

UTILISATION AND CONTRIBUTION OF FOREST RESOURCES TO IMPROVE FOOD SECURITY IN DRY REGIONS OF AFRICA

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ABSTRACT. The unsustainable harvest of forest resources in dry regions of Africa has contributed to forest degradation and increased the prices of forest resources in local markets. Many people in dry regions, especially in sub-Saharan Africa, have been harvesting forest resources to supplement food sources due to poor crop production as a result of erratic rainfall. This review seeks to explore the utilisation and contribution of forest resources to improving food security in the dry regions of Africa. Forest resources are highly utilised by poor resource farmers in rural areas as a means of poverty alleviation, income generation and to improve human livelihoods. Resources such as non-timber forest products (NTFPs) contribute to human

nutrition, income generation, food sources and to improve living standards. NTFPs, such as honey, waxes and medicines, have been reported to contribute income in countries, such as Kenya, Tanzania, Zambia and Zimbabwe, creating more opportunities for rural people to improve their living standards and reduce food insecurity. These resources contribute to hidden hunger though the utilisation of fruit, vegetables, honey, wild meat and edible worms, especially to the children under five years of age. Climate change has also created variability in the availability of forest resources in dry regions, and this has altered their contribution to human livelihoods and food security.



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INTRODUCTION

Forests in dry regions are important for social and cultural values, economic development and provision of environmental services, and they play a major role in improving human livelihoods and reducing poverty in developing countries (Andika *et al.*, 2014; Belcher, 2005; Belcher and Kusters, 2004). Forests act as an important source of poverty alleviation in dry areas (Kupurai *et al.*, 2021; Shackleton *et al.*, 2007; Sunderlin *et al.*, 2005). Forest resources can contribute directly to supporting livelihoods of more than 90% of the poorest population in the world (Darius *et al.*, 2014; Rasmussen *et al.*, 2017a), either through subsistence, forest clearance for agriculture uses, income from selling timber and non-timber forest products (NTFPs), such as edible worms, fruit (Kugedera, 2016; Maroyi, 2013) and vegetables (Wunder *et al.*, 2014). Scholars have started to explore the various contributions of forests to food security and human nutrition, especially for those people living in forest zones (Ickowitz *et al.*, 2014; Powell *et al.*, 2013a, b). These contributions cannot significantly contribute to food security alone but reduce the hidden hunger caused by micronutrient deficiency (Stein and Qaim, 2007), as confirmed by consuming *Ziziphus mauritiana* and *Z. mucronata*, which contain a lot of iron to reduce anaemia. Forest products, such as fruit, are a source of important macronutrients, such as iron, calcium, vitamin C (e.g.,

Sclerocarya birrea fruit skin) and vitamin E (Hiliwepo van Hall, 2013; Kiptot *et al.*, 2014), needed to reduce hidden hunger in children.

Forest resources remain one of the major sources of livelihood for most humans in the dry regions of Africa. People living in dry regions of sub-Saharan Africa (SSA) mainly depend on forest resources for food since crop production is very low due to erratic rainfall (Muchai *et al.*, 2020). Many people living in SSA are in rural areas where agriculture is rainfed and occasionally affected by frequent droughts, leading to crop failure. Most rural areas are dry areas associated with forests and woodlands. People in these regions depend on harvesting and gathering forest resources as a means of alleviating poverty and improving food security (Kupurai *et al.*, 2021; Rasmussen *et al.*, 2017b). Forest products gathered and harvested by people in dry regions not only benefit these people but also industries involved in value addition and processing forest products, such as edible worms, fruit, beeswax, honey, medicine and vegetables. Forests in dry regions of Africa play an important role in poverty alleviation, human livelihood improvement and increased food security, especially for rural people who survive on less than USD per day, and equip them with nutritional products.

Forests in dry African regions are rich in biodiversity that is important in supplying resources, such as water, reducing soil erosion and providing aquatic resources, such as fish, reeds and water weeds, which play an important role in traditional rituals, for example, used as medicine (Rasmussen *et al.*, 2017). These forests contribute more to

rural human livelihoods than any other resources utilised in rural areas (Agrawal *et al.*, 2013). The only challenge is the lack of economic accounting of these contributions (Agrawal *et al.*, 2013; Kupurai *et al.*, 2021); hence, accounting for these resources can create more opportunities for local industries and people living in forested areas. It is paramount to account for any contribution from forests and value the resources as a means of moving towards economic and rural development since revenue collected from selling forest resources can be given back to communities for development. Forests have the potential to contribute more towards the developing world, especially in rural development and economic and food security (Agrawal *et al.*, 2014). These products do not solely provide monetary value but improve nutrition, reduce mortality rates for the under-fives (Cheo and Kugedera, 2021), increase standards of living and human health through consumption of medicines and herbs (Kugedera, 2016; Shackleton *et al.*, 2015; Wunder *et al.*, 2014), and improve food security through provision of fruits, edible worms (Maroyi, 2013) and leafy vegetables, which provide essential nutrients (FAO, 2023b). Forests provide a safety net for rural people through the provision of cheap resources, such as honey, fuelwood, minerals, vegetables and pastures for grazing animals. There is limited information about the contribution of non-timber forest products to human livelihoods and how climate change affects forest product utilisation. These gaps can only be identified by conducting a synthetic review, as this will allow researchers to

