

Social and Ecological Change in the Argan Woodlands, Morocco

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Foreword

I find it useful to briefly contextualize the origins of this work, just as it is often useful to understand where theories and ideas come from, so I will explain briefly my background, how I came to work on the argan woodlands, and how the topic evolved, from the first idea to this thesis.

I always enjoyed being «out in the wild», whether running in the woods, hiking in the mountains, swimming in a lake or camping in a sierra. Family holidays made for familiarity with the Alps, and the discovery of the Pyrenees I remember as a beauty shock. As a teenager, in part due to my interest for J. Krishnamurti's teachings, I became increasingly conscious that my wellbeing (and I thought, that of others, too) was intrinsically linked to the possibility of being in touch with nature. As I began traveling on my own further than family holidays had permitted, I came to know places where that nature was being changed at a pace much faster than I had ever seen at home, and the consciousness of the importance of «being in touch» soon turned into a concern that we might have less and less to be in touch with in the near future. Meanwhile, it also became clear to me that many people had little choice as to the way they used natural resources, and could hardly be blamed for overuse or mismanagement. Quite in range with my time, I was thus asking myself the question of whether there can be any *sustainable development* (and if yes, then how). It is because of that question that I studied Geography, and ended up doing a PhD - yet I can hardly say that I have found an answer.

My involvement with Morocco started with two and a half months summer holidays in 2001. I had been looking for a place exotic yet close enough, sunny, and with mountains. All that I found, and more: the landscapes were gorgeous, and it was definitely sunny. But what impressed me most was the rural way of life. Any visitor could feel the depth of tradition and history behind the little mountain villages, the comings and goings of their inhabitants, the small maize plots or the palm trees. This fascination for (exotic) traditions is something most first-time visitors experience in Morocco - and that the Ministry

of Tourism abundantly uses in its advertisement campaigns. For some it fades away with time, for others it persists - sometimes to the point of obscuring the fact that the Moroccan countryside actually *changes*, and fast. For me it was a little of both. A one-month experience drawing maps in an Oasis of the South deepened my interest in topology and in the traditional organization of land tenure and water management. But it was not before the beginning of this thesis that I came past the stage of fascination to start dealing with the complexities of present-day rural Morocco.

When visiting Morocco for the second time, I became aware of a story of people protecting trees because of a new product sold as a fair-trade good on European markets - argan oil. That simple story fitted well my worldview of the moment, eager as I was to demonstrate that it made economic sense to protect nature. So, later, I thought up a research topic around argan trees, argan oil, and sustainable development, contacted Eric Lambin and, with his support, found a funding and started a PhD on «The Moroccan argan forest: forest cover change, economic valuation and conditions for a sustainable use». At that time the main perspective was to be the economic valuation of ecosystem services, influenced by Robert Costanza and the ecosystem valuation literature. I also was to analyze forest cover changes from a land tenure perspective, referring to the literature on the commons around the works of Elinor Ostrom. The analyses were to be at the regional level, covering the whole argan forest, and the whole research had a strong normative component.

By the time of my mid-term assessment, I had realized that I would not be able to detect forest cover change at the regional scale, were I not to devote my whole PhD to it, and I had restricted the study area to a zone that had not yet been studied, and that could be monitored using very high resolution images. I had also discovered how strongly migration and globalization had shaped life in the argan region, and accordingly shifted the perspective away from the ecosystem valuation theory and commons management towards one more influenced by the literature on land change science, globalization,

and livelihood transitions. My research question became «what are the pathways of change in the argan woodlands?».

In the end, I have learned a lot, both in term of understanding the local environmental and social history and present dynamics, and in terms of learning the know-how of geography research: how to deal with field work and interviews, how to ask and answer relevant questions, how to link the particular with the general, and how to communicate results. And, of course, the more I learned, the more I became aware that most of the work lay ahead. Still, I hope that this thesis reflects what I have learned, and that the reader will learn something from it.

