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BACHELOR'S THESIS

International Cooperation for Agricultural and Rural Development

Miombo woodlands as a source of livelihood: A review

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Declaration

I hereby declare that I have done this thesis entitled “Miombo woodlands as a source of livelihood” independently, all texts in this thesis are original, and all the sources have been quoted and acknowledged by means of complete references and according to Citation rules of the FTA.

In Prague 16 April 2021

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Sára Kružíková

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Abstract

The Miombo woodlands represent specific ecosystem that spreads across southern African countries. Despite the relatively rich publication history, there is no concise literature review available that would summarize current knowledge on Miombo. Such review might help to understand the role of this unique ecosystem in current changes in socioeconomic, institutional, and environmental dynamics. Therefore, the aim of the thesis was to review available literature on Miombo with regard to its role in agricultural and rural development. Specific aims of the thesis were to review scientific literature indexed at Web of Science on Miombo woodlands with special attention given to on farming systems, ecological economics, and sustainability, ii) review contributions and linkages of Miombo to livelihood strategies, and iii) identify main socioeconomic factors influencing the use of Miombo by local households. Methodology of the thesis was based on reviewing scientific articles published at Web of Science database. Data were analysed mainly through standard scientometrics approaches in order to classify existing literature into scientific categories, provide overview of methodologies used for data collection and analysis, identify focused regions, and variables used in studies related to agricultural economics, farming systems, and ecology. The results show that current knowledge on Miombo forest in scientific literature has been growing exponentially over the last 40 years. However, less than 25% of published articles deal with social, agricultural, and economic issues. Most articles on Miombo were related to environmental sciences, forestry, or plant sciences. Nevertheless, more than 50% of existing literature has been indexed in Q1 category, indicating high-level of scientific relevance. The results also show that Miombo is one of the essential sources for the livelihood for people living in the developing rural areas, particularly as a source of wood, food, medicine, or as grazing areas. Apart from direct benefits, studies highlighted services such as shading, climate stabilisation, or water regime, provided by Miombo woodlands to local ecosystems.

Key words: non-timber forest products, scientometrics, southern Africa, Web of Science, forest

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1. Introduction

We have greater evidence of how forests are critical to livelihoods, with a better understanding of the trade-offs and more exact confirmation that healthy and productive forests are essential to sustainable agriculture. And we have proof of the significance of forests and trees for the quality of water, for contributing to the energy needs of the future, and for designing sustainable, healthy cities (FAO 2018). Rapid growth of human populations around the world since the middle1900s rise use of natural resources, including forests (World Bank 2004; WRI 2005). Close to 1.6 billion people – more than 25% of the world's population depend on forest to maintain their livelihood (World Bank 2004; FAO 2015). Forests have many functions due to their multipurpose character. One of the main outputs obtained from the forest are non-timber forest products (NTFPs) are specific commodities of biological origin other than timber from natural, modified, or managed forested landscapes. They are composed of fruits and nuts, vegetables, medicinal plants, gum, resins, essences, rattans, palms, fibres, flosses, grasses, leaves, seeds, mushrooms, honey, and lac etc. (Marshall et al. 2003; Shackleton et al. 2004). They can be used as building material or food, they also have ornamental or religious significance. They are an essential component for obtain the basic needs of households (Cheng Deng et al. 2020). Particularly, they play important and crucial role in time of crisis when regular supplies are limited or even discontinued (Fisher & Shivley 2005; McSweeney 2005; Paumgarten 2005; Kamanga et al. 2009; Heubach et al. 2011). Income generated from forest helps to alleviate poverty of households living in rural areas and/or those with poor resource base (Cavendish 2000; Angelsen & Wunder 2003; Fisher 2004; Sunderlin et al. 2005; Vedeld et al. 2007; Sunderlin et al. 2008; Yemiru et al. 2010; Hogarth et al. 2013; Mulenga et al. 2013). Share of forest contribution to household living standard vary across the world from less than 10 to more than 60% and is associated with various conditions (McSweeney 2002; Ambrose-Oji 2003; Fisher 2004; Mamo et al. 2007; Shackleton et al. 2007; Illukpitiya & Yanagida 2008; Mcelwee 2008; Quang & Noriko 2008; Kamanga et al. 2009; Babulo et al. 2009; Yemiru et al. 2010; Heubach et al. 2011; Bosma et al. 2012; Kar & Jacobson 2012; Rayamajhi et al. 2012; Tieguhong & Nkamgnia 2012; Hogarth et al. 2013; Angelsen et al. 2014; World Bank 2019).

Forest environmental income is generally considered as cash income generated from forest resources' commercialization. For instance, forest income from commercial forestry or plantation is not considered as 'forest environmental income', because it is an investment activity and the return from such an activity is a profit, not an 'environmental income' (Cavendish 1998; Cavendish 2002). Environmental income thus refers to extraction from non-cultivated sources, i.e. natural forests, other non-forest wildlands such as grass, bush and wetlands, fallows, but also from wild plants and animals. Most of forest income is environmentally sourced ("subsidy from nature"). Forest and non-forest and environmental income combined make up total environmental income, representing the sum of "incomes (cash or in kind) obtained from the harvesting of resources provided through natural processes not requiring intensive management" (CIFOR 2007). Even forests and trees contribution to household cash income is equal roughly to 20% and any exclusion of forests from rural livelihood would cause severe effects on poverty rates (Vedeld et al. 2007; Miller et al. 2016; FAO 2018). This bachelor thesis deals with Miombo woodlands, one of the most important dry forest-savannah biomes of the world. It is an open deciduous woodland characteristic for dry areas of eastern and southern Africa. Miombo forests do not just represent an important habitat for African fauna and flora, but various products collected in this biome strengthen livelihoods by producing safety nets during periods of weak crop yields or seasonal lacks. Majority of rural households residing close by forests profit a big amount of forest products for both direct consumption and trade, including charcoal production, fuel, food products and wood for cooking (see e.g., Mulenga et al. 2013; Gumbo et al. 2018).

2. Literature review

2.1. Current stage of world forests

Forest covers all climate zones and are spread over all world regions. Their area decreased over the last centuries, as in the period of pre-industrial area, forests covered globally 5.9 billion hectares compare to 4 billion at present, which currently represent 31 percent of the global land area. Moreover, their distribution across the earth surface is not equal (see Figure1).