note areas for further research. This review sought to explore the utilisation and contribution of forest resources to improve food security in dry regions of Africa.

MATERIALS AND METHODS

Data collection

A comprehensive literature search was performed in May–June 2022 from Web of Science, Google Scholar and Scopus for publications on soil fertility management strategies used to improve crop production in semi-arid regions in Africa. Our search was restricted to soil fertility management options in semi-arid areas of Africa and the published papers fulfilled the following criteria: (i) published in accredited journals, (ii) an experiment performed in semi-arid areas in African countries, (iii) underwent peer review and (iv) published from January 1994 to December 2020. The search was performed using the following keywords: forest resources, forest products in Africa * contribution, utilisation*forest products * Africa and non-timber forest products * Africa, "utilisation of forest products" (Topic) or "non-timber forest products" (Topic) or "Utilisation of non-timber forest products" (Topic) and "contribution of forest products" (Topic) and "indigenous fruit". A total of 168 articles were retrieved from this search. We employed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) to identify publications for inclusion (*Figure 1*). The selected papers were evaluated and duplicate articles were removed, leaving a total of 120 articles. These articles were further screened, and 45 articles were

removed, as they did not meet the required criteria. Conference papers, articles published in non-peer-reviewed publications, and duplicates were removed. A total of 75 articles were assessed for eligibility and 10 articles were excluded due to unmatching treatments, averaged data, and difficulty in extracting data from graphs. After eligibility, 65 articles were included in the synthesis.

Utilisation of forest resources

The utilisation of forest resources has been a topical issue in Africa. Forest resources in some areas are underutilised, especially in African countries, such as Zimbabwe, Namibia, Mozambique and other sub-Saharan countries.

Underutilisation mainly occurs in dry regions, where people gather and harvest forest products to extract a single product and leave valuable parts. This occurs with *Sclerocarya birrea*, as people harvest fruit to produce fermented juice, leaving skins and nuts that can produce more valuable products, such as soda and butter (Kugedera, 2016; Seed Awards, 2011).

People in dry regions of Africa lack technical knowledge of how to utilise forest resources to benefit their livelihoods and generate income (Kugedera, 2020; Kupurai *et al.*, 2021) and improve human livelihoods and food security (Rasmussen *et al.*, 2017a, b). In some areas, there is overexploitation of forest resources; for example, in *Ziziphus mauritiana*, overharvesting damages the tree, reducing its growth and sometimes causing tree death.

This causes a decline in the production of fruit, wine, beer and income due to improper utilisation.

The utilisation of forest resources varies depending on the type of resource; for example, fruit can be eaten raw (Chidumayo and Gumbo, 2010; Kugedera, 2016), cooked or dried (Kupurai *et al.*, 2021). Some fruit, such as that from *Sclerocarya birrea*, are used to produce fermented juice (Kugedera, 2016, 2020; Maroyi, 2013; Shackleton and Shackleton, 2005), produce nuts that are consumed raw (Maroyi, 2013) or roasted to produce snacks (Kugedera, 2020), and produce butter (Kugedera, 2020; Maroyi, 2013; Seed Awards, 2011).

Fruit from *Adansonia digitata* is value added to produce sweets when mixed with sugar, juice and porridge (Kugedera, 2016, 2020; Seed Awards, 2011). Timber forest products are used to produce furniture, kitchen utensils (Chivaura-Mususa, 2000; Kugedera, 2016) and firewood.

NTFPs have a variety of uses that vary from food to medicine and generate income after selling the product. For example, selling honey brings in a lot of money. In local markets, one bottle (375 mL) of honey costs US\$3.50–5, which is more than what people in rural areas live with on a daily basis.

This creates a lot of income from harvesting one bee hive, which is estimated at US\$210–300. This causes a lot of changes to living standards as people can use money to acquire products such as beds, refrigerators, solar panels and equipment to drill boreholes for irrigation since dry regions receive erratic rainfall.

