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Forests, Trees and Landscapes for Food Security and Nutrition

A Global Assessment Report

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Chapter 4
Drivers of Forests and Tree-based Systems for Food Security and Nutrition

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Abstract: In the context of this chapter, drivers are considered to be natural or anthropogenic developments affecting forests and tree-based systems for food security and nutrition. They can improve and contribute to food security and nutrition, but they can also lead to food insecurity and malnutrition. For analytical purposes, drivers are separated here into the following four interconnected categories: (i) environmental, (ii) social, (iii) economic and (iv) governance. When reviewing scientific findings twelve major drivers (i.e. population growth, urbanisation, governance shifts, climate change, commercialisation of agriculture, industrialisation of forest resources, gender imbalances, conflicts, formalisation of tenure rights, rising food prices and increasing per capita income) were identified within these four categories. They affect food security and nutrition through land use and management; through consumption, income and livelihood; or through both. These drivers are interrelated and can have different consequences depending on the social structure; for example, they can support food security for elite groups but can increase the vulnerability of other groups.

4.1 Introduction

Drivers of change are the subject of a vast scholarly literature. In the context of this report, drivers are understood as natural or anthropogenic developments affecting *forests and tree-based systems*[1] for *food security* and *nutrition*. This chapter aims to provide a structured and comprehensive overview of major findings from this literature in an effort to better understand the interrelations among these drivers and how they impact on food security and nutrition. It covers drivers that improve and contribute to food security and nutrition as well as those leading to increased food insecurity and poor nutrition. Changes to improve food security and nutrition result for example in an increased availability of food and better nutrition. In contrast, changes that lead to food insecurity increase the vulnerability of both *ecosystems* and humanity. Identifying drivers and understanding their impact pathways is essential to determine options for effective interventions by enhancing positive and minimising negative effects (see Chapter 6).

Driving forces can originate at different spatial scales and can be distant or proximate. In this chapter, attention is paid in particular to those drivers constraining forests and tree-based systems for food security and nutrition in vulnerable regions, i.e. the tropics, neo-tropics and sub-Saharan Africa. Both the environmental and the human components of forests and tree-based systems for food security and nutrition are subject to changing dynamics presenting a different picture over time. These dynamics also imply that drivers and effects are strongly interrelated and can mutually affect each other. Consequently a simplified classification as driver or effect sometimes falls short in addressing this complex relationship.

The chapter builds on a framework (see Figure 4.1) to categorise drivers and trace their impact pathways. According to their content, drivers can be separated for analytical reasons into the following four interconnected categories: (i) environmental, (ii) social, (iii) economic, and (iv) *governance*. Environmental drivers refer to developments in nature (many of which have themselves anthropogenic causes) that change food security. Social drivers include the role of patterns of social differentiation, inequalities and changes in influencing forests and tree- based systems for food security and nutrition. Economic drivers relate to direct and indirect impacts from economic activities that are both economy-wide and site specific. Governance refers to those institutions setting the rules of the game, differentiating between state and non-state governance. The drivers identified in these four groups mainly impact food security and nutrition through two major pathways: changes in land use and *(forest) management* or changes in consumption, incomes and livelihoods (see Figure 4.1). Both pathways determine food availability, access and stability that ensure food security and nutrition.

This chapter presents findings from available scholarly literature for each category of driver and ends with a summary of major results. Literature about drivers referring to the interrelation between forests and tree-based systems on the one hand, and food security and nutrition on the other, is rare. For this reason, the authors of this chapter reviewed literature on the subject of change from both scientific areas - *forests* and food security - and linked them to present a comprehensive overview of relevant drivers.

4.2 Environmental Drivers

Before reviewing different environmental drivers it should be highlighted once again that environmental and anthropogenic developments are marked by a complex, mutual relationship. Environmental drivers are themselves consequences of human action, policies and societal processes. Consequently the underlying interactions between social, political, economic and ecological processes are difficult to isolate from each other. The effect of human activities on ecosystems has been large enough to warrant the call to rename the current geological era as the Anthropocene (Crutzen, 2006). Many critical thresholds of the earth's biophysical systems have already been crossed as a result of human activity (Rockström et al., 2009). These processes have uneven impacts on different sections of humanity (Mohai et al., 2009). People living

[1] All terms that are defined in the glossary (Appendix 1), appear for the first time in italics in a chapter.

directly off production from the earth's ecosystems are particularly affected by these changes. Factors such as increasing temperatures, variable precipitation, *fragmentation, deforestation, invasive species* and loss of biological diversity affect not only the extent of forest but also the structure and species composition within forests (and therefore, forest products) thus impacting on the availability of food and nutrition.

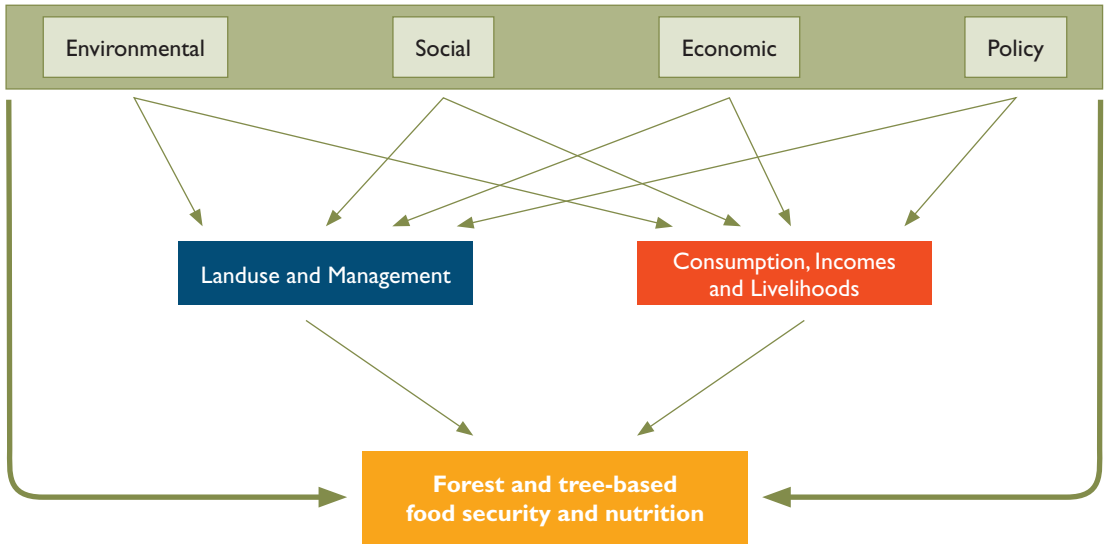
Three significant larger scale environmental drivers that impact directly on the forests-food nexus will be discussed in this section: *climate change,* deforestation and forest transitions, and invasive species. The identification of larger scale drivers of forest change and food security is important given the conventional understanding that forest *degradation* is often the result of local processes such as conversion to agriculture, grazing and harvest of forest produce. While these local practices do have impacts they are generally small-scale, reversible and are often regulated by local bodies. The larger drivers listed below however call for action at national and global scales.

Climate change

Climate change is affecting global and local ecological processes in many ways. Though the consequences are complex, there is enough evidence that ongoing and future changes are going to be drastic. The Intergovernmental Panel on Climate Change (IPCC) notes that by the end of this century rates of climate change as a result of medium to high emission levels "pose high risk of abrupt and irreversible regional-scale change in the composition, structure, and function of terrestrial ecosystems". There is widespread evidence that the poorest regions in the world, such as sub-Saharan Africa, will be affected the hardest by climate change. The IPCC report notes that "increased tree mortality and associated forest dieback is projected to occur in many regions over the 21st century, due to increased temperatures and drought" (IPCC, 2014). The effects of climate change, combined with land cover change such as reduced forest cover and fragmentation, exacerbate impacts (Afreen et al., 2010). These climate-induced changes affecting forest cover imply both direct and indirect consequences for food security and nutrition: direct consequences result from changes in the availability and quality of food and nutrition, while indirect consequences result from changes in income and livelihoods related to forest products. The consequences of climate change for forests and tree-based systems for food security and nutrition, however, are not well understood although comprehensive reviews of climate and agricultural *food systems* have been published (Vermeulen et al., 2012).

The IPCC more specifically forecasts the following changes concerning forests: a decrease in tree densities in parts of North Africa, range shifts of several southern plants and animals, changes in plant phenology and growth in many parts of Asia (earlier greening), distribution shifts of many plant and animal species upwards in elevation and an increase in tree mortality and forest fire in the Amazon. Climate-induced effects will interact with ongoing *landscape* changes to produce a range of synergistic outcomes with significant effect on plant and forest health (Pautasso et al., 2010). Studies have demonstrated that climatic impacts interact with other landscape level drivers of change to affect biological assemblages and ecosystems. For instance, some landscapes might hinder the dispersal of species and thus prevent species from shifting range (adapting) as climate regimes change (Garcia et al., 2014). Tropical tree species are going to be the most affected by climate change as they are already close to their

Framework of drivers directly and indirectly impacting on forests and tree-based systems for food security and nutrition Figure 4.1



thermal tolerances (IPCC, 2014). The inability of species to adapt to changing climates combined with phenological changes such as earlier flowering (and thus reduced fruit yields and production) could result in direct impacts on the amount of forest resources available for harvest and use by local communities, particularly impacting those communities that are most dependent on forests.

