

# Dry forests, livelihoods and poverty alleviation: understanding current trends

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## SUMMARY

Dry forests play a significant role in the livelihoods strategies of millions of people, including many of the world's poorest. This paper reviews the role of dry forests in providing goods and services to the rural poor. The review shows that while dry forests are essential, rural communities are engaged in multiple activities that generate income and the economic importance of forests and trees is context specific. Although the majority of households benefit from forest resources, poorer households tend to generate more relative income from forest products than wealthier households. Community forestry, tourism and payment for environmental service (PES) are promising alternative sources of environmental income, but the outcomes for the poorest remain uncertain. Trade in non-timber forest products (NTFP) is often viewed as a last resort and provides the safety net to cope with both environmental and economic shocks, especially for women. Hence, beyond timber, there are few examples of dry forest products that have generated a sustainable source of significant wealth. As such, it seems likely that dry forests will continue to play a more supplementary role in direct poverty alleviation but an increasingly important role as a safety net that prevents the most vulnerable from slipping into increased poverty and food insecurity during times of crisis.

Keywords: dry forest, income, rural livelihoods, poverty, safety net

## Forêts sèches, moyens d'existences et la lutte contre la pauvreté: comprendre les tendances actuelles

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Les forêts sèches jouent un rôle important pour la subsistance de millions de personnes, particulièrement les communautés et individus les plus pauvres au monde. Cet article examine le rôle des forêts sèches dans la fourniture de biens et de services pour les ménages ruraux pauvres. L'analyse montre que les forêts sèches sont essentielles pour la subsistance mais leur importance économique est différente selon le contexte. Bien que la majorité des ménages bénéficient de ressources forestières, les ménages les plus pauvres ont tendance à générer des revenus relativement plus importants des produits forestiers, comparés aux ménages plus aisés. La foresterie communautaire, le tourisme et le paiement des services environnementaux (PSE) sont des sources alternatives prometteuses de revenus, mais les résultats pour les plus pauvres restent incertains. Le commerce des produits non ligneux de la forêt (PNLF) fournit un filet de sécurité pour faire face à des chocs économiques et environnementaux et représente une importance cruciale pour les femmes. Au-delà du bois, peu de produits forestiers génèrent une source durable de richesse pour les ménages. En tant que tel, il semble probable que les forêts sèches vont continuer à jouer un rôle complémentaire dans la lutte contre la pauvreté, mais un rôle de plus en plus important en tant que filet de sécurité qui empêche les ménages de sombrer dans une pauvreté accrue et l'insécurité alimentaire en temps de crise.

## Los bosques secos, subsistencia y el alivio de la pobreza: comprendiendo las tendencias actuales

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Los bosques secos juegan un papel importante en sostentar la vida de millones de personas, quienes incluyen muchos de los más pobres del mundo. Este artículo examina el rol de los bosques secos en tanto que los prestan bienes y servicios para los pobres rurales. La revisión muestra que aunque los bosques secos son esenciales, las comunidades rurales se dedican a múltiples actividades que generan ingresos y la importancia económica de los bosques y los árboles depende de contextos específicos. Aunque la mayoría de los hogares se benefician de los recursos forestales, los hogares más pobres tienden a generar más ingresos relativos de los productos forestales que los hogares más ricos. La silvicultura comunitaria, el turismo y el pago por servicios ambientales (PSA) son fuentes alternativas prometedoras de ingresos del medio ambiente, pero

los resultados para los más pobres siguen siendo inciertas. El comercio de productos forestales no maderables (PFNM) a menudo se considera un último recurso y proporciona la red de seguridad para hacer frente a los choques ambientales y económicos. Por lo tanto, más allá de la madera, hay pocos ejemplos de productos de bosque seco que han generado una fuente sostenible de riqueza significativa. Como tal, parece probable que los bosques secos seguirán desempeñando un papel complementario en la mitigación de la pobreza más directa, pero un papel cada vez más clave como una red de seguridad que impide que las familias caigan en la pobreza y confrontan más inseguridad alimentaria en tiempos de crisis.

## INTRODUCTION

Dry forests play an important role in the livelihoods of millions of people worldwide, including many of the world's poorest (Cunningham *et al.* 2008, Waeber *et al.* 2012, Campbell *et al.* 1997). The African Miombo alone is thought to directly provide livelihoods for over 100 million people in both urban and rural areas (Mahapatra *et al.* 2005, Campbell *et al.* 2007, Syampungani *et al.* 2009). Furthermore, dry forests are known to play an important but complex role in supporting the agricultural systems on which millions of subsistence farmers depend (see also: <http://www.environmentalevidencejournal.org/content/pdf/2047-2382-3-25.pdf>).

Despite their importance, dry forests remain among the world's most threatened and least studied of the forested ecosystems and may face greater threats than humid forests (Janzen 1988, Miles *et al.* 2006, Portillo-Quintero and Sánchez-Azofeifa 2010, Gillespie *et al.* 2012, Aide *et al.* 2012, Blackie *et al.* 2014). It has also been suggested that the goods and services that dry forests provide are significantly different from humid forests, and thus the forests require significantly different approaches to management and conservation (Gumbo *et al.* 2010, Makonda and Gillah 2007, Wunder 2001, Blackie *et al.* 2014).

