

The value chain of traded products of medicinal plants in Tanzania: the emerging role of formulators

Traded
products of
medicinal
plants

1

Eziacka Mathew Mpelangwa

*Department of Agricultural Economics and Agribusiness,
Sokoine University of Agriculture, Morogoro, United Republic of Tanzania*

Jeremia Ramos Makindara

*Department of Business Management, Sokoine University of Agriculture, Morogoro,
United Republic of Tanzania*

Olav Jull Sørensen

*Department of Business and Management, Aalborg University,
Aalborg, Denmark, and*

Kenneth Michael-Kitundu Bengesi

*Department of Policy Planning and Management, Sokoine University of Agriculture,
Morogoro, United Republic of Tanzania*

Received 13 June 2021
Revised 27 September 2021
Accepted 4 October 2021

Abstract

Purpose – Products of medicinal plants play significant roles in management of diseases. Their accessibility through trade plays a key role in health, economic and livelihood improvement. However, the traceability of the production process from their source in Tanzania is lacking. This study aims to depicture the production process of formulated products of medicinal plants.

Design/methodology/approach – The study applied the value chain theory using qualitative data from literature review and survey to practitioners of traditional medicine. Survey data were collected through 15 in-depth interviews and ten focus group discussions in five regions of Tanzania.

Findings – Input to output structure is performed through a five actors' value chain. The raw material is provided by harvesters who collected medicinal plants from wild. The processing is conducted by wholesalers and formulators. The wholesalers add value by drying, milling and bulk packaging of individual medicinal plants. Formulators mix different medicinal plants to create readymade products for specified diseases. Distribution is done by retailers and healers. There were six regulating and two supporting organizations. Private supporters were millers and transporters. Governance structure was deduced to be relational. Relational governance was a result of lack official standards along the value chain.

Originality/value – The described value chain can be used to guide investments in production of products of medicinal plants by improving formulation technology.

Keywords Supply chain, Traditional medicines, Africa, Marketing, Formulation

Paper type Research paper

1. Introduction

The World Health Organization (WHO) recognizes traditional medicines as one of the key strategies to solve the 21st-century health challenges of expanding coverage of health services (WHO, 2019). The traditional medicine and medicinal plants in particular play significant roles in neglected diseases, which lack incentives to develop modern drugs and vaccines for small markets (Andrade-Cetto, 2005). Accessibility of products of medicinal plants through trade is one of the pillars that can reduce the stipulated health challenge.



This study was sponsored by the Green Resources Innovation for Livelihood Improvement (GRIL) – DANIDA Project.

The authors wish to acknowledge the contribution of Dr. Faith Mabiki on conceptualization of the study and Prof. Jonas Eduardsen for guidance in the literature review.

In Africa, the accessibility of product of medicinal plants is vital because of the pluralism health system, which includes both traditional and allopathic health services (Kasilo *et al.*, 2019). Access to products of medicinal plants has resulted into thriving trade in different parts of Africa (Gakuya *et al.*, 2020). For example, in Tanzania, about 400 medicinal plants as well as a number of formulated products have been traded in different markets (Hilonga *et al.*, 2019; Veldman *et al.*, 2020).

Value addition to medicinal plants such as transporting, drying, milling, packaging and distribution have shifted them to economical products in both rural and urban areas (McMillen, 2012). Currently, medicinal plants are considered as a source of livelihood to people who are involved in different value addition activities along the chain (Delbanco *et al.*, 2017; Staden *et al.*, 2011). A value chain describes the products of medicinal plants in terms of health and economy perspectives (Booker *et al.*, 2012; Volenzo and Odiyo, 2020).

The value addition to medicinal plants produces formulated products, which dominate the domestic markets in Tanzania (Staden *et al.*, 2011). These formulated products, through mixture of several medicinal plants, are considered more effective in treatment of diseases than individual medicinal plants (Otieno *et al.*, 2008). The formulated products pass through different production stages from production to consumptions (Heinrich, 2015). The stages are performed by different actors in different geographical locations.

Despite the visibility of the formulated products of medicinal plants in the domestic markets of Tanzania (Posthouwer *et al.*, 2018), their traceability of the production process from the source is lacking. The production structure as well as governance of actors along the value chain in the domestic markets is seldom understood (Veldman *et al.*, 2020). Moreover, in previous studies, there is a missing link between the traded medicinal plants and their actors, particularly regulators (Delbanco *et al.*, 2017; Heinze *et al.*, 2019; Hilonga *et al.*, 2019; Veldman *et al.*, 2020).

The inadequate understanding of production value chain has consequences on trade in products of medicinal plants. The consequences include little investment in production and promotion (Volenzo and Odiyo, 2020), compromise of quality (Gakuya *et al.*, 2020) and ineffective biodiversity conservation (Manzano *et al.*, 2020). Thus, African biodiversity-rich countries, such as Tanzania, become sources of raw materials rather than innovators and active participant of the global economy of medicinal plants (Langwick, 2010).

Therefore, this study sought to map the production process of formulated products of medicinal plant in the domestic markets of Tanzania. The study aimed to apply the value chain concept to answer two research questions; (1) what is the input to output structure, in terms of actors and activities of the formulated products of medicinal plants? and (2) what is the dominant governance structure of the actors in the described value chain? These questions unpack the interplay of traded products and their actors, and the missing links in the previous studies.

The relevance of this study is to improve the accessibility of the formulated products of medicinal plants as one of the pillars to meet the 21st-century health challenge to increase health coverage (WHO, 2019). The value chain can provide holistic insights to improve safety, quality, efficacy and biodiversity conservation of medicinal plants. The interventions can be more effective when it targets both products and actors along the value chain than either products or actors alone. Further, the policies intervention on health and economical improvement of products of medicinal plants along the value chain can be well designed and implemented in a known value chain. With proper intervention along the value chain, African countries can benefit like their counterparts countries in Asia, such as China, India and Nepal (Pyakurel *et al.*, 2018).