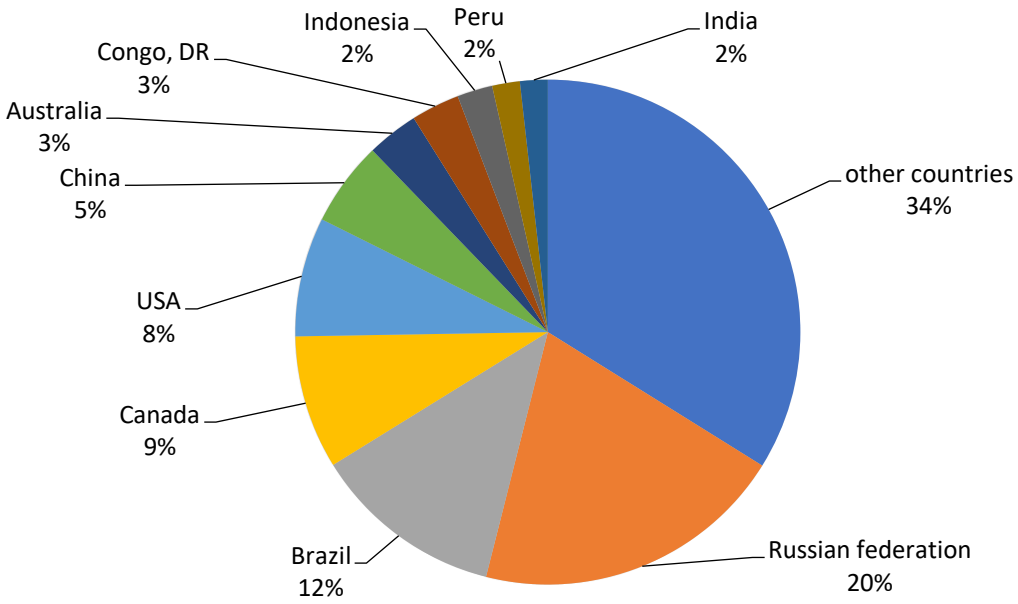

Figure 1
Global distribution of forests showing the ten countries with the largest forest area, 2020 (million hectares and % of world's forest)
Source: data from FAO (2020)

More than half of the world's forests are distributed in only five, however by far the largest, countries: the Russian Federation, Brazil, Canada, the United States of America, and China, and two-thirds of forests are found in ten countries (FAO & UNEP 2020). Despite of various reforestation efforts, the forest area decreased by almost one percent during the last three

decades (see Figure 2), which is almost 450,000km^2. This size of area can be compared to the size of Sweden (Faostat 2020).

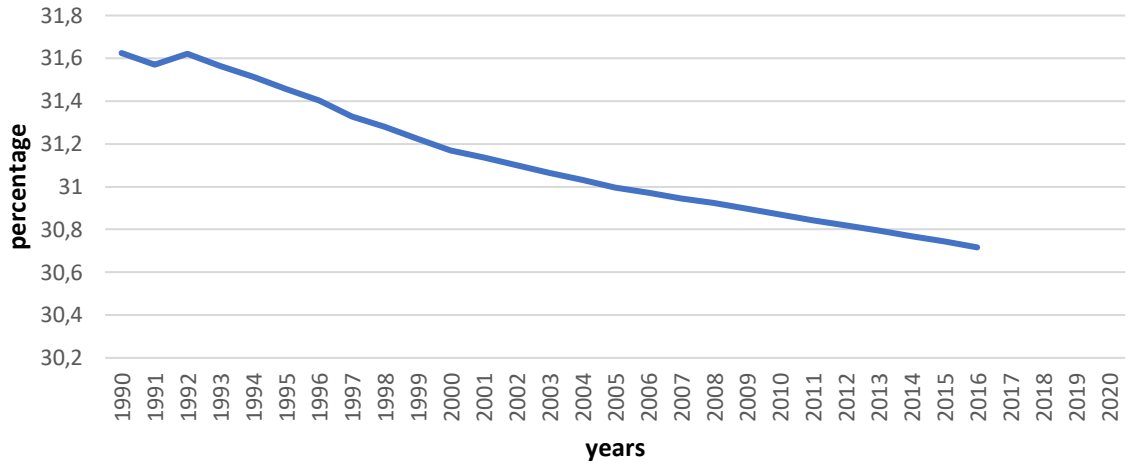

Figure 2
Forest cover at global level 1990-2016 (% of land use)
Source: Faostat (2020)

Forest is an abundance of flora and fauna in relatively small space, high diversity and density of organism. Forest biological diversity can be taken into consideration at several levels, which includes ecosystem, landscape, species, population and genetic. Nevertheless, forest structure and diversity differ among regions. Generally, there are several types of forest covers in the world: tropical, boreal forests (taiga), temperate and subtropical (see Figure 3) (Butler 2020).

Figure 3
Proportion and distribution of global forest area by climatic domain in 2020
Source: United Nations (2020)

2.2. Forests' deforestation and degradation

Deforestation and degradation are one of the big global problems of our planet, whose course and consequences directly or indirectly affect the life of entire population. Not only deforestation, together with other factors, contribute to climate change and affect the natural running of ecosystems, but it is also a stimulus for many social changes. Degradation represents rather short-term but also constant decreasing of the fertile capacity of land. It covers the different forms of soil degradation, poor human livelihood resulting in further deforestation, decreasing of quality and quantity of water resources, and decreasing of the productive capacity of rangelands (UNEP 1992; FAO, UNDP & UNEP 1994; Butler 2020). Degradation is usually result of deficiently regulated or poorly managed logging or another unregulated extractive activity in many cases carried out at a small-scale by bigger number of actors. Relating to Reduced Emissions from Deforestation and forest Degradation (REDD+) degradation has been associated together with deforestation. On some occasion of degradation and deforestation are causally connected, (e.g., construction of access lanes for timber extraction can enhancement the expectation of following deforestation through transformation of forest to agricultural land) (Herold & Skutsch 2011; Morales-Barquero et al. 2014). Moreover, deforestation is the felling or diminishing of forests area by humans. Deforestation is one of the biggest problems of global land use. Determines of deforestation are generally based on the area of forest cleared for human use, together with elimination of the trees for timber products and for croplands and grazing lands. Practically, clear-cutting, all the trees are removes from the land area, which fully destroys the forest. Deforestation is also discussed as a cause of erosion (FAO, UNDP & UNEP 1994; Stuart 2020). It has been estimated that deforestation contribute almost 25% of global atmospheric carbon emissions, a main factor leading to global warming (Baccini et al. 2012; Morales-Barquero et al. 2014; Van Khuc et al. 2018). The most concentrated deforestation and deforestation occurs in tropical forests. International Tropical Timber Organization estimated that almost 850 million hectares are degraded in tropical forests (Yokohama 2002; Morales-Barquero et al. 2014).