The products and services provided by dry forests include, amongst others, timber, firewood, food, and primary health care and ecosystem services such as watershed protection, soil amelioration and drought mitigation. Given that the majority of forest users extract products mainly for subsistence, and an important part of the trade happens 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).

### Scope of this paper

The focus of this paper is a review of the links between poverty alleviation and livelihoods of the rural poor living in or adjacent to dry forest areas, although interactions with larger-scale actors (such as forestry plantation organisations) are also considered where relevant.

This paper examines the trends in the role of global dry forests in providing goods and services upon which the livelihoods of the rural and urban poor depend. This paper is neither a comprehensive nor a systematic review, as such, it is rather the summary of current trends that characterize dry forests in various parts of the world. Some studies were undertaken in regions where humid and dry forest types exist and which do not refer clearly to the dry forest were excluded. The search string used was (“dry forest\*” OR “dipterocarp

forest\*” OR “semi-deciduous forest\*” OR “monsoon forest\*” OR “semi-desert” OR “miombo” OR “Chaco” OR “forest\* savannah” OR “wood\* savannah”) AND (“livelihoods”). We included only English-language, primary field studies undertaken in dry forests areas in our review. Peer-reviewed research as well as grey literature from respected organizations were also included.

### Definitions

Many of the forest products we refer to in this article are defined differently by different authors. For example, Shackleton *et al.* (2007) consider small-scale timber extraction to be a type of NTFP. Some include fuelwood as a type of timber, while others classify it as an NTFP (Mantau *et al.* 2007). This review defines timber as all wood extracted from the forest that is used in construction or the making of large items such as furniture. Fuel wood is considered an NTFP, but in this paper it is treated separately during the analysis. For the purposes of this review, NTFPs include animals, fruits and other resources taken from the forest that do not fall into the categories of timber or wood-based fuels (fuelwood and charcoal).

## CURRENT TRENDS IN LIVELIHOOD GOODS AND SERVICE FROM DRY FORESTS

### Timber, fuel and energy

Timber remains one of the most lucrative uses for 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 important dry forest products in India (Davidar *et al.* 2007), while in Zambia timber and carpentry are among the most valuable contributions to livelihoods (Jumbe *et al.* 2008). The Miombo forest has some extremely high value species, such as *Dalbergia melanoxylon* (African Blackwood), one of the world's most valued timbers on the global market (Jenkins *et al.* 2002, Ball 2004) with an estimated value of \$1.5 million/year from exports (Beale, 1995). Hence, the pressure on African Blackwood is high. For example, in Tanzania more than half of felled logs have been found to have a smaller diameter than the official authorized minimal dbh (Ball 2004). The negative impacts of single species selection have been reported in other regions of the Miombo forest (Grundy and Cruz 2001, Mudenkwe 2006, Makungwa and Kayambazinthu 1999, Luoga *et al.* 2002). However, one of the major arguments in favor of promoting sustainable timber production is to enhance the formal employment of those in local communities. However studies

show that this is not often achieved through large-scale logging. In a study conducted in the dry forests of Cambodia, McKenney *et al.* (2004) found that where conventional logging and management was implemented, fewer than 5% of local households were directly employed. Similar findings are reported by Sunderlin (2006). Moreover, research has found that conventional operations can marginalise communities, generate conflict and have detrimental effects on livelihoods overall (McKenney *et al.* 2004, Sunderlin 2006). For example, McKenney *et al.* (2004) report that logging companies felling valuable resin-producing trees that are central to local livelihoods is a major reason why Cambodian households remain economically vulnerable.

Dry forests play a major role in the provision of fuel across the world. The provision of energy is frequently cited as the most important forest use, particularly in Africa and Latin America (Clarke *et al.* 1996, Campbell *et al.* 1997, Fisher 2004, Barrance *et al.* 2009, del Castillo *et al.* 2011). A number of studies have been conducted in both India and Cambodia, but these rarely focus on dry forests exclusively (Davidar *et al.* 2007, Sagar and Singh 2004, Top *et al.* 2004a, 2004b, 2006). However, what is available suggests that fuel is typically the most important product collected from dry forests in the region (Davidar *et al.* 2007, McKenney *et al.* 2004). The collection of fuel as a 'free' resource (in monetary terms) is particularly important in some areas, since without access to this resource households would require significant additional purchasing power. It is important to highlight that wood fuel supports many livelihoods indirectly – for example large amounts of fuel are required to support brick-making, charcoal production or to extract Shea butter and other products. Wood fuel is also important has also a very important s Also for cooking and treating unsafe water and has therefore a significant value for nutrition and health (Campbell *et al.* 1997, Shackleton *et al.* 2007, Sunderlin 2006, Gumbo *et al.* 2013).

In Latin America, much of the available literature suggests that fuel is usually the most important resource derived from Latin American dry forests, and is used significantly by the poor (Albuquerque *et al.* 2005, Lucena *et al.* 2007, del Castillo *et al.* 2011, Suarez *et al.* 2012). The sale of fuelwood is important to livelihoods in many areas, particularly in Africa (Campbell *et al.* 2007) where large urban populations continue to drive demand (Table 1).

