey production and other products produced by stingless bees

Pot-honey is the major product produced by stingless bees which is of high nutritional and medicinal value compared to honey produced by stinging bees. Other products from stingless bees are pollen and propolis. Stingless bees also help to increase productivity of several crops through pollination process. The honey is stored inside pot-like structure and thus the name pot-honey (Plate 2). The quantity of honey production in stingless bees varies greatly depending on the species. Some stingless bee species produce honey to simply satisfy the nutritional needs of the colony while others produce an excess available for humans. The quantity of honey production in a Stingless bee species also depends on the quality of the environment, competition with other bee species for floral resources and bee management. Generally, the quantity of honey produced by any potential stingless bee species is low compared to that which is produced by honey bees. The average annual production in most stingless bee species is rarely above one liter per colony, except for very few species that are known to produce more than that.

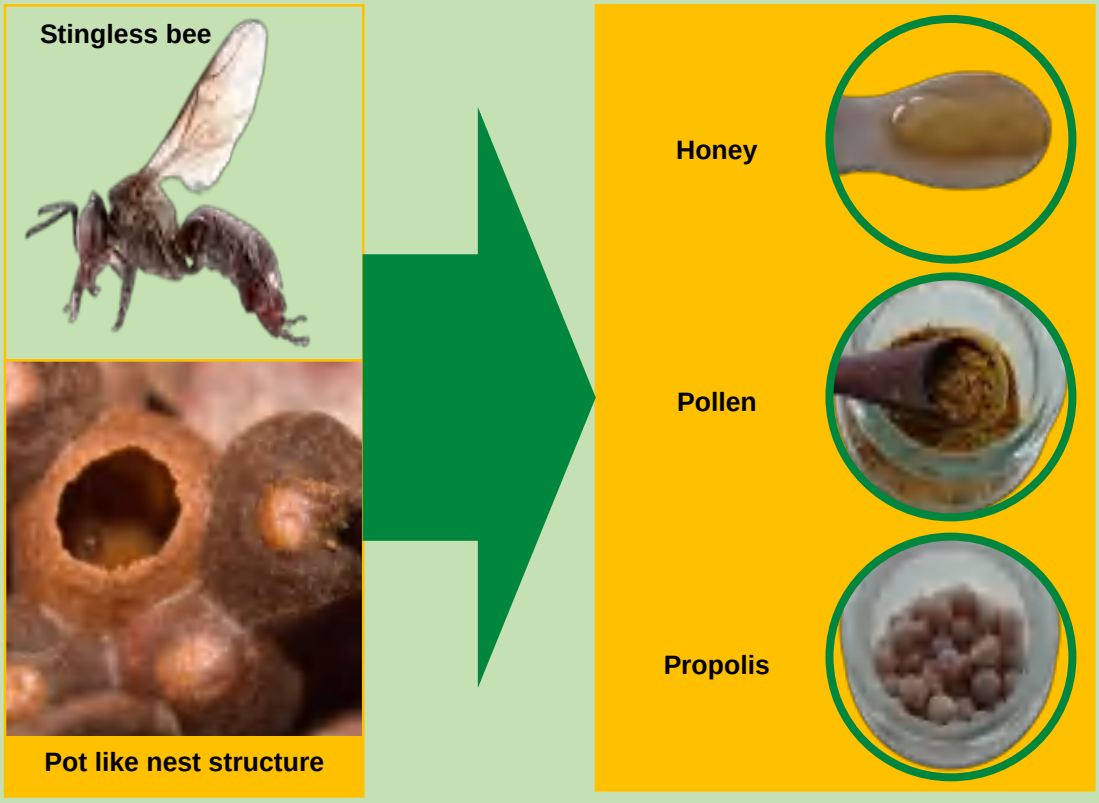


Plate 2: Pot like nest structure where stingless bees store honey

Pot-honey value chain

The pot-honey value chain starts from input supply to consumption (Figure 1).