Generally, changes in land cover have crucial consequences for worldwide diversity and ecosystem services, degradation of biological resources or shifts in regional climate. These

changes are closely associated to climate change (Foley et al. 2005; Hansen et al. 2013; Kim et al. 2014; McDowell et al. 2015; Schwantes et al. 2017; Phiri et al. 2019). Particularly, in Sub Saharan Africa, land cover changes represent a great problem, particularly because of increasing human activities, conservation procedures, and minimize carbon. Fast land cover changes are usually driven by deforestation through the transformation of forests to non-forests surface, e.g., cropland and plantations. And further the main reason of rapid changes in many Sub-Saharan Africa countries, mostly through deforestation and forest degradation is absence of efficient land use policies (Challinor et al. 2007; Mulenga et al. 2009; Syampungani et al. 2010; Conway & Schipper 2011; Brandt et al. 2018; Phiri et al. 2019). There are many factors closely linked to land cover changes and could be generally arranged in to two categories: direct and indirect ones (Kleemann et al. 2017; Van Khuc et al. 2018; Austin et al. 2019). Direct factors are for example agricultural expansion, logging, and mining, where human activities are based on intended land use and they have direct effects on the land cover. Indirect factors are based rather on combination of human behavioural and institutional dynamics, such as population dynamics, policies, or poverty, and natural processes, particularly climate change (Zuidema et al. 2008; Morales-Barquero et al. 2014; Weatherley-Singh & Gupta 2015; Quintero-Gallego et al. 2018; Phiri et al. 2019).

One of main reasons causing deforestation and degradation mentioned above were institutional issues. Forests do not have always clear ownerships and/or forest protection cannot be maintained probably because of lack of resources, effort, or low institutional power. These aspects are sometimes called as tragedy of commons. The tragedy of the commons characterizes a status in economic branch of knowledge when particular users, who have free access to a resource unhampered by shared community-based structures or formal rules that manage access and use, operate independently according to their own self-interest and, opposite to the general good of all users, cause depletion of the resource through their clumsy and unorganized action (Margaret 2020). Elinor Ostrom became known thanks to finding out the solution (Maureen 2011). Ostrom believes that the “tragedy” in these situations is not unavoidable. Instead, if the farmers or households plan to cooperate with one another, observing each other’s use of the land and applying rules for managing it, they can avoid the tragedy. This would happen even though open-access resource systems that usually tent to failure due to excessive use, such as in case of over-fishing. Generally, there are many examples where members of a community with limited access to a common

resource cooperate to exploit those resources wisely without failure (Margaret 2020; Nobel Prize 2021).

2.3. Savannah forest

Almost half of the global forest cover is situated to tropical areas, land areas approximately bounded by the tropic of Cancer and Capricorn (Butler 2020). More than 60% of tropical forests consist of tropical rainforest, while the remaining ones are represented by various forest types of tropical coniferous forests, savanna woodland, and mountainous forests (Figure 4).

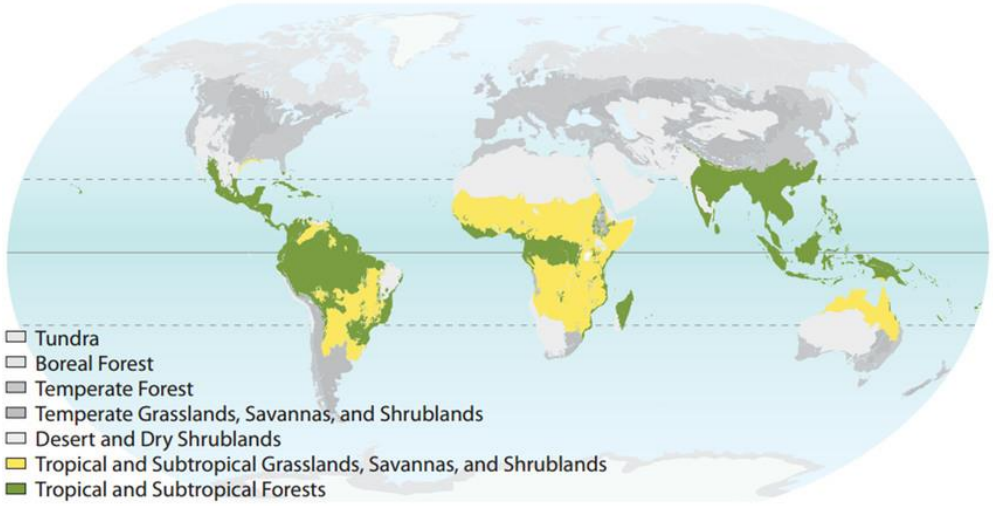

Figure 4
Map of the world terrestrial biomes
Source: UNEP-GRID-Arendal 2009; modified from Olson et al. 2001.

Over relatively short distances, the borderline between these biomes can be indistinct with ecotones between the major types. Subtropical rainforests have a lot in common with tropical rainforests. Anyhow, the density of subtropical rainforests and tropical forests mark them out; in temperate forests, most of the vegetation is in the form of trees, and there is not wide vegetation along the land level. In the meantime, subtropical forests tend to have wide vegetation that extends to a couple feet above the ground. Ecosystem services play an important role in our planet. For example, they affect the climate through evapotranspiration and the carbon cycle (Butler 2020). Trees in tropical rainforests draw water soaked in forest soil and release it back into the atmosphere, where it forms mists and clouds and regulate

rainfall, which cools the local climate. In addition, the clouds formed reflect more sunlight back into space, helping to cool the entire Earth. Forest ecosystems, further filter water, serve as reservoirs of rainwater and supply it with streams and rivers and lakes (Nunenz 2019; Butler 2020). Subtropical forests may be found around the border of the tropics. The savannah is open grassland consists of areas with very few trees and shrubs. This biome is usually close by forest or semi-desert country. There are two types of savannas: tropical and semi-tropical savannas. Savannas are located on six of the seven continents, the largest are found in equatorial Africa. The countries where you can find savannas include Sub-Saharan African countries Kenya, Zimbabwe, Zambia, Botswana, South Africa, and Namibia, various part of Australia, or Belize, Honduras, Venezuela, and Columbia in Latin America, and particularly in India in Southern Asia (Abdallah & Monela 2007).

Most of these regions are considered still as poor or less developed compare to Global North. All over the world, the dependence on forests for livelihoods tends to be highest in areas with high forest cover and pervasive poverty (Sunderlin et al. 2008; Smith 2019). Thus, a key challenge is to maintain the sustainable management of dry forests and woodlands of Sub-Saharan Africa that are essential for local economy and people's livelihoods. Many people face threats from land use and climate change. Tropical and subtropical forest areas support the livelihoods of their communities through nourishment use of products, and income gained from the sale of non-timber forest products (NTFPs) or wood product. Especially in rural tropical Africa, there is a need to understand the potential of forest and NTFP resources and to use them as widely as possible (Malhotra & Bhattacharya 2010; Pandey et al. 2011; Mulenga et al. 2013; Shackleton et al. 2015). Additionally, apart from direct positive impacts on household income and food security, forest provide various indirect benefits for households and surrounding ecosystems.