Although woodfuel remains important, a worldwide review of woodfuel and charcoal (not exclusively on dry forests) conducted by Arnold *et al.* (2003) found that global demand for woodfuel is falling, while demand for charcoal is rising. This is supported by Jumbe *et al.* (2008), who cites official Government of Zambia figures showing that 41,000 rural households (equivalent to 1.5% Zambian households) were directly involved in charcoal production, and an additional 4,500 people are employed in related activities such as transportation and distribution. Arnold *et al.* (2003) show that in certain areas of Sub-Saharan Africa, tens of thousands of poor farmers and small traders supplement 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 remains the most common non-agricultural activity of household members.

One interesting finding of this review is that the importance of the safety net role of charcoal production for vulnerable households. In some areas farmers are abandoning cultivation in favor of charcoal production (Malimbwi *et al.* 2000), which may have implications for future food security. Studies in Northern Mali show that this transition to charcoal production is shown to be one of the most important coping strategies especially for the poorest and most vulnerable households (Brockhaus *et al.* 2013).

Arguments related to sustainability of livelihoods based on fuel production from dry forests are debatable. 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, while Makonda and Gillah (2007) argue that woodfuel demand is the second largest cause of deforestation in the developing world. Chidumayo and Kwibisa (2003) consider charcoal production to be among the gravest threats to dry forests in southern Africa. By contrast, Arnold *et al.* (2003) concluded that there is little evidence to show that demand for fuel wood has substantially outpaced supply (as was feared in the 1980s) and that fuel demands are rarely a cause of large-scale deforestation, they do suggest that new management techniques are required to cope with charcoal demand. Other scholars consider commercialisation of charcoal production for supplying the urban demand to be the more significant determinant which has changed the spatial pattern of deforestation in many dry forest areas (Ribot 2001, FAO 2010, Kutch *et al.* 2011,

TABLE 1 Summary of woodfuel's contribution to income and energy consumption in different dry forest countries

	Contribution	Regions	Citations
<b>Energy consumption</b>	75% of energy consumption	Sub-Saharan Africa (excluding South Africa)	Mwampamba (2007)
	70% of all energy used	Southern Africa	Syampungani <i>et al.</i> (2009)
	80% of country's energy needs	Zambia	Chidumayo (1987)
<b>Income</b>	US \$309 m annually to income	South Africa	Shackleton <i>et al.</i> (2007)
	70% of cash income of rural household	Tanzania	Makonda (2007)
	40% household's income	Malawi	Fisher (2004)

Zulu *et al.* 2013). With the climate change debate, deforestation and woodfuel linkages are gaining more attention since woodfuel has links both to energy policy and carbon sequestration programs (Sills *et al.* 2011).

Forest policy reforms were put in place in some West African countries (for instance Mali) to reorganize and regulate the fuelwood sector by creating formal Rural Wood Markets, acting in delimited forest with a harvesting quota, a point of sale and a management agency. The study conducted by Gautier *et al.* (2005) shows that these markets have improved woodcutters' livelihoods, they also led to selective wealth redistribution among villagers and forest departments. Charcoal is often made from slow growing species that are particularly vulnerable to overexploitation because they produce a dense, slow-burning charcoal.

### Non-timber forest products (NTFPs)

Beyond fuel and timber, dry forests provide a wide variety of products that may supplement local livelihoods. However, in many regions the role of NTFP's is still difficult to record as the majority of the trade occurs in informal markets (Vantomme 2003) and therefore their real contribution has never formally been accounted for in the national economy. Some evidence does however exist for a few significant NTFPs, such as, for instance, Shea butter in Burkina Faso which is the third most important national export (Schreckenber 2004) or in Ethiopia where gums and resins rank second after livestock in the overall household livelihood (Mekonnen *et al.* 2013).

The contribution to income varies depending on the type of NTFP's considered (Table 2). In Asia and Africa, food is a particularly valuable resource that can contribute to income when sold or reduce household expenditure when consumed

directly. Dry forest products such as medicinal herbs, and honey are also important as tradable goods and much work has been done on contribution of such non-timber forest products (NTFPs) to local incomes, mostly in the Miombo. For example, Shackleton *et al.* (2007) estimate that there are over 300,000 traditional healers in South Africa alone, the majority of whom are thought to be making use of dry forest products. However, the type and importance of such trade differs between regions. Research from across Asia and Africa indicates that purchased food is often heavily supplemented by dry forest foods and the value of foods collected and consumed by households may be entirely reliant on dry forest foods during some seasons (Hegde and Bull 2008). Many wild foods are thought to be important sources of nutrients (Brigham *et al.* 1996, Abdallah and Monela 2007, Packham 1993, Somnasang and Moreno-Black 2000), and thus wild food may also be important to livelihoods indirectly through their positive contribution to health and nutrition (Ickowitz *et al.* 2014).

