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Review

Role of Dry Forests in Rural Socio-economic Development in Sub-Saharan Africa

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Abstract

FAO defines tropical dry forests as those experiencing a tropical climate, with summer rains, a dry period of 5 to 8 months and annual rainfall ranges from 500 to 1500 mm. Dry forests and woodlands are the main vegetation type in sub-Saharan Africa, covering over 17.3 million km^2 in a total of 31 countries. Dry forests supply a wide range of ecosystem services, thus playing a significant and complex role in supporting the agricultural systems on which millions of subsistence farmers depend. In Sub-Saharan Africa, forest goods and services are extremely important for rural livelihoods, supplying food, medicine, shelter, fuels and cash income. The objective of this review is therefore to evaluate and synthesize the role of dry forests in the development of rural people and to indicate future research directions. Based on the reviewed literatures dry forests play a number of roles in the development of rural households, the main role of dry forests is that forest products supply livelihoods in the form of basic needs and income. The income from forest was in the form of subsistence and cash. In sub-Saharan African countries, forest products contribute about 75-90% of the energy consumption of households. Non-timber forest products (NTFPs) contribute as low as 4% (Zimbabwe, Thailand and India) up to as high as 95% (South Africa) of household income, 32.6% of annual household subsistence (Ethiopia) and 47-50% of forest product income (Ethiopia). The main beneficiary from forests was the rural poor, in that the poor households generate high income from forests when compared to their rich counterparts Female headed households gain higher income from forests than men headed households. Furthermore women were participated on forest products that are easily accessible and which do not need physical strength. Dry forests also play significant role in generating employment opportunity, to attract tourists and for cultural and spiritual values. In order to increase the benefit of women and rural poor in general there should be training and value addition in forest products. Furthermore appropriate rules and regulations should be in place in resource access to conserve the resource base.

Keywords: Tropical dry forests, Sub-Saharan Africa, non-timber forest products, household subsistence, employment.

Introduction

FAO defines tropical dry forests as "those experiencing a tropical climate, with summer rains, a dry period of 5 to 8 months and annual rainfall ranges from 500 to 1500 mm". The FAO map of the tropical dry forest shows that the largest areas of dry forest are in South America, sub-Saharan Africa and northeast India. Large amounts are also present throughout Southeast Asia, northern Australia and parts of the Pacific, Central America and the Caribbean (Chidumayo and Marunda, 2010). Dry forests and woodlands are the major forest cover in sub-Saharan Africa, covering over 17.3 million km^2 in a total of 31 countries (Chidumayo and Marunda, 2010). A northern part of dry forests extends across western Ethiopia, South Sudan and into the Central African Republic, while a southern zone stretches from Zambia across Zimbabwe and into Mozambique (FAO, 2003).

Whether they consist of permanent marshland, small, seasonally dry ponds, or vast inland deltas, wetlands located within or around dry land forests are main ecological zones for agricultural and pastoral dry land livelihood strategies (Scoones, 1991). Dry forests are the smallest part of the world's subtropical and tropical forests and they support the world's poorest people (Waeber*et al.,* 2012). For example, as Waeber *et al.* (2012) indicates the African miombo alone is thought to be source of livelihoods for more than 100 million people in urban and rural areas. Dry forests are also a source of a wide range of ecosystem services, thus playing an important and complex role in providing support for the agricultural systems on which millions of subsistence farmers rely up on (Chidumayo and Maruda, 2010).

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In Sub-Saharan Africa, forest goods and services are highly significant for rural livelihoods, supplying food, medicine, shelter, fuel and cash income (Kaimowitz, 2003). It is estimated that more than 15 million people in Sub-Saharan Africa gain their cash income from forest-based enterprises such as fuel-wood and charcoal sales, small-scale saw-milling, commercial hunting and handicraft (Kaimowitz, 2003). Most of forest users extract products mainly for subsistence, and a significant part of the trade takes place informally (Shackleton, *et al.,* 2007; Jumbe *et al.,* 2008). The contribution of dry forests to the formal gross domestic product is relatively low in many dry forest countries (Kalame *et al.,* 2009). Forest resources is used as a safety net or economic buffer during times of the year when other resources are scarce or during years when crops fail and resources are insufficient (Shackleton *et al.,* 2007). Evidence suggests that NTFPs are particularly important for "reducing vulnerability, ensuring food security, in providing cash income to some of the poorest sectors of society, and in contributing more generally to improved rural welfare, livelihood security and diversification" (Shackleton and Gumbo, 2010). In some contexts, high-value NTFPs have the capacity to generate higher revenues than timber and may lead to rural development (Adam *et al*., 2013). However, because most of the trading of NTFPs in Africa happens in informal markets, the full contribution of forests to rural household and national economies is poorly understood (Shackleton and Gumbo, 2010). A lot of studies are conducted in the role of dry forests in the socio-economic development of the households. However, they use different methodologies, different unit of analysis and of different objectives. Therefore, the purpose of this review was to evaluate and synthesize the role of dry forests in the socio-economic development of rural people and indicate the future research direction on dry forests.