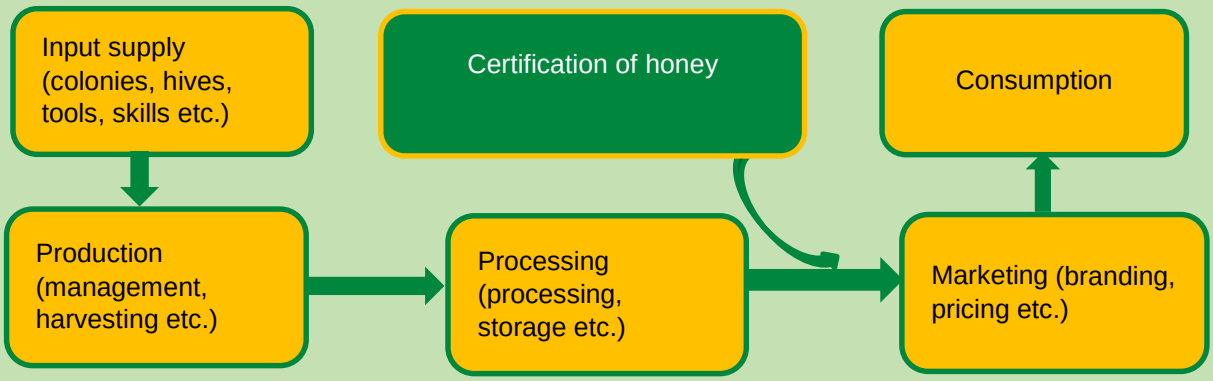


Figure 1: Pot-honey value chain

Pot-honey harvesting and processing

Harvesting

Pot-honey can be harvested from wild colonies and domesticated colonies. Honey harvesting in wild colonies can be done by hunting wild colonies whereby harvesting methods involve tree cutting, digging out underground nests and scrapping out the whole nest. Food storage pots from the stingless bee nest are usually crushed using bare hands to release the stored honey which is then filtered to remove debris and packed into plastic bottles. This method is nonhygienic and results into contamination of the harvested honey. Also, bee colonies are

usually lost due to nest destruction or contamination of the nest with honey which attracts destructive pests.

Harvesting in domesticated colonies usually involves tilting the stingless bee boxes, piercing the honey pots and collecting the flow into a vessel. This method destroys young larvae that fall from their provisions and attract phorid flies and other parasites that damage the nest.

There are alternative methods for harvesting pot-honey in both wild colonies and domesticated colonies. This involves sucking honey directly out of pots using syringes or other suction devices (Plate 3). This method has shown to improve the quality of harvested honey and significantly reduce colony losses. Also, the use of compartmented hives offers the possibility to harvest honey from storage pots without disturbing or contaminating the brood.

Plate 3: Pot-honey harvesting using syringes

Processing

Pot-honey has a higher water content which makes it prone to fermentation. Several methods have been identified to solve the problem of fermentation in pot-honey.

- Keeping pot-honey under refrigeration after harvesting can help to maintain the natural properties of the honey;
- A “maturation process” whereby after harvesting, pot-honey is maintained in closed recipients at room temperature where it is naturally fermented. Within three months the fermentation stops and the honey can be stored in a room temperature for a long period without deteriorating;
- Alternatively, pot-honey can be pasteurized by heating up to 60-70 °C in the container in which it will be sold and stored for up 2 years at a room temperature; and
- Dehumidification process, which withdraws water from the honey and alter some physico-chemical properties to resemble those of *Apis* honey while retaining the pharmacological content of pot-honey.

Uses of pot-honey

Pot-honey can be used as a food and medicine (therapy). It is famous for its strong healing power. The therapeutic uses of pot-honey include to cure “cold” and “hot” diseases, respiratory infection, digestive disorders, eye diseases (cataract), wound healing, post birth recovery, fatigue, skin ulcers, delivery enhancer, gastritis (stomach aches), and pterygion treatment, bruises and anti-diabetic.

Marketing potential

The world market for pot-honey is in its infant stages. However, the demand of pot-honey is expanding due to its healing power both at local and international markets. Thus there is a good opportunity for African countries including Tanzania to pursue the untapped potential market.

Opportunities

- Tanzania is endowed with enormous forest resources which are favourable habitats for Stingless bees;
- There is high diversity of Stingless bees to support extensive meliponiculture;
- Tanzanian policies support beekeeping practices including meliponiculture; and
- Beekeeping is widely encouraged as an alternative means to improve livelihood of rural communities and conserve forest resources.

Challenges

- The beekeeping industry in the country prioritises domestication of stinging honey bees rather than Stingless bees;
- The meliponiculture is rarely and poorly practiced in the in the country;
- Low production of pot-honey. The average annual production of pot-honey in most species of stingless bees is rarely above one liter per colony with the exception of very few species;
- Poor harvesting methods thus destroy bee colonies;
- High technology for harvesting and processing technology to ensure quality of pot-honey. Adoption of some of these methods in Tanzania may be difficult especially by small scale beekeepers;
- Limited knowledge on proper packaging and branding of pot-honey;
- Beekeepers have no access to proper market for their product, fetching lower unit prices which limit development of their livelihood. This discourages the growth of meliponiculture and its large-scale contribution to industrial development; and
- Financial accessibility to actors throughout the beekeeping value chain is a limiting factor to the adoption of proper technologies.

Conclusion and recommendations

- Tanzania provides good habitat for stingless bees;
- Meliponiculture is a highly potential venture for Tanzania;
- Improving the value chain of pot honey will stimulate commercial meliponiculture;
- Efforts should be made to develop alternative cost-effective processing options in order to improve shelf-life and storage of pot-honey; and
- Pot-honey being organic and of high nutritional and medicinal value, can potentially fetch high prices in the market.