After this introduction, the rest of this paper is organized as follows: Section 2 describes the research trend of trade in products of medicinal plants from literature review followed by conceptual framework in Section 3. Section 4 explains the research methodology. The

findings and analysis are presented in Section 5; the discussion is presented in Section 6, while conclusion and recommendation are presented in the last section.

2. Research trend of trade in products of medicinal plants

The trend of trade in products of medicinal plants was explored through literature review. The review was carried out with the purpose of finding the value addition activities along the value chain in Tanzania. However, the number of identified articles was small, so literature search was expanded to include Sub-Saharan African (SSA) countries because of similarity in practices (Andel *et al.*, 2015). The review involved content analysis using a qualitative approach to synthesize the information from appropriate literatures.

2.1 Search of reviewed literature

The keywords used were traditional medicine (substituted with herbal medicine, medicinal plants and ethnobotany) with value chain (substituted with trade, commercialization, industry, supply chain and market) followed by Tanzania and SSA. The databases searched were Science Direct (Elsevier), Web of Science, ABI/INFORM collection and Scopus. The checkup of citations and reference lists was conducted to find relevant articles otherwise skipped from databases. Relatively few relevant studies (20) were found on the trade practices in products of medicinal plants. This implies that the literature review method was a more narrative than a systematic review (Snyder, 2020).

The reviewed articles were grouped into three: effect of traded medicinal plants on biodiversity sustainability (12 articles), quality and/or efficacy (five articles) and supply/value chain (three articles). The studies on biodiversity sustainability of medicinal plants used Jusu and Cuni-Sanchez's (2014) method of market survey, coupled with a field visit as a rapid tool to identify most traded medicinal plants. For the case of supply/value chain articles, one was an empirical article, while two were conceptual framework development. Although the framework for value chain analysis for traded medicinal plants were developed by Booker *et al.* (2012), empirical studies were rarely found.

2.2 Trade in products of medicinal plants

The literature describes the trade in products of medicinal plants in SSA as buoyant intra trade. The value of the traded medicinal plants has been estimated to be US\$300,000 in Johannesburg; US\$7.8m in Ghana; US\$1.5 in Gabon and outskirts regions of Kenya was US\$25,900 (Delbanco *et al.*, 2017; Towns *et al.*, 2014). In Tanzania, at Kariakoo Market in Dar es Salaam, the value was estimated to US\$200,000 (Posthouwer *et al.*, 2018).

The trade evolution of medicinal plants products in Tanzania dates back to the 1960s where the promotion of medicinal plants products was patronized by the government (Langwick, 2010). The early developments were motivated by the self-reliance policy, which ended in 1984 with structural adjustments where the market economy policies were opted (Langwick, 2010; Stangeland *et al.*, 2008). New private entrants on the trade observed in 1990s were caused by the spread of the HIV/AIDS pandemic (Mc Millen, 2012). Commercialization of the products of medicinal plants emerged at this period because the HIV/AIDS patients did not have any significant assistance from modern hospitals (Stangeland *et al.*, 2008). The heightened use and flourish of trade called for a regulation mechanism for public safety where the Law of Traditional Medicine was established in 2002 (Mbwambo *et al.*, 2007).

The trade in products of medicinal plants evolved from community gift to trade commodities to both rural and urban areas with development of complex networks of supply chains (Hilonga *et al.*, 2019; Mc Millen, 2012). The actors have been increasing over time to perform different emerging activities like formulation, packaging and distribution (Veldman *et al.*, 2020). Despite the difference in the length of the value chain, literature still indicates the trade has shifted from personal contacts between healers and patients to a number of nodes

along the value chain such as harvesters, vendors and traditional healers with different distribution centers like shops and herbal clinics (Posthouwer *et al.*, 2018; Otiemo *et al.*, 2015).

The trade supply chain in literature has been described to include different number of actors; harvesters/farmers/collectors, middlemen, traditional healers and vendors (Jusu and Cuni-Sanchez, 2014; Staden *et al.*, 2011; Street *et al.*, 2008), with different interactions. Harvesters/farmers/collectors can sell to anyone along the supply chain. The conduct of trade has been explained to be informal conducted in the hidden economy (McMillen, 2012). The nature of informality has been described in different faces such as unregistered products, unregistered distribution points and poor packaging (Volenzo and Odiyo, 2020). The described conduct rarely explains the relationship of the actors along the value chain.

2.3 Value chain of traded products of medicinal plants in Tanzania

Studies conducted in relation to the trade in products of medicinal plants in Tanzania include Hilonga *et al.* (2019), McMillen (2012), Otiemo *et al.* (2015), Posthouwer *et al.* (2018) and Veldman *et al.* (2020). These studies (except McMillen, 2012), whose objectives were biodiversity conservation, focused on the identification of the most traded medicinal plants. McMillen's (2012) study was concerned with the effect of market settings on conservation of the traditional knowledge.

Two studies involved in the supply chains of medicinal plants on the surveyed markets identified different actors as follows: McMillen (2012) identified four actors, namely, harvesters, healers, vendors and customers. Hilonga *et al.* (2019) identified four actors; harvesters, middlemen, vendors and traditional healers. However, the nature of the studies left aside the value addition activities.