The contribution of forests to rural livelihoods

Timber, fuel and energy

Timber remains one of the most rewarding uses of forests, with some dry forest species such as mahogany and teak being of particular commercial value (Sunderlin, 2006). Timber for construction wood is one of the most significant dry forest products in India (Davidar *et al.,* 2007), while in Zambia timber and carpentry are among the highly important contributions to livelihoods (Jumbe *et al.,* 2008). The Miombo forest has some specifically high value species, such as *Dalbergia melanoxylon* (African Blackwood), one of the world's most important timbers on the global market with an estimated value of $1.5 million/year from exports. Most of Ethiopians use wood or charcoal for fuel, and natural forests are the major source of energy supply for both products (Bekele, 2011). The source of Saw logs and other industrial wood are from both natural forests and plantations forests; smallholder woodlots planted primarily with *Eucalyptus* species are the major source of posts and poles for house construction (Bekele, 2011). The contribution of Fuel wood was 57.8% of the total forest income while other forest products (construction material and medicinal plant) contribute 2.3% to total forest in come in northern and south western of Ethiopia (Busha *et al*., 2015). As reported by Abebaw (2012), Teshome (2015) and Asfaw (2013), the extraction of fuel wood from the forest was reported as a major source of incomes derived from forest for rural households in different parts of Ethiopia. Another study In Malawi revealed that fuel wood harvest is the major forest based activities and attached this to the fact that fuel wood is the major source of cooking energy in the country. A global assessment by Vedeld (2004) showed the dominant role of fuel wood in forest environmental incomes for the rural poor. Study by Yinger *et al*. (2007) shows that the source of 90% of the energy used in Ethiopia is derived from biomass. Income from fuel wood collection was the second most important forest income contributing about 47 and 36% of the annual forest income in Hammer district, Ethiopia (Fikir *et al*., 2016). In most studies, available fuel is usually the most important resource derived from Latin American dry forests, and is consumed largely by the poor (Suarez *et al.,* 2012). The trading of fuel wood is important to livelihoods in many areas, particularly in Africa (Campbell *et al.,* 2007) where large urban populations continue to drive demand. Davidar *et al.* (2007) claim that livelihoods based on fuel wood collection in Indian, dry forests are no longer managed in a sustainable manner due to excessive demand and extraction. Although wood fuel remains important, a worldwide review of wood fuel and charcoal conducted by Arnold *et al.* (2003) found that global demand for wood fuel is decreasing, while demand for charcoal is increasing in Zambia (Table 1).

Income from forest products

Forests provide products for different purposes at households and industrial levels (Appiah, 2009). These products are grouped into timber and non-timber products (NTFPs). Although timber products are highly valued worldwide, the NTFPs which play a significant role in sustaining livelihoods of communities living around forest areas have been given minimum concern. In addition to wood, dry land forests give numerous other products. Ethiopians use at least 413 different wild plant species for food and spices (Lulekal *et al*., 2011) and more than 600 wild plant species for medicinal purposes (Deffar *et al*., 1998). Forests also play a significant role to national and regional economies, but its contribution usually underestimated in national income accounts. Forest provides different products that, through their subsistence and cash income, are of significant for household livelihoods. The major products that bring income to the households include timber and NTFPs (Table 2).

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Table 1. Summary of wood fuel's contribution to income and energy consumption in different dry forest countries.