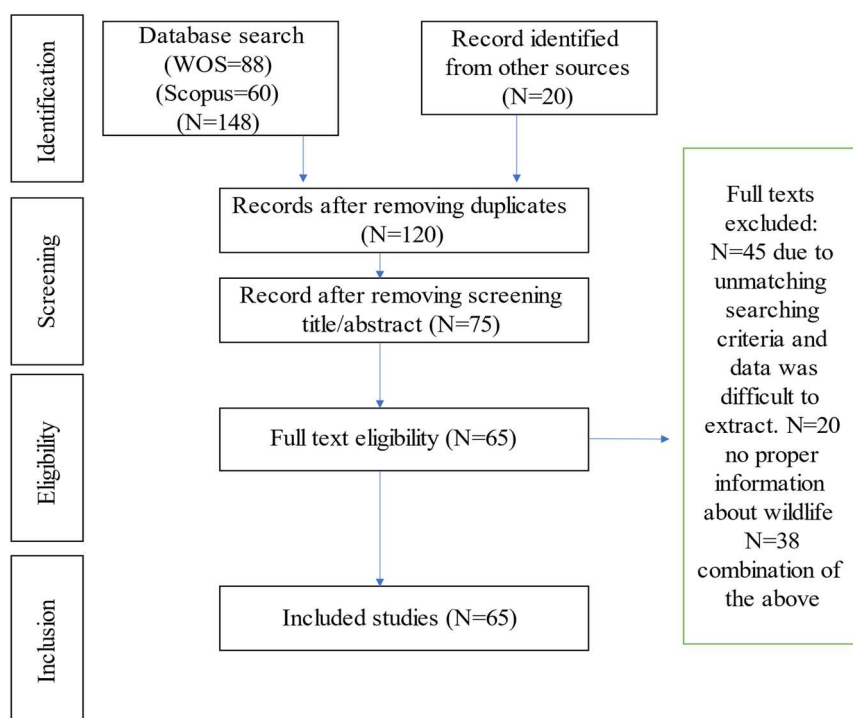


Figure 1 – Flow chart showing how data searching, identification and selection were performed

Types of forest resources

Forest resources occur in various forms, including NTFPs and timber forest products (TFPs). These are the main categories in which all forest resources fall. These resources are important for both humans and local industries as they support human livelihoods, improve food security, provide raw materials for the production of other products and create employment opportunities.

(a) NTFPs

These are biological materials extracted for human use from forests other than timber. These forest products do not include processed timber and include various biological materials that are extracted from trees. Others include inhabitants of trees, such as bees that provide honey and edible worms, such as

mopane worms and edible locusts. NTFPs are a major source of food for rural people living in remote areas that are drought prone, disease-infested and far away from major cities, growth points or areas that are easily accessible. Some NTFPs are used as medicines to cure a variety of diseases (Kugedera, 2016) and sources of vitamins (for example, from *Sclerocarya birrea*) (Hiliwepo-van Hall, 2013; Maroyi, 2013). These provide materials that can be used to improve soil fertility, produce farming implements and provide small amounts of cash for smallholder farmers (Gumbo *et al.*, 2010; Shackleton and Shackleton, 2004a, 2004b). NTFPs improve food security and are nutritious (Hickey *et al.*, 2016), reduce outbreaks of nutritional deficiencies, and increase the income and

standard of living (for example, production of soda and butter from Marula fruits in Chivi, Zimbabwe, which empower women and change their lifestyles) (Kugedera, 2016, 2020; Seed Awards, 2011). NTFPs are major resources extracted cheaply from forests and bring in a lot of income. For example, traditional healers in southern Africa charge a cattle or cow to cure some ailments using medicines harvested from forests, such as tree roots, bark and leaves (Shackleton and Pandey, 2014; Shackleton *et al.*, 2015; Tewari, 2012). NTFPs are among the forest resources that supply green social security to the largest portion of the world population through the provision of edible fruits, building material, fuel wood, other food resources and medicines (Shackleton *et al.*, 2015; Wunder *et al.*, 2014). Other NTFPs, such as honey, contribute greatly to countries such as Tanzania and Zambia, where exports of this forest product bring in over US\$500 000 (Chidumayo and Gumbo, 2010). In Zimbabwe, honey production is one of the highest paying NTFPs for rural people, and other organisations have started honey industries that benefit people and encourage sustainable forest resource management.

(b) Timber forest products (TFPs)

TFPs are products that include timber, such as poles from trees, especially indigenous trees that include *Brachystegia* species used in wood carving, making of kitchen utensils and production of small boats. TFPs are mainly used in industries that manufacture furniture. TFPs are more valuable and create a wide range of products that are more expensive. These

products have a paramount role in infrastructure development, such as road and rail construction, and schools, clinics and shops use timber products for roofing. The production of TFPs from trees plays a huge role in employment creation, economic development and improvements in the standard of living. Products produced from TFPs, such as wood carvings, have been reported to bring in a huge amount of income in countries such as Zimbabwe and Kenya, where exports are estimated at over US\$20 million (Choge, 2004; Shackleton and Gumbo, 2010). In Zimbabwe, wood carving was one of the highest paying industries from the 1990s to early 2007, before being affected by several policies and other issues that reduced the business.