In Thailand, Moreno-Black *et al.* (1996) found that the sale of wild foods was particularly important. In some rural markets, almost half of the plant species and up to 13% of animals on sale are non-domesticated and collection of wild foods is sometimes considered economically more efficient than engaging in paid work in order to buy food (Somnasang and Moreno-Black 2000). However, in most cases income from sales seems to be considered supplementary to other income sources and insufficient to provide sole livelihood support (Moreno-Black *et al.* 1996). Similar results are reported from the dry forests of Cambodia, where in many areas NTFP's (including animals/meat) collection and trade is second only to farming in its importance to livelihoods (McKenney *et al.* 2004).

TABLE 2 Summary of non-timber forest products (NTPF's) contribution to income in different dry forest countries

Contribution	Regions	Products	Citations
4%–6% of total income	Zimbabwe, Thailand, India,	Food	Cavendish (2000), Somnasang and Moreno-Black (2000), Mahapatra and Tewari (2005), Cavendish and Campbell (2008)
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 and Olsson (2006)
This income contributes to 32.6% of annual household subsistence,	Ethiopia	Gums and resins	Mekonnen <i>et al.</i> (2013)
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	Clarke <i>et al.</i> (1996), Campbell <i>et al.</i> 2004, Dovie (2004), Shackleton and Gumbo (2010)
25–60% of mean per capita income	Southern India	NTFP	Narendran <i>et al.</i> (2001)

In India, Wacber *et al.* (2012) argue that dry forests are more important than other forest types for provision of NTFP's, Mahapatra and Tewari (2005) found that in Indian dry forests, poorer families often barter wild foods for staples or for edible goods such as salt and edible oil.

## 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 megafauna is a major attraction for foreign and domestic tourists (Shackleton *et al.* 2007). Nature tourism is worth billions of dollars to Miombo countries (Hasler 1999, Spenceley 2010) and dry forest tourism in South Africa alone is thought to be worth between US\$2.5 and US\$6 billion annually (Shackleton *et al.* 2007).

Although a significant proportion of tourism revenue goes to corporations rather than communities (and jobs for locals may be low-skilled and poorly paid), local entrepreneurs are increasingly able to secure contracts for support services such as laundry and security (Shackleton *et al.* 2007, Spenceley 2010). Furthermore, even a regular low wage may be disproportionately 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 generate significant returns for communities. For example, Spenceley (2010) claims that in Botswana income from some such 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 [cite].

Several authors point out that aside from providing income, tourism projects may also present wider economic benefits. 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 (Hasler 1999, Shackleton *et al.* 2007, Salomão and Matose 2007, Spenceley 2010). However, Salomão and Matose (2007) found that in Mozambique, while many projects do generate investment and community benefits, poor contracts, low negotiation skills and enforcement issues result in communities often receiving less than they should.

The Communal Areas Management Programme for Indigenous Resources (CAMPFIRE) schemes in Zimbabwe (a pioneer programme in developing benefit sharing schemes) are probably the most well studied, and show that community tourism can be a significant income generator. CAMPFIRE 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 CAMPFIRE (Campbell *et al.* 2007, Frost and Bond 2008, Spenceley 2010). According to Spenceley (2010) at least 560,000 people consistently benefit from CAMPFIRE (about 5% of the national population, based on figures for

2010 published by ZIMSTAT 2012). However, although it does generate its own income, CAMPFIRE attracts most of its revenue from donors (Campbell *et al.* 2007, Hasler 1999). Hasler (1999) argues that the ratio of donor to self-generated funds is as high as four to one, raising questions over the long-term sustainability of the scheme. McDermott-Hughes also argues that tourism through CAMPFIRE has led to black farmers in Zimbabwe losing control of land as wealthier white elites have sought to capitalise on the opportunities provided by previously undesirable land (McDermott-Hughes 2003).

Beyond the southern African Miombo, tourism and its potential in the dry forests appear to be under researched. For example, while Geneletti *et al.* (2011) find that there is significant potential for tourism in Latin American dry forests, there is very little systematic information on the value or type of tourism that occurs in dry forests specifically. Where tourism is considered, this is generally in the context of tourist impact on the biophysical aspects of the forest, rather than on livelihoods (for example, Castillo *et al.* 2005, Quesada and Stoner 2004).

Similarly, although Gaughan *et al.* (2009) note that some Cambodian dry forests draw millions of tourists each year and create a major demand for local products such as charcoal and agricultural goods, little quantitative information on how this affects livelihoods is currently available. Indeed, dry-forest-specific tourism throughout Asia is not adequately represented in the scientific literature and thus the impact on livelihoods is hard to assess.

## Other goods and services

The role that dry forests play in providing other less tangible and indirect benefits, such as ecosystem services (water management, erosion control, soil quality etc.) is important to livelihoods. Although the relationships are not well understood, dry forests are thought to have a direct influence on water flows and aquifer recharge, thus affecting the severity of agricultural problems such as floods and droughts (Campbell *et al.* 2004, Castillo *et al.* 2011, Malmer and Nyberg 2008, Marunda and Bouda 2010). In the Miombo, despite extensive deforestation, there is evidence that farmers are aware of this role. For example in Zimbabwe, farmers rated ecosystem services such as water retention as some of the most valuable functions of the dry forest (Campbell *et al.* 1997).