2.4. Role of forests in livelihood in tropics

As stated in previous sub-chapter, forests as almost renewable resources and the way in which people benefit to improve their livelihoods depends on social management and natural resilience (FAO 2005; Herdiansyah et al. 2014). Financial dependency is linked to forest biodiversity increasing monetarization of global economy, forest are more and more used for income generation (Cavendish 2000; Angelsen & Wunder 2003; Fisher 2004; Sunderlin

et al. 2005; Vedeld et al. 2007; Sunderlin et al. 2008; Yemiru et al. 2010; Hogarth et al. 2013; Mulenga et al. 2013). While subsistence collection of forest products is usually linked to sustainable management, financial intentions lead to forest degradation (Fisher and Shivley, 2005; McSweeney, 2005; Paumgarten, 2005; Kamanga et al., 2009; Heubach et al., 2011). For a large number of people forests and forest products and services represent both direct and indirect sources of livelihood, providing a main part of their physical, spiritual, economic and material lives (Arnold 2001). However, people with such dependence on forests usually occur in remote rural areas with poor infrastructure and narrow or inadequate access to markets and other basic services that result in limited options for livelihood development in terms of improving of connection to monetarized economy. The issue facing many local communities is not simply the renovation of trees in their region but the increase of a political and social landscape that enables their ability to make to secure their livelihoods (Sabogal et al. 2005).

Rural households, particularly in tropical countries, collect forest products mainly for subsistence (Kazungu et al. 2020). A large proportion of the world's poor live in rural areas, with acute cases of rural poverty occurring mainly in sub-Saharan Africa, and South Asia. Landless, subsistence farmers, or herders aim to accomplish their basic needs. Selling in the market is not beneficial in all cases, if one will deduct the expenses of inputs from the sales' revenue, the share of commercial sales towards smallholders' income should be very small. And what is identified as one of the leading activities and interests of smallholders. Selling food in the market actually lead to small amount money and does not add much to the household's liquidity which is important to raise smallholders out of subsistence (Rapsomanikis 2015; Kazungu et al. 2020). Rural people often play role in the value chains of forest biodiversity, for example by collecting wood and non-wood products mainly for subsistence or for market. It is proven that poorer people and households lead up to use Miombo resources for subsistence, while richer households exploit them for cash income (Gumbo et al. 2018). As a result, about two-thirds of rural people in developing countries live generate their livelihood at around 475 million smallholder farms, working on land plots smaller than two hectares, which makes many of them food insecure, lacking adequate cash resources and access to services and/or competitive markets (Rapsomanikis 2015). Rural household manage about 28 percent of the global land surface, these areas contain number of hotspots of biodiversity and majority of ecologically unharmed forests. In these countries,

as farms become gradually smaller in last decades, exists an increasing threat to be both detached from the market and consequently enjoy lower incomes and remain in subsistence (FAO 2015; Kazungu et al. 2020).

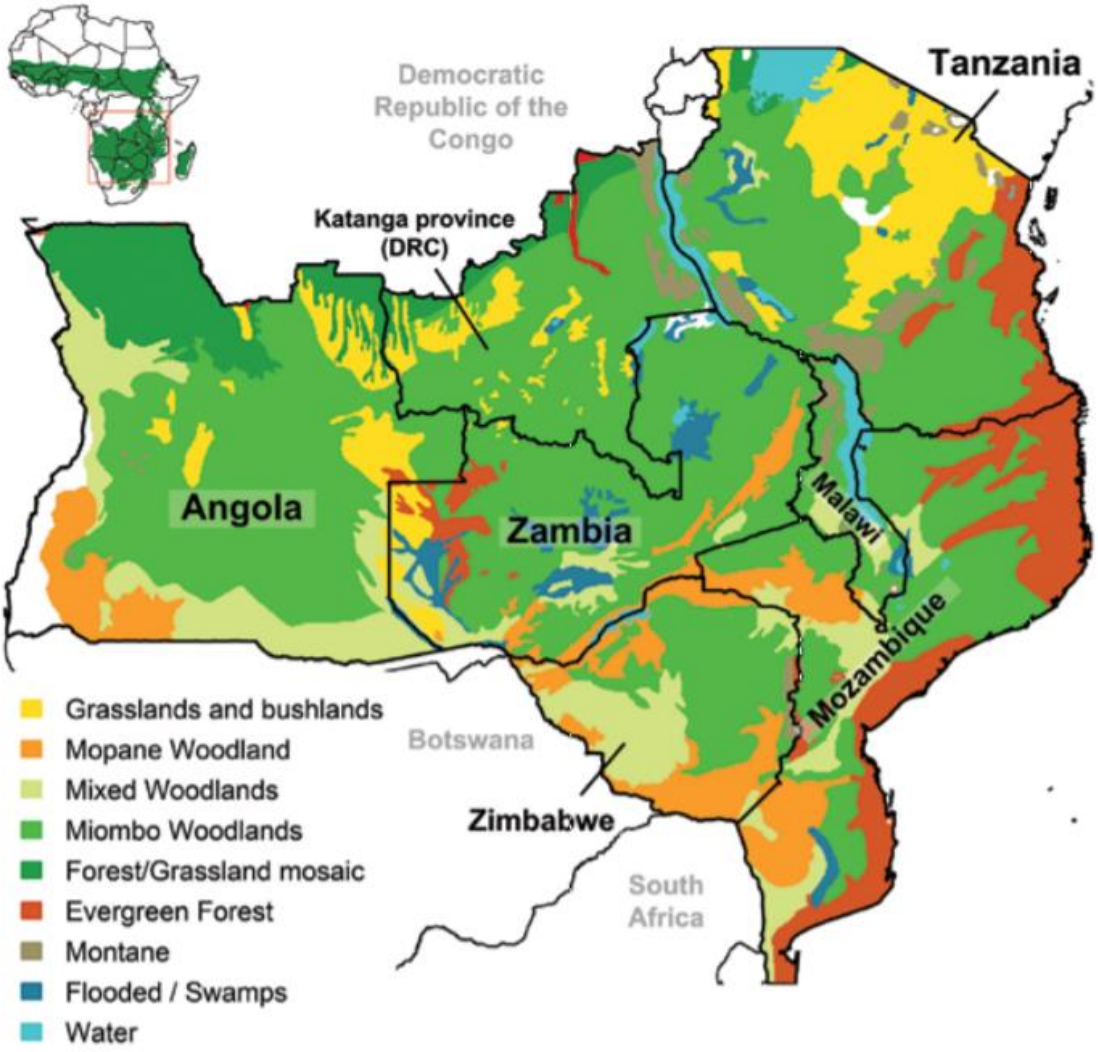

Figure 5

Map of Main land cover types in the Miombo ecoregion.