Business Ecosystems as the Approach to Create Value and Appropriate Value for Small Firms in Emerging Markets

Introduction

The beekeeping industry in Tanzania has the highest potential for production and commercialization of bee products. However, it has failed to do so because of limited scope and scale to compete effectively and capture enough value caused by actors in beekeeping value chain are arm's length transactional-based and working in isolation (fragmented) and they fight each other within the value system. This has resulted into sustained poverty amongst beekeepers for failure to develop solutions to capture enough value from their activities.

Value creation and capture for all participating firms and society cannot be done in a vacuum and by an individual firm. It requires a properly developed and managed business network or ecosystem. This can be achieved by changing the current Industry Architecture (IA). IA defines the strategic constructs through which firms can work together to create value to customers and capture value for participating firms. Firms collaborate to receive complimentary products and components in an ecosystem. Therefore, the Tanzanian beekeeping IA should be changed from transactional to collaborative through business ecosystem approach. An approach which is an architecture of value proposition which firms interactively deliver value created to customers. Hence, through IA business model, beekeeping industry in Tanzania can attain its potential.

The value-creating system of the beekeeping ecosystem in Tanzania

According to research findings by Tutuba and his colleagues, on the value creating system of beekeeping ecosystem, the existing industry architecture is characterized by:

- Actors working solely, fragmented, arm's length and transaction-based; and
- Actors with complementary assets like honey traders have more bargaining power and take the largest share of the pie while reducing the pie of others due to access to potential markets and performing value addition activities.

Moreover, beekeeping ecosystem begins by identifying: (1) the focal firm which assumes the leading role; (2) producers and traders (potential actors); (3) potential areas of investment; and (4) specific services and service providers.

The key requirements are: Commitment among participating actors and long-term planning; signing agreement/contracts; participating actors should have different assets, competencies, and capabilities so that they can abundantly contribute to the focal value creation activities depending on their position in the value chain.

The critical success factors set the platform around which the roles, activities, positions, investment, and competencies is constructed upon. The critical success factors include production efficiency (productivity), adequate volume, reliable supply, quality assurance (hygienic practices in harvesting, storage, processing, and packaging), and traceability.

Equally important is having a known brand name as one of the entry qualifications, honey bulking or aggregation where honey producers are organized to bring together their produces (honey) to a collection point, honey blending to get homogeneous quality and lock-in and collaboration strategies are necessary to ensure long-term relationship. Besides in buying and selling honey, including comb honey, and in developing long term business relationships.

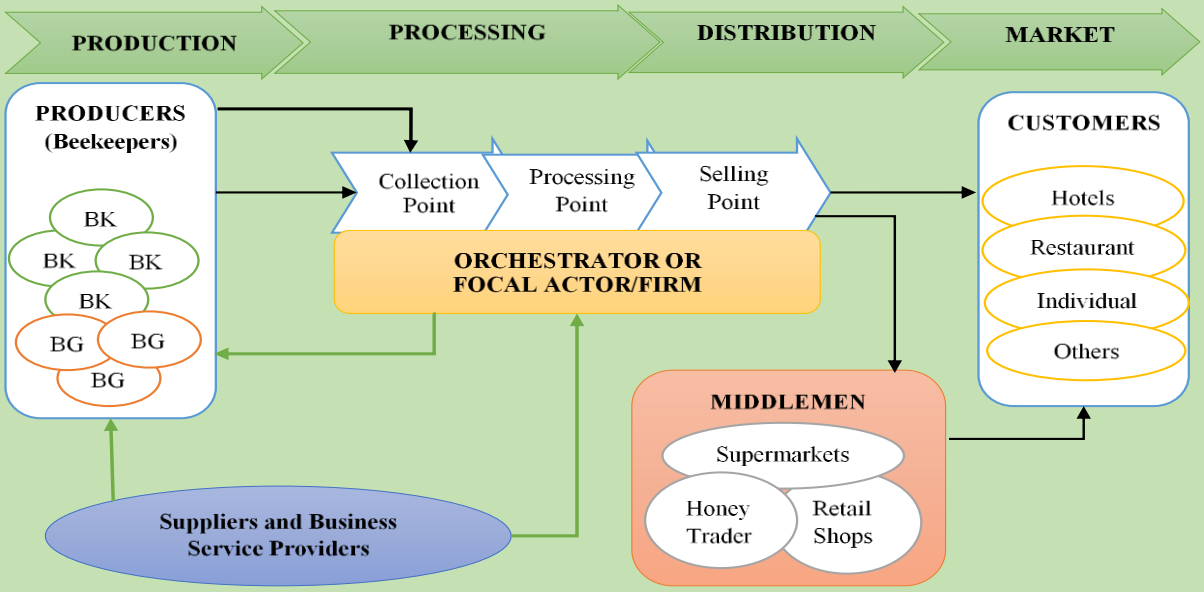


Figure 1: The beekeeping value chain based on the ecosystem approach

Note: BK – Beekeeper and BG – Beekeeping Group

The industry architecture should be structured as shown in Figure 1 below such that ecosystem actors can integrate resources towards value proposition. In this ecosystem alignment, varied sets of actors and their cooperative behaviours should aim to pursue a focal value proposition.