Similar kind of studies on trade of products of medicinal plants trended in other parts of SSA. For example, Delbanco *et al.* (2017) in Northern Kenya, Heinze *et al.* (2019) in Northern Angola, Jusu and Cun-Sanchez (2014) in Sierra Leone, N'danikou (2011) in Southern Benin, Quiroz *et al.* (2014) in Benin and Towns *et al.* (2014) in Gabon. All these studies were more concerned with biodiversity conservation of medicinal plants than trade development.

However, the works of Booker *et al.* (2012), Petersen *et al.* (2015) and Volenzo and Odiyo (2020) found two main aspects of the supply chain of medicinal plants, a description of types of value chains and a description of the different supporting activities such as transports and storage, which are missing in studies conducted in Tanzania.

Therefore, from the review on traded products of medicinal plants, it can be summarized that available information includes most traded medicinal plant types, their amount and value and the description of value chain based on the conceptual development with few empirical studies. This ascertains a gap on information of the value additional processes, specifically, to the finished products, which comprise a mixture of different medicinal plants, and dominate the local markets.

3. Conceptual framework

The value chain concept was adopted to meet the research objective for this study. The value chain is described as a full range of activities performed to bring a product from its conception to end use and beyond (Rundassa and Azene, 2018). This includes activities such as research and development, design, production, marketing, distribution and support to the final consumer (Kaplinsky and Morris, 2001).

The basic dimensions for mapping of a value chain have been actors, value addition, geographical dimensions and governance (Gereffi, 1994; Kaplinsky and Morris, 2001; Meng *et al.*, 2019). The major scopes of value chain studies have been intra- or inter-firms, whereas the coverage scope could be domestic, regional or global operations. The combination of dimensions and scopes has led to different streams of value chain such as global value chain, supply chain, and value stream (Gereffi, 1994; Hines *et al.*, 1999).

This study's conceptual framework used dimensions of value addition activities on the primary value chain. The scope included value chain governance and organization supporting activities under given geographical locations (Figure 1).

From literature review, the value addition activities can be categorized into raw material acquisition, which mainly comes from wild sources (Hilonga *et al.*, 2019), processing such as mixing and packaging (Otieno *et al.*, 2008; Staden *et al.*, 2011; Volenzo and Odiyo, 2020) and distribution through vendors, stalls and herbal clinics (Jusu and Cuni-Sanchez, 2014; Posthouwer *et al.*, 2018). The value addition activities were used to identify actors and product flow along the value chain, while geographical location was used to describe both sources of raw materials and processing areas. Further, the regulation and facilitation offered by public and private organizations were activities conducted to support the primary value chain. The scope of the value chain was for intra- and inter-firm activities for domestic market of Tanzania.

The study analyzed the governance along the value chain as proposed by Gereffi and Stark (2016). Governance explains the authority and power relationship among actors and how the exchange flow is coordinated along the value chain. The proposed governance was based on the two extremes of market and hierarch governances. The categorization was based on the extent of information codification and ability of actors to meet the specifications of the exchanged products (Hernandez and Pedersen, 2017). Based on the categorization, five types of value chain governance have been described in the literature; market, modular, relational, captive and hierarch (Rundassa and Azene, 2018), as briefly explained below.

In market governance, the transactions are easily codified, specifications are relatively simple and suppliers are capable of producing the products. The chain coordination mainly is conducted by the price mechanism (Rundassa and Azene, 2018). In modular governance, the suppliers make products to specifications of buyers. Modularity rises with increase of codification (Hernandez and Pedersen, 2017). In relational governance, codification is difficult, which makes interactions complex. Suppliers and buyers are mutually dependent because of complexity (Sorensen, 2009). Relational governance is coordinated through reputation, social and spatial proximity, family and ethnic ties (Rundassa and Azene, 2018). Captive governance is practiced when the ability to codify and complexity product specification are high, but supplier capabilities are low (Hernandez and Pedersen, 2017). The hierarchy governance is characterized by complex products whose specifications cannot be coded (Rundassa and Azene, 2018). The lead actors have to dominate others to meet the required specification (Rundassa and Azene, 2018). The study used the most prevailing features to determine the governance structure.

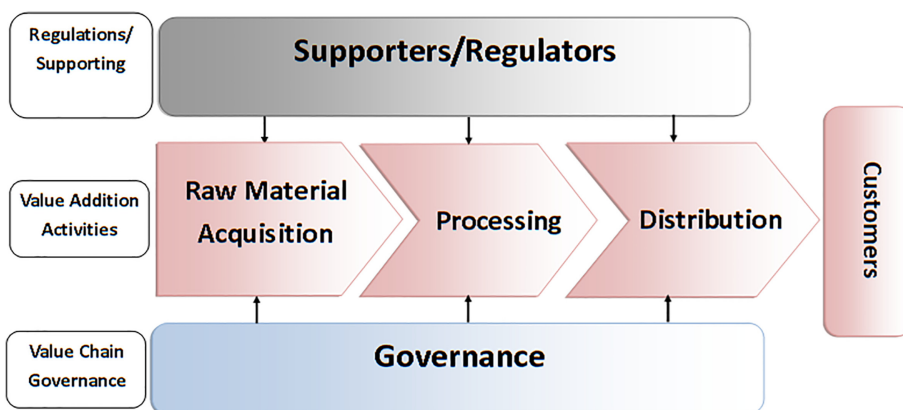


Figure 1.
Conceptual framework
of the value chain of
traded products of
medicinal plants

4. Research methodology

4.1 Study area

This study was carried out in five regions of Tanzania (Figure 2). Two regions were selected to represent rural settings (Njombe and Manyara) and other two (Morogoro and Arusha) represented urban settings, while one region (Dar es Salaam) was taken as the market hub. In each region, two districts were selected.