Source: FAO (2018)

Specific benefit of tropical forest is additional income from eco- or agrotourism. Profit from tourism can be considered as non-consumable use of forests and it is estimated that up to eight billion tourists come to the protected areas in one year worldwide (FAO & UNEP 2020). The term ‘forest-dependent people’ is in general used to characterize human

populations that obtain some profits from forests in several ways (Newton et al. 2016). As stated earlier, for millions of people around the world play significant role in their livelihoods NTFPs (Malhotra & Bhattacharya 2010; Pandey et al. 2011; Shackleton et al. 2015). In Savanna forest, forests are important provider of protein for nearby living households. The primary source of protein for majority people is hunted bushmeat or fishing, while surpluses are sold on markets (Ndoye & Tieguhong 2004; Gyimah & Dadebo 2010). For women, forest provide various supplies to their livelihood through collection of food, medicinal plants, or creating craft materials from forest species (Shackleton et al. 2011).

2.5. Miombo forests

Specific type of Savanna forest is Miombo woodlands. These ecosystems have been created mainly of deciduous tropical woodlands and dry forests covering approximately 2.4-2.7 million km^2 especially in regions across southern Africa (Figure 4) such as Angola, Democratic Republic of the Congo, Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe (see e.g., Mulenga et al. 2013; Gumbo et al. 2018; Goldberg 2020). The Miombo woodlands is situated to a tropical and subtropical grasslands, savannas, and shrublands biome, prevailing soils are characterized as poor for nutrients. The mean annual rainfall ranges from 650-1,400 mm (Goldberg 2020). It consists of four woodland savanna ecoregions: i) Angolan miombo woodlands, ii) Central Zambezian miombo woodlands, iii) Eastern miombo woodlands, and iv) Southern miombo woodlands, which are organized by the huge amount of occurrence of *Brachystegia-Julbernardia* tree species. It is located over a range of climate zones ranging from humid to semi-arid, and tropical to subtropical or even temperate. Altogether, 21 species of *Brachystegia* appear in miombo woodland and three other species of each of the related genera (Campbell 1996; Gambiza et al. 2000). Even though the soil is dry and lacks nutrients, this forest is home to several species, especially endemic bird species. Miombo trees in particular are a source of livelihood or shelter for animals such as: African elephant, African wild dog, sable antelope and Lichtenstein's hartebeest. Miombo woodlands are very important environmental resource, contributing mainly to rural household economies in sub-Saharan Africa. It is also very important in terms of nutrition and food for rural communities (Gumbo et al. 2018). Miombo also provide big amount of different good and services for locals e.g., food, medicines, fertilisers, energy, fibre, cultural and spiritual values and climate regulation (Campbell 1996). Nevertheless,

despite of high diversity, ecological value, and economic potential for local livelihood and food security, very little is known about the farming, social, and economic characteristics, and practices on Miombo use.

3. Aims of the Thesis

The Miombo woodlands represent unique ecosystem that spreads over southern part of African continent and provide basic source of livelihood for millions of local households. Nevertheless, there is limited recent literature analysing social and economic aspects of sustainable management of such ecosystem. Thus, the main aim of the thesis was to document current stage of knowledge on Miombo woodlands, their role in livelihood strategies of households, and potential barriers of their sustainable use for food security and income generation.

Specific objectives of the thesis were to review existing literature on Miombo woodlands with special attention to:

- review of existing literature on Miombo woodlands in scientific literature with special regard to agricultural, institutional, and household economics
- document existing studies on contribution of Miombo woodlands to livelihood of local households, including methodological approaches used
- identification of socioeconomic factors influencing the use of Miombo woodlands by local households

4. Methodology

Reviewing of existing literature

For literature review, Web of Science database served as a main source of information. Key word “Miombo” was used to identify suitable publications. Results were limited to articles and last four decades and thus covered timeline since 1979. All data were analysed through scientometrics methods and further analysis were performed with results/articles associated to agricultural and socioeconomic categories. MS Office Excel was used as main mean for data analysis (Gann 2019; Liberto 2021).

Contribution of Miombo woodlands to livelihood

Based on titles and abstracts of identified results, suitable studies were identified to document most common methodological approaches, socioeconomic and biophysical variables, and respondents’ characteristics to review current knowledge and type of studies carried on Miombo woodlands (Mulenga et al. 2013; Handavua et al. 2018; Kazungu et al. 2020).

Identification of socioeconomic factors influencing the use of Miombo woodlands

Last section was linked specifically to identification of relevant socioeconomic, and also biophysical, variables linked to use of Miombo woodlands, find out relevant publications and consensus on use of these variables, their potential impacts, and analytical tools and methods.

5. Results

5.1. Current knowledge on Miombo forest in scientific literature

Figure 6 demonstrates that the evolution of published articles dealing with Miombo topic has been increasing over the years on the Web of Science. Overall trend in publications has exponential line, the steepest increase of amount of articles dealing with Miombo is seen mainly in the last 5 years.

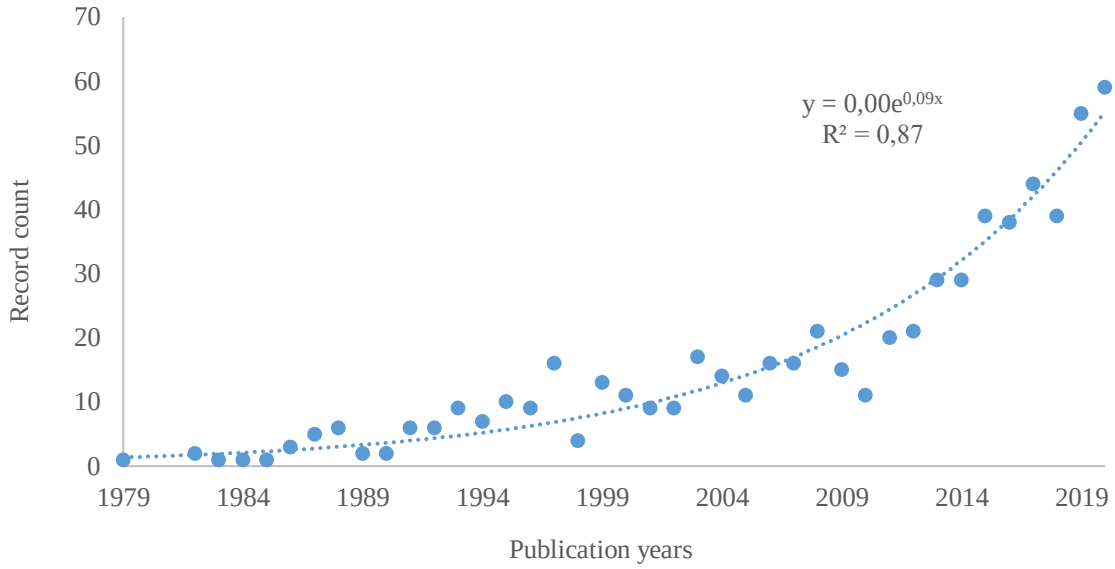

Figure 6
Evolution of publication on Miombo in scientific literature
Source: Web of Science (2020)