Effect of climate change on forest resources and food security in dry regions

Woody plants in the form of trees with canopy cover of more than 10% of the ground can be regarded as dry land vegetation. Climatologically, dry lands can be characterised as having a dry season spanning three months. Drylands are often dominated by frequent droughts, flash floods and vulnerability to climate change (CIFOR, 2010). African dry forests face complicated challenges that relate to the issue of livelihoods of forest-dependent people. For example, in South Africa, drylands offer a number of goods and services in the form of NTFPs, timber, carbon sequestration, and protection of biodiversity and watersheds.

Other NTFPs obtained from the drylands include bushmeat, fruit, insects, honey, beeswax and medicines for

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woodland-dependent communities (Nhemachena *et al.*, 2020). The services accessed from the woodlands are indicated in *Table 1*.

However, the benefits of dry lands are threatened by degradation and deforestation, which leads to conversion of these areas into agricultural production and increased demand for charcoal and fuelwood (Serdeczny *et al.*, 2016). Drylands are also threatened by encroaching deserts and climate change, and the forestry sector is marginalised compared to agriculture and water.

Due to warming, the intensity and frequency of extreme events have been projected to increase in the dry regions of Africa (IPCC, 2019). The drylands of Africa are characterised by high rainfall variability, which is very unpredictable, and increasing temperatures. Extreme events, such as tropical cyclones,

heatwaves and droughts, are common (Kupika *et al.*, 2018). Drylands are now characterised by increasing surface land temperatures and evapotranspiration rates and marked reductions in precipitation. Climate models project that in Africa, temperatures will increase more quickly than the global average in the 21st century, and extreme events will also increase. By 2050, the temperature will surpass today's 2°C levels (UNDP, 2018). Much higher projections are predicted in West Africa and the Sahel region, where temperatures are expected to rise by 4–6°C at the turn of the 21st century. In terms of rainfall, Southern Africa is predicted to become drier. Forests have become vulnerable in the last 2–3 millennia, and they are more prone to fires, much more open and less carbon dense (James *et al.*, 2013).

Table 1 – Main provisioning services from woodlands in dry regions of Africa

Product	Beneficiary				
	Local use as a safety net	Local subsistence consumption	Rural markets	Urban/regional markets	International
Wild foods					
Wild fruits	high	high	medium	medium	medium
Wild vegetables	medium	medium	Low	No reports	No reports
Mushrooms	low	medium	medium	low	No reports
Edible insects	medium	medium	medium	medium	low
Honey	Low	low	medium	medium	Low but increasing
Bushmeat	medium	high	medium	Medium	low
Building and craft materials					
Barks and fibres	low	medium	medium	medium	No reports
Thatching grass	medium	High	High	medium	No reports
Construction poles	low	high	medium	low	No reports
Medicinal plants	low	high	high	high	medium

Source: (Ryan *et al.*, 2016).

The woodlands in Zimbabwe, Zambia and Tanzania are threatened by agricultural intensity and also experience erratic weather patterns and fluctuating climate cycles, which also threaten the productivity of these drylands. Woodland-dependent communities are thus affected by changes in plant phenology in the form of seed production, which affects flowering and thus pollinating agents, such as bees and other insects. In Eastern and Southern Africa, the warming of the climate has affected fruiting. For example, in Uganda (Kibale National Park), negative correlations exist between minimum temperatures and the fruiting of trees (Chapman *et al.*, 2005). Similar findings have been demonstrated for *Strychnos spinosa* in Lusaka, Zambia (Chidumayo and Gumbo, 2010), where fruit production is negatively affected by high temperature. Thus, climate warming has the potential to affect fruit and seed production in woodlands in Africa, tree regeneration and the genetic diversity of plants. These changes have a ripple effect on communities dependent on NTFPs, as there is a likelihood of a decline in the goods and services that are available. This therefore increases the vulnerability of people who are dependent on forests and also on dryland agriculture. According to the UNDP (2018), 6 of 10 people rely on agriculture for their livelihoods. Due to climate change, it is expected that about 9 billion people will need to be fed by 2050, and rapid agricultural transformation is needed most in Africa. El Nino-induced warming in Africa has led to the destruction of crops, and for the 2014–2016 El Nino season, there was a food emergency for

about 4 million people, although there was a decline of the figures to 2.6 million in 2017. Using Somalia as an example, about 6 million faces near famine, and more than 50% of the population is food insecure due to the disruptive nature of climate (UNDP, 2018). Focusing on Southern Africa, maize losses are between 18 and 22% in SSA, and Zimbabwe and South Africa losses are over 30%. Models of other crops have shown a 2% reduction in sorghum production and a 35% reduction in wheat production by 2050. This implies that the people of the drier regions will be much more food insecure due to climate change.