There is a shared understanding in the literature that climate change will affect the most vulnerable groups, especially women (Brody et al., 2008). An indirect effect of climate change is expected from increasing world food prices with harsh consequences for the poorest, including women. Literature dealing with gender imbalances of climate change impacts mainly refers to food security and agriculture. However, findings could be transferred to forests and tree-based food systems and food security and nutrition. In particular, the literature identifies a number of reasons for the gender-differentiated vulnerability of climate change impacts. Amongst these, are different coping and adaptive abilities of men and women (UNDP, 2012) depending on the inequalities in access to assets as well as legal socio-cultural barriers preventing women from effectively responding to climate change (UNDP, 2012).

Deforestation and forest transition

Deforestation and forest transitions interact with food security and nutrition in many ways, directly impacting on the extent of forest available for the harvest of fruit and other forest- and tree-based diets. In particular, deforestation and forest degradation affect biodiversity and the variety of food available through habitat loss and forest transformation.

The process of deforestation is complex and goes beyond the simple removal of trees; there is a continuum of forest structures that complicates what is understood as forests, and is accompanied often by rapid regrowth. The relationship between deforestation and forest dependence is neither inverse nor linear. It has been demonstrated that forests with intermediate levels of diversity are as viable for *livelihoods* as diverse forests, and *secondary forests* have been shown to provide more forest products than highly diverse forests (Saw et al., 1991). There is increasing evidence that in some instances areas that were deforested are now indistinguishable from *primary forests* (Willis et al., 2004). The conventional understanding that current forested landscapes are remnants of past deforestation and degradation has been revisited by studies that have shown that these forests might have been raised by people through active management and customary practice (Fairhead and Leach, 1996; Virah-sawmy, 2009).

While during the past decade deforestation rates have decreased globally, some countries are showing increasing rates of reforestation (Meyfroidt and Lambin, 2011). Reforestation is occurring due to a host of factors such as flows of labour, capital, conservation policies, and the valuation of and markets for *ecosystem services* (Hecht et al., 2006). The valuation of ecosystem services and reducing emissions from deforestation and forest degradation, enhancing forest carbon stocks, sustainable management and conservation of forests (REDD+) has implications for the governance and local use of forests (Phelps et al., 2010) (see Section 4.5). Consequently, policies that encourage reforestation risk having equally adverse impacts on local communities - by preventing access to forest resources - as those that encourage deforestation. Equally, policies that are aimed at reducing deforestation and degradation by local communities often lead to deprivation and livelihood insecurity (DeFries et al., 2010).

Studies have shown that there is a direct relationship between tree cover, tree species diversity and food security especially of vulnerable groups (Ickowitz et al., 2014; van Noordwijk et al., 2014). Changes in the extent and type of forest have implications for the provisioning of food, and for food security and nutrition of local and distant human populations.

Global rates of deforestation have been high for the last few centuries and have been driven by such factors as agriculture (commercial and subsistence), mining, urbanisation and infrastructure expansion (Hosonuma et al., 2012; Williams, 2003) (see also Chapter 3). Globalisation and urbanisation trends starting in the 1980s have changed the agents of deforestation from local population use to capital-intensive commercial farming that supplies distant markets (Rudel et al., 2009). In a review of the history of forest clearing, Williams (2008) concludes, on the basis of four estimates, that the total area of forest that has been lost is between 19 and 36 percent which, while still a large area, is not as devastating as commonly perceived. Recent trends show that agriculture is the biggest driver of deforestation accounting for 73 percent of deforestation worldwide, while mining accounts for seven percent, infrastructure for 10 percent and urban expansion for 10 percent (Hosonuma et al., 2012). Agri-businesses such as cattle ranching, soybean farming and oil palm plantations are now the most important drivers of forest loss globally (Boucher et al., 2011; Rudel et al., 2009). There are regional variations in the significance of drivers of deforestation, with urban expansion for example, being the most important in Asia. Commercial agriculture accounts for 68 percent of forest loss in Latin America and 35 percent in Africa and Asia (Hosonuma et al., 2012). DeFries et al. (2010) show that forest loss is strongly correlated with urban population growth and the export of agricultural products. Furthermore, the interrelation between forests and water has been highlighted in many studies (e.g. Malmer et al., 2010). Rainfall does not provide sufficient water supply in many countries so households depend on sources of groundwater that are often found in or near forested land. Deforestation affects water supply in different ways depending on local conditions.

Invasive species

Another ecological driver of local forest change is invasive species which are often a result of altered management. Plants and animals have been constantly moved to new areas for a range of purposes and have been agents of positive as well as adverse change (Kull and Rangan, 2008; Robbins, 2004). Managing landscapes for the control of invasive species has implications for food security through the increase in resources such as fodder, game

Ginger or Kahili lily *(Hedychium gardnerianum)* is a plant native to the Himalayas that has become an invasive species in the Azores where it was introduced as an ornamental plant in the 19th century. Photo © PJ Stephenson

and tree species. The change in composition of forests or the dominance of certain species has ecological determinants but as has been often recorded these follow from changes in management regimes and policy contexts (Dove, 1986; Robbins, 2004). While there has been some effort in defining and identifying invasive species, what is equally important is to identify the reasons that species were introduced and what social, economic and ecological contexts enabled their spread. Often the introduction of species has had positive impacts on food systems such as with many tropical *agroforestry* systems (Ewel, 1999), while at other times it has had negative impacts, such as with forestry tree species for fuelwood and timber that have had adverse impacts on food species and water availability (Richardson and van Wilgen, 2004).

The incursion of non-native species into terrestrial ecosystems has a long history through the exchange of plants and animals as a result of human movement. Some of these species become invasive and lead to structural and species changes in the forest as well as altering ecological processes, ultimately affecting food availability. Recent research shows that invasive species are resulting in *biodiversity* loss and low regeneration rates of other native species (Ticktin et al., 2012). The ecological consequences of invasive species are high, as are socio-economic outcomes (Pysek and Richardson, 2010). For example, in South Africa, the value of native fynbos ecosystems has been reduced by over USD11.75 billion because of invasive species (van Wilgen et al., 2001).

Furthermore, the changes induced by climate change encourage certain species to move into forest habitats. The increase in energy availability in forests as a result of the shift in ranges of native species enables invasive species to fill the available capacity in these areas (Chown et al., 2013). In a study of the impacts of an invasive species on a *non-timber forest product* species in India, Ticktin et al. (2012) have demonstrated that *Lantana camara* suppresses the regeneration of seedlings of the forest tree species and leads to drastic changes in population growth of this species.

A strong relationship exists between governance regimes and ecological outcomes. Forest areas that have seen recent incursions of invasive species are also areas in which customary practice has been suspended as a result of territorial governance regimes. Management regimes that have banned fires have seen significant increases in densities of invasive species (Debuse and Lewis, 2014) leading Robbins (2004) to assert that "it is not species, but sociobiological networks that are invasive". Zero burn policies that are practised in India and Brazil have resulted in a range of adverse outcomes due to policies not being socially contextualised (Carmenta et al., 2011). The continued narrative of the degradation caused by local practices such as fire has been shown to be unfounded in many forest types. For example, Welch et al. (2013) have shown how indigenous burning in the Cerrado savannah of Brazil has assisted vegetation recovery. Ensuring that the management of landscapes for forest regeneration or to control invasive species is consistent with historical practices promotes both local culture and food security.

The effects of invasive species on livelihood and food security are not uniform within or across communities. As Shackleton et al. (2006) have shown in South Africa, invasive species that have adverse impacts on some sections of the local population are being used to considerable advantage by other sections of the community. While ecological studies have highlighted the impact of invasive species on biological diversity and provisioning of resources, it should be noted that humans have historically relied on such species for food and other requirements. Equally, as forests are being transformed by species introductions and by changed management regimes, people are evolving coping strategies to maintain their livelihood systems. Many communities have optimised the use of introduced species to their benefit and enhanced their livelihood options through the use of such species whether directly for food (e.g. fruits of *Opuntia* sp. in South Africa) or through the sale of products derived from these species (e.g. charcoal from *Prosopis juliflora* in India). The outcomes of environmental changes on food security are complex and require context-specific responses and strategies.