This Figure 7 illustrates the frequency of keywords used in approximately 100 articles on the Web of Science. The figure shows that mostly used keywords in articles are forest, miombo, Africa, conservation, deforestation, forest products. Furthermore, it is clear from the figure that keywords like livelihood and rural livelihood are no longer so often used, which explains to us that articles related to social, agricultural, and economic issues are not published to a large extent. It is also clear that African countries are appearing as keywords, so we can assume that these are the countries in which Miombo is located. There are also keywords related mainly to the biological sciences (eg. mammals, soil nutrients,

biodiversity, soil carbon etc.) which is confirmed by Table 1, that most of the published articles deal with this topic.

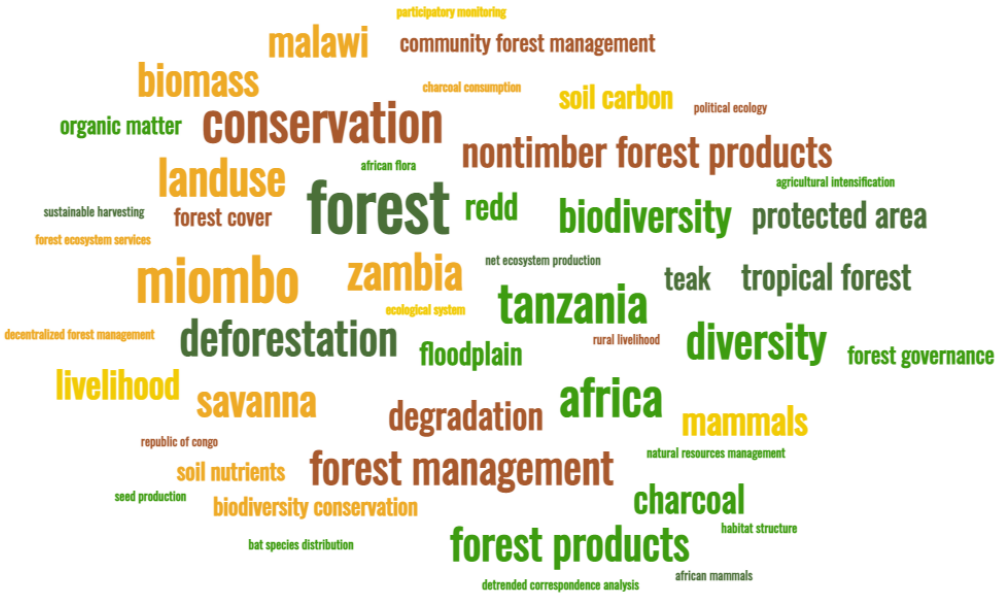

Figure 7

Frequency of keywords used in articles on WoS, when searching for articles under the keyword miombo

Source: Web of Science (2021)

From research area we purposively chose only those related to agricultural and socioeconomical topics. Which are, Agriculture, Biodiversity Conservation, Business Economics and Sociology. Table 1, illustrates that less than 25% of published articles deal with social, agricultural, and economic issues. Most articles on miombo were published to a greater extent related to the topics of e.g., environmental sciences, forestry, plant science etc.

Table 1. Research Areas – Miombo

Research areas		Absolute count	in %
1	Environmental Sciences Ecology	270	42.3
2	Forestry	145	22.7
3	Agriculture	64	10.1
4	Plant Sciences	60	9.4
5	Biodiversity Conservation	50	7.8
6	Geology	37	5.8
7	Zoology	34	5.3
8	Remote Sensing	33	5.2
9	Science Technology Other Topics	30	4.7
10	Physical Geography	28	4.4
11	Entomology	22	3.4
12	Business Economics	20	3.1
13	Imaging Science Photographic Technology	18	2.8
14	Meteorology Atmospheric Sciences	16	2.5
15	Mycology	15	2.3
16	Energy Fuels	14	2.2
17	Biotechnology Applied Microbiology	11	1.7
18	Water Resources	11	1.7
19	Engineering	10	1.6
20	Evolutionary Biology	10	1.6
21	Life Sciences Biomedicine Other Topics	10	1.6
22	Veterinary Sciences	9	1.4
23	Paleontology	8	1.2
24	Geography	7	1.1
25	Sociology	7	1.1
26	Biochemistry Molecular Biology	6	0.9
27	Anthropology	5	0.8

Source: Web of Science (2020)

Table 2. Source Titles – Miombo

Source titles		Record count	%	Impact factor (2019)	Impact factor years	Quartile category
1	Remote Sensing of Environment	11	1.7 %	9.085	9.626	Q1
2	Journal of Ecology	7	1.0 %	5.762	6.488	Q1
3	Energy Policy	5	0.7 %	5.042	5.693	Q1
4	International Journal of Applied Earth Observation and Geoinformation	5	0.7 %	4.650	5.391	Q2
5	Remote Sensing	9	1.4 %	4.509	5.001	Q2
6	Agriculture Ecosystems Environment	5	0.7 %	4.241	4.825	Q1
7	Journal of Geophysical Research Atmospheres	5	0.7 %	3.821	4.349	Q2
8	Journal of Biogeography	5	0.7 %	3.723	4.107	Q1
9	Biomass Bioenergy	5	0.7 %	3.551	4.038	Q2
10	Forest Ecology And Management	52	8.1 %	3.170	3.581	Q1
11	Plos One	7	1.0 %	2.740	3.227	Q2
12	Global Ecology and Conservation	8	1.2 %	2.526	3.202	Q2
13	Journal of Vegetation Science	6	0.9 %	2.698	3.177	Q2
14	Biodiversity and Conservation	8	1.2 %	2.935	3.097	Q1
15	Forest Policy and Economics	8	1.2 %	3.139	3.085	Q1
16	Palaeogeography Palaeoclimatology Palaeoecology	6	0.9 %	2.833	3.021	Q2
17	Forests	11	1.7 %	2.221	2.484	Q1
18	Environmental Conservation	6	0.9 %	2.434	2.401	Q2
19	Biotropica	5	0.7 %	2.090	2.353	Q2
20	Cryptogamie Mycologie	6	0.9 %	2.245	2.126	Q3
21	Agroforestry Systems	11	1.7 %	1.973	2.105	Q2
22	South African Journal of Botany	5	0.7 %	1.792	2.061	Q2
23	Journal of Zoology	9	1.4 %	1.724	1.992	Q2
24	Journal of Forestry Research	5	0.7 %	1.689	1.475	Q2
25	Journal of Tropical Ecology	9	1.4 %	1.163	1.268	Q4
26	Southern Forests	17	2.6 %	1.160	1.223	Q3
27	African Journal of Ecology	32	5.0 %	0.713	0.786	Q4
28	Discovery and Innovation	6	0.9 %	0.033	0.058	Q4
29	Annales Entomologici Fennici	8	1.2 %	0.000	0.000	…