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both in the English and the French meaning of the word. Thanks finally to the many friends who shared bits of my life during these four years - I won't name you all here, but I am sure those who read these lines will recognize themselves...

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1. Introduction

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1.1. Objective and outline of the thesis

Humans have modified ecosystems throughout their history. But the scale and speed of human-induced changes to all types of ecosystems today is unprecedented. These changes are determined ever more by forces beyond the local, enmeshed in a worldwide web of interrelated places and actors. People and organizations around the world are becoming increasingly mobile, extending their horizons and agency beyond past boundaries and homes. Globalization is nothing new, but in the last half century it has taken new dimensions, as have ecological and social change.

Understanding the extent and the causes of these changes, and how they are related with each other and with the processes of globalization, has become a key scientific challenge. Policies designed to curb ecological degradation and manage social transitions can be effective only if they are based on deep understanding of the causes of change, and in this tremendously complex world, understanding is not a simple task. Geography, by considering the spatial dimensions of change, provides an appropriate framework to examine the complex determinants of ecological and social change in a way that transcends, to a certain extent at least, disciplinary foci. The ability of geography to integrate into a coherent whole the knowledge produced by the many disciplines working towards an understanding of parts of the earth social and ecological system makes it a useful base on which to build this deep understanding.

Although tropical deforestation has attracted most attention in the media, other biomes have been changing fast too. Drylands are home to more than two billion people, and cover over a third of the Earth's land surface (Uriel et al. 2005). They are also particularly sensitive to degradation (Reynolds et al. 2007), with 10 to 20% currently undergoing one or more forms of degradation (Uriel et al. 2005). Woodlands play an important role in some dryland environments, both socially, through the provision of various non-timber products, and ecologically, through the protection of soils, the maintenance of favorable micro-climatic conditions, and associations with other species (Malagnoux et al. 2007). They also constitute a non-negligible

part of the world's total forests: 6% of the world forests are dry woodlands.

The argan (*Argania spinosa*) woodlands are one example of dry woodland that covers about 950,000 ha in Southern Morocco, mostly between the High Atlas and the Anti-Atlas Mountains, in a region bordering the Sahara desert. They constitute a unique resource, and have long been central to the livelihoods of local populations, providing wood for construction, tool-making heating and cooking; fodder for goats and camels; shade for rain-fed crops; and an oil that is now a famous cosmetic ingredient in the western world, where it is sold at skyrocketing prices.

The argan woodlands are widely perceived to have receded strongly during the last decades, among other things due to the expansion of irrigated crops, logging, and overgrazing¹. In recognition of that threat and of the close relationship that binds local inhabitants with argan trees, the argan region was designated as a UNESCO «Man and the Biosphere Reserve» in 1998. It then became a champion of sustainable development, a concept that framed much of the subsequent policy interventions in the area. Argan oil marketing by women-owned cooperatives, in particular, was perceived as a solution for both improving rural livelihoods and protecting the forest. Efforts were made to plant trees, prevent logging, and support the emergence of argan oil cooperatives and local development associations. These efforts were carried to a large extent by national and foreign development agencies. Today the case of argan oil cooperatives is often brandished as a success story of conservation and development through the commercialization of local forest products. But despite the discourses on degradation and sustainable development, empirical facts and analyses are still largely absent. The picture of social-ecological dynamics in the region is dominated

¹ The term «overgrazing», when used in this text, refers to the traditional normative concept of grazing above the carrying capacity of an area. I am aware that both the concept of overgrazing and that of carrying capacity are disputed (see for example Davis 2004) and I will therefore refer to this term only when considering opinions, discourses and worldviews. When referring to the activity I simply use the term «grazing».

by «common sense» narratives that have yet to find empirical support.