4.3 Social Drivers

This section discusses conflict, relative poverty and inequality, and demographic changes as social drivers that influence forests and tree-based systems for food security and nutrition. It highlights the role of deeply-rooted patterns of social differentiation and inequalities in influencing forests and food systems, both in terms of land use and management as well as income

and livelihood. Conflict is considered since forests are often at the centre of conflicting interests, whereas the sheer movement of people from rural, urban and transnational spaces are some of the defining characteristics of the contemporary era with considerable effects on tropical forests and forest-dependent communities.

Donkey cart crivers, Senegal.
Photo © Terry Sunderland

Conflicts in and about forests

About 243 million hectares of the world's closed forests are located in areas affected by conflicts since 1990 (De Koning et al., 2008). A substantial body of scholarly and grey literature has been devoted to conflicts that emerge from competing claims and interests - commercial, subsistence and cultural - over resources in forested landscapes. This section focuses on how conflicts, spill over into forested landscapes as well as on conflicts that are endemic to forests themselves. The impact of such conflicts on forests and food security can be understood in terms of direct access to foods sourced from forests and indirect effects on food security, for example, via wood for fuel which is essential for cooking in many countries of the world.

During the past 20 years, armed conflicts have struck forest areas in more than 30 countries in the tropics. The prominent examples include Cambodia, Democratic Republic of the Congo, Liberia, Myanmar and Sierra Leone where rebel warfare largely played out in remote cross-border forest areas (De Koning et al., 2008). Africa is home to most of the forest at risk whereas Asia has the highest number of forest dwellers at risk (De Koning et al., 2008). An estimated three-quarters of Asian forests, two-thirds of African forests and one-third of Latin American forests have been affected by violent conflict (de Jong et al., 2007). The mere overlap between forest and conflict areas does not necessarily mean that the forest or forest rights have any role to play in motivating or perpetuating conflicts. However, because of the risks involved due to instability and insecurity, it can be assumed that these areas only serve in a limited way as a source of food.

Studies on the correlation between countries' forest cover and the emergence and duration of civil conflict show contradictory results (e.g. Collier and Hoeffler, 2001; Lujala, 2003; Rod and Rustad, 2006). Nevertheless, different studies identified that forests can facilitate or prolong conflicts, for example through flows of finances to competing parties, use of forests for patronage, transport of weapons by loggers, agriculture and hunting pressures, and social and economic buffers. For instance, forests and forest products have been exploited by armed groups, (e.g. military and rebels) to strengthen their fighting capacities (see for example, Baral and Heinmen, 2006, for Nepal; Dudley et al., 2002; de Merode et al., 2007, for the Democratic Republic of the Congo). General implications of such conflict on food security of forest dependent communities are difficult to predict. Armed conflict can weaken pre-existing institutions governing access to forest food but it can also offer new and extra-legal channels. Effects on food security and nutrition depend on the larger political economy in which the conflict is situated and the interaction with the formal and informal institutions that govern the forests. For instance, de Merode et al. (2007) note that there was a fivefold increase in illegal trade of bushmeat for local consumption and sale during the civil war in the Democratic Republic of the Congo. In contrast Baral and Heinmen (2006) highlight that the Maoist movement and ensuing civil conflict in Nepal between 1996 and 2006 largely undermined both conservation efforts and the livelihoods of local people by hampering their ability to derive income from forests and limiting households' access to food and nutrition.

Conflicts can also be more endemic to forested landscapes (de Jong et al., 2007). These tend to be localised and non-violent, though some may escalate to violent armed conflicts. Through an analysis of forest-related conflicts in five Asian countries, De Koning et al. (2008) classify such conflicts as emerging from the following, interrelated factors: (a) contested statutory and customary *tenure*, (b) exclusionary conservation and economic development policies, and (c) poor coordination between land use planning agencies. For example, conflict between local communities and oil palm plantation corporations in Indonesia due to overlapping claims over land and weak protection for customary land rights, illustrates the first type of conflict (Colchester and Chao, 2013; Li, 2014; Sheil et al., 2009). The implications of such conflicts over oil palm expansion (as is the case of large-scale land acquisition for other agricultural commodities such as soy) are ambiguous from a food security perspective. On the one hand, the rapid expansion of oil palm is driven, to a large part, by demand for cooking oil among poor and middle class households in Indonesia domestically (26 percent) and internationally (73 percent) (Obidzinski et al., 2012). On the other hand, such expansion is displacing local people and undermining their source of food and income through loss of direct access to landscapes that were previously used for food provisioning and thus changing incomes and livelihoods. Similar conflicts can be observed in other countries where industrial use of forestry and weak forest tenure interplay, affecting in particular indigenous peoples. These issues are not only prevalent in the tropics, such as in South America where forests have been replaced with forest plantations

by global forest enterprises (Kröger, 2012), but also in temperate regions such as in the north of Scandinavia, where there are reindeer herding conflicts (Raitio, 2008).

From a gender perspective, conflicts over forest products are often covert and confined to the intra-household level due to different preferences for forest and tree products and unequal access to them (Agarwal, 2010; Rocheleau and Edmunds, 1997; Sarin, 2001; Schroeder, 1999). In their seminal research in sub-Saharan Africa, Rocheleau and Edmunds (1997) find that although property rights are gender exclusive and women lack formal titles to individual or communal land, women still enjoy *de facto* rights to fuelwood, certain plants and animals. However, in areas that have undergone commercialisation of forest products, a remapping of the boundaries often occurs. Men as strategic actors bypass women's micro-rights and maintain their privilege in the landscape. Similarly, Elias and Carney's (2007) study of the shea tree (*Vitellaria paradoxa*) in Burkina Faso shows that rural women have historically collected, marketed and transformed shea nuts into multi-purpose butter for consumption and sale. The growing global trade in shea butter supplied to food and cosmetic industries represents an opportunity to further poor women's incomes, although such international sales have also led to a re-configuration of rights and claims over shea tree with many women losing access as a consequence. Both these studies suggest that women contest their loss of access at the household level but this does not amount to substantive changes in tenure regimes.

Livestock feeding, Labe, Guinea.
Photo © Terry Sunderland

Relative poverty and inequality

This sub-section mainly focuses on social and gender balance questions concerning relative poverty and inequality. The relationship between poverty and food security from the perspective of per capita income will be described in Section 4.4 on economic drivers.

A wide range of studies note that rural poverty and remaining natural forests tend to share overlapping spaces. A significant proportion of people suffering from extreme poverty live in forest-based ecosystems (Mehta and Shah, 2003 for India; Sunderlin and Huynh, 2005 for Viet Nam; World Bank, 2003; Zhou and Veeck, 1999 for China). Sunderlin et al. (2005) posit that these are likely to be a product of some of the following interrelated factors: (a) most forests and extremely poor people are located in remote areas and out of the reach of the market economy and technological processes; (b) forests are often a refuge for poor and powerless peoples; (c) forests have "pro-poor characteristics" because they are open access or have low barriers to access. Nevertheless, communities who either live in forested landscapes and/or who rely on forests are neither homogeneous nor uniformly-dependent on forests. Existing distribution of power and the structure of incentives mediate who can access, use and control forest products for consumption, income and livelihoods (see also Section 4.5 in this chapter).

Research on the equity dimensions of community forestry in Nepal demonstrates that poor and rich households do not have symmetric opportunities to benefit from forest resources. Adhikari et al. (2004) present an econometric analysis of the impact of the private endowments of forest user group member households on forest access for consumption purposes. Using data from the Middle Hills they find that poorer households face more restrictions in accessing forest products than less poor or relatively better off households (see also Chapter 3). In the Terai region of Nepal where societal inequalities are even more pronounced and forest products are of higher value, Iversen et al. (2006) found that households that belong to the richer echelons of user groups have a vested interest in maintaining the widely observed practice of charging a subsidised member price for high-value products such as timber. By being required to pay in advance, poorer households are excluded from accessing high-valued products. Richer households on the other hand, derive considerable income by ensuring that there is a high margin between member price and market price when re-selling high-valued products in the local market, and thereby, siphoning off disproportionate benefits from communal resources. Similar findings of "elite capture" and the spill over of pre-existing societal divisions in the allocation of forest products for consumption, income and livelihoods have also been observed by other analysts in the context of sub-Saharan Africa, such as by Coulibaly-Lingani et al. (2009) for Burkina Faso, and Jumbe and Angelsen (2006) in Malawi.

Most analysts agree that increasing women's active participation in the institutions established to govern access and command over forests would support both women's empowerment and household food provisioning (UN Women, 2014). This is particularly relevant since both unpaid care work (cooking, taking care of children and the elderly etc.) and collection of food, firewood and

fodder from forests are acknowledged as highly feminised tasks across the world (UN Women, 2014). Research findings show that women's participation in forest governance is lagging behind in many different contexts from South and East Asia to Latin America and sub-Saharan Africa (Agarwal, 1997; Agarwal, 2001; Mai et al., 2011; Mairena et al., 2012; Mukasa et al., 2012; Nightingale, 2002; and Sarin, 2001). Agarwal (2001) attributes women's limited voice and influence in forest governance regimes to gender inequalities in men and women's personal and household endowments. These inequalities manifest themselves in terms of women's low bargaining power vis-à-vis men in negotiating for their interests in forests at the household and community levels. Coleman and Mwangi's (2013) cross-country study in Bolivia, Mexico, Kenya and Nicaragua has identified two main determinants affecting women's participation in forest governance: education of household heads and institutional exclusion, which in turn supports Agarwal's analysis from South Asia (for more information about governance and gender inequalities see Chapter 3 and Section 4.5 in this chapter).