4.2 Sample and procedures

The study units were actors on the nodes of the value additions along the value chain of products of medicinal plants in the selected districts. Sampling procedures were based on the following arrangement: The list of the registered traditional medicine practitioners (TMPs) was collected from the district coordinators of traditional medicine. The TMPs were categorized based on the three nodes of raw material acquisition, processing and distribution (as explained in conceptual framework) based on the knowledge of district coordinators and leaders of the TMPs. From each node, two people were purposively selected to participate in the focus group discussion. The selection criteria were experience, age variation and sex.

The triangulation of the content discussed in the focus group discussion as well as clarification of some debated issues was done through in-depth interviews to some TMPs within the districts. The selection of the TMPs for in-depth interviews was purposive and solely done by researchers. The selection criterion was exemplary performance on the categorized nodes but was not selected to participate in the focus group discussion. The researchers and regulators of traditional medicines participants for in-depth interviews were identified by their respective institutions.

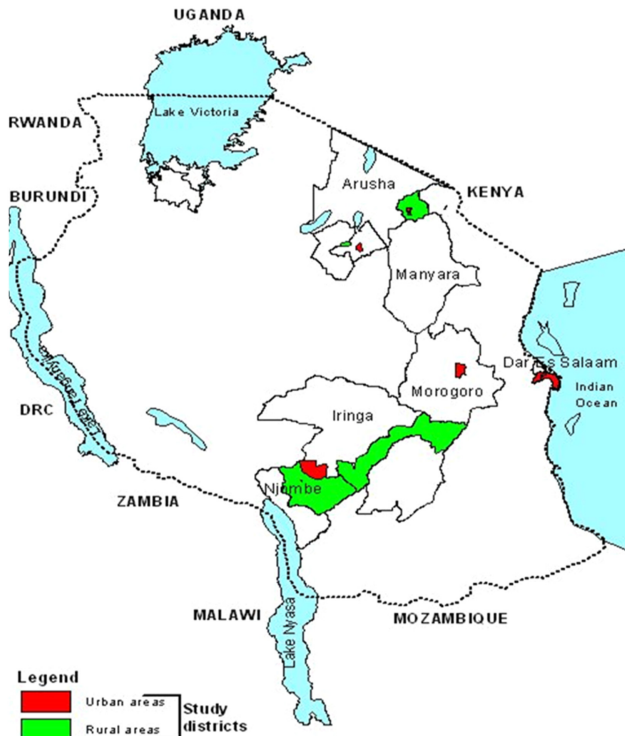


Figure 2.
Tanzania map
indicating study areas

4.3 Data collection

Data were collected through ten focus group discussions, one in each selected districts. In total, 97 TMPs participated in focus group discussions; ten for each district, except nine for Njombe, and eight for Simanjiro. Among them, female participants were 23.7% and male were 76.3%. The youngest participant was 24 years old, while the eldest was 76 years old. Most (72%) of the participants had primary education, and only 24% had secondary education, while 4% had collage education level.

In addition, 15 in-depth interviews were carried out. The in-depth interviews included nine TMPs at various value chain nodes, four researchers from the Institute of Traditional Medicine (ITM) of Muhimbili University of Health and Aligned Sciences (MUHAS) and two regulators from the Directorate of Traditional Medicines in the Ministry of Health, Community Development, Gender, Elderly and Children (MHCDGEC).

The focus group discussions and in-depth interviews were guided by prepared and reviewed guidelines. An average of 130 min focus group discussion was conducted with traditional healers and an average of 70 min in-depth interview was conducted. Also, all participants provided their consent to participate before the interview.

4.4 Data analysis

Data were analyzed using content analysis followed by the analytical hierarchy, as described by [Spencer et al. \(2003\)](#). NVivo 12, computer-assisted software, was used in qualitative data analysis. To ensure that the emerging concepts came from the data, they were cross-checked with scribed and voice records continually. Based on the content analysis procedure, the themes were directly derived from this process.

Value chain mapping followed [Humphrey's \(2005\)](#) recommendation on value chain mapping. The mapping identified value addition activities based on the product flow. The value chain was based on the details of the intra- and inter-firms' value addition activities. The view of the value chain map delimitation was based on the identified actors and product flow along the value chain up to the customer access.

5. Findings and analysis

5.1 The input-output structure

The deduced value chain had five actors performing different activities along the chain ([Figure 3](#)). The raw material acquisition was carried out by harvesters of medicinal plants from wild sources. Although there were harvesters who had planted few medicinal plants, harvesting was observed to be seasonal and in selected geographical locations. Most of the wild harvest of medicinal plants was conducted in dry seasons, which was mainly from June to early October. The medicinal plants of the same species from hot areas and top of mountains were preferred than those in cold areas and foot of mountains. It was rare for harvesters to add value to harvested medicinal plants. They only prepare like chopping them for transportation. The harvesters sold the individual medicinal plants in terms of roots, leaves, barks or seeds.

The processing of medicinal plants was conducted by two actors, wholesalers and formulators. The wholesalers purchased the medicinal plants from harvesters located in different parts of the country and carried out activities such as drying, milling and bulk packaging of individual medicinal plants. The wholesalers have the storage facilities but also stalls for displaying their medicinal plants. The milling of medicinal plants was major value addition done by wholesalers and performed through services providers. Wholesalers sell the individual medicinal plants, normally in bulk.