This thesis contributes to the understanding of ecological and social change and their interrelations in dryland environments, with particular reference to dry woodlands. By examining both social and ecological changes over the last half century in a particular area, and linking these changes to dynamics at various scales, it tries to overcome disciplinary boundaries and build a comprehensive understanding of social and ecological change in the region, so as to inform policy and science. The objective of the thesis can be expressed as follows:

«Understanding coupled land cover and livelihood changes in a globalizing dry woodland region»

The background section below (Section 1.2.) defines and briefly elaborates on each expression in this phrase: dry woodland region (Section 1.2.1.1.), land cover changes (Section 1.2.1.2.), globalization (Section 1.2.2.), and livelihood changes (Section 1.2.3.). This is followed by a description of the case study - both the general settings of the argan woodland region, and the study area itself (Section 1.3.), and by a section describing fieldwork and data (Section 1.4.).

The rest of the thesis is organized in three parts. Chapter 2 focuses on the extent and proximate causes of tree density change in the argan woodlands, using remote sensing and field data - the *land cover change* part. Chapter 3 looks at one aspect of *globalization*, the rise of niche products worldwide, including argan oil, and assesses its potential for poverty alleviation, based on household interviews. Finally, Chapter 4 builds on the two preceding chapters to take a broader perspective and integrate *livelihood* and *land cover change* over the long term, looking at how one influenced the other.

1.2. Background

1.2.1. Land cover change in dry woodlands

1.2.1.1. Dry Woodlands

Dry woodlands are understood here to mean «arid and semi-arid forests and woodlands». Though there are numerous definitions of the term «woodlands»², when using that word I refer to areas covered by trees, irrespective of tree density or of the degree of human intervention implied in their management. When the word «forest» is used in the text, it refers to the legal land use category, as understood by forest officers in the country. Dry woodlands include most of North African and Sahelian forests and woodlands, parts of the Miombo woodlands and bushland in Central and Southern Africa, the Dry Chaco, Caatinga and Mediterranean ecosystems in South America, the Brigalow Belt in Australia, as well as parts of Mexico, the United States and Central and South Asia. They provide key ecosystem goods and services to over one billion people living within the arid and semi-arid climatic zones (Uriel et al. 2005). Ecosystem goods provided by dry woodlands include fodder, fuelwood, wood for tool-making and other uses, medicines, herbs and other non-timber forest products and tradable goods; ecosystem services include soil stabilization, climate change mitigation, water conservation, and erosion and desertification control (Malagnoux 2007; FAO 2010; Rotenberg & Yakir 2010). Several authors demonstrated the importance of forest products for local populations, especially for the rural poor (Sunderlin et al. 2005; Shackleton 2007; Salehi et al. 2010). It has also been demonstrated that dry woodlands are often carefully managed environments, and that what appears as natural or «wild» ecosystems under threat from human overuse may actually owe its very existence to the people accused of degrading it, as shown for the case of Guinean woodlands in the seminal work by Fairhead and Leach (1996; see also McCann 1999, pp. 79-107).

² See for instance the list provided by the FAO at <http://www.fao.org/DOCREP/005/Y4171E/Y4171E50.htm> (last accessed 20 July 2012).

1.2.1.2. *Land cover changes*

Land cover refers to the physical and biological cover over the surface of land. This includes several cover classes (i.e. water, vegetation, bare soil, artificial structures). *Land use* refers to the human use of that land. Changes in land cover and land use are the object of *land change science*, an emerging discipline in environmental studies (Turner et al. 2007). Land cover changes are understood as *degradation* if they result in a loss of natural productivity, biodiversity or usefulness, or if they create or shift risks of environmental hazards (Robbins 2004 pp. 91-6). The Food and Agriculture Organization defines forest degradation in particular as “changes within the forest which negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services” (FAO 2004), a definition that may be applied to open woodlands as well. Clearly the use of the word degradation depends on the definition of a baseline (what is the natural state from which degradation occurs), and to some extent also on the point of view of particular agents (to whom is the system losing usefulness).