The business model structure of the orchestrator in the beekeeping ecosystem

The research results presented the orchestrator's business model of the beekeeping ecosystem. Table 1 summarises elements of the business model as established after mapping the activities of the orchestrator as it is connected to other ecosystem actors onto the business model canvas.

Table 1: Orchestrators' Business Model Elements of the beekeeping industry in Tanzania

Business Model Element	Description of the Business Model element
Customer segments	**Customers:** Local brewers, traditional healers, and individuals in both rural and urban markets **Potential customers are** individual household customer segment in the urban market
Value proposition	**Value scopes:** Pure, natural and organic honey; traceability (vegetation and nectar source); colour, viscosity, and flavour; branded packs **VP:** The promise to deliver quality and unadulterated honey brand from an accustomed source
Channels	**Communication:** Mixed strategies – word of mouth, social media, trade fairs and exhibitions **Distribution:** Mixed channel
Customer relationships	Personal assistance, self-service, and social interactions

Revenue streams	**RS:** Transaction revenues. The revenue comes from selling packed honey; different packs for diverse consumers **Sales nature:** Both cash and credit sales **Pricing:** Both negotiated and fixed pricing depending on the grade of the honey product, volume or quantity, and the type/characteristic of a customer segment **Payment structure:** Mixed – cash, mobile money, bank transfer
Key resources	**Physical resources:** hives, bee suits, harvesting materials, processing room/house, processing, and packaging machines, and packaging material **Human resources:** Skilled people to perform different activities in the beekeeping value chain Financial resources
Key activities	**Honey production:** apiary and colony management, harvesting, and storage **Aggregation and processing:** Extraction, refining or filtration, blending, and de-crystallization **Channel Management**: Packaging, storage, and trading
Key partnerships	**Actors in the value chain:** Beekeepers, Suppliers of beekeeping inputs, Traders **Secondary actors:** Financial institution, researchers, business supporting institutions
Cost structure	**The most expensive resources:** Production inputs like beehives, suits, and harvesting materials; honey processing facilities like the house and machines **The most expensive activities:** Apiary management, management of the collection centre and operating the processing centre, honey processing, and packaging, trading, and transportation

Source: Researcher, 2020

Conclusion and recommendations

Transformation of beekeeping industry architecture from a transactional to ecosystem-based value chain is a long process that requires a determined mind change and commitment. The business model is shaped by an orchestrator and aligning other potential organizations with different assets and competencies into a business ecosystem. Not only the competencies of the participating firms determine the collective competitiveness of the ecosystem but also how it is structured and managed.

The ecosystem orchestrates beekeeping actors via a collection point where commercial volume can be achieved through aggregation. This architecture improves beekeepers' ability to capture more value as they can access potential and profitable market as well as complementary assets to efficiently produce honey, such as to improve productivity. Furthermore, collaborative channel management lower competition as traders sell the same brand and serve the same customer segment: The orchestrator brands the honey during the processing stage, and pass it to ecosystem traders in the distribution channel. In this regard, changing the industry architecture through an ecosystem (collaborative) approach increase the size of the pie as well as the pie of industry actors in the ecosystem. Beekeepers improve their value creation and value capture abilities by the new business opportunities that could not have been seized without the business ecosystem.

Proposed Paradigm Shift for Honey Markets: A Case Study for Njombe and Siha Districts

Introduction

Globally, beekeeping is one of the major enterprises from non-timber forest products. Beekeeping produces honey, which is the source of food and raw material for manufacturing industries like pharmaceuticals. Furthermore, beekeeping is a source of employment and income at a household and national level. Currently, Russia, China, USA, Mexico, Argentina, Canada, Brazil and Australia are the major producers of honey, while the most consumers and net importers of honey include Germany, Japan, USA and UK. In the continent of Africa, Tanzania has been amongst producers of honey for decades. In 1960s, it was reported to export up to an average of 467 metric tonns of honey per annum and honey was among the significant non-wood products from the forests with a higher contribution to the national GDP and international trade.

Nevertheless, by year 1997, honey production and export had been reported to decline in Tanzania while the demand for honey in the world market including European Union has been reported to increase. According to research findings in 2013, the honey marketing in Tanzania was not promising at all due to lack of organized marketing systems for local and foreign markets. Other factors are lack of market collection centres (MCC) for honey for bulk-marketing, every honey producer sold his/her honey independently, poor honey packaging and labelling, no reported organ or machinery responsible for marketing honey from individual producers, lack or presence of few marketing cooperatives, savings and credit Societies for honey producers and poor transport and distribution means. Besides, low prices and limited market information are constraints to commercialization of honey.

Following this situation several mapping studies and projects on honey value chain have been conducted to identify deficiencies and propose the way forward for improvement. Of the studies, the United Nations Development Programme (UNDP) commissioned a mapping study on honey value-chain in Njombe and Siha districts in 2014 to identify the causes of underperformance of beekeeping. The study identified honey marketing as a root cause and proposed a formation of marketing cooperative, saving and credit societies and identify financial institution(s) and prospective markets and link them with target producers' groups (beneficiaries). Therefore, this study evaluates the extent to which the honey marketing has improved; and the influence of proposed paradigm on improvement of honey marketing in Njombe and Siha districts.