Source: Web of Science (2020)

The table 2. shows that over 30% of the articles belongs to the group with index Q1, this means ranking among the 25% best journals in the same field. Nine source titles belong to the category Q1, 14 source titles belong to the category Q2, 2 source titles belong to the category Q3 and 3 source titles belongs to the category Q4. Due to table, we can say that these titles with Q4 have also quite low Impact Factor (IF). Conversely, titles with Q1 have quite high IF e.g., Remote Sensing of Environment title has 9.626 IF (5years), this title publishes all its journals in English and over 15% of articles are open to access and over 80% Subscription and Free to Read Citable. Remote Sensing of Environment title publishes the publications of scientific and technical results on theory, experiments, and applications of remote sensing of Earth resources and environment. Belongs here areas dealing with e.g., agricultural and soil science, ecology and environmental science. forestry and range, geography, and land information systems (Elsevier 2008). Another title that can be considered a quality resource is Agriculture Ecosystems Environment, deals with the interface between agriculture and the environment. Covers topics such as: ecology of agricultural production methods, influence of agricultural production methods on the environment, including soil, water, and air quality, and use of energy and non-renewable resources, agroecosystem management (Elsevier 2008).

Following source titles, i.e. Agriculture Ecosystems Environment, Forest Ecology and Management, Plos One, Forest Policy and Economics and Agroforestry Systems, are those that belong to our selection (agricultural and socioeconomical topics), the table also shows that these source titles belong to the category Q1 and Q2.

5.2. Contributions of Miombo forests to livelihood strategies

The value of miombo woodlands to rural livelihoods is clearly recorded (Campbell et al. 2007; Chidumayo & Gumbo 2010; Dewees et al. 2010, 2011; Jew et al. 2016). Various studies point out the importance of miombo woodlands because of its supply of ecosystem services and subsidy to food security (Dewees 1994; Syampungani et al. 2009), and income generation (Akinnifesi et al. 2006; Chirwa et al. 2008). Miombo trees are significant in the area of central and southern Africa, the woodlands are home to some 8,500 plant species; over 300 which are trees. They supply food and they are also home for wildlife, including antelopes, giraffes, rhinos, lions and some of the largest populations of elephants in Africa.

Miombo woodlands are also home to millions of rural people, many of them are depended on the woodlands and natural resources for their livelihood (Goldberg 2020). Miombo utilization is mainly plenty of products and environmental services (Figure 3).

In 1996 these specific woodlands were home to more than 40 million people, and products made from miombo can meet the basic needs of another 15 million people (Campbell et al. 1996). According to FAO is estimated that nowadays the miombo woodlands sustain the livelihoods of more than 100 million rural poor and 50 million urban people (Djoudi et al. 2015; Gumbo et al. 2018).

Table 3. Various products and environmental services provided by Miombo woodlands

Wood	Human consumption	Animal consumption	Environmental services	Other products
Firewood	medicine	fodder	shade	Fibre
Charcoal	wild plants	bee forage	ornamental	gum, glue, latex
Timber	edible insect		nitrogen fixation	tannin, dye
Shafts	honey			
boat building	mushrooms			

Source: Shackleton et al. 2010, VECEA team 2017, Handavu et al. 2019

Across sub-Saharan Africa, more than 90% of the rural population uses firewood for cooking (IEA 2019). In 2017, the average wood production was estimated at 16,724,000 m^3 (FAO 2019), of which a large part was intended for consumption as firewood by rural communities. Much of that wood comes from the Miombo ecosystem. Miombo can be used in many ways, products and environmental services of Miombo can be for example wood, human consumption, animal consumption, medicine, charcoal and it can also serve as a shade (Shackleton et al. 2010, VECEA team 2017, Handavu et al. 2019).

5.3. Socioeconomic factors influencing the use of Miombo products

Based on our literature review, we identified following variables that influence utilisation of Miombo by local households. Table 4 illustrates main agricultural and socioeconomic variables mostly use in rural households.

Table 4. Overview of main agricultural and socioeconomic variables influencing use of Miombo forest

Variable	Definition	Expected effect	References
Household characteristics			
HH head age	Age of household member with major influence over decision making process	Elder HH head age tend to collect more products for subsistence, while young prefer commercial collection	Hegde et al. 2017; Kazungu et al. 2020; Mulenga et al. 2013
HH size	Task-oriented group of people living at one place	Larger HH size would lead to commercialization as more people collect bulk amount (comparative advantage in labour)	Kazungu et al. 2020; Mulenga et al. 2013
NTFP income	Income/ profit generated from non-timber forest products	The poorer households are relatively more dependent on income from the extraction and sale of NTFPs than wealthier households	Kazungu et al. 2020; Mulenga et al. 2013
HH education of head	Education level of rural communities	Higher education levels are associated with low dependence on forests	Mulenga et al. 2013; Handavua et al. 2018; Kazungu et al. 2020
HH gender of head	Male/female		
HH participating in charcoal production		A number of factors such as ready market and poverty may have contributed to the dominance of charcoal production among other forest use practices	Kazungu et al. 2020; Handavu et al. 2018
Institutional characteristics			
Access to credit	Household members had access to credit in the last 12 months (dummy 1 = yes/0 = otherwise)		Kazungu et al. 2020
HH welfare		Careful policy considerations are required to ensure rural household welfare improvement while sustaining the forest	Mulenga et al. 2013
Total remittances	Household-earned income from remittances	Share of total sample income (%) - 1.2	Kazungu et al. 2020

Table 4. Overview of main agricultural and socioeconomic variables influencing use of Miombo forest (cont'd)