Contribution of forest resources to improving food security

Food insecurity in SSA is intense, especially in rural communities where people fail to meet food requirements per household and utilise less than USDper day. Many people have a meal either once or twice a day, and most meals are referred to as unbalanced diets. However, to improve food security, people in SSA can utilise forest resources for food, income generation and other social uses. Forest resources have been reported to be one of the major sources of improving food security in dry regions. People in these regions have been reported to harvest forest resources, such as fruit, vegetables and edible worms for food. Instead of consuming other food sources, such as maize, forest products contribute immensely to food security. Most people rely on fruit that they consume raw, dried or boiled (Maroyi, 2013; Kugedera, 2020), to produce juice for consumption (Rasmussen *et al.*, 2017a; Shackleton and Shackleton, 2005; Shackleton *et al.*,

2015), and to sell to earn money, which they use to purchase other food resources, such as sugar, mealie meal and cooking oil (Kugedera, 2016). Forest resources may have a direct or indirect contribution to food security in dry regions, depending on how these resources are utilised. A good example is when people harvest timber for the production of yokes used for ploughing with an oxen-drawn plough. This contributes to improved draught power, which leads to improved crop yields. These crops are harvested to improve food security. Timber products contribute indirectly to food security (Kupurai *et al.*, 2021), and NTFPs contribute directly through their utilisation (Hickey *et al.*, 2016). Income can also be generated by selling wild herbs in South Africa (Kugedera, 2016; Shackleton *et al.*, 2002), which people can then use to buy food.

People in dry regions of Africa have a lot of confidence in NTFPs for improving human livelihoods and food security (Shumsky *et al.*, 2014), and their use for food security could create a win-win situation for reducing poverty and conserving biodiversity in Africa (FAO, 2023b). Local markets in countries in SSA, such as Zimbabwe, depend more on NTFPs as a means of sustaining food resources at any time of the year. These resources are important in people's diets on a daily basis, as they contribute to disease control (Maroyi, 2013), increasing the provision of essential micronutrients (Chidumayo and Gumbo, 2010). The utilisation of NTFPs exposes people to a balanced diet (Hickey *et al.*, 2016) and improves food production, as some forest resources improve crop yields. NTFPs' contribution to human

livelihoods has been reported to range from 10 to 60% of the total household income (Asfaw *et al.*, 2013; Rasmussen *et al.*, 2017a). Harvesting NTFPs is a source of household income after they are sold in local markets (Areki and Cunningham, 2010; Shackleton *et al.*, 2015; Wunder *et al.*, 2014). In the 20th century, the contribution of forest resources to food security has been reported to be at an increasing rate due to the value addition made on most harvested NTFPs. Most people have gained knowledge on how to add value to these forest resources, for example, wine production from *Z. mucronate* and *S. birrea* and snacks produced from *A. digitata* as a means of improving the value of resources and raising their contribution to human livelihoods and food security.

Production of juice from Bush mango has been reported to be a boost for food security in countries such as Senegal, as this increases industrial development and access to food for people living within and around forests. The establishment of the Rutenga *Amarula* plant in Zimbabwe also contributes greatly to food security and living standards for people in this area. This is similar to a report by Shackleton and Gumbo (2010), who reported that many poor people benefit daily from NTFPs for their livelihoods and security in most countries, although these benefits are not accounted for by many policies. Millions of children, men and women from many SSA countries harvest natural resources from forests for human consumption (Chidumayo and Gumbo, 2010) and trade. These resources, especially NTFPs, have been reported to

form an important component of daily livelihood needs through the provision of fruit, medicine, cheap building material, farming implements and secure availability of food for everyone (Campell and Luckert, 2002). Selling NTFPs is an important means used by poor people living within and around forests and woodlands to generate income to buy food and make everyone food secure in dry regions of Africa and beyond.