Formulators mixed different medicinal plants to create ready-made products for treating specific diseases. Different from harvesters and wholesalers, formulators sell the products by

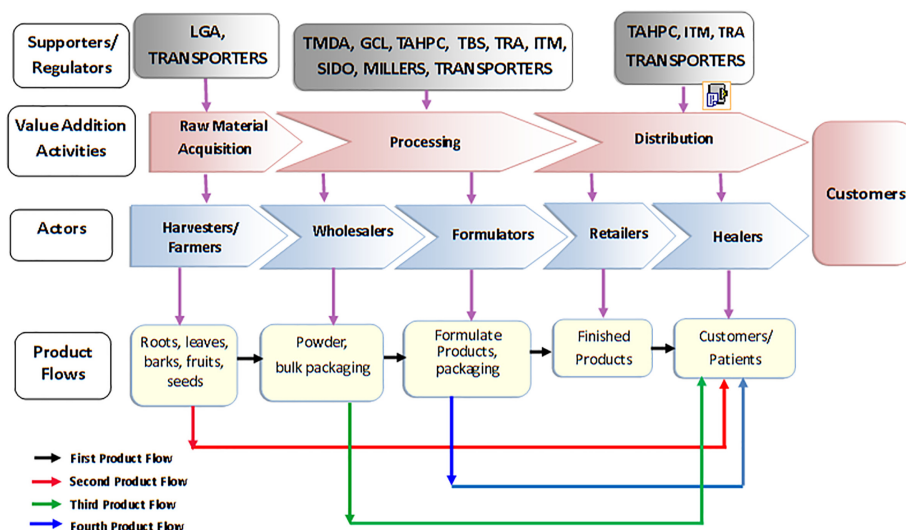


Figure 3.
Value chain of
products of medicinal
plants in Tanzania

description of uses other than name of individual medicinal plants. Finished products states were powder, tablets, capsules, syrups, rubbing medicines, soaps, lotion and jelly. Further, formulation process was also conducted by other professionals such as medical doctors.

Distribution of products of medicinal plants was done by retailers and healers. Retailers were in different forms; there were those who had shops for products of medicinal plants and hawkers/ambulant sellers. Retailers purchase their products from wholesalers and repackage individual medicinal plants into small quantities for retail consumers. Retailers with shops normally sell other imported products of medicinal plants mainly from Arabic countries and India. The healers in this distribution category used their herbal clinics. These healers purchased the products from retailers or the formulators they have contact with. While some of the healers sell the products of medicinal plants in the pre-packed forms by formulators, others change the packaging to include the identities of their herbal clinics.

There were four product flows to reach the final customers (Figure 3). The first (black arrows) was the emerging product flow. This flow was the most prominent in traded products of medicinal plants value chain. This flow was dominant in the market hub of Dar es Salaam and observed to emerge in urban areas of Arusha and Morogoro. These urban areas were dominated by the fourth product flow (blue arrows). The retailers were emerging in these urban areas. The second (red arrows) was the dominant product flow in the rural areas. These were customers who need specific medicinal plants, other than a product for specified diseases.

In case of regulatory and supporting organizations, six regulatory authorities and two supporting institutions were identified. These were government-based organizations that included Local Government Councils (LGC), Tanzania Medical and Drug Authority (TMDA), Tanzania Bureau of Standards (TBS), Government Chemistry Laboratory Agency (GCLA), Traditional and Alternative Health Practices Council (TAHPC), Tanzania Revenue Authority (TRA), Institute of Traditional Medicines (ITM) of MUHAS and Small Industries Development Organization (SIDO). The services provided by private organizations were milling and transport. Specified functions of these organizations along the value chain of products of medicinal plants as well as the primary actors they work with are summarized in Table 1.

Category	Name of the organization	Functions related to value chain of products of medicinal plants	Concerned actor along the value chain
Regulatory authorities	LGC	Control the access of medicinal plants from wild sources	Harvesters
	TMDA	Control transportation of medicinal plants from their respective districts Control for GMP in products of medicinal plants	Formulators
	TBS	To register products of medicinal plants that have qualified official procedures. Registered products can be sold in pharmacies	Formulators
	GCLA	To control the quality of the products with predetermined production procedures and standards	Formulators
	TAHPC	Certify products of medicinal plants for public safety Determination of the harmful substances in the products of medicinal plants	Wholesalers Formulators Retailers Healers
	TRA	Registration of healers in traditional medicine industry Registration of the working premises for traditional and alternative health Registration of the products of medicinal plants based on persistence community uses	Wholesalers Formulators Retailers Healers
	ITM	Collection of the revenue to traders of products of medicinal plants	Wholesalers Formulators Retailers Healers
Supporting institutions/ organization	SIDO	Training on the best practices of traditional medicines Training basic formulations of products of medicinal plants to different states such as tablets	Formulators Healers
	Millers	Training on packaging of products of medicinal plants products	Formulators
	Transporters	Training on formulation of products medicinal plants, specifically soaps and jelly Milling of different parts of medicinal plants Transportation of medicinal plants and their products	Wholesalers Harvesters Wholesalers Formulators Retailers

Table 1.
Function of regulatory and supporting organizations along the value chain of products of medicinal plants

The formulators were the most regulated actors along the value chain of products of medicinal plants (Table 1). However, it was observed that due to poor understanding of the functions, high costs of abiding with requirements of regulatory authorities and little market benefit between registered and non-registered products, most of the products were not registered by any of the regulatory authorities. There was one respondent who had one registered products by the TAHPC. The domestic products of medicinal plants were not allowed in the shelves of the modern medicines pharmacies because they have not been authorized by the TMDA. All chain actors, except harvesters admitted to pay income taxes to the TRA.

5.2 Dominant governance along the value chain

It was reported by both participants of focus group discussions and practitioners in in-depths interview that the mode of working is based on relationship basis. The value chain actors were working with people whom they have historical background with. The wholesalers work with harvesters they know personally or inherited from the people they learned from or connected by the person they knew. Formulators had retailer shops where they previously had relationship. The little flexibility was from retailers of finished products to customers, although retailers admitted that some customers get reference from someone who had purchased the products before.