	Contribution	Regions	Author
Energy consumption	75% of energy consumption	Sub-Saharan Africa (excluding South Africa)	Mwampamba (2007)
	70% of all energy used	Southern Africa	Syampungani *et al.* (2009)
	80% of country's energy needs	Zambia	Chidumayo (2010)
	90% of the energy	Ethiopia	Yinger *et al.* (2007)

Table 2. Contribution of NTFPs for household income.

Contribution	Regions	Products	Author
4%–6% of total household income	Zimbabwe, Thailand, India,	Food	Cavendish (2000)
40–60% of women's income and 15–20% to overall household income.	Burkina Faso	NTFP	Tincani (2012)
25%–62% of food intake	South central Africa	Food	Packham (1993)
10–50% of harvester's income in Sudan	Sudan	Gums and resins	Elmqvist (2006)
This income contributes to 32.6% of annual household subsistence.	Ethiopia	Gums and resins	Mekonnen *et al.* (2013)
21.4% of house hold income	Ethiopia (hammer district)	Gum and resins	Dagim *et al.* (2016)
47 – 50% of forest product income	Ethiopia (hammer district)	Honey	Dagim *et al.* (2016)
23% of house hold income	Ethiopia (Gore District)	NTF	Debela (2004)
34% of house hold income	Ethiopia (Somali region)	NTF	Worku *et al.* (2014)
39% of house hold income	Ethiopia (Wenbera district)	NTFPs	Mekonnen (2013)
32% of house hold income	Ethiopia (Somali region)	Gum-resin	Worku (2013)
34.8% and 35.2% of the total household income	Ethiopia, (Liben and Afdher Zones)	NTFP	Adefris *et al.* 2014
22% of house hold income	Africa, Asia, and Latin America	NTFPs	Vedeld (2004)
15% of house hold income	Malawi (Chiradzulu District)	NTFP	Kamanga (2009)
15–20% household income	Zimbabwe	NTFP	Cavendish (2000)
20% household income	Botswana	NTFP	Chipeta and Kowero (2004)
Between 19% and 95% of income	South Africa	honey and edible caterpillars	Shackleton and Gumbo (2010)
25–60% of mean per capita income	Southern India	NTFP	Narendran *et al.* (2001)

NTFPs are the most important income earning products for rural people living near to the forests; they contribute significantly to household income, food security, and household healthcare as well as, provision of multiple social and cultural values (Ojea *et al.*, 2016; Endamana *et al.*, 2016). The dry lands of Ethiopia and Sudan get considerable economic gain from NTFPs specifically from the commercialization of gum and resin products. Gum and resin production and commercialization gives significant amount of cash income contributing 14 and 23% of the total household income in Sudan and Ethiopia, respectively (Abitew *et al.*, 2014).

Thus, in the face of the limited alternatives and the prevailing environmental conditions affecting crop and livestock productivity, gum and resin production provides an important livelihood option that offers major (cash) income-generating opportunities for enhancing and diversifying the household incomes (Abitew *et al.*, 2014). Another study conducted in Hammer district, Ethiopia indicate that income from forest products contributes about 21.4% of the total household income in rural areas (Fikir *et al.*, 2016).

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This was compatible with the study conducted in Zambia, which showed that forest income is the first or second most important income which contributes about 20% of total household income in the study area (Charles *et al.*, 2009). Gums and resins are among the most economically important NTFP of dry forests of several regions. Trading of gums and resins products as a source of income was observed and the average annual income from Gums and resins was estimated to be 152 ETB in Ethiopia (Fikir *et al.*, 2016). A study in northern and south western Ethiopia indicated that the total income generated from the forest products, gums and resins harvesting contributed 39.9% of the total forest income (Busha *et al.*, 2015). The increasing demand for NTFPs for subsistence and cash income generation has been reported in many developing countries (Steele *et al.*, 2015), aggravated by the poor returns from agriculture and other off-farm income activities.

Forest income contributes 21.4%to the total income, which was second to livestock income, even without considering of income from fodder and grazing in Hammer district, Ethiopia (Fikir *et al.*, 2016). According to this study income from honey collection contributed significantly to the annual forest income of households which is about 47-51%. The share of forest income in the total annual household income was 15% in Chiradzulu District, Malawi (Kamanga, 2009), 23% in Gore District, Southwestern Ethiopia (Debela, 2004), and up to 22% in Africa, Asia, and Latin America (Vedeld, 2004). Worku *et al*. (2013), in his study in Somali region, Southeastern Ethiopia found a 34% annual income contribution from dry forests (Mekonnen, 2013). Dry forests contributed 39% of the total annual household income in Wenbera district, Northwestern Ethiopia. 32% of the annual household income in Somali region, Eastern Ethiopia, was generated from the harvesting and sale of one forest product, Gum-resin (Worku, 2013).