Forest resources for human nutrition

NTFPs provide essential micronutrients that are required to meet an individual's dietary needs. Fruit contributes largely to human livelihoods, as it is harvested from forests when it is ripe and consumed directly (Rasmussen *et al.*, 2017a, b; Vira *et al.*, 2014). Several authors (Johns and Sthapit, 2004; Stephenson *et al.*, 2010; Tontisirin *et al.*, 2002) have recommended the consumption of NTFPs to combat micronutrient deficiencies, and this has been reported as the best way to reduce nutrient deficiencies. *Amaranth* leaves and mushrooms are recommended sources of zinc supplements (Mofya-Mukuka and Simolok, 2015). Vitamin A sources, which can be provided by forest resources in Zimbabwe and other African countries, include mangoes and guavas. Powel *et al.* (2013a) highlighted that "in rural parts of Tanzania, wild foods contribute 2% of energy intake and 19–30% of vitamin A, vitamin C and iron."

From a nutritional perspective, Vinceti *et al.* (2013) and Powell *et al.* (2011) suggested the uptake of forest resources to compensate for vitamin A, iron, folate, niacin and calcium. A

vitamin A deficiency causes night blindness, which is associated with higher rates of infections, such as (diarrhoea, measles and respiratory infections (Vinceti *et al.*, 2013). Forest resources, such as African carotenoid-containing indigenous vegetables and fruit, are good dietary sources of vitamin A (Mofya-Mukuka and Simolok, 2015; Underwood, 2004; Vinceti *et al.*, 2013). Most vegetables harvested in forests are leafy vegetables, such as *Cleome gynandra*, *Moringa oleifera* and *Corchorustridens* (Maroyi, 2013). These are important to human health, as they are nutritive, with most of them boosting the immune system, including *Moringa oleifera*. The FAO (2014) highlighted that, globally, the aforementioned products make a significant contribution to diet variety and nutrition (Ickowitz *et al.*, 2014; Powel *et al.*, 2013a,b).

The FAO (2013a) highlighted that edible insects are good sources of protein and fat. Dunkel (1996), FAO (2013b) and Schabel (2010) indicated that some insects are good sources of vitamins and minerals. Insects are also harvested from common tree species, such as mopane (*Colophospermum mopane*) for mopane worms and flying termites (Mofya-Mukuka and Simolok, 2015). People in southeastern Zimbabwe depend more on *Brachstegia* species in Miombo woodlands, where they harvest edible worms and insects for consumption.

Wild animals can also be harvested from forests through hunting to produce meat. Common animals harvested from forests include hare, birds, kudu and antelopes. Arnold *et al.* (2011), Mofya-Mukuka and Simolok (2015), and Vinceti *et al.* (2013) suggested that bush meat is the main protein supplement in the Congo

and Amazon basins. Golden *et al.* (2011) postulated that iron deficiency contributes to an increase of about 29% of anaemic children in Madagascar. A study carried out in Zambia by Mofya-Mukuka and Simolok (2015) suggested that forest resources for iron supplementation include amaranth leaves, jute leaves and the small flowered kenaf. Fruits, such as those from *Sclerocarya birrea*, are harvested when ripe and consumed directly (Kugedera, 2016; Maroyi, 2013) or processed to produce fermented juice, which is nutritive and consumed by people in most rural areas of the dry region (Shackleton and Shackleton, 2005). Its kernels can be removed to obtain nuts, which can be eaten as snacks (Maroyi, 2013) or

processed to produce butter for consumption and sale (Kugedera, 2016; Leakey, 2005; Maroyi, 2013; Seed Awards, 2011). The FAO (2023a) recommended the uptake of dried seeds of *Parkia biglobosa* and *Anacardium occidentale* as iron supplements in areas where meat is scarce.

Socioeconomic importance of forest resources

Forest resources play an important role in improving the socioeconomic aspects of many people's lives in dry African countries.

This socioeconomic aspect is an important component of the day-to-day lives of people. These are discussed below.

Table 2 – Values contributed by NTFPs to human livelihoods (US\$) in different regions of Africa

Region / country	Values contributed by NTFPs to human livelihoods (US\$) per year	Sources
Zimbabwe, Chivi	50–1500	Kugedera (2016); Kupurai <i>et al.</i> (2021); Maroyi (2013)
Zimbabwe	436	Cavendish (2000)
Zimbabwe	50–85	Campbell <i>et al.</i> (1996); Campbell <i>et al.</i> (2002a, b)
South Africa	565–1200	Dovie (2004); Shackleton <i>et al.</i> (2002); Twine <i>et al.</i> (2003)
Eretria	386	Araia (2005)
Botswana	335	Shackleton and Gumbo (2010)

Source: Some parts are adapted from Shackleton and Gumbo (2010)

Table 3 – Nutrient contents of some African indigenous fruit per 100 g edible portion