Demographic change: migration, urbanisation and agrarian transformation

In 2013, the world population totalled 7.2 billion and it is projected to reach 9.6 billion by 2050, with most growth in developing regions, especially Africa (UN, 2013). Consequently the demand for food, feed and fibre will increase and the land area per capita to feed all the people will decline. Some analysts such as Vanhanen et al. (2010) conclude that without improved agricultural productivity, rising food demands will result in increasing deforestation and forest degradation to make way for agriculture. But others point out that trade-offs between agricultural intensification and food production are also equally possible. Through a review of historical and cross-country studies, Angelsen and Kaimowitz (2001) concluded that the impact of intensification, is dependent on technology type (labour-intensive or capital-intensive); farmer characteristics (income and asset level, resource constraints); and context (policy incentives, market conditions etc.) (Angelsen and Kaimowitz, 2001). While of high relevance, population growth is not the only demographic driver pressuring on the forest-food system; interrelated drivers include changes in consumption patterns (see Section 4.4 in this chapter), migration, urbanisation and agrarian transformation.

Although migration of people is by no means a new phenomenon, the sheer number of people moving between rural and urban areas and transnationally is unprecedented. The UN's Economic and Social Council (ECOSOC) (2013) estimated that in 2010 alone, the number of international migrants was approximately 214 million, while internal migrants totalled 700 million. These were merely documented figures and are likely to be far surpassed. While international migration has become one of the defining features of globalisation, the world's population is also increasingly becoming urban. To date 54 percent of the world's population resides in urban areas with an expected increase of 11 percent by 2050 (UN, 2014). North America, Latin America and the Caribbean, and Europe are considered the world's most urbanised regions. Although Africa and Asia remain mostly rural, urbanisation is expected to be faster in these regions than in the others (UN, 2014). Small cities and towns in Asia, Africa and Latin America that lie in or near tropical forest areas are likely to experience the greatest magnitude of urbanisation (UN, 2011).

From a food security perspective, these trends have important implications for availability of, access to and relative dependence on forest products for food and income. However, research on the nexus between migration, urbanisation and forests remains very limited, let alone from a food security perspective. Forest governance involves territorialisation and the bounding of people to specific geographies. Hecht (forthcoming) calls for going beyond the conventional wisdom that sees migration as either disruptive to forest systems or as a livelihood failure. Instead, rural communities are increasingly multi-sited and dispersed, continuing rural production even as they depend also on other sources of off-farm income.

Major mechanisms through which migration and urbanisation affect rural communities and forests include: land abandonment, remittances, changes in rural labour availability, variations in the gender composition of households, and shifting demands of urban consumers on agricultural land and rural resources (Brondizio et al., 2014; Padoch et al., 2008; Parry et al., 2010). Much of this research is focused on forest cover and income and has not yet been concerned with implications for food security and nutrition more directly, although potential implications can be inferred. For instance, research in the state of Amazonas in Brazil is showing that the persistent marginalisation of remote, forest-based communities (due to a combination of long distances from markets, persistent under-investment in infrastructure and educational facilities) is compelling these communities to migrate to peri-urban areas. While such an exodus might present opportunities from a conservation perspective, it is likely to be changing their use of forests for food and fuel, and rendering them more dependent on market vagaries for food provisioning (Parry et al., 2010). Findings from scholarly literature suggest that migration and associated remittances are reducing relative dependence on forests for consumption, income and livelihoods. This is in turn, leading to a decline in land change from forest to agricultural land (Eloy et al., 2014 for Brazilian Amazon; Hecht and Saatchi, 2007 for El Salvador; and Schmook and Radel, 2008 for Southern Yucatan, Mexico) as remittances are being used to buy food rather than to produce and source food from forests.

Urbanisation can have contradictory implications on forests and tree-based systems for food security and nutrition. On the one hand, urbanisation can lead to a reduction in forest food consumption patterns, with more emphasis on processed products and food safety (see Section 4.5). On the other hand, research also shows that urban populations can maintain their rural consumption patterns with

considerable effects on land use and management. In sub-Saharan Africa, for instance, the rate of urbanisation is level with rising demand for fuelwood consumption. In other words, urbanisation has not accompanied a decline in fuelwood consumption patterns as previously expected (e.g. Zulu, 2010 for Malawi). These findings are also supported by research in Amazonia showing that rural-urban migrants keep their forest product consumption patterns in cities and continue to play a role in rural land use decisions (Padoch et al., 2008 for the Amazon; Tritsch et al., 2014 for French Guiana). Arnold et al. (2006) undertook a global analysis of woodfuel demand and supply which showed that there is no need for large-scale forestry interventions devoted to the provision of fuelwood for urban consumers as was hypothesised in the 1970s due to steady supplies from rural areas. But the growing urban demand for charcoal is likely to impact on tropical forests and poor, rural users in Africa in particular as they compete with urban consumers.

Migration and urbanisation have led to profound changes in socio-economic systems and have contributed to the feminisation of rural landscapes in many contexts (Deere, 2005; DeSchutter, 2013). Agarwal (2012) is careful not to insinuate that migration is causing feminisation, rather that the agrarian transition or the shift of workers to industry and services, and from rural to urban areas in developing countries, has been gendered. The proportion of women workers in agriculture increased across developing countries, in particular in South America and Oceania. According to Agarwal (2012), women farmers lack access and command over credit, land, production inputs, technology and markets. Hence, she argues that effects of volatile food prices and projected effects of climate change will very likely have a disproportionate impact on women as farmers and providers of household food. Scholarly literature focusing on the nexus of gender, migration and forest governance yields contradictory results in terms of whether male out-migration can empower women to play a bigger role in forest decision-making and enjoy greater access to forest products for themselves and their families. In Nepal, for example, transnational migration and remittances are emerging as major sources of employment. Migrants in Nepal are exclusively men due to a combination of intra-household constraints and governmental restrictions on women migrating. Giri and Darnhofer (2010) understand male out-migration as an opportunity for increasing women's access to forest resources and power over forest governance. An ethnographic study by Basnett (2013) indicates that this opportunity very much depends on interlocking gender and social differentiation.

While many countries are experiencing a "disappearing of peasantries" with declining contribution of agriculture to national economies and labour allocation to agriculture, others are witnessing a "repeasantrisation" as is evident in tropical forested landscapes (Rigg and Vandergeest, 2012). The latter trends are particularly evident in Southeast Asia and the Amazon in the face of commodity booms and large-scale, agro-industrial plantations of oil palm, rubber, pulp etc. (Kaimowitz and Smith, 2001; Wunder, 2001) and the resultant absorption of labour back to rural areas. For instance, Li (forthcoming) points out that rapid expansion of oil palm plantations in West Kalimantan (Indonesia) has accompanied significant deforestation, the dispossession of indigenous peoples' access to rubber and rice smallholdings and a casualisation of employment of plantation workers. Migrant labourers are compelled to bear all risks associated with migrating and being apart from their families; they have limited control over their work environment and scant means to negotiate for change. Indigenous Dayaks in comparison, lose access to forests and trees on which they had relied for direct food provisioning, income and livelihood. Food security amidst declining mosaic landscapes is therefore a challenge for both migrants and indigenous people alike.

4.4 Economic Drivers

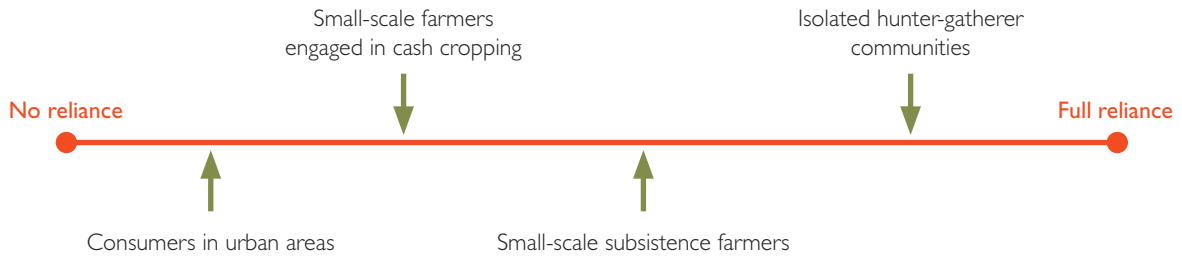
This section provides an overview of the main economic drivers affecting the relationships between on the one hand, forests and tree-based systems, and on the other, food security and nutrition, documenting and illustrating the main points using materials featuring a range of products (e.g. bushmeat, fruit, nuts etc.) at different scales (global, regional, national, local). It does not include related general topics, such as the identification of economic drivers that contribute to increased urbanisation which affects general food consumption patterns. We distinguish two types of driver impacts: (i) economy-wide derived impacts, such as the impact of a new national food safety policy on bushmeat trade and consumption; and (ii) site specific indirect impacts from economic activities that only influence food security through other mechanisms, such as the construction of roads into forest areas supplying forest foods.