Forest income with wealth group

There was variation among wealth groups in the relative dependence on dry forests. Even though the higher absolute income earned by the well-off households, the very poor and poor households depend more on dry forest income. Dry forests provide more than half of the annual income of the very poor and poor households (Adefris *et al.*, 2014). As indicated by Abitew *et al*. (2014), from the comparative analysis of different wealth groups in Ethiopia and Sudan, it was found that the income generated from forest product in protected resource access is particularly useful for the poor, while with increased commercialization, the barriers could be higher resulting in the control of resources and market opportunities for the better-off households. In absolute terms the mean NTFP income for households in the highest wealth quartile was the highest at $1,225 compared to that of other wealth groups.

This shows that the poor earn the lowest absolute income from the forest compared to the rich. The rich are able to invest more capital in NTFP harvesting activities in order to get high volumes which translate into higher values. Users from wealthier households were more participated in commercial collection of forest products. Commercial harvesting of NTFPs involves extraction of high volumes of NTFPs. The wealthy used modern harvesting techniques like use of power saws in collection of timber for firewood and charcoal that translates into short harvesting time but high volumes of products obtained. The contribution of NTFP income for households in the lowest quintile was relatively higher (53%) compared to that of households in the highest quintile (28%). This means that poorer households are relatively more dependent on NTFP collection, this shows an important variations in the extent to which forest dwellers rely on the forest resource (Tugume *et al.*, 2015).

Safety-net functions of forest goods

It is well studied that forests and forest products complement to the well-being and, at times, the very survival of millions of rural poor throughout the world (Sunderlin *et al.*, 2005), such advantages are used by rural people and urban communities (Shackleton, 2005). In many developing countries forest products are the major component of the livelihoods of the majority of rural households, and to a lesser extent for urban households (Byron and Arnold, 1999). Forest products are the main source of livelihood for the forest dependent households and complementary for others (Sunderlin *et al.*, 2005). Dry forests are very important in attaining food security because of their direct role in providing food, particularly in times of scarcity and in extreme famine conditions. In addition, it is believed that the nutritional intake of people who live near dry forests is affected by the dietary and nutritional diversity of wild foods (Chidumayo and Marunda, 2010).

The perception of NTFPs as a "free" resource extends to their perceived strength as a rural safety-net, however, there are factors that mainly affect the use of NTFPs and opportunity costs engaged in their collection. Whilst NTFPs can be easily obtainable, factors such as land tenure, resource availability and accessibility, institutional dynamics, the available options and, population dynamics (age, wealth and gender) affect consumption (Kepe, 2002). When considering the factors that potentially govern regular NTFP use, the perception that the strength of NTFPs as a rural safety-net depends in their easy accessibility may be damaged. The season of availability of forest products is vital for those households that do not use forest resources frequently or in large amounts, this shows the safety-net function of forest products, or an economic buffer in adverse times (Shackleton, 2005).

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Households consume forest resources on a regular basis and in meaningful quantities for direct household consumption usually earn a significant accumulation of assets (Shackleton, 2004). There are a lot of evidences that dry forest ecosystem services help reduce sensitivity and increase adaptive capacity of households and communities to climate change. Poorest households depend on provisioning services to cope with crisis (Brockhaus *et al.,* 2013). Several adaptation studies show that diversification including forest and tree products are important for people to survive with climate variability (Fisher *et al.* 2010). Furthermore, forests play an essential 'safety net' role, supporting households and their livelihoods in times of crisis (Djoudi *et al.,* 2013). Hence, there is a greater concern that the deterioration and loss of those resources would aggravate already existing vulnerabilities (Shackleton *et al.,* 2012).