Species	Energy (kca)	Protein (g)	Vit C (mg)	Vit A (retinol) (µg)	Iron (mg)	Cal (mg)
<i>Adansonia digitata</i> L.	340	3.1	150–500	0.03–0.06	1.7	360
<i>Grewia tenax</i> (Forssk) Fiori	N/A	3.6	N/A	N/A	7.4–20.8	610
<i>Sclerocarya birrea</i> Hochst	225	0.5	68–200	0.035	0.1	6
<i>Tamarindus indica</i> L.	270	4.8	3–9	0.01–0.06	0.7	260
<i>Ziziphus mauritiana</i> Lam.	21	1.2	70–165	0.07	1	40

Source: Kehlenbeck *et al.* (2013); Vinceti *et al.* (2013)

Source of income

Some fruits are sweet, such as *U. kirkiana* and wild apricots, which can be sold to generate an income for smallholder farmers, and they can use this money to pay fees (Rasmussen *et al.*, 2017a) and buy groceries (Shackleton and Shackleton, 2005). Common fruits in semi-arid regions of Zimbabwe include *Adansonia digitata*, *Azanza garckeana*, *Berchemia discolor*, *Uapaka kirkiana*, *Ziziphus abyssina*, *Ziziphus mucronata* and wild mango. These fruits can be preserved by drying and then consumed later (Shackleton *et al.*, 2011). Mixing *A. digitata* with fresh milk and honey or sugar produces a sour beverage that is favourable to children. Honey and some of the fruit can be sold at growth points and in urban areas to generate income. NTFPs play an important role in supporting rural populations through income generation (Sunderlin *et al.*, 2005) after selling these products. Rasmussen *et al.* (2017a) postulated that most rural communities in America, Asia and Africa benefit a lot from NTFPs, which support their lives. In Namibia, Mojeremane and Tshwenyane (2004) pointed out that rural people harvest marula fruits to produce wine, butter and soda, which are sold at high prices to generate income to pay fees, buy farming inputs and pay for rentals.

Medicine

Medicines are also obtained from forests where people harvest tree bark, leaves and roots (Kugedera, 2016). Marula bark, roots and leaves have been known to cure sexually transmitted diseases (Leakey, 2005; Mariod and Abdelwahab, 2012), coughs and sores (Hiwilepo-van Hal, 2013; Maroyi, 2013;

Ngorima, 2006). Other trees are also used to treat sores, such as *Terminalia sericea* bark and Mopane leaves, which are known to cure an upset stomach.

Fuel source

Forests are used as sources of fuel (wood and charcoal). The World Bank (2015) highlighted that 65% of natural energy in Africa comes from wood and charcoal. The FAO (2011) highlighted that wood is a principal source of energy in Rwanda, while charcoal is a basic necessity in urban areas. The Biomass Energy Strategy in Rwanda pointed out that, in 2007, forests contributed up to 80% of the total energy needed in Rwanda.

Employment source

Forestry services, logging, timber production, solid wood production, pulp and paper manufacturing, and wood furniture making are sources of employment for most rural African countries. Haggblade and Hazell (1989) and Kilby and Liedholm (1986) reported that 20–45% of full-time employment was from non-farm activities in rural areas and 30–50% of rural household income is from forest resources where youths are employed. Nzeh *et al.* (2010) postulated that employment from non-farm activities was high, especially in Nigeria.

Opportunities and constraints in the sustainable utilisation of food forest products

Africa relies heavily on the environment for its sustenance. Rural communities largely depend on the environment and forest food products for their daily subsistence. However, there are so many challenges that outweigh the

benefits of the sustainable utilisation of food forest products. Opportunities that are derived from food forest products include being alternative livelihood safety nets during difficult times, improving the nutritional value in rural communities and providing alternative local dishes. In addition to fuelwood, NTFPs, such as food forest products and animal fodder, are important for people's livelihoods in Africa (Gumbo, 2010). The constraints hindering the sustainable utilisation of resources include but are not limited to climate change, unsustainable harvesting methods, environmental policies and marketing strategies.

Rural communities endowed with mopane worms in Zimbabwe harvest them for economic gain as they sell them to generate income. Mopane worms are harvested by rural people within their areas of residence or they travel to areas with mopane trees to harvest the worms. Mopane worms are found in Zimbabwe's dry regions, such as Gwanda and Beitbridge and they rescue many people in the drylands from poverty but only on a temporary basis since the worms are only available during the rainy season. Mopane worms can easily be dried and preserved.

In Botswana and South Africa, they are available all year round. The mopane worm is a good source of protein and can also be fed to children when mashed. These regions are exposed to harsh climatic conditions (Mogotsi *et al.*, 2011), and agricultural activities are rarely successful. Therefore, mopane worm harvesting is a very important alternative to non-agricultural economic activity. In addition to generating money for local communities in these dry

regions, worms complement the dietary requirements of the local people.