Efforts are now being made to investigate options for payments for environmental services in dry forest areas. While the majority of such research has been in Latin America, examples are also available for the dry forests of Asia and, to a lesser extent, Africa (Brown *et al.* 1993, Walker and Desanker 2004, Glenday *et al.* 2008, Williams *et al.* 2008). For example, PES to smallholders in order to preserve the forest are reportedly being considered in Laos (Midgeley *et al.* 2012), while several new schemes based on paying for the carbon stored in dry forests are being trialled in Mozambique (Palmer and Silber 2012). The long-run sustainability of such projects and the ability of communities to maintain carbon stocks over time are still uncertain (Perez *et al.* 2007).

Livestock was reported to frequently graze the dry forest in several regions and the transfer of manure and leaf litter to fields is thought to be important in soil quality (Scoones and Toulmin 1995, Clarke *et al.* 1996, Campbell *et al.* 1996, Cavendish 2000, Gambiza *et al.* 2010, Marunda and Bouda 2010, Dewees *et al.* 2011). In India, Davidar *et al.* (2007) report that grazing cattle in the dry forest has created a new livelihood of manure collection that has become important for the poor in some places. Significant portions of African livestock are found in pastoral systems, based on woodlands trees and shrubs. Those systems provides a considerable part of the red meat, milk and other livestock products as well as employing a significant number of people (Kirkbride and Grahn 2008). Poultouchido (2012) notes that in Ethiopia, despite establishment of large plantations, natural forest remains more important for grazing. Fodder from dry forests and woodland savanna play a crucial role in the livestock sector especially during the dry season (Ouédraogo-Koné *et al.* 2006). Furthermore, several studies on adaptation show that in different parts of the Sahel, selling animals is one of the most important coping strategies to crop failure, due to droughts (Barrett *et al.* 2001, Brockhaus *et al.* 2013). Shepherd, (2008) illustrate a new dimension of this trend by showing that the emergence of landlessness in some Sahelian regions, is itself embedded in a more complex evolution towards a more socially differentiated economy in which livestock, and therefore savanna woodlands as a fodder provider, may play a crucial role in providing incomes for the land-poor.

#### THE SAFETY NET ROLE OF DRY FOREST: CAN DRY FOREST SUPPORT THE ADAPTATION OF LIVELIHOODS TO CLIMATE CHANGE AND VARIABILITY?

The IPCC (2007) predicts complex Sahelian vegetation changes - with significant impact on the availability of ecosystem services for livelihoods. The report highlights existing uncertainties in future changes in Sahelian vegetation. Some studies simulate a reduction in cover and productivity, like for instance the one in southern African savanna in response to the observed drying trend since 1970 (Woodward and Lomas 2004). Other studies indicate subsequent regeneration during wetter periods (Rasmussen *et al.* 2001, Hiernaux and Turner 2002), highlighting the resilience of Sahelian savanna to drought. Few experimental studies quantifying the effects of CO<sub>2</sub> on tree growth and demography in savannas and grasslands, suggest however that an increasing of CO<sub>2</sub> observed over the last promotes an increases in woody plants in these ecosystems (Kgope *et al.* 2010).

There is growing evidence that dry forest ecosystem services help reduce sensitivity and increase adaptive capacity of households and communities to climate change. Poorest households rely on provisioning services to cope with crisis (Shackleton *et al.* 2007, Fisher *et al.* 2010, Pramova *et al.* 2012, Brockhaus *et al.* 2013). Several adaptation studies show that diversification including forest and tree products are crucial for people to cope with climate variability (Osbah

*et al.* 2008, Fisher *et al.* 2010). Furthermore, forests play an essential 'safety net' role, supporting households and their livelihoods in times of crisis (Shackleton *et al.* 2007, Djoudi *et al.* 2013). Hence, there is a greater concern that the degradation and loss of those resources would exacerbate already existing vulnerabilities (Shackleton *et al.* 2012).

Evidence from Malawi suggests that the most vulnerable households (lowest income, less educated and more risk-averse household members) depend highly on forest products for their coping strategies (Fisher *et al.* 2010). In Mali charcoal production was the most important strategy of women to adapt to drought and pastoralist communities rely highly on trees (leaves and fruits) to assure survival of their livestock during prolonged drought periods (Djoudi *et al.* 2011).

Verchot *et al.* (2007) found out that in semi-arid Kenya, and in order to cope with droughts, farmers have developed parkland systems with the fast-growing indigenous *Melia volkensii* to take advantage from the quick financial returns from high value timber. In Rajasthan, farmers sell fodder from *Prosopis cineraria* and *Zizyphus nummularia*, to substitute lost income from crops due to droughts. They also collect fuel, for own use and sale when crop production fails (Rathore 2004). Farmers in Burkina Faso sell the leaves of the *Adansonia digitata* during the drought months and they reported earnings of up to US\$300 in this period (Sawadogo 2011).