Benefits from employment

Even though forests contribute significantly to national and regional economies, this is usually underestimated in national income accounts. In developing countries, forest-based enterprises contribute about 13–35% of all rural non-farm employment, equivalent to 17 million formal sector and 30 million informal sector jobs (Angelsen and Wunder, 2003). The timber industry in these countries earn something in the order of USD 30–40 billion worth of timber and processed wood products each year, although only a small portion currently benefits poor households. This is supported by Jumbe *et al.* (2008), who cited official Government of Zambia figures showing that 41,000rural households (equivalent to 1.5% Zambian households) were directly engaged in charcoal production, and an additional4, 500 people are employed in related activities such as transportation and distribution. Arnold *et al.* (2003) showed that in certain areas of Sub-Saharan Africa, tens of thousands of poor farmers and small traders complement their incomes by selling fuel wood. Similarly, Gautier *et al.* (2005) found in Mali that 22% of household members were involved in wood cutting activities and it is still the most common non-agricultural activity of household members. South Africa boasts a vibrant formal forest products sector employing approximately 66 000 direct employees (with over 3,00,000 dependents) and supplying some livelihood for over 10,000 small-growers providing the industry with timber. This represented 7.3% of national GDP in 2002 (Evans *et al*., 1998). There is also out-sourcing of forest sector requirements so that opportunities for small-scale, independent entrepreneurs offering services such as weeding, thinning, and felling, have burgeoned.

Cultural and spiritual benefits

Venerated, especially large, trees of various species–designated as '*Shengo*' trees are clearly visible in some places. The beliefs associated with such tree are gradually decreasing due to the exposure of the rural farm communities to modern thinking. At present these trees mainly serve to provide shade for elders and as a meeting place to resolve various social issues and for praying. No one dares to cut and use any part of such trees. Such tree species as *Podocarpus falcatus* (Thunb) Mirb and *Focuser Forssk* are two known sacred tree species that are favored as meeting places. Any tree that grows in such a meeting place is traditionally considered as sacred, and people are prohibited from cutting them. There is a similar tradition in Dibandiba and AletaWendo, Ethiopia. Similarly, in Kenya, it is found big fig trees considered sacred (Mesele, 2007).

Gender

Considering women's connection with NTFPs, these products have historically and continue to form a main part of their work and responsibility. The collection of everyday NTFPs, particularly food, fuel and craft materials, has always given to the domain of women (Neumann and Hirsch, 2000). Men, on the other hand, are often the main harvesters of less regularly used products such as timber, building and fencing poles and honey that require hard physical labour, or of products that are procured deep in the forest. Men are also responsible for hunting. Forest use has thus long had a strongly gendered dimension, which, in turn, may be reflected in and transferred through the commercial trade in forest products. The study by Chileshe (2005) revealed that most forest product harvesting and sale is seasonal, and the collection and trade of mushrooms, fruits, vegetables and insects are considered activities for women and children, whereas high value forest products such as honey and charcoal is controlled by men. The roles are usually unequal with women having less control and ownership over resources. In South Africa, it is found that 73% of NTFPs collected by women in while men collected 27% (Shackleton, 2004). In India 98% of women versus 91 of men collect NTFPs. To some extent these gender differences result from the physical nature of the work, however in many cases they are the result of age-old tradition of use. A study conducted in the western and southern lowlands of Ethiopia by Busha *et al.* (2015), revealed that there is a significant difference between forest income between female headed households which accounts 22.4% of the total income and male headed households which contribute about 15.4% of their total income. The average total dry forest income (cash and subsistence) was Birr 3676 for male headed households and 2000 for female headed households in Liben zone, Ethiopia. Similarly, in Afdher Zone, Ethiopia, the average total dry forest income for female headed households was less (Birr2451) than those of male headed households (Birr 3496).