Regions that are naturally endowed with food forest products have yet to sustainably benefit from their resources. This is due to the fact that the locals are usually exploited by middlemen from big cities, who often buy food forest products at a very low price to resell at a higher price. Moreover, the lack of value added to food forest products, such as mopane worms, has made it difficult to sustainably improve the livelihoods of the local people. Middlemen make huge profits from food forest products by repackaging them into smaller and more expensive packs for local and international markets. Consequently, the food forest products benefit outsiders more than the locals, who are the custodians of the forests that produce the products. Value addition is a recurrent constraint on the sustainable use of all food forest products in Africa. The harvesting of wild loquat, honey and guava in Zimbabwe all seem to benefit big traders from the large cities at the expense of the local communities. Grieg-Gran *et al.* (2015) noted exploitative working conditions and low returns for collectors of forest food products.

The integration of national regional institutions dealing with food forest products is integral in promoting the sustainable utilisation of food forest products. Regional cooperation in the administration of food forest products is advantageous, as multiple countries contribute to trans-boundary issues for regional integration while benefiting from established bilateral projects and good practices (JICA, 2013). Good practices may include sustainable

ecosystem management and trade pacts. Phytotrade Africa is a natural product trade association operating in Southern Africa. It has 60 members across nine countries, including Mozambique and South Africa (Grieg-Gran *et al.*, 2015). Its mandate is to advance organic and fair-trade standards for wild harvested products. In 2008, it penetrated the European Union (EU) market by securing an EU Novel Foods decision, and it supplied baobab fruit to the European food and drink market. Ecoproducts is one of Phytotrade Africa's trading members and is based in the Limpopo Province of South Africa, working with 1000 women who obtain an income from

the harvesting of baobab fruit. However, the main challenge is that regional organisations are limited in their extent and they are yet to spread to the marginalised regions of the continent.

Local communities lack the capacity to market food forest products. In Nyanyadzi, Manicaland Province, communities produce honey in large quantities (*Figure 2*), and they struggle to market their produce. They do not have the expertise, financial resources or capacity to market and distribute their honey nationally or beyond Zimbabwe. This militates against the ability of rural communities to sustainably benefit from forest food products.



Figure 2 – Piles of honey at Nyanyadzi in Chimanimani, Manicaland Province of Zimbabwe

Environmental policies that are supposed to support poor local communities, such as Zimbabwe's Communal Land Forest Produce Act (Chapter 19:04), may be a constraint on the sustainable use of food forest products in Zimbabwe. The Minister of Environmental Affairs is responsible for issuing licences for the exploitation of forest food products. In as much as inhabitants of communal land obtain permits authorising them to harvest the forest produce for free, they are usually ignorant of the procedure and are fleeced and exploited by traders from the big cities. The revenue realised from licences is administered by local authorities within whose area the forest produce concerned is situated and where there is no local authority by the District Development Fund or Forestry Commission. The Forest Commission can therefore use the proceeds from licensing fees to fund forest conservation initiatives. The local authority and the District Development Fund can utilise the revenue for infrastructural development. Such initiatives can be vital in promoting the sustainable utilisation of food forest products by local communities, as they realise the benefits emanating from taking good care of their forests.

CONCLUSIONS AND RECOMMENDATIONS

NTFPs harvested from dry forests in dry regions of Africa have demonstrated that they are important sources of food and income, alleviating poverty and reducing food insecurity, especially for resource-poor people in rural areas. NTFPs contribute more to human

livelihoods, reducing dietary deficiencies, especially for trace elements that are lacking in other food sources. NTFPs have been reported to contribute largely to the income of both local and foreign markets, for example, waxes, honey and medicines in countries such as Kenya, Zambia, South Africa and Zimbabwe. Income generated from the marketing of forest resources has been used to transform human livelihoods, reduce food insecurity and improve standards of living. Fruit, plants and edible worms (insects) are nutritious and can be used as sources of food to meet nutritional demands for HIV/AIDS patients. Indigenous knowledge systems contribute more to the utilisation and degradation of forest resources, especially through the use of some forest resources as medicine, for example, increased harvesting of *Lippia javanica* in most SSA countries due to the outbreak of the COVID-19 pandemic. This improved human immunity as a result of the immune boosters (zinc) contained in the plant. This also brings in a new dimension in the sustainable management of forest resources. Climate change also contributes to forest degradation in dry regions, as some species face extinction due to drought, outbreak of unknown fires and even overharvesting of forest resources. The lack of economic valuation of NTFPs in many countries makes these resources unrecognised in many countries' revenues and are not included in financial accounting systems. Sustainable forest resource management is recommended to improve the utilisation and management of forest resources. This can be done by involving local communities around forests to be

part of the management to reduce violations of forest management policies.

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