In Niger (Garrity *et al.* 2010) and in Burkina Faso (Sawadogo 2011) community-managed trees such as *Faidherbia albida*, *Prosopis africana*, *Combretum glutinosum*, *Guiera senegalensis*, *Piliostigma reticulatum*, and *Bauhinia rufescens*, produce a supply of dry-season fodder for livestock and provide firewood, for income diversification and increased food security during times of food scarcity. The communities generate a variety of wood products and have also established a sustainable rural fuel-wood market (Tougiani *et al.* 2009). Studies show that recent droughts had less negative impacts on the livelihoods of communities who were engaged in those initiatives, as people could cope better with the climatic and economic shocks in comparison to other villages (Sendzimir *et al.* 2011). Several studies show that livestock is one of the most important coping strategies in the west and east African savanna. During dry years, pastoralist, agro-pastoralist and farmers generate their income by using fodder tree and forest resources to raise more goats and sheep (Batterbury and Forsyth, 1999).

Studies on mitigation potential of dry forest are few. However, there is a growing consensus that carbon sequestration is an emerging opportunity for livelihoods in the drylands (Mortimore *et al.* 2008, Chundama and Gumbo 2009, Skutsch and Ba 2010). Trade-offs between adaptation needs and mitigation objectives can be crucial in the dry forest regions. Reid *et al.* (2004) estimated that a conversion of savannah to croplands results in a loss of 95% of above-ground and 50% of below-ground carbon. In the Miombo, forest deforestation for charcoal production was found as a high source of carbon emission with a per capita emission rate of 2 - 3 t CO<sub>2</sub> y<sup>-1</sup>. In West Africa, Tiessen *et al.* (1998) show that due to overgrazing, exploitation for fuel wood and

shortened fallow periods more than 50% of the land is under a management regime with minimal carbon returns.

Management regimes seem to be crucial for carbon returns in several dry forest areas. Results from Madoffe *et al.* (2012) indicate that village forests have higher stock of carbon than the central government and local government forests. Even though carbon potential is low compared to other forest areas in the world, many governments in the drylands of Africa are starting to engage in REDD mechanisms such as in Zambia and Burkina Faso. It is not yet clear how much of the financial benefits of carbon will flow into local livelihoods, however some studies on dry forest suggest that already 10% of the financial value of the carbon filtering back to the communities, would still represent a considerable incentive (Skutsch and Ba 2010). Hence, more studies are needed to explore the potential of carbon as an ecosystem services and to analyse the potential and the challenges of REDD for livelihood resilience. Securing benefits from carbon for livelihoods in many dry forest areas is subject to major uncertainties, challenges and barriers related to ambiguous and overlapping rights, as well as major trade-offs between different users and stakeholders.

## POVERTY, EQUITY AND DRY FORESTS

### Gender in the context of Dry Forest

In all regions there is a clear delineation in the types of livelihoods that men and women derive from the dry forest. While there are some differences between regions, the similarities in gender control over resources across the regions are striking. In general, in all regions unprocessed, low-value wild forest products for domestic use (such as wild plants and firewood) are generally found to be utilized more heavily by women and children, while commercially valuable products (for example meat, timber and charcoal production) are frequently controlled mainly by men (Campbell 1987, Clarke *et al.* 1996, Marshall and Newton 2003, Sileshi *et al.* 2007, Camou-Guerrero *et al.* 2008, Shackleton and Gumbo 2010).

One interesting exception seems to be the dry forests of Thailand. Moreno-Black and Price (1993) report that the wild food trade is already heavily commercialized, yet remains dominated by women. Furthermore, the livelihoods value of such sales is sometimes significantly larger than the contribution made by their husbands through more traditional means. Another exception is shea butter manufacturing in the dry forests of West Africa. In some households commercialization of NTFP's such as Shea butter and *Parkia biglobosa* products is highly important for women in West Africa. In Burkina Faso, Tincani (2012) shows that forest contributed

up to 40–60% to women's income who were involved in shea butter production and national statistics suggest that around four million women are involved in the trade and/or transformation of shea butter (Maiga and Kologo 2010). Although the value of butter is low as a proportion of total income, the trade is essential in providing women with their own income and can cover a large part of their own annual expenditure (Schreckenber 2004)<sup>1</sup>.

As a result of the different ways in which men and women utilise forests, the way in which they perceive the forest may be different, and policies to improve management or livelihoods based on dry forest products need to take into account the gender context. For example, in Mexican dry forests, women were found to be more than twice as likely to identify regulatory ecosystem services as an important function of the dry forest than men (Castillo *et al.* 2005), which has important implications for policy aimed at conserving such services. Chitiga and Nemarundwe (2003) argue that failure to consider such differences has undermined some efforts at sustainable management in the Miombo. Similarly, there is evidence from Asian and African dry forests to suggest that commercialization of dry forest products risks doing more harm than good to women', because they are likely to lose control of any resources that increase in value (Belcher and Kusters 2004, Shackleton and Gumbo 2010).

### Poverty alleviation and Dry Forest

Since the goods and services that dry forests provide are essential in directly and indirectly supporting livelihoods (particularly of the poorest), it would seem logical to explore how these livelihoods can be made more profitable in order to alleviate poverty. However, whether forests on their own can be sufficient to support livelihoods that can move significant numbers of people out of poverty seems unlikely.