Proposed paradigm to improve honey marketing

Table 1 below indicates the proposed paradigm shift and its constructs and how each construct works and key actors who can assist the proposed paradigm to improve honey marketing.

Table 1: Proposed paradigm, its components and key actors

Name	Construct	Components	Key Actors
Proposed Paradigm	Availability of Organ and Machinery Responsible for HM	✓ support for markets' accessibility ✓ taking brokers' responsibility ✓ providing pertinent market information ✓ identify/link markets with producers ✓ engaging/sensitizing producers' groups on formation of Marketing Cooperatives and Savings and Credit Societies ✓ educating producers on honey's value-addition and quality control ✓ promoting/securing honey's quality	Research and academic institutions, SIDO, TBS, DEDs & Financial institutions
	Availability of Market Collection Centres (MCC) for Honey Marketing (HM)	✓ established place(s) for educating honey producers ✓ established place(s) for collecting honey ✓ established place(s) for processing and packaging honey ✓ established place(s) for selling honey	DEDs, Beekeeping Associations, SIDO, Research Institutions
	Availability of Potential Market for Honey	✓ presence of market for taking all produced honey ✓ presence of not locally-based market for large quantities of produced honey ✓ presence of market which is no longer based on immediate market (passer-by people) ✓ presence of market which is easily accessible by honey producers ✓ presence of market with lowest risks ✓ presence of market with honey product crossing international borders ✓ presence of market with honey receiving good price and in a simple way than imported honey	Ministry of Industries and Investment, local & International Trade Fairs, Supermarkets and Malls
	Availability of Quality Honey	✓ there is clear and non-opaque honey ✓ there is fresh and more highly valued than imported honey ✓ there is honey that observes the demands from foreign market outlook ✓ there is honey associated with value addition	TBS, Research Institutions and Dealers in supply of processing equipment
	Packaging and Branding	✓ there are now stackable, plastic buckets with tight fitting lids for transporting honey ✓ there are adequate packaging materials for honey ✓ there is adequate type of branding and subsequent labelling to create name and/or provide necessary and tangible information ✓ the honey packaging is done for marketing other than for only transporting ✓ honey packaging is done presumably outside the production locality	SIDO, VETA, Dealers in supply of packaging materials, branding and labelling of products

Note: SIDO - Small Industry Development Organisation, TBS - Tanzania Bureau of Standards, DEDs - District Executive Directors and VETA - Vocational Education Training Authority

The findings below evaluate to what extent the proposed paradigm shift has helped to improve honey marketing in the two districts, Njombe and Siha.

Honey marketing before and after paradigm shift 2015 in Njombe and Siha districts

The surveyed honey producers/practitioners had a general view that availability of Market Collection Centre (MCC) (49%) and organ/machinery (52%) had improved honey marketing (HM) to a small extent, after 2014. However, majority responded that availability of potential markets (54%) and packaging or branding (61%) had not at all improved HM, while majority responded that availability of quality honey (67%) had to a moderate extent improved HM. The mean score analysis also confirm the above results (See Table 2).

Table 2: Extent to which HM is improved following the proposed paradigm in 2014

Variable	Sample size	Mean	Standard deviation
1. **Availability of Organ/Machinery for HM**	170	2.791	1.614
2. **Availability of MCC for HM**	170	2.913	1.136
3. **Availability of Potential Market for HM**	170	2.083	1.312
4. **Availability of Quality Honey**	170	3.452	.765
5. **Honey Packaging and Branding**	170	.904	1.103

The results in Table 3 below also indicate that there was significant difference in honey marketing before and after the proposed paradigm in 2015 in both Njombe and Siha. Though the established overall significant indicated higher mean score of honey marketing before than after proposed paradigm in 2015 of 180.17 and 177.50 respectively.

Table 3: Paired samples statistics

	Mean	N	Standard mean deviation	Standard error mean
HM (before 2015)	180.17	170	5.16	.94
HM (after 2015)	177.50	170	5.15	.94

Moreover, the model predicted the influence of proposed paradigm on HM had shown a significant and positive relationship between proposed paradigm and honey marketing in the two districts.

Table 4: Influence of the proposed paradigm on HM

	B	t	Sig.
(Constant)	6.09	19.001	<.001
Availability of Organ/Machinery for HM	.513	8.309	<.001
Availability of MCC for HM	.417	5.369	<.001
Availability of Potential Market for HM	.482	6.268	<.001
Availability of Quality Honey	.351	6.137	<.001
Honey Packaging and Branding	.347	6.133	<.001
Multiple R	.838[a]		
R Square	.591		
Adjusted R	.57		
ANOVA (F, SIG.)	49.073 (< .001)		

This result suggests that the more the honey producers and other stakeholders implement the proposed paradigm, the more improved honey marketing is achieved.