It was noted that customers know and access products of medicinal plants through peer communication within the community. The person who has been well treated by a certain healer will refer his fellow, most of the time relatives and neighbors, to that healer or products of medicinal plants that helped him/her. The consumption of the products of medicinal plants relies on peer assurance other than information from regulatory authorities.

From the theory of global value chain, this kind of governance is referred to as relational (Gereffi and Stark, 2016). This kind of governance occurs when buyers and sellers rely on complex information that is not easily coded (Rundassa and Azene, 2018). Complex information, which is difficult to code in trade of products of medicinal plants, can be referred to lack of raw materials and products official standards. Identification of the proper medicinal plants by wholesalers relied on experience and trust on harvesters. For example, one of the wholesalers in Dar es Salaam identifies medicinal plants by the smell and taste from trusted harvester but had never seen the tree. In such situation, it is difficult for such wholesaler to change the harvesters.

5.3 Economic return along the value chain

The discussion on the economic return along the value chain indicated that the income distribution was skewed. The harvesters were the least gainers, while formulators were the highest gainers. The clarification sought through an in-depth interview of one of the famous formulated brand of Ngetwa Herbal Medicine is explained in Window 1.

Window 1. Trade return along the value chain, a case of Ngetwa Herbal Medicine

Ngetwa Herbal Medicine was the famous brand introduced in the market in 2000s. Ngetwa was manufactured in Moshi, northern Tanzania, but distributed throughout the country. Ngetwa was known for treatments of fever, swollen feet and reproduction cases in women. Ngetwa was formulated by the retired medical doctor, and it constituted three medicinal plants. The formulator owned the ratio of each medicinal plant and their parts used. It was believed that Ngetwa was the first Tanzanian herbal medicine to be packaged in the labeled modern boxes of 100 g each. The average selling price at Kariakoo Market was Tsh1,500 (about US\$1 by that time exchange rate).

Two raw medicinal plants were purchased at the processing unit from individual harvesters at Tsh3,000 per Kg of each dried parts. One raw medicinal plant was ordered from a wholesaler at Tsh5,000 per kg because it was not available around Moshi. About 2 kg of locally purchased medicinal plants was used with 1 kg of ordered medicinal plant. The 5 kg of Ngetwa produced by raw materials of Tsh11,000 was equivalent to 50 packets of 100 g each. Other major costs were packaging materials, which costed Tsh200 per packet, and labor costs, which varied depending on the monthly production where it was approximated to Tsh100 per packet of final product, including utilities. The production cost of each packet of 100 g of Ngetwa costed around Tsh520. The gate selling price to wholesalers was about Tsh1,000 per packet, and wholesalers sold at Tsh1,200 to retailers.

Based on Ngetwa Herbal Medicine, the final product sales price constituted income distribution along the value chain (in percentage of final retail price) as follows; harvesters 8%, wholesalers 6.7%, formulators 52%, wholesaler 13.3% and retailers 20%. The formulator was making a gross margin of 92% after the variable costs, compared to 20% of wholesalers and retailers.

It was argued that harvesters depend on the wild resources, so they have negligible investment costs, and that harvesters could have the highest net margin percentage compared to other actors along the value chain actors. However, the small percentage share of the wholesalers and harvesters to the final price of formulated Ngetwa Herbal Medicine (Window 1) indicates the poor income distribution on the lower side of the value chain.

6. Discussion

The observed actors of value chain were different from the frameworks of the herbal medicine value chain developed by [Booker *et al.* \(2012\)](#) and [Volenzo and Odiyo \(2020\)](#). Primary processors were not visible in current value chain. Some of the primary processing like cleaning, drying and scratching were done by either harvesters or wholesalers. The formulators observed in this chain were not in other frameworks. The difference can be from perspective of value chain, where [Booker *et al.* \(2012\)](#) and [Volenzo and Odiyo \(2020\)](#) included exporters, while the current study focused on the domestic market. The regulators, facilitators and product flow captured in this study add to the framework of the value chain of traded products of medicinal plants.

The formulators were new entrants in the value additions of products of medicinal plants as they were not observed by other studies. These formulators have emerged mainly for two reasons; starting of specialization in the traditional medicine industry where some healers choose to sell medicines as the trade evolves and engagement of new entrants in the industry from allopathic health services such as medical doctors and pharmacies. The formulators are drivers of the value chain because they mainly own the knowledge of medicinal plants and their rational combination to treats specific diseases. Formulators also purchase in bulk and have access to capital and technology.

The deduced value chain of products of medicinal plants has geographical scope in both sources of raw materials and processing areas. Most of the raw materials are sourced in the wildness, as also observed by [Hilonga *et al.* \(2019\)](#). The value addition processes are conducted in the urban areas. The geographical scope on value chain can help to answer an interesting phenomena observed by [Delbanco *et al.* \(2017\)](#) on abundant of some species on Mt. Marsabit while they were highly demanded in other urban centers. The reasons can be unsuitability of those species based on their geographical location, harvesters' lack of network to market in urban areas with demand or infrastructure problem taken as common to rural areas supplying medicinal plants.

The explained geographical scope of the value chain provides vital information on the conservation of medicinal plants, which has been the main concern of the trade studies on medicinal plants. The conservation should focus not only on the particular tree species but also on their respective geographical locations. The scarcity in hot areas and top of mountains should not be confused by the abundance in the cold and foot of mountains, and vice-versa.

The relational governance along the value chain provides the hint on the dominance of the trade of products of medicinal plants in the informal economy. Unfolding the complex information in the trade could help institutional monitoring, which would not require personal relationship to assure quality of raw materials as well as final products. For example, during the interview with a producer of the Ngetwa Herbal Medicine, they were forced to use close friends and relatives for distribution, because they realized that the product was adulterated in the distribution chain. Therefore, relational governance can be also an outcome of little internal production capacity. They lack unique technology for packaging and sealing the products, which can avoid counterfeits.