As is the case for food security more broadly, there are no generally accepted indicators to measure the diverse and contextually variable forest and food security relationships (Carletto et al., 2013; Coates, 2013). Economic drivers may hence impact differently across locations, actors and time. This is illustrated and exemplified in the forest-food security reliance continuum in Figure 4.2 Forest foods contribute to food security in two main ways: (i) directly through the provision of nutrients, and (ii) indirectly through generation of income, typically through cash sales (see also Chapter 2).

While it has long been recognised that forest foods can be important for food security (e.g. Bharucha and Pretty, 2010; FAO, 1989; Pimentel et al., 1997) there is scant quantitative information on the economic importance of forest foods in most locations and at all scales, including household and nationally. Angelsen et al. (2014), in a study of around 8,000 households in 24 developing countries found that, in terms of household incomes, food products constituted the second most important group of forest products and the most important from non-forest environments. Forests have also been found to provide famine foods in response to multiple adverse events

The forest food security reliance continuum, with examples (based on Smith-Hall et al., 2012)

Figure 4.2



(covariate shocks) and income in response to isolated adverse events (idiosyncratic shocks) (Dewees, 2013; Ngaga et al. 2006; Wunder et al., 2014). Forest foods are mostly traded locally or sub-nationally in non-transparent markets marred by problems including inefficiencies leading to high losses, seasonal supplies, lack of credit facilities and rudimentary knowledge of consumer preferences (e.g. Grote, 2014; Jamnadass et al., 2011; Vinceti et al., 2013).

There appears to be a continuum of forest food product commercialisation (see also Chapter 2): from products that are occasionally bartered in villages, to small-scale trade in regional markets along informal chains, to national and international trade along formal chains. The private sector appears to play a prominent role everywhere. Furthermore, products move along the continuum in response to changes in demand and supply; for example, cashew and shea nuts have moved from wild collection to domestication and cultivation in West Africa as has grasscutter farming. Homma (1992) provides an overview of domestication processes. Products and actors at different points on the continuum are impacted differently by economic drivers. For example, the impact of sustainable harvest certification initiatives will have a larger impact on internationally-traded spices than on locally-bartered fruits. In addition, there will be variations in data availability; for instance, there is usually no national data available on products that are harvested and traded in informal markets, such as forest foods in West Africa (Bertrand et al., 2013) and spices from the Himalayas (Olsen and Helles, 2009). The nature of appropriate public policy responses will also vary along the continuum. In the following sub-sections, we review state-of-knowledge on four key economic drivers.

Income per capita

Global per capita gross domestic product (GDP) is steadily increasing, except for a short downturn in 2008-09 due to the global financial crisis, and has been termed a global mega-trend driving per capita demand for food (Cassman, 2012). As income increases, households' demand for food increases less than proportionally (Engel's Law, see Cirera and Masset, 2010) and there is generally a dietary shift with decreasing importance of starchy staples (e.g. rice, wheat) and increased consumption of meat, fish, fruits and vegetables (Cassman, 2012; MEA, 2005). It has been noted, however, that higher incomes may not lead to improved food security if the additional income is spent on other items such as clothes, cell phones or tobacco (Dewees, 2013). In their above-mentioned survey, Angelsen et al. (2014) found forest food income to range from USD 49 (in purchasing power parity) in Africa (five percent of total household income) to 717 (15 percent) in Latin America, with a global average of 128 (six percent). There are few examples of how price changes impact forest food resources and their management; in an excellent study of timur (*Zanthoxylum armatum*, a small tree yielding fruits used for spices and condiments), Hertog and Wiersum (2000) show how increasing market prices drive intensification of forest management including a shift of production from public to private lands.

There are four main issues to note in relation to rising incomes and forest foods. First, many forest foods are likely, in economic terms, to be inferior goods (demand decreases with rising incomes and increases with declining incomes) and rising incomes would thus mean less forest food production extraction and reliance. Delang (2006) notes, however, that forest food gathering is important in many rural communities with low economic growth, and likely to remain so. It is also noteworthy that forest food consumption is increasing in some high income countries, e.g. in northern Europe apparently in response to perceptions that food should be locally grown, organic and aesthetic, indicating that we need to understand the dynamics of forest food consumption better. Second, rising per capita income is one of the factors driving the expansion of supermarkets in much of the global south (e.g. Humphrey, 2007; Reardon and Hopkins, 2007). This is likely to have long term impacts on traditional markets and outlets for forest foods, such as fresh fruit, including through a shift away from spot purchasing and introduction of grades and standards; all changes indicating an ongoing fundamental restructuring of many forest food markets. It may also potentially lead to impacts on nutrition. Third, there is large variation geographically and along the commercialisation continuum. For instance, per capita GDP in Africa grew from USD

1,400 in 1991 to USD 1,700 in 2008 (Groningen Growth and Development Centre: Total Economy Database) and the level of per capita income appears to be too low for households to make the transition to consumption of industrially-processed products, meaning that forest food products still play a key role in calorie intake and dietary composition in poorer households (Okojie and Shimeles, 2006). Fourthly, with rising incomes and urbanisation, people tend to eat more meat and milk products, for example, increasing the demand for crops as feed (Grote, 2014). This may also impact forest foods, notably demand for bushmeat. Urbanisation may also increase demand for semi-processed foods as the opportunity costs increase as women find employment which could increase processing of forest foods, and is also likely to lead to more focus on food safety and labelling, which could challenge small-scale producers of forest foods.

Absolute and relative food prices

Absolute food price levels directly affect household-level food consumption choices. Recent spikes in key agricultural food commodity prices in 2008-09 and 2010-11 affected the livelihoods and food security of millions of people (Akter and Basher, 2014; Brown et al., 2009; FAO, 2008) and led to riots (Berazneva and Lee, 2013). Studies indicate that country and regional agricultural food prices behave differently from international food prices (Brown et al., 2012; Minot, 2014) due to low integration of local and regional markets into international markets. Data on forest food prices appear very limited; it is difficult to collect, due to the high number of products and the frequency of informal trading, and thus not systematically monitored. Such data deficiencies impede our ability to analyse and understand forest food price dynamics.

There is also a price volatility difference within regions or countries. For instance, Minot (2014) observed higher agricultural food price volatility in main cities than in secondary cities, indicating different effects of price changes on different segments of society. Assuming that forest foods are mainly traded outside main cities, this would indicate less price volatility for such products. Agricultural food price increases impact most severely on the poorest households and particularly so if they are female-headed (Akter and Basher, 2014; Benfica, 2014; Drimie and McLachlan, 2013); the reason may be that such households do not have the asset base required to smooth income or consumption shortfall. A recent study specifically found that asset-poor households are most likely to use forests as part of their coping strategies (Wunder et al., 2014). It has also been observed that fluctuating agricultural food prices can decrease local food production and reduce employment opportunities (Tiwari and Joshi, 2012) and that price spike patterns and associated inadequate public policy responses may follow a repeating pattern in some countries (Ellis and Manda, 2012). Balancing national food availability with affordable food prices can be challenging (Haug and Hella, 2013). In terms of household-level food security, however, it has been noted that households can respond to rising agricultural food prices in different ways, such as downgrading food quality to maintain quantity, that serve to limits the nutritionally harmful effects of higher prices (Gibson, 2013).

There are close linkages between food, energy and financial markets that may explain much of the recently observed agricultural food price spikes and volatility (Grote, 2014; Tadesse et al., 2014). In particular, rising fossil fuel prices and biofuel policies may be a key driver of high grain and oilseed prices as biofuel production becomes financially more attractive (Gorter et al., 2013; Grote, 2014; Tokgoz et al., 2012), a situation that may be exacerbated by increased speculation on agricultural commodity markets (Grote, 2014). These processes, in combination with insecure property rights (Godfray et al., 2010), could contribute to land grabbing – the process of appropriating land and resources to produce commodities and accumulate wealth (Nevins and Peluso, 2008) – in the global south, with differential geographical impacts on forest food products. For instance, economic growth in China and the associated demand for wood fibre has arguably led to state-sanctioned corporate land grabbing in Lao PDR that has negatively affected local people's access to forest food products (Barney, 2008) while the same economic growth has simultaneously improved the possibilities for high altitude Himalayan communities to sell wild harvested products on new markets (Shrestha and Bawa, 2014).