Organisation during mushroom gathering	Communities formed small groups where each group had specific days within the week when they collected mushroom	High level of community organisation may lead to higher profit	Handavu et al. 2018
Biophysical characteristics			
Walking distance from HH forest (Miombo)	Household distance to forest periphery	HH close to forests will be more likely to use forestland for agricultural purposes	Kazungu et al. 2020; Mulenga et al. 2013
Landholding size (ha)	Size of land holding by HH	Small size of land per household may be attributed to inadequate capital	Mulenga et al. 2013; Handavua et al. 2018; Kazungu et al. 2020
Distance to nearest district town (km)	HH distance to town	People living closer to cities can use Miombo primarily for commercialization	Mulenga et al. 2013; Handavua et al. 2018; Kazungu et al. 2020
Income shock -Crop failure	Sudden event that impacts on the vulnerability of a system and its components	High capacity to cope with shock, which, in turn, affect some livelihood capitals. For example, investments into capital assets or the education of household members	Kazungu et al. 2020

Source: Web of Science (2020)

Table 4 is consisting of household characteristics, institutional characteristics and biophysical characteristics. From the Table 4 it is clear that the elder household head age, people live closer to the Miombo woodlands and poorer people are more dependent on Miombo, as a source of livelihood. While young people and larger household size more likely use Miombo for commercial utility. It is also possible that factors such as poverty and lack of job opportunities lead people to charcoal production. NTFPs are an important source of livelihood for rural communities, especially during times of economic, social or biophysical shocks. Ensure rural household welfare improvement while sustaining the forest is challenging (Mulenga et al. 2013). It is also proven that if people organize a group collection of NTFPs, they have a better chance of gaining more profit in the markets. The small size of cultivated land per household may be associated with inadequate capital to purchase farm tools and agricultural inputs and may lead to lack of satisfy basic household needs (Handavu et al. 2018).

Table 5. Overview of essential studies published on prioritized issues

Topic	Country/Region	Number of respondentd	Methodological tool	References
Rural HH participation in markets for nontimber forest products in Zambia	Zambia - Central Copperbelt, Luapula, Northwestern, Southern, Western	8,094 HH	Cragg tobit alternative model, systematic random sampling	Mulenga et al. 2013
Forest use strategies and their determinants among rural households in the Miombo woodlands of the Copperbelt Province, Zambia	Zambia - Copperbelt Province	260 to 372 HH	Random sampling method to select respondent, snowball method	Kazungu et al. 2020
Socio-economic factors influencing land-use and land-cover changes in the miombo woodlands of the Copperbelt province in Zambia	Zambia - Copperbelt Province	372 HH and 30 discussants	Random sampling using lottery method, questionnaire, card game method, statistical analysis methods	Handavua et al. 2018

Source: Web of Science (2020)

Studies published on prioritized issues were geographically situated mainly in Zambia. Studies were working in generally with almost 10,000 households respondents that were random sampling method selected. Most common quantitative methods used for data analyses were random sampling method, household interviews, village market surveys and questionnaires. Most relevant indicators were indicators that affect the use of Miombo by local households e.g., Education of head, ages of head, gender of head, landholding size and size of households.

6. Discussion

Based on our results, we documented current stage of knowledge on Miombo woodlands, their role in livelihood strategies of households, our results/numbers obtained mainly through scientometrics. Results show that the number of articles dealing with Miombo is increasing, which is confirmed by Figure 6, which means that more and more people are starting to deal with and research this issue. The reason why people deal with the topic of Miombo more than years ago may be the lack of resources for livelihood. People are trying to find a new source of livelihood, income, etc. We have found that articles dealing with social, agricultural, and economic issues are not published on such a large scale as environmental, forestry, plant science - this is confirmed in Table 1. The reason may be, for example, less interest and knowledge in research dealing with the above issues. People are more concerned with the biological factors of Miombo. But according to the increase in the number of articles on Miombo, we can say that in the future there will be more articles that will deal with social, agricultural, and economic issues of Miombo. From source titles which belong to our selection (agricultural and socioeconomical topics), Agriculture Ecosystems Environment has the highest IF and belongs to 25% top magazines in the same field (Table 2). Also, we can say that poorer households are relatively more dependent upon NTFPs as a livelihood (Mulenga et al. 2013; Kazungu et al. 2020), which is confirmed by Table 4, and confirm our hypothesis of a positive relationship between poverty and dependence on natural resources such as NTFPs – Miombo (Mulenga et al. 2013). Miombo is used by people mainly for their subsistence, which just prevails over commercialization (Kazungu et al. 2020). If people were more oriented towards commercialization, it could be more beneficial for them. But market access is not equal. Also, greater use of Miombo could also lead to overexploitation. Results are limited by the following factors: Based only on Web of Science, only one specific key word: MIOMBO, record count limited to number 5. Selected specific research areas. Articles published 1979-2020. In future research, data could be used as a root of overview about Miombo current situation. Also, for summary about literature knowledge about Miombo topic in Web of Science. Also, data could be more focused on the issue of socio-economic factors influencing the use of Miombo (field research). Focus on only one location. It could be said that when we compare the methodologies and socio-

economic indicators with those in Tanzania (Jew et al. 2019), they are similar. Variables such as age of head, size of household, gender of head, etc, are almost the same. Methods to generate data are also quantitative and qualitative. Household surveys are used in combination with focus groups, interviews, observations. All respondents depend on firewood from the Miombo woodlands for their energy needs (Jew et al. 2019). But these articles dealing with socioeconomic factors are only a fraction, compared to those dealing with plant science. However, we cannot compare our results obtained with scientometrics with others on this topic, because so far, no scientometric analysis on Miombo has been made. We can assume that if we performed a scientometric analysis on others scientific databases, the results would be similar.

7. Conclusion

Bachelor thesis documents the role of Miombo woodlands on human livelihoods. The aim of the work was to review scientific articles with special regard to those focused on farming systems, ecological economics, livelihood, and sustainability. During the reviewing scientific articles published at the Web of Science database, we came up with several results. Data gained through scientometrics identified/showed that current knowledge on Miombo forest in scientific literature has been growing over the last four decades years, but less than a quarter of published articles deal with social, agricultural, and economic issues. Most articles on Miombo were published to a greater extent related to the topics of e.g., Environmental Sciences, Forestry, Plant Science etc. Over one third of these articles belong to 25% top magazines in the same field. One of the main results is the classification of existing literature into scientific categories, provide an overview of methodologies used for data collection and analysis, identify focused regions, and variables used in studies related to agricultural economics, farming systems, and ecology. Next, impact of Miombo woodlands on human livelihoods is that Miombo is one of the essential source for the livelihood of people living in the developing rural areas but it is also affect by socio-economic factors. Socio-economic factors affect the extent and utilization of Miombo products. Miombo not only serves people in the rural areas as a source of wood, it is also used for human consumption, animal consumption and environmental services. Last, most important indicators associated to use of Miombo woodlands are age of household head, size of household, gender of head, household welfare, landholding size, distance to nearest district town and walking distance from household forest. We conclude that mainly bigger households, young people and people living closer to cities use Miombo mainly for commercialization. While elder households head age, tend to collect more products for subsistence.

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