Conclusion and recommendations

It is concluded that, respondents had different views about the influence of different constructs of the proposed paradigm on honey marketing. There are some factors that can improve honey markets such as market collection centre and quality of honey. Other factors, such as packaging and branding, had no effect on honey market.

The model indicated significant and positive relationship between proposed paradigm and honey market in Njombe and Siha Districts. This suggest that the proposed paradigm has not been implemented fully in respective districts and hence government and other stakeholders should unequivocally implement the proposed paradigm to improve honey marketing in respective districts and Tanzania at large.

Distribution Map of Pollen and Honey Types in Tanzania

Introduction

Tanzania is one of the ten-mega countries in the World with high potential in beekeeping for production of honey and beeswax. Over 95% of beekeeping in Tanzania is practiced in these Savannah forests "Miombo woodlands". Honey contributes to about 33% of the household income source compared to other sources like agricultural crops and other forest products. Most of the high production areas for bee products are concentrated in the Miombo woodland areas as compared to non-Miombo woodland areas (Table 2).

Table 2: High and medium potential beekeeping areas and un-exploited beekeeping areas in the Miombo

High producing area			Medium producing area			Un-exploited areas		
District	**Potential (tonns)**	**Actual (tonns)**	**District**	**Potential (tonns)**	**Actual (tonns)**	**District**	**Potential (tonns)**	**Actual (tonns)**
Kahama	4,000	500	**Kondoa**	3,000	300	**Lindi**	8,000	50
Mpanda	8,000	1,500	**Kiteto**	2,000	250	**Songea**	6,000	50
Sikonge	6,000	2,000	**Babati**	1,200	150	**Iringa**	5,000	40
Urambo	6,000	1,400	**Kibondo**	4,000	250	**Biharamulo**	4,000	15
Nzega	4,000	400	**Handeni**	3,000	150	**Kasulu**	4,000	5
Tabora	5,000	1,200	**Kigoma**	3,000	100	**Newala**	4,000	15
Chunya	6,000	400	**Arumeru**	1,500	100	**Tunduru**	4,000	15
Manyoni	8,000	600	**Rufiji**	2,500	50	**Singida**	3,000	5
Bukombe	5,000	800	**Nkasi**	1,500	50	**Hai**	2,500	5

Pollen and their ecological significance

Pollen assemblages are from multiflora honeys and they provide wide range of fingerprinting on ecological patterns and diversity of the contributing parent taxa of plants in different areas in the country.

Pollen density in actual counts from the surveyed zones

Pollen assemblages from the agro-ecological zones are shown. The highest pollen density is found in Western zone (Sikonge District), (Figure 1). Also, different honey bee colors can be observed in Figure 2.