The term *degradation*, when used in this text, is understood to be equivalent to «tree density loss», independently from the causes of this loss. Indeed tree loss in the argan woodlands is associated with a loss of natural productivity: argan trees are a foundation species to the *Argania* ecosystems, so that their loss is related to other changes that collectively decrease primary productivity, and probably also biodiversity (see the feedback loop in Figure 2.1.). Tree loss also equates to a loss of usefulness, because the trees are essential to local agricultural and pastoral activities and argan oil production (see Section 1.3.1.2.). The baseline for measuring degradation is set as the state of the woodlands at the beginning of the study period. Ecosystem variability may make baselines irrelevant because these only capture a snapshot of a fluctuating system and thus provide no appropriate basis for the measurement of degradation. The density of argan woodlands however does not fluctuate over the short and medium term (this is not true of leaf and grass biomass, which fluctuate greatly from one year to another), so that it is unlikely that

the state at the beginning of the study period captures an exceptionally high or low density. Another issue is that of response and recovery from disturbance: disturbance may be needed to maintain some ecosystems, and what appears as destruction may in fact be temporary if fast recovery occurs after the time of observation (Robbins 2004, pp. 98-103). While some degree of disturbance (human or non-human) may be necessary to the persistence of the argan woodlands, the complete removal of trees at current density levels seems unlikely to fall within this category, as trees cut are not being replaced at any perceptible time scale. Recovery from disturbance may be fast for grasses that keep underground seed banks, but it is not for argan trees. For all these reasons I consider that tree density loss may reasonably be assimilated to degradation in the argan woodlands.

Though tropical moist deciduous forests have attracted much more attention in land change science, land cover changes are important in dry woodlands as well. Dry woodlands have been receding in several areas, sometimes at rates comparable to those found in tropical rainforests (Zak et al. 2004; Seabrook 2006). In spite of this, still surprisingly little is known today as to the extent and processes of change in these woodlands. In the Sudano-Sahelian region, the question of whether there is a secular trend in woodland cover decrease at the regional scale is debated (see for example Schlesinger 1996; Chamard & Courel 1999; Gonzales 2001). In North Africa there is wide agreement that woodlands have been receding (Benabid 1996; Sutton & Zaimeche 1996; Benbrahim et al. 2004) but little scientific evidence on the extent of the change has been produced. Land cover changes in South American drylands have been better documented. Several figures of deforestation have been published, from a 29% decrease between 1972 and 2007 in the central Chaco (Gasparri & Grau 2009), to over 80% decrease (including conversion of primary to secondary forests) between 1969 and 1999 at the southern edge of the Arid Chaco (Zak et al. 2004). In central Chile, about 42% of the original dry woodland area was lost between 1975 and 2008 (Schulz 2010). In the Australian Brigalow Belt, the clearing of native woody vegetation has a long history, and was still going on in recent decades, with an estimated 1.10^6 ha of

woody vegetation cleared between 1995 and 2004 (Seabrook et al. 2006). In other areas, such as Southern Africa and Central and South Asia, evidence has been scarce.

One reason for the absence of a clear picture of dry woodland change worldwide is the difficulty of monitoring change with classical tools such as national forest inventories and surface change estimates. Dry Woodlands are often not included in national forest inventories (Grainger 1999). Surface change estimates vary widely and, where they are available and consistent, they may still not reflect actual biomass and productivity changes, which may be under- or over-estimated depending on whether density is increasing or decreasing (Rautiainen et al. 2011; Conchedda et al. 2011).

The causes of dry woodland change are likewise difficult to track down. Evidence shows that processes of land cover change in drylands are complex and involve interacting social and biophysical drivers (Geist & Lambin 2004, Reynolds et al. 2007). Most of the literature on drylands, however, focuses on local causes. The literature on deforestation in tropical forests, by contrast, focuses mostly on social and distal causes. This focus on either social or biophysical, and either local or remote drivers is also found throughout the literature on dry woodlands. Actually, based on a review of this literature, causal explanations of dry woodland degradation can be classified into *four interpretations*, each emphasizing the remote or the local, the social or the biophysical. Though they are not mutually exclusive, authors often tend to emphasize one interpretation over the others. These are briefly reviewed hereafter.