Dry forests are important in inter-household poverty alleviation because they are thought to provide an 'equalising' role in many societies, helping to reduce the gap between richest and poorest (Cavendish and Campbell 2008, Fisher 2004, Shackleton *et al.* 2008). In all regions, the evidence shows that the poor are generally reliant on dry forest products for a greater proportion of their livelihoods than richer households, even if they use lower resource volumes (Barrance *et al.* 2009, Belcher and Kusters 2004, Cavendish 2000, Clarke *et al.* 1996, Del Castillo *et al.* 2011, Fisher 2004, Shackleton *et al.* 2010, Shackleton *et al.* 2007, Somnasang and Moreno-Black 2000). Nevertheless, forests do tend to remain important even for wealthier households (Benz *et al.* 2000, Hegde and Bull 2008, Kalaba *et al.* 2009).

One of the major reasons why forests are important to the poor is that such livelihoods make use of common pool resources and usually require little or no equipment and

<sup>1</sup> Shea production is also an interesting example of a sustainably managed system of NTFP collection, since trees are usually not common pool resources but are integrated with agricultural systems on private land.

investment. As such, start-up costs are low and access can be negotiated fairly easily, meaning that participation can be relatively fluid, depending on the household's economic and social situation at the time and the other options available. Shackleton *et al.* (2007) report that such qualities explain why many small-scale vendors of dry forest products in South Africa originally entered the trade during times of crisis. The significance of forest resources is the greatest for peri-urban households that have access to forests and to urban markets for forest products (Monela *et al.* 2000). Forest products contributed about 50% of total income also in more remote communities. Meshack (2003) reports that households obtain at least a third of their total income from forests in the West Usambaras in northern Tanzania. In Morogoro and Dodoma regions 68% of household's total income are generated from the forest (Monela *et al.* 2000).

NTFPs contributes to income generations of the poorest but evidence from many dry forests show that NTFPs are rarely enough to support widespread poverty alleviation (Sunderland *et al.* 2004). For example, Thailand is among the countries where dry forest NTFPs are most highly commercialized, almost 50% of plant species and up to 13% of animals on sale in some rural markets being non-domesticated. Yet vendors of dry forest products consider sales to be a supplement to other income sources, and insufficient to support a livelihood (Moreno-Black *et al.* 1996).

Elsewhere, commercialisation of forest products has been mixed at best, and some studies suggest that commercialisation may in fact have negative consequences for the very poorest (Shackleton and Gumbo 2010). Evidence from Asia suggests that NTFP processing (where the majority of value can be added) is rarely realistic for small-scale producers because the additional opportunity costs become too high (Belcher and Kusters 2004).

Similarly, while small-scale forestry may have poverty alleviation potential even in logged-over areas and whether this can address the needs of the very poorest (who may not have access to land) is still unclear. Many management regimes continue to favour NTFP-based livelihoods over even sustainable timber extraction, despite the far greater value of the latter. For example, in the majority of Cambodian dry forests timber extraction is forbidden even under community forestry schemes (which allow extraction of NTFPs and firewood only), despite the fact that sustainably managed timber could generate significantly greater returns (Sunderlin 2006). In Burkina Faso, Tincani (2012) show that changes in land-use policy and further investment are needed to fully capture the value of dry forests to mitigate households' poverty. Generally, a decreasing dependence on natural resources is observed when wealth increases in different regions (Escobar and Aldana 2003, Shackleton 2006). Some authors attribute this correlation to the safety net role of dry forest for poor households, since those face more food shortages (Neumann and Hirsch 2000, Mulenga *et al.* 2011). As such, it seems likely that dry forests will continue to play an important but supplementary role in livelihoods but more important role as a safety net, particularly to prevent households from slipping into poverty during times of crisis (Shackleton *et al.* 2011, Fisher 2011,

Djouidi *et al.* 2013). However, it seems unlikely that dry forests alone are sufficient to deliver widespread poverty alleviation. Policymakers and researchers need to investigate other strategies for livelihood development in dry forest areas.

#### *Is community forestry enhancing equity and livelihoods in the context of dry forest?*

Several models of community forestry have indeed emerged most of which seem to be primarily aimed at conserving biodiversity while tackling poverty in rural areas (Sunderlin 2006, Midgeley *et al.* 2012).

The research that is available shows that in dry forests community forestry has the potential to be successful in generating community benefits, but require sound design and strong political will (Datta and Chatterjee 2012). In fact, in most regions examples of both successful and unsuccessful schemes have been documented. In the state of Quintana Roo in Mexico, a number of studies have concluded that communities have successfully managed production forests to produce a variety of hard and softwoods, including mahogany (Snook *et al.* 2003). Other studies elsewhere in Mexico have drawn similar conclusions (Klooster and Masera 2000). Meanwhile in Bolivia, sustainability certification in community forestry was found to have led to higher returns from timber, but increased management requirements meant that incomes did not rise and impact on livelihoods was minimal (Markopoulos 1998).