Training tree nursery workers in Zaraninge Forest Reserve, Tanzania. Photo © PJ Stephenson

Markets and policies

The linkages between forests and food security reflect a wide range of policy interests related to health, development, human rights, biodiversity conservation, forests, food, trade and agriculture. Forest foods present a highly complex challenge to public policy institutions at different scales due to the wide range of potential user groups, the diverse motivations that drive collection and the lack of reliable data and information on trade flows, nutritional values and consumer preferences (Johns and Eyzaguirre, 2006; Toledo and Burlingame, 2006; Vinceti et al., 2013). There is also a high degree of variability in the levels of

product collection, processing and marketing in different forest food product value chains making monitoring and regulation difficult. According to the FAO (1997), the non-timber forest product (NTFP) sector is generally dominated by the rural poor and labour-intensive small-scale industries, making it important for policy mechanisms to carefully differentiate between subsistence and commercial forest food activities. Here, equitably managing resource access becomes a key challenge for policy due to the generally low barriers to market entry and broad participation by both women and men in forest food collection (Arnold, 2008). While the subsistence-based forest food sector tends to have less impact on forest resources than the commercial sector (Neumann and Hirsch, 2000), it is often difficult for policy frameworks to effectively separate these activities due to the dynamic nature of forest food markets, which are often highly seasonal, and where products classified as "traditional"can quickly become commercial and where "commercial" products can be replaced by substitutes (FAO, 1997). When considering the ongoing structural transformations that have been occurring in the agricultural sector (in a wide sense), other important policy issues affecting commercial forest food production and trade include the urban demand for safe, responsibly-produced and high quality foods that is driving processes of certification and labelling (Grote, 2014) and the need to simplify regulatory regimes to reduce transaction costs for producers and develop a framework supporting producer organisations (Dewees, 2013).

International bodies of particular importance to forest food markets include the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which limits and regulates the trans-border trade of many wild food species also in relation to forest foods such as bushmeat (e.g. Bennett, 2011); the Millennium Development Goals (MDGs) which seek to reduce hunger and poverty while maintaining ecosystem services, *inter alia* leading to more focus on the green economy including the importance of forest food products to livelihoods (e.g. Rasul et al., 2012); the Convention on Biological Diversity (CBD) which assures the protection of genetic, species and ecosystem diversity and the World Trade Organization (WTO) which regulates the trade policies of nations and products, requiring clear and agreed standards and definitions to enable commercialisation (Precillia Ijang et al., 2011). The impacts of these global institutions are contested in scholarly literature as they might lead to perverse effects. For example, critics of the WTO argue that the liberalisation of commodity trade and reduction of farm protection resulted in food dependency of substantial areas in the global South (Lawrence and McMichael, 2012).

Recognising that forest ecosystems are likely to play their most important role in household food security through diversifying diets and providing essential sources of nutrients, a number of observers have called for greater policy integration focused around meeting the nutritional and health needs of local resource users (Arnold, 2008; Bharucha and Pretty, 2010; Johns and Eyzaguirre, 2006). Improving the sustainable utilisation of diverse forest foods to support food security and nutrition likely will involve engaging local users in research and decision-making processes, facilitating information flows, enabling access to credit and markets, developing community-based education programmes, supporting the development of user/producer organisations and improving efficiency by reducing transaction costs or encouraging technology adoption and innovation (King, 2008; Shumsky et al., 2014; Tontisirin et al., 2002).

Production system changes

Production systems refer to the general production structure in a country that influences land use patterns. The type, size, location, and dynamics of production systems are *inter alia* determined by economic incentives, for example, in response to new or collapsing markets influenced by processes of globalisation, certification or changes in market efficiency. Two examples in relation to forest food products are: (i) formerly subsistence bushmeat products being commercialised and entering informal value chains as new demands and urban bushmeat markets were created by processes of urbanisation in Benin (Bertrand et al., 2013), and (ii) the currency devaluation in Brazil in 1999, combined with an international price increase of soybeans and beef, and control of hoof and mouth disease, leading to large scale soybean and cattle production in central-west Brazil (Chomitz, 2007), replacing forest food producing savannah woodland (de Souza and Felfili, 2006). Predicting rates of change for individual production systems is difficult, as is quantifying the impact of changes on forest food production.

4.5 Governance

Governance includes traditional state-centric decision-making as well as broader-based processes at a range of different scales. These broader systems of "governance" are not just driven by states and their domestic ambitions, but also by global markets and by a range of non-state actors that include civil society, businesses and international non-governmental and governmental organisations. This section explores the role of governance as a driver of forest-related goals and policies, and the implications for food security and nutrition of different stakeholders.

In recent years, three main drivers can be identified in the shift from state to more broad-based decision-making regimes in the forest sector: globalisation, ecosystem service thinking and economic valuation. Firstly, regarding globalisation, forest governance has historically been driven by social, economic and environmental imperatives of states (Sikor et al., 2013; Vandergeest and Peluso, 1995), but the interests and influence of global and non-state actors have progressively widened and deepened due to both expanding and new frontiers of financial investments (Muradian et al., 2013; Murray Li, 2007; Sullivan, 2013). These local to global stakeholders are connected across scales by value chains and their incipient public and private producer and trade standards regimes (McDermott et al., 2012), by civil society mobilisations

for forest and food justice (Martinez-Alier, 2014; Schlosberg, 2013; Sikor and Newell, 2014), and by emerging global socio-ecological narratives such as that on planetary boundaries (Rockström et al., 2009).

Secondly, regarding ecosystem services thinking, this framework has gained enormous buy-in as a means of (re) conceiving the relationship between humans and ecosystems, including the view of humans as separate to nature, and nature as a provider of services to humans. The ecosystem services framing has influenced thinking about the relationship between forests and food security (Poppy et al., 2014a; Poppy et al., 2014b) and has been successfully promoted by important science-policy platforms, including the recently formed Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), and major conservation non-governmental organisations (NGOs) (Turnhout et al., 2013).

Thirdly, regarding valuation, there has been a revalorisation of rural landscapes, in terms of financial, political and cultural values attached to particular goals and practices (Sikor et al., 2013). For example, in the wake of food price inflation in the late 2000s, crop yield narratives received a boost and there was a re-emphasis on highlighting lands that were considered underutilised or producing only a fraction of their yield potential (e.g. in statistical databases, maps, World Bank reports). It has been argued that this shift in how lands were valued globally has contributed to governments supporting policies that facilitated the global land rush (Li, 2014). Similarly, use of the ecosystem services framework has generated financial valuation of forest hydrological and carbon storage services. Such new forms of valuation provide legitimacy to particular forms of governance such as state regulation to protect downstream and global citizens, or public-private partnerships to market forest carbon offsets. However, the incorporation of new, global values as drivers of forest governance also pose risks, with some stakeholders under threat of losing control over previous ways of valuing and governing forests (Hunsberger et al., 2014; Martin et al., 2013b; Pascual et al., 2014).

State-focused governance

Although the rising influence of global discourses, institutions and markets has created significant shifts in governance regimes over tropical forest-agrarian landscapes, there are numerous instances in which the influence of national states and sub-national actors has been retained and even reinforced. Some states still exercise considerable control over the way land is allocated to different uses (Sunderlin et al., 2008; White and Martin, 2002), and the way in which property rights and tenure are regulated, including public versus private and commercial use, the establishment of protected areas and the exploitation of land for agriculture (Sikor et al., 2013).

There is considerable variation amongst countries which continue to adopt a state-centric approach to governance. The dominant discourse and scope of state interests differs dramatically. Instruments may range from top-down implementation of policies to delineate the landscape into categories with associated rules, to participatory land use planning exercises or even the designation of indigenous lands for decentralised governance. Hence the impacts of such approaches on the food security of forest-adjacent populations are varied.

State-focused approaches to governance of forests and surrounding landscapes endure particularly in certain circumstances: where states seek to maintain political control over economic activity and development; in circumstances in which tenure and land use are considered by central governments to be related to issues of internal security; where the state seeks to reconcile the interests of different ethnic and minority groups; and where land management is part of the process of defining citizenship itself (Beswick, 2011; Lestrelin et al., 2012; Li, 2010). Under these conditions, rapid modernisation of agriculture is commonly promoted and traditional practices such as *shifting cultivation* and inter-cropping are disincentivised or even discriminated against (Fox et al., 2009; Padoch and Pinedo-Vasquez, 2010). For example, in Lao PDR participatory land use planning has been employed by the national government with the explicit purpose of ending shifting agricultural practices and stabilising cultivation among ethnic minorities in mountainous outlying regions (Lestrelin et al., 2012). Some, or even many, people may benefit from formalisation of tenure and modernisation of farming methods.