The *demographic* interpretation explains the degradation of dry woodlands by the overuse of resources, usually as a consequence of population increase. Overuse can take the form of overgrazing, fuelwood harvesting, or trade in forest products such as fruits and seeds. Human-induced degradation may trigger self-sustaining degradation patterns, where aging and less resilient woodlands are more vulnerable to shocks, such as severe droughts and pest invasions. This line of argumentation is equivalent to the neo-

Malthusian discourse identified by Adger et al. (2001) in debates on desertification (for examples of the demographic interpretation in dry woodlands see Barbero et al. 1990; Buttoud 1994; Benabid 1996; M'Hirit et al. 1998; Chamard & Courel 1999; Singh 2003; Odihi 2003; Ozer 2004; Salehi et al. 2008; Schultz et al. 2010; Säumel et al. 2011).

The *climatic* interpretation is that climate change, and in particular the increasing length and frequency of droughts, causes trees to die. Fuelwood harvesting is not seen as a threat because people harvest mostly dead wood. Projections of rising hydric deficit in most climate change scenarios are the main cause for concern (see Benjaminsen 1993; Nagothu 2001; Hiemstra-van der Horst & Hovorka 2009; Fensham et al. 2009; Hiernaux et al. 2009).

The *economic* interpretation sees dry woodland degradation as a consequence of urbanization and the expansion of agriculture and rangelands, driven by favorable economic and institutional conditions (see Zak et al. 2004; Seabrook 2006; Boletta et al. 2006; Gasparri & Grau 2010; Schulz 2010).

The *political* interpretation emphasizes the political dimensions of change and of discourses about change. Some authors question the very existence of human-induced degradation in dry woodlands, arguing that evidence is scant and that the idea of degradation may be used to justify intrusive land-use and development policies and maintain neo-colonial power structures. Others consider degradation as a result of unsustainable activities encouraged by neoliberal economics, such as intensive irrigated agriculture, or of the marginalization of poor populations through the appropriation of land by elites. The first line of argument is familiar to some political ecologists; the second lies closer to what was identified by Adger et al. (2001) as the «populist» discourse on dryland degradation (see Bush 1997; McCann 1999; Ribot 1999; Nagothu 2001; Katz 2002; Davis 2006; Davis 2007).

While these four interpretations all have elements of truth, in themselves they provide only partial explanations of the drivers of change in dry woodland. We will see in chapter 2 that there is much

to gain from integrating these different perspectives into a common framework.

1.2.2. Globalization and market integration

The first sentence of the «globalization» entry in the Dictionary of Human Geography reads:

«A big buzzword in political speech and a ubiquitous analytical category in academic debate, globalization operates today rather like modernization did in the mid-twentieth century as the key term of a master discourse about the general state of the world.» (Sparke 2009)

Acknowledging this and the fact that the existence of globalization, its new-ness, its origins, its nature, and its meaning are debated topics among geographers and social scientists, I nevertheless use the word globalization in this text, in the broad sense of «the widening, deepening and speeding up of global inter-connectedness» (Held et al. 1999), or, as Giddens put it,

«the intensification of world-wide social relations which link distant localities in such a way that local happenings are shaped by events occurring many miles away and vice versa.» (Giddens 1990: 64)

In that sense, the word globalization is focused on a process rather than on the existence of a global scale itself.

Part of this globalization process occurs through markets, as more and more places integrate or are integrated to national and transnational commodity chains and labor markets. This has numerous implications for livelihoods and land cover change. As rural places integrate larger economies, the conditions of production and work are altered. New opportunities for labor and new markets for locally produced goods emerge; new inputs for production and consumption become available. On the other hand, greater

competition may force people out of their livelihoods and greater demand for local products may prompt overexploitation of resources. The social and environmental outcomes of integration may thus be positive or negative depending, among other things, on the comparative advantage of the integrated region (as discussed in Chapter 4).