In Laos, Sunderlin (2006) found that community forestry delivered incomes to locals that were competitive with other (limited) local employment opportunities, but notes that some research has found that community forestry worsened poverty for the poorest. Community forest is increasing in popularity in Cambodia, Laos and Vietnam, but that issues ranging from illegal logging to a failure to define rights and responsibilities correctly have undermined several schemes (McKenney *et al.* 2004, Sunderlin 2006). Meanwhile in India, Datta and Chatterjee (2012) reported that although dry forests were home to some of the country's most successful joint forest management (JFM) schemes during the 1980s, many have since lost local credibility by failing to provide adequate benefits and sustainable management options due to poor management strategies.

In Southeast Asian dry forests, there have been some attempts to improve community forestry in natural logged over forest, but the difficulties in implementing a viable system have so far been overwhelming (McKenney *et al.* 2004, Sunderlin 2006).

Similar outcomes have been reported in the southern African Miombo. In Tanzania, community forestry was found to have delivered community-level benefits (such as schools) and improvements in forest condition, but that the poorest ended up worse off in some cases (Blomley *et al.* 2008, Lund and Treue 2008). In South Africa, Obiri *et al.* (2002) find that state-managed forests have been more successful at conserving high-value timber species than community management programmes. In Zimbabwe, community management models applied to other resources have not always transferred effectively to dry forest timber management, and over-exploitation



of timber has remained an issue in areas where other pressures (such as population growth) have been acute, suggesting that there are limitations to the model (Tyynelä and Niskanen 2000). Community management actions seem to be relevant for people's engagement in conservation activities. In Burkina Faso studies show that participation in forest conservation activities was strongly related to membership in community-based forest management associations (Brännlund *et al.* 2009).

For example, although such programmes are relatively widespread throughout Asian dry forests, most evaluations tend not to consider a particular forest type. More studies that evaluate dry-forest specific projects, or that compare experiences in different forest types would be valuable additions to the existing body of literature.

In many areas, dry tropical forests pose management challenges for large timber production. Most of the native tree species are slow growing especially because of the long dry season where biological activity is reduced to a minimum. Fire and grazing are important environmental challenges. Keller *et al.* (2007) shows that while reduced-impact logging is often not sufficient to guarantee the sustainability of timber yields, application of silvicultural treatments that substantially enhanced the growth rates of are efficient.

## CONCLUSIONS

The literature reviewed shows that dry forests are essential in livelihoods especially for the poor people living in or adjacent to the forests. The products and services provided include amongst others timber, firewood, food, and medicine and ecosystem services such as drought mitigation. However, most rural livelihoods are complex and involve multiple income sources, the importance of which may change over time (for example beekeeping, timber, fruit sales). Thus, the role of dry forests in individual livelihoods is likely to change depending on circumstances.

Most rural livelihoods are complex and involve multiple income sources, the importance of which may change over time (for example beekeeping, timber, fruit sales). Thus, the role of dry forests in individual livelihoods is likely to change depending on circumstances. Although both rich and poor households use dry forests for livelihoods, the forest is frequently found to be more important to poor households or those suffering from economic shocks (see Shackleton *et al.* 2007).

It is questionable as to whether dry forests alone can be sufficient to lift significant numbers of people out of poverty. Beyond timber, there are few examples of dry forest products that have sustainably generated significant wealth to date. In many cases, it appears that NTFP trade is a last resort for those living in poor, remote communities with few other livelihoods options. The commercialisation of dry forest NTFPs has been difficult, with many running into problems in delivering consistent quantity, quality or sustainability (Schrekenberg 2004, Mandondo 2006, Silési *et al.* 2007), and even where sustainable commercialisation has taken place (such as with shea butter), the trade may represent only a very small proportion of total income, enough to be important, but not

enough to sustain a household alone (Schrekenberg 2004). In many cases, it appears that the NTFP trade is a last resort for those living in poor, remote communities with few other livelihoods options (Shackleton *et al.* 2007), and systems for management and sustainable exploitation are frequently absent or underdeveloped (Sunderland *et al.* 2004).

It is important to reiterate that the safety net role of dry forest to support people to cope with climatic and non-climatic shocks is very crucial with increasing climate variability and shocks (Shackleton *et al.* 2007, Djoudi *et al.* 2011). Droughts had less negative impacts on the livelihoods of communities in regions where forest resources were restored as people could cope better with the climatic and economic shocks by taking advantages from both, provisioning and regulating services provided by forest and trees. Indirectly dry forest contributes to the safety net of households by providing fodder for livestock, and animal selling is one of the most important coping strategies in in the dry forest areas.

Even where sustainable commercialization has taken place the trade may represent only a very small proportion of total income – enough to be important, but not enough to sustain a household alone (Schrekenberg 2004). Systems for management and sustainable exploitation are frequently absent or underdeveloped (Sunderland *et al.* 2004). The results from community forestry, tourism and PES are more promising, but the outcomes for the poorest under such systems remain uncertain. Several studies show the considerable role of forest for livelihoods resilience to climate change and variability. However, the patterns of future changes in the regulation services at the landscape level and how they might change agricultural production systems remain uncertain.

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