However, rapid, state-driven agrarian change can also have detrimental impacts on food security and nutrition among poor or minority local actors, including indigenous communities whose livelihoods and culture have been particularly tied to forest habitats, and who are least able and willing to adapt (Baird and Shoemaker, 2005; Dounias and Froment, 2011). Even where policies appear to decentralise forest governance and grant additional local powers, women or minority groups may be further excluded from decision-making processes or suffer from restricted access to food from forests (Sikor and Ngoc Thanh, 2007). Similarly, formalisation of property rights does not always equate to maintained or improved access to resources because negotiation processes – both formal and informal - involve many actors, and the effects on access within local food systems are uncertain (Andersson, 2004). Where ultimate control of tenure is exercised by the state, smallholder tenure over farmland and forests (and associated subsistence needs) may also be undermined by decisions made by powerful non-local actors, such as private corporations granted government concessions for industry, infrastructure or energy projects (Agrawal et al., 2008). This can occur through not only large scale land grabs but also "control grabs" which may involve the imposition of state-influenced contract farming arrangements to the exclusion of poor local actors and a reduced ability to grow or to buy food (Huggins, 2014).

State-focused governance regimes often create zones for different land uses which tend to partition the landscape (de Groot et al., 2010). This division of land is often mirrored in states' institutional structures, with separation of responsibilities across different government departments. The separation of forestry from agricultural decision-making is generally detrimental to integrated landscape management.

However, national scale approaches are not without their merits and may protect local populations from adverse effects of global market forces. Without state intervention, global markets and agendas can drive increased inequality and dispossession, through which local perspectives can easily be given lower priority than global goals such as carbon sequestration or biodiversity conservation (Arts and Buizer, 2009). Bolivia's approach represents a good example where the movement for indigenous rights has supported the granting of substantial autonomy over indigenous land rights as an "ethno-environmental fix" (Anthias and Radcliffe, 2013; Cronkleton et al., 2011). However, in many developing countries there is poor capacity to effectively decentralise environmental management (Tacconi, 2007).

State-focused governance can include renegotiation or even rejection of internationally-designed conservation instruments, to better fit the national context. While international discourses and influences are far from absent in these situations, they are instead transformed or negotiated to serve state interests. By such means, payments for ecosystem services (PES) and Reducing Emissions from Deforestation and Forest Degradation (REDD/REDD+) schemes have been "demarketised" into tax and subsidy arrangements. These may promote increased participation including of stakeholders with limited productive assets, for whom potential impacts on land and forest tenure, and associated food access may be averted (Bennett, 2008 and Sikor, 2013 for China; Cronkleton et al., 2011 and Uberhuaga et al., 2011 for Bolivia; Milne and Adams, 2012; Phelps et al., 2010). The development of REDD+ is also connected with fears about "recentralisation" (e.g. Phelps et al., 2010) affecting the use and dependence of local people on forests. Greater state and non-local control, for instance through the designation of protected areas directly impacts livelihoods and decreases access to food from the forest (West et al., 2006).

Governance beyond the state: markets and non-state actors

Multi-sectoral and multi-scale forms of governance do not replace state-focused governance of forests and tree-based systems for food security and nutrition, but become integrated in different ways, as noted above with reference to PES and REDD+. Systems for certifying ethical and sustainable forest management took off in the early 1990s after it became clear that a global forest governance convention was not going to emerge from the UN process (Strassburg et al., 2012). Certification is a market-based intervention typically involving standards that are established and monitored through networks of producers, NGOs and private sector partners. Some certification schemes like the Forest Stewardship Council (FSC) particularly stress their independence from governments whilst others prefer to have state government involvement. Even in the former case, governments remain influential through their control of the legal and policy levers that provide the operational context for forestry and food production (Hysing, 2009). In Tanzania, for example, the state maintains some control over price setting for commodities across the forest-farm landscape, including for tree food crops such as cashews.

Payments for ecosystem services were also originally promoted as non-state forms of governance, using market-based approaches to reducing deforestation and forest degradation (Ferraro and Kiss, 2002; Wunder, 2005). In practice, however, states have either been significant gatekeepers, determining what kind of PES is legitimate, or have actually instigated PES schemes as federal programmes for transferring resources to rural forest management (McAfee and Shapiro, 2010; Milne and Adams, 2012; Shapiro-Garza, 2013). Payments for ecosystem services exemplify the growing presence of hybrid governance approaches, operating across scales and with public, private and civil society involvement. Other key forestry sector examples include REDD+ and the EU's Forest Law Enforcement, Governance and Trade (FLEGT) initiative (Glück et al., 2010).

The past ten years have seen considerable optimism for the potential opportunities presented by these new governance configurations. In some cases, new market and network-based governance approaches are explicitly targeted at generating synergies between forest conservation and food security. For example, Brazil's Sustainable Agricultural Network is reported to be a rigorous system for ensuring that the Brazilian cattle supply chain is managed to reduce deforestation (Newton et al., 2014). This has a very high potential to achieve synergies between food security and reduced deforestation (Strassburg et al., 2014). More generally, forest certification, PES, REDD+ and FLEGT are not promoted as directly addressing relationships between forests and food security. However, it is probably fair to argue that managing this relationship has often been part of their rationale. First and foremost, these forms of governance respond to past concerns that state-based forest management has not often succeeded in linking forest conservation with local livelihood and food security (Adams et al., 2004; Ferraro, 2001; Salafsky and Wollenberg, 2000; Wunder, 2001). Secondly, PES schemes in particular respond to ecosystem services research that provides evidence of forest-food security linkage, such as the role that landscape biodiversity plays in achieving more productive and stable agricultural systems (Cardinale et al., 2012). Thirdly, concern about tropical deforestation has led global consumers to reflect more on how global food systems impact on both environmental sustainability and the livelihood needs of southern producers (Schlosberg, 2013).

Whilst optimism has been high, evaluations of the effects of certification and PES-based forms of governance present a mixed picture. There are already a number of reviews of the state of knowledge about the impacts of certification (Blackman and Rivera, 2011; Romero, 2013; Romero et al., 2013; SCR, 2012) and the impacts of PES (Miteva et al., 2012; Pattanayak et al., 2010; Samii et al., 2013; Wunder, 2013). These reviews highlight that evidence for both environmental and social outcomes remains quite weak, in part because of the difficulties and costs involved in undertaking robust impact evaluations, but also highlighting that these market-based approaches do not provide easy and readily scalable ways of improving sustainability across forest-food landscapes. The evidence base for fledgling REDD+ and FLEGT is even

more limited, whilst specific evidence relating forestry policies with food security outcomes is almost absent.

Often, market or incentive-based governance interventions are ill-suited to bringing about synergies between environmental and social goals, as shown by a growing body of research. One reason stated is that the logic of market efficiency stands in opposition to the need for equity that is so fundamental to distribution of basic needs such as food security. There is a specific literature related to forest and agricultural carbon markets that identifies constraints on achieving synergies between carbon mitigation and local livelihoods. Firstly, policy-making and funding for mitigation and adaptation tend to be separate (Klein et al., 2005; Locatelli et al., 2011), meaning that livelihoods and food security are not integrated with thinking about landscape carbon. Secondly, there is uncertainty about the effects of different carbon mitigation interventions on food security, partly due to lack of adequate monitoring (Harvey et al., 2014). Thirdly, there are factors that constrain communities and individuals from taking part in mitigation-oriented carbon and agricultural projects. Such access problems can result from unsuitable financing (Siedenburg et al., 2012), problems of tenure (Robledo et al., 2012), local inequalities arising from, for example, wealth and gender constraints (Brown and Corbera, 2003; Lee et al., forthcoming), and discrimination based on ethnicity or social histories (Martin et al., 2013a).

There remains considerable disagreement about whether market and incentive-based approaches to forest governance can overcome such problems and deliver synergies with local livelihood and food security. Some scholars argue that they have the potential to bring new streams of revenue to rural communities as well as enhancing ecosystem services that support food security in the longer term (Harvey et al., 2014; Smith et al., 2013). There is also some evidence that PES and certification improve land tenure security for local people. Despite being market-based, FSC certification can contribute to more rather than less democratic governance of forests (Dare et al., 2011; Meidinger, 2011). Furthermore, a major review of the effects of certification found cases where it enhances land tenure security for local people (SCR, 2012). Improvements in land security are also noted for PES schemes (Tacconi et al., 2013) and in some REDD+ pilot projects (Hoang et al., 2013; Maraseni et al., 2014).