7. Conclusion and recommendations

This study applied the value chain concept to answer two research questions pertaining traded products of medicinal plants in Tanzania; (1) what is the input to output structure, in

terms of actors and activities, of the formulated products of medicinal plants? and (2) what is the dominant governance structure of the actors in the described value chain? It was deduced that the input to output structure is performed through a value chain, which has five actors performing different activities along the value chain. The actors include harvesters who provide raw materials, and wholesalers and formulators who are involved in processing of medicinal plants. The wholesalers carried out activities such as drying, milling and bulk packaging of individual medicinal plants. Formulators mixed different medicinal plants to create readymade products for treating specific diseases. Other actors are retailers and healers who distribute products of medicinal plants. Retailers purchase their products from formulators, and the healers distribute products through their herbal clinics.

In case of regulatory and supporting authorities, six of the regulatory authorities and two supporting institutions were identified from the government side. The private supporters were transporters and millers. In case of the dominating governance structure of the actors along the value chain, it was deduced to be relational. Relational kind of governance was a result of lack of raw materials and products' official standards.

The regulatory framework of products of medicinal plants calls for policy intervention to harmonize the similar responsibilities performed by different organizations. Policies should further harmonize the quality standards provided by different regulatory authorities. Other services providers, such as financial services providers and technology incubators, should be sought to help formulators acquire modern technology. This kind of assistance could help the formulators to comply with good manufacturing practices (GMP).

In addition to improving the framework for value chain research on medicinal plants by including regulatory and supporting organization, this study can be used to guide efforts of investments in production and promotion of products of medicinal plants where formulation technology can be further investigated and improved. The quality improvement can be specified at each value chain node, while biodiversity conservation can focus not only on the species but also their geographical location. The limitation of the study is empirical analysis of economic analysis of returns to all actors along the value chain. This kind of analysis, together with needs assessment to prioritize kinds of medicinal plants to be processed, is recommended for further studies.

References

- Andel van, T.R., Croft, S., van Loon, E.E., Quiroz, D., Towns, A.M. and Raes, N. (2015), "Prioritizing West African medicinal plants for conservation and sustainable extraction studies based on market surveys and species distribution models", *Biological Conservation*, Vol. 181, pp. 173-181.
- Andrade-Cetto, A. (2005), "Neglected diseases in Africa: a challenge for medicinal plants research", *African Journal of Traditional, Complementary and Alternative Medicine*, Vol. 2 No. 3, pp. 213-214.
- Booker, A., Deborah, J. and Michael, H. (2012), "Value chains of herbal medicines-research needs and key challenges in the context of ethnopharmacology", *Journal of Ethnopharmacology*, Vol. 140, pp. 624-633.
- Delbanco, A., Cuni-Sanchez, A. and Neil, D.B. (2017), "Medicinal plant trade in Northern Kenya: economic importance, uses, and origin", *Economic Botany*, Vol. 71, pp. 13-31.
- Gakuya, W., Mitchel, O., Stephen, K., James, M., Peter, G., Peter, M. and Joseph, M. (2020), "Traditional medicine in Kenya: past and current status, challenges, and the way forward", *Scientific African*, Vol. 8, pp. 1-7.
- Gereffi, G. (1994), "The organization of buyer-driven global commodity chains: how US Retailers shape overseas production networks", *Commodity Chains and Global Capitalism*, Praeger Publishers, Westport, CT, pp. 95-122.
- Gereffi, G. and Stark, F. (2016), *Global Value Chain Analysis: A Primer*, 2nd ed., available at: <https://hdl.handle.net/10161/12488>.