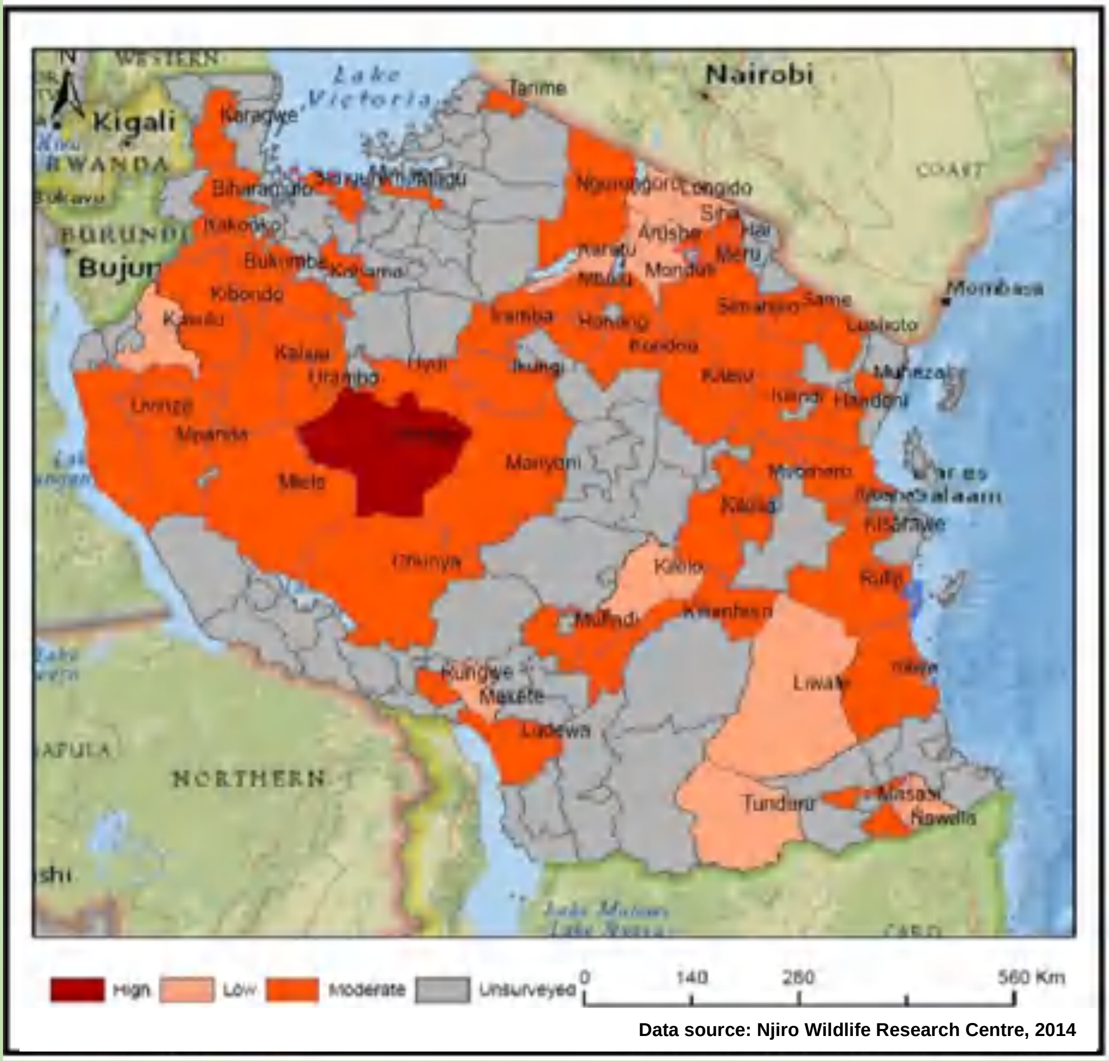


Figure 1: Pollen density in actual counts from the surveyed zones and districts

Honey colours

1. White
2. Light brown
3. Brown
4. Dark brown

Pollen

Figure 2: Honey colours and pollen

The following tables 2,3,4, 5 and 6 shows honey components of various tree species and their location. Also, different type of honey bee colours can be seen from zones, regions and districts.

Table 2: Pollen and honey types from surveyed zones

No	Zone	Region/ District/ Honey colour	Honey compounds
	Central	Manyara (Hanang – **Brown colour**) Singida (Ikungi, Iramba Manyoni Mkalama - **Brown colour**) Dodoma (Kondoa – **Brown colour**)	*Olea* spp. *Acacia* spp. *Euphorbia* spp. *Cassipounea molasana* *Prunus africana* *Vitex* spp. *Combretum psidioides* *Albizia* spp. *Grewia bicolor* *Terminalia* spp. *Syzygium* spp. *Rauvolfia caffra* *Pseudoprosopsis fischeri* *Meremia tuberosa* *Justicia* spp. *Combretum* spp.
	Coastal	Pwani (Bagamoyo, Kibaha, Kisarawe, Rufiji - **Brown colour**) Lindi (Kilwa – **Brown colour**)	*Bersama abyssinica* *Phoenix reclinata* *Terminalia* spp. *Cocos nucifera* *Rapanea melanophloeos.* *Bersama abyssinica* *Acacia* spp. *Mangifera indica* *Hyphaene* spp. *Rapanea melanophloeos* *Julbernardia globiflora* *Abelmoschus esculentus* *Avicennia marina*

Table 3: Pollen and honey types from surveyed zones

No	Zone	Region/ District/ Honey colour	Honey compounds
	Eastern	Morogoro (Kilombero - **Light brown to Brown colour**, Kilosa – **Brown colour**)	*Albizia gummifera* *Combretum* spp. *Ficus thonningii*. *Annona senegalensis* *Markhamia obtusifolia* *Pterocarpus angolensis* *Albizia gummifera* *Bersama Abyssinica* *Cussonia spicata* *Maesa lanceolata*. *Eucalyptus* spp. *Myrianthus holstii* *Phyllanthus* spp. *Indigofer* spp. *Ocinum suave* *Bombax rhodognaphalon*. *Diospyros* *Erythrina* spp. *Euphorbia* spp.
	Lake Victoria	Kagera (Biharamulo - **Light brown colour**) Geita (Bukombe - **Light brown colour**)	*Rhus natalensis*. *Cordia africana* *Jubernardia globiflora* *Ehretia* spp. *Julbernardia globiflora* *Delchampia* *Rhus natalensis* *Lannea* spp. *Isoberlinia* spp. *Coffea* spp.