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This was in contrast to the findings of Asfaw *et al*. (2013) where forest income of female headed households was much higher, but these communities lived close to markets and did not need means of transport to transport forest products. The purpose of dry forest product harvesting for cash was more among female headed households than male headed households. About 31% and 32% of the total income of female headed households in Liben and Afdher, respectively, came from dry forests, whereas the share of dry forest income was 34.4% and 35.6% for the two zones, respectively (Asfaw *et al*., 2013). This is because for females dry forest income was the fastest, most accessible and relatively stable income source. Women benefit from many NTFP-based activities (including trade) because they are part time. For woman-headed households where the woman is unable to leave her family in search of alternative livelihood strategies, NTFPs are vital for livelihood sustainability. As women are largely responsible for the gathering of NTFPs they often form groups to support each other and to provide security. This aids in create social ties, which may in turn be a safety-net during adversity (Asfaw *et al*., 2013). Women, because of gender differentiated roles and rights; often face many disadvantages that hinder their ability to engage in economic activity, including NTFP commercialization. For example, the poor, uneducated and sometimes illiterate women who rely on the NTFP trade tend to have little status in society and thus are more disadvantaged than men and may be at the receiving end of unfair treatment. This is compounded by the fact that they are frequently involved in the lower end of the value chain, form part of unpaid family labour, or are employees and therefore lack power over key functions. Such hidden 'women's work' tends to go undervalued. Women's traditional roles in the home also mean that they are often constrained by their household and caregiver duties, which may limit their mobility and time to participate in some of the more rewarding activities in the value chain or to engage in the trade on a full-time basis. Different studies revealed that both women and men depended on the forest but there was variation in the products collected by each gender. Women were mostly engaged in collection of wild foods, firewood and medicinal plants for home use thus contributing to their low value due to low volumes collected. On the other hand men were involved in more labour intensive activities involving commercial extraction of fire wood, construction materials and charcoal burning which offered high values and are produced deep in the forest. Even though there is difference in the quantity and frequency of dry forest product collection, both female and male headed households reported to earn income from forests. However, female headed households generated less total income from dry forests compared to male headed households.

Tourism

The value of tourism to livelihoods in the dry forests has been studied most extensively in the southern African Miombo, where the presence of charismatic large animals is a major attraction for foreign and domestic tourists (Shackleton *et al.,* 2007). Tourism in the dry forest is generate billions of dollars to Miombo countries (Spenceley, 2010) and in South Africa dry forest tourism is estimated to generate between US$2.5 and US$6 billion annually (Shackleton *et al.,* 2007). Although a significant proportion of tourism income goes to corporations rather than communities and the jobs opportunity for the community may be low-skilled and low paid, local entrepreneurs are increasingly able to secure contracts for support services such as laundry and security (Spenceley, 2010). Furthermore, even a regular low wage may be highly important to livelihoods if other income sources are erratic and unreliable (Shackleton *et al.,* 2007). Tourism projects that return funds directly to the community have become increasingly popular and can produce significant returns for communities. For example, Spenceley (2010) reported that in Botswana income from some tourism projects is found to be equal to or greater than the average local wage, while in some Namibian projects annual income per household is enough to cover a household's food bill for three months. In addition to supplying income, tourism projects may also provide wider economic advantages. For example, in many Miombo tourism enterprises, employees may gain benefits such as accommodation, food, training, medical insurance and pension contributions that would not be available in many other local positions, while improvements in schools, roads or mills may benefit other community members not directly employed (Spenceley,2010). However, Salomao and Matose (2007) in Mozambique found that, while many projects do generate investment and community benefits, low contracts, low negotiation skills and enforcement issues result in communities often receiving less benefit than they should have to get. The Communal Areas Management Program for Indigenous Resources schemes in Zimbabwe (a pioneer program in developing resource sharing schemes) are probably the most well studied, and show that community tourism can be a significant income generator. The communities have typically received around 46% of the total revenues from wildlife tourism, such that between 1989 and 2001 communities received an estimated US$20m from the sector (Campbell *et al.,* 2007; Spenceley, 2010). According to Spenceley (2010) at least 560,000 people consistently benefit from tourism (about 5%) of the national population.

Conclusion

Dry forests generate high amount of income to households in the form of basic need and cash. Poor households generate highest portion of forest income from their total

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household income from forest products. However the reach households generate high amount of absolute income from forest products. In most of the cases women are key actors in local rural and urban markets, they are seldom major players in the more high value trade which tends to be dominated by men. In many NTFP commercialization both men and women may be involved, either independently at different stages or together for certain functions but in many such cases women may be subordinate to men or may carry out activities that have limited visibility. Promotion of trade in traditional NTFPs may therefore not always be of benefit to women. Dry forests play a great role in supplying basic needs, income and used as safety nets during seasonal extremes. Dry forests are still the main source of fuel in sub-Saharan Africa, and means of income for many countries by attracting tourists.

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