-
- Heinrich, M. (2015), "Quality and safety of herbal medical products: regulation and the need for quality assurance along the value chains", *British Journal of Clinical Pharmacology*, Vol. 80 No. 1, pp. 62-66.
- Heinze, C., Mateus, D., Francisco, D., Christoph, N. and Thea, L. (2019), "Economic potential of selected native plants from Cuanza Norte, Northern Angola", *Economic Botany*, Vol. 73 No. 1, pp. 96-111.
- Hernández, V. and Pedersen, T. (2017), "Global value chain configuration: a review and research agenda", *Business Research Quarterly*, Vol. 20, pp. 137-150.
- Hilonga, S., Otieno, J.N., Ghorbani, A., Pereus, D., Kocyan, A. and de Boer, H. (2019), "Trade of wild-harvested medicinal plant species in local markets of Tanzania and its implications for conservation", *South African Journal of Botany*, Vol. 122, pp. 214-224.
- Hines, P., Rich, N. and Esain, A. (1999), "Value steam Mapping. A distribution industry application", *Benchmarking: An International Journal*, Vol. 6 No. 1, pp. 60-77.
- Humphrey, J. (2005), *Shaping Value Chains for Development*, GTZ Publication, Eschborn.
- Jusu, A. and Cuni Sanchez, A. (2014), "Medicinal plant trade in Sierra Leone: threats and opportunities for conservation", *Economic Botany*, Vol. 68 No. 1, pp. 16-29.
- Kaplinsky, R. and Morris, M. (2001), *A Handbook for Value Chain Research*, Brighton, United Kingdom, Institute of Development Studies, University of Sussex, Brighton.
- Kasilo, O.M.J., Wambebe, C., Nikiema, J.-B. and Juliet, N. (2019), "Towards universal health coverage: advancing the development and use of traditional medicines in Africa", *BMJ Global Health*, Vol. 4, pp. 1-11, e001517.
- Langwick, S. (2010), "From non-aligned medicines to market-based herbals: China's relationship to the shifting politics of traditional medicine in Tanzania", *Medical Anthropology*, Vol. 29 No. 1, pp. 15-43.
- Manzano, S., Jose, A. and Francisco, M. (2020), "Worldwide research trends on medicinal plants international", *Journal of Environmental Research and Public Health*, Vol. 17, p. 3376.
- Mbwambo, Z.H., Mahunnah, R.L.A. and Kayombo, E.J. (2007), "Traditional health practitioner and the scientist: bridging the gap in contemporary health research in Tanzania", *Tanzania Health Research Bulletin*, Vol. 9 No. 2, pp. 115-120.
- McMillen, H. (2012), "Ethnobotanical knowledge transmission and evolution: the case of medicinal markets in Tanga, Tanzania", *Economic Botany*, Vol. 66, pp. 121-131.
- Meng, B., Xiao, H., Ye, J. and Li, S. (2019), *Are Global Value Chains Truly Global? A New Perspective Based on the Measure of Trade in Value-Added*, Institute of Developing Economies, IDE Discussion Paper No. 736.
- N'Danikou, S., Achigan-Dako, E. and Jennifer, W. (2011), "Eliciting local values of wild edible plants in southern Benin to identify priority species for conservation", *Economic Botany*, Vol. 65 No. 4, pp. 381-395.
- Otieno, J., Macha, K., Hosea, M., Lyaruu, H. and Mahunnah, R. (2008), "Multi-plant or single-plant extracts, which is the most effective for local healing in Tanzania?", *African Journal of Traditional Medicine, Complementary and Alternative Medicine*, Vol. 5 No. 2, pp. 165-172.
- Otieno, J., Abihudi, S., Veldman, S., Nahashon, M., van Andel, T. and de Boer, H.J. (2015), "Vernacular dominance in folk taxonomy: a case study of ethnospecies in medicinal plant trade in Tanzania", *Journal of Ethnobiology and Ethnomedicine*, Vol. 11, p. 1.
- Petersen, L.M., Moll, E.J., Hockings, M.T. and Collins, R.J. (2015), "Implementing value chain analysis to investigate drivers and sustainability of cape town's informal economy of wild-harvested traditional medicine", *Local Environment*, Vol. 20 No. 9, pp. 1040-1061.
- Posthouwer, C., Veldman, S., Abihudi, S., Otieno, J., van Andel, T. and de Boer, H. (2018), "Quantitative market survey of non-woody plants sold at Kariakoo market in Dar Es Salaam, Tanzania", *Journal of Ethnopharmacology*, Vol. 17, pp. 280-287.

- Pyakurel, D., Sharma, I. and Hall, C. (2018), "Pattern of change: the dynamics of medicinal plant trade in far-Western Nepal", *Journal of Ethnopharmacology*, Vol. 224, pp. 323-334.
- Quiroz, D., Towns, A., Legba, S., Swier, J., Brière, S., Sosef, M. and van Andel, T. (2014), "Quantifying the domestic market in herbal medicine in Benin, West Africa", *Journal of Ethnopharmacology*, Vol. 151, pp. 1100-1108.
- Rundassa, W. and Azene, D. (2018), "Global value chain evolution, feature and significance: literature review", *Journal of Social Sciences*, Vol. 4, p. 1.
- Snyder, H. (2020), "Literature review as a research methodology: an overview and guidelines", *Journal of Business Research*, Vol. 104, pp. 333-339.
- Sørensen, O.J. (2009), *Formation, Organization and Management of the (Global) Value Chain in a Theoretical Perspective*, Working Paper Series No 52, International Business Economics Aalborg University.
- Spencer, L., Ritchie, J. and Connor, W. (2003), "Analysis: practices, principles and processes", in Ritchie, J. and Lewis, J. (Eds), *Qualitative Research Practice: A Guide for Social Sciences Students and Researchers*, 1st ed., Sage Publication, London, pp. 199-218.
- Staden, J., Ndhkala, A., Stafford, G. and Finnie, J. (2011), "Commercial herbal preparations in Kwazulu-Natal, South Africa: the urban face of traditional medicine", *South African Journal of Botany*, Vol. 77, pp. 830-843.
- Stangeland, T., Dhillon, S.S. and Reksten, H. (2008), "Recognition and development of traditional medicine in Tanzania", *Journal of Ethnopharmacology*, Vol. 117, pp. 290-299.
- Street, A., Stirk, W. and Staden, J. (2008), "South African traditional medicinal plant trade—challenges in regulating quality, safety and efficacy", *Journal of Ethnopharmacology*, Vol. 119, pp. 705-710.
- Towns, A., Quiroz, M., Guinee, L., Boer, H. and vanAndel, T. (2014), "Volume, value and floristic diversity of Gabon's medicinal plant markets", *Journal of Ethnopharmacology*, Vol. 155, pp. 1184-1193.
- Veldman, S., Ju, Y., Otieno, J., Abihudi, S., Posthouwer, C., Gravendeel, B., vanAndel, T. and de Boer, H. (2020), "DNA barcoding augments conventional methods for identification of medicinal plant species traded at Tanzanian markets", *Journal of Ethnopharmacology*, Vol. 250, p. 112495.
- Volenzo, T. and Odiyo, J. (2020), "Integrating endemic medicinal plants into the global value chains: the ecological degradation challenges and opportunities", *Helvion*, Vol. 6, e04970.
- WHO (2019), *WHO Global Report on Traditional and Complementary Medicine 2019*, World Health Organization, Geneva, License: CC BY-NC-SA 3.0 IGO.

Corresponding author

Eziacka Mathew Mpelangwa can be contacted at: eziackam@gmail.com