Table 4: Pollen and honey types from surveyed zones

No	Zone	Region/ District/ Honey colour	Honey compounds
	Mountainous Northern and North-Eastern	Arusha (Arusha, Karatu - **Light brown colour**, Meru, Monduli – **Brown colour**, Ngorogoro - **Light brown to brown colour**) Manyara (Babati - **Dark brown colour**, Mbulu - **Light brown to brown**) Kilimanjaro (Hai, Siha – **Brown colour,** Same - **Light brown to brown colour**) Tanga (Handeni, Kilindi - **White to light brown colour**, Lushoto, Muheza - **Light brown to brown**	*Thelypteris* spp. *Albizia* spp. *Prunus africana* *Erythrina* spp. *Albizia* spp. *Croton* spp. *Polyscias fulva* *Rauvolfia caffra* *Newtonia* spp. *Ficus* spp. *Bombax* spp. *Cussonia* spp. *Allanblackia* spp. *Hypericum* spp. *Helichrysum* spp. *Diospyros* spp. *Sterculia* spp. *Ocotea* spp. *Parinari excelsa* *Drypetes* spp. *Clausena anisata* *Olea* spp. *Macaranga* spp. *Acacia* spp. *Cordia africana.* *Balanites* spp. *Dombeya torrida* *Myanthus holistii.* *Beilschmedia* spp. *Bersama* spp. *Podocarpus* spp. *Schefflera* spp. *Podocarpus* spp. *Halleria lucida* *Grevillea robusta* *Augaria salicifolia*

Table 5: Pollen and honey types from surveyed zones

No	Zone	Region/ District/ Honey colour	Honey compounds
	North-Central	Manyara (Kiteto, Simanjiro – **Brown colour**) Arusha (Loliondo, Longido – **Brown colour**)	*Acacia* spp. *Albizia* spp. *Dombeya* spp. *Cassipourea* spp. *Drypetes* spp. *Ficus* spp. *Euclea* spp. *Olea* spp. *Leonotis* spp. *Lantana* spp. *Euphorbia* spp. *Clausena* spp. *Cordia* spp. *Croton* spp. *Erythrina* spp. *Grewia bicolor* *Combretum* spp.
	North-Western Highland	Kigoma (Kakonko, Kasulu, Kibondo - **Light brown to brown**	*Julbernardia* spp. *Isoberlinia* spp. *Psychotria* spp. *Justicia* spp. *Rhus* spp. *Lannea* spp. *Cordia africana* *Delchampia* spp. *Coffea* spp. *Combretum* spp.
	Southern	Linda (Liwale - **Light brown to brown colour**) Mtwara (Masasi, Newala, Tandahimba - **Light brown to brown colour**) Ruvuma (Tunduru - **Light brown to brown**)	*Julbernardia* spp. *Lannea* spp. *Tamarindus* spp. *Anacardium* spp. *Pericopsis* spp. *Cussonia* spp. *Mangifera* spp. *Isoberlinia* spp. *Treculia africana*

Table 6: Pollen and honey types from surveyed zones

No	Zone	Region/ District/ Honey colour	Honey compounds
	Southern Highland	Iringa **(**Kilolo**,** Mufindi - **Brown colour);** Njombe (Ludewa, Makete - **Brown colour**) Mbeya (Tukuyu – **Brown colour**	*Schefflera umbellifera* *Polyscias fulva* *Justicia* spp. *Zanthoxylon gilletii* *Myrica salicifolia* *Cassipourea molasana* *Halleria lucida* *Maesa lancelota* *Rapanea melanophloeos* *Eulophia* spp. *Geranium* spp. *Dodonea viscose* *Carduus* spp. *Albizia* spp. *Allophylus africanus* *Psychotria* spp. *Coffea mufindiensis* *Ilex mitis*
	Western	Mbeya (Chunya – **Brown colour**) Shinyanga (Kahama - **Light brown to Brown colour**) Tabora (Kaliua, Sikonge, Urambo, Uyui - **Light brown colour**) Katavi (Mpanda, Mlele - **Light brown colour**) Kigoma (Uvinza - **Light brown colour**)	*Julbernardia* spp. *Combretum* spp. *Cordia* spp. *Uapaca* spp. *Isoberlinia* spp.

Conclusion and recommendations

- In Western Tanzania (Uvinza District), pollen assemblage is highly influenced by the high representation of ***Julbernadia* spp.**, ***Isoberlinia* spp.** and ***Uapaca* spp**. However, there is a "silent signal" of human disturbance occurring in the Malagarasi wetland basin. Therefore, these areas need further assessments;

- In Central Tanzania, "Itigi thickets" dominated by ***Pseudopsosis fischeri***, ***Baphia mombassae*** and ***Combretum psidioides*** are important in terms of its uniqueness to bee diet. Further, in northern and north-eastern Tanzania, non-pollen taxa (***Cyathea*** and ***Thelypteris***) is an important contributor of bee diet in honey samples (Lushoto and Muheza Districts). Hence they need to be well conserved;

- In Southern and Coastal Tanzania, there is higher contribution of ***Anacardium occidentale*** and ***Cocos nucifera*** that showed importance of farmland areas as source of bee diet. Hence proper conservation steps needs be implemented; and

- In Southern highlands are mainly composed by *Psychotria*, ***Spermacoce* spp.**, ***Vangueria*, *Rubus*, *Geranium*, *Bidens*, *Eclipta*, *Schefflera*** and ***Justicia* spp**. Therefore, this brings about the need for emphasis on the contribution of home gardens.

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