In contrast, there are also many studies that highlight the risks associated with market- and incentive-based approaches. Studies of FSC and Rainforest Alliance operations have found that the costs of accessing certification outweigh the benefits, meaning low uptake of FSC in developing countries (Marx and Cuypers, 2010) and among smallholders (Auer, 2012; Gullison, 2003; McDermott et al., 2015), and a bias towards large producers (McDermott et al., 2015; Pinto and McDermott, 2013). Scholars show that in order for PES and REDD+ schemes to target those who are most able to (competitively) provide services, access to schemes has often been restricted to those with appropriate assets such as land (Porras et al., 2008) or education (Zbinden and Lee, 2005), favouring larger operations and wealthier farmers (Pagiola and Platais, 2007) and reducing opportunities for

Local market, Chittagong, Bangladesh.
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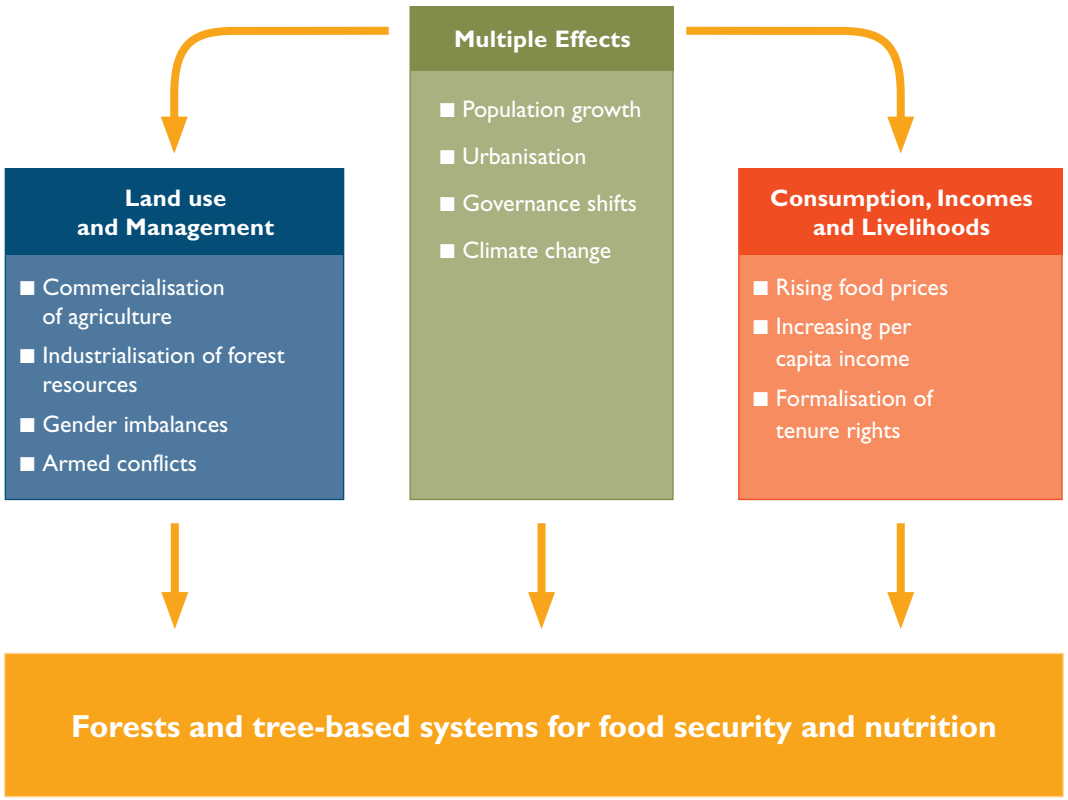
women (Boyd, 2002; Lee et al., forthcoming). The fact that certification and PES schemes tend to offer small returns also means that those who sign up tend to have low entry costs, suggesting that they are already at or near to achieving the required practices with very little management change required (Arriagada et al., 2009; Blackman et al., 2014; Gómez-Zamalloa et al., 2011; Honey-Roses et al., 2009).

One particular concern, expressed primarily in theoretical works, is that the economic valuation of ecosystem services, and their incorporation into global commodity markets, enhances the risk of local and indigenous communities being dispossessed of land and related rights and access (Büscher et al., 2012; Li, 2014; Matulis, 2014; McAfee, 2012). This is an important concern because it suggests that recently popular approaches to governing forests could directly threaten local conditions for food security. Careful research is required and it is important to note that empirical evidence to date is limited and suggestive that risks and outcomes vary considerably according to context. Studies of some certification processes, such as on the Roundtable on Sustainable Palm Oil (Silva-Castañeda, 2012) and the Roundtable on Responsible Soy (Elgert, 2012), find a democratic deficit that leads to marginalisation of smallholder concerns for food and livelihood security. In these cases, certification legitimises new partnerships between environmentalists, private sector agro-industrialists and recent migrant populations, threatening land security for indigenous and peasant communities and weakening their pre-existing relationship with NGOs (Elgert, 2012). In similar fashion, Ibarra et al. (2011) describe how an indigenous community in Mexico withdrew from a PES scheme because of growing concerns about loss of self-determination over its own food systems.

The role of market-based mechanisms in the provision of food security and nutrition from forests and tree-based systems is complex and ambiguous. It remains impossible to generalise and as with broader governance effects, context is essential to understanding the relationships.

Major drivers affecting forests and tree-based systems for food security and nutrition

Figure 4.3



4.6 Conclusions

This chapter aimed to provide an overview of natural and anthropogenic drivers affecting forests and tree-based systems, to understand how they affect food security and nutrition and to identify interrelations among them. For analytical reasons, these drivers were categorised as environmental, social, economic and governance.

Following our framework introduced at the beginning of this chapter forest- and tree-based drivers can affect food security and nutrition through changes in land use and management or through changes in consumption, income and livelihood. Some drivers affect food security in both ways (Figure 4.3).

The effects of the following drivers on food security and nutrition travel through land use and management as well as through consumption, income and livelihood:

- Population growth places pressure on forests and tree-based systems for food security and nutrition by changing consumptions patterns and by reducing the relative availability of food. Furthermore, population growth leads to changes in land use management forms, resulting in, for example, commercialisation of agriculture and industrialisation of forest resources;
- Urbanisation leads to changes in forest food consumption patterns, with more emphasis on processed products and food safety issues. These changes in demand also lead to changes in land use management, e.g. commercialisation of agriculture. When combined with male migration, urbanisation can lead as well to a change of gender balance in rural areas.
- Governance shifts from state-focused government to multi-sectoral and cross-scale governance present better prospects for integration of different interests and goals related to forest and food systems. The resulting (global) emphasis on ecosystem services can also bring opportunities for improved synergies between forest and food systems, changing management forms and changes of income and livelihood structures. However, when governed by market logics, such valuation poses risks to local control and access over resources.
- Climate change can directly affect the availability and quality of food and nutrition by the appearance of new species. It furthermore impacts forests and tree-based systems for food security and nutrition through forcing changes in land-use and adoption of management forms, and through changes in income from forest products. Climate change consequences are considered not to be gender-balanced and affect vulnerable groups the most.

The following indirect drivers lead to increased *food insecurity* and poor nutrition by forcing changes in land use and management:

- The increasing commercialisation of agriculture to feed a growing (urbanised) population is accelerating forest loss and thereby reducing the availability of forests and tree-based products for food security and nutrition.
- The industrialisation of forest resources (e.g. in plantations) leads to the displacement of local people and undermines the availability of and access to food and nutrition. This change of production format is often based on, and enabled by, weak forest tenure rights.
- Gender imbalances, with male domination, lead to the prioritisation of land uses involving commercial/timber products at the expense of food.
- Conflicts, and in particular armed conflicts, in forest landscapes can lead to exploitation of forest resources and undermine conservation issues. These conflicts often detach households from forests and tree-based food and nutrition. However, armed conflicts weaken institutionalised rules of the game and can also open new (illegal) access to food.

Another set of drivers impacts on forests and tree-based food security and nutrition by changing incomes and livelihoods:

- Formalisation of tenure rights fosters benefit sharing amongst those living in and with the forest. On the other hand, increased formalisation of tenure rights can contribute to increase vulnerability and reduce food security, in particular for the poorest.
- Rising food prices may be less pronounced for many forest foods than for agricultural foods as the former are primarily traded and consumed outside major cities. Data on forest food markets is, however, scant.
- Increasing per capita income changes households' food consumption patterns. This needs to be better understood in relation to ongoing changes in structure and operation of national and regional forest food markets. However, the gathering of forest food will remain important in rural communities with low economic growth.

The range and diversity of drivers demonstrate the interconnectedness between drivers and effects; for example, networked governance leading to gender imbalance can lead to the prioritisation of timber over food. Responding to these messy, interrelated sets of drivers with effective options is a major challenge of our time. This challenge is further exacerbated as the drivers of forests and tree-based systems for food security and nutrition do not allow for a generalisation of causal effects. Social structure influences whether the consequences lead to improvements for food security and nutrition or lead instead to increasing vulnerability. Determining factors are, for example, localities, with urban and rural situations gaining and suffering differently from changes; drivers of change might strive for and achieve positive effects for food security for some groups but result in contradictory effects for the poorest. Hence, responses to drivers need to ensure that they do not only address a relatively small number of elite, but also to find ways to incorporate the aggregated impacts of local, informal responses to drivers. Local stakeholders are in fact not only the most vulnerable, but it can be assumed that they are also the most sensitive to new and innovative response options. The challenge is to maintain the balance to ensure food security and nutrition, and at the same time ensure the sustainability of forests and tree-based systems.

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