A number of land use / land cover change dynamics linked specifically to transnational globalization have been identified: the *displacement* effect, in which land uses migrate from a place to another (e.g. as a consequence of land zoning policies); the *rebound* effect, in which more efficient technology reduces production costs, ultimately causing greater consumption of land; the *cascade* effect, in which a particular land use conversion triggers a chain of secondary conversions; and the *remittance* effect, the combined effect on land use of the reduction of labor force through migration and of the remittance money sent home by migrants (see Lambin & Meyfroidt 2011). The emergence of *niche products* constitutes another potentially important effect of globalization, in that it links distant places and people through the constitution of global high-value commodity chains. This connection has strong implications for rural livelihoods, which are discussed in chapter 3. So do other aspects of globalization, such as the widening of labor markets: it has been recognized that, as a response to both the new opportunities offered by market integration and to the pressure of increasing competition in globalizing economies, livelihoods around the world have evolved towards greater mobility and diversity (Rigg 2006). These changes and their causes are the object of the following section.

1.2.3. Livelihood changes

A livelihood is «the way that an individual or a household ‘gets by’» (Rigg 2007: 32), or, in Ellis’ terms, «[t]he activities, the assets, and the access that jointly determine the living gained by an individual or household» (Ellis 1999). Though the concept of livelihood goes beyond the material aspects of earning a living to include social and cultural dimensions, in this text the focus remains with the material

aspects. The rise of livelihoods as an analytical concept can be attributed to an attempt to re-emphasize agency in development studies traditionally characterized by a preference for structural perspectives. Livelihood studies address the complex ways in which people engage with different activities and organize themselves to earn a living, rather than focusing on the possibilities and restrictions imposed by a political context. As a consequence, they have often fallen into the reverse trap - that of underplaying structural or political factors (Rigg 2007: 35). Four main «failures to engage» have been identified in livelihood studies: «with processes of economic globalisation, with debates about politics and governance, with the challenges of environmental sustainability and with fundamental transformatory shifts in rural economies» (Scoones 2009). In this text I try as much as possible not to fall prey to these pitfalls.

The attention to livelihood changes is an answer to the fourth of these failures, in that the concept explicitly acknowledges the changing nature of livelihoods over time. Indeed, livelihoods have been changing worldwide, probably more so in recent times than ever before. Rigg (2006) proposed a list of changes occurring in the rural South that is worth quoting at length:

- Occupations and livelihoods in the countryside are diversifying.
- Occupational multiplicity is becoming more common and more pronounced.
- The balance of household income is shifting from farm to non-farm.
- Livelihoods and poverty are becoming de-linked from land (and from farming).
- Lives are becoming more mobile and livelihoods correspondingly delocalized.
- Remittances are playing a growing role in rural household incomes.
- The average age of farmers is rising.
- Cultural and social changes are being implicated in livelihood modifications, and in new ways.

The factors causing these changes, he calls «propelling forces», which are in the number of five: the erosion of the profitability and returns to smallholder agricultural production; the emergence of new opportunities in the non-farm sector, both local and non-local; environmental degradation; increasing land shortages; and cultural and social change.

This depiction of livelihood changes and their causes meets the idea developed by Bryceson (1996) that parts of the world (and particularly Africa, where she worked) are undergoing *deagrarianization*, which she defines as «a process of: (i) economic activity reorientation (livelihood), (ii) occupational adjustment (work activity), and (iii) spatial realignment of human settlement (residence) away from agrarian patterns». Bryceson, however, focused mostly on structural causes to deagrarianization, and particularly on the effects of structural adjustment programs in pushing people out of agriculture. The work on deagrarianization has also been criticized for being totalizing and not acknowledging other directions of livelihood adaptation and diversification, including from non-farm to farm activities (Yaro 2006). Still, the thesis directs attention to the sweeping changes that are occurring in many rural areas of the world, and raise important questions as to whether they make people better off in the end, and to what extent they are linked to the environment - both in causing and in being caused by environmental change. The implications of these livelihood changes are discussed in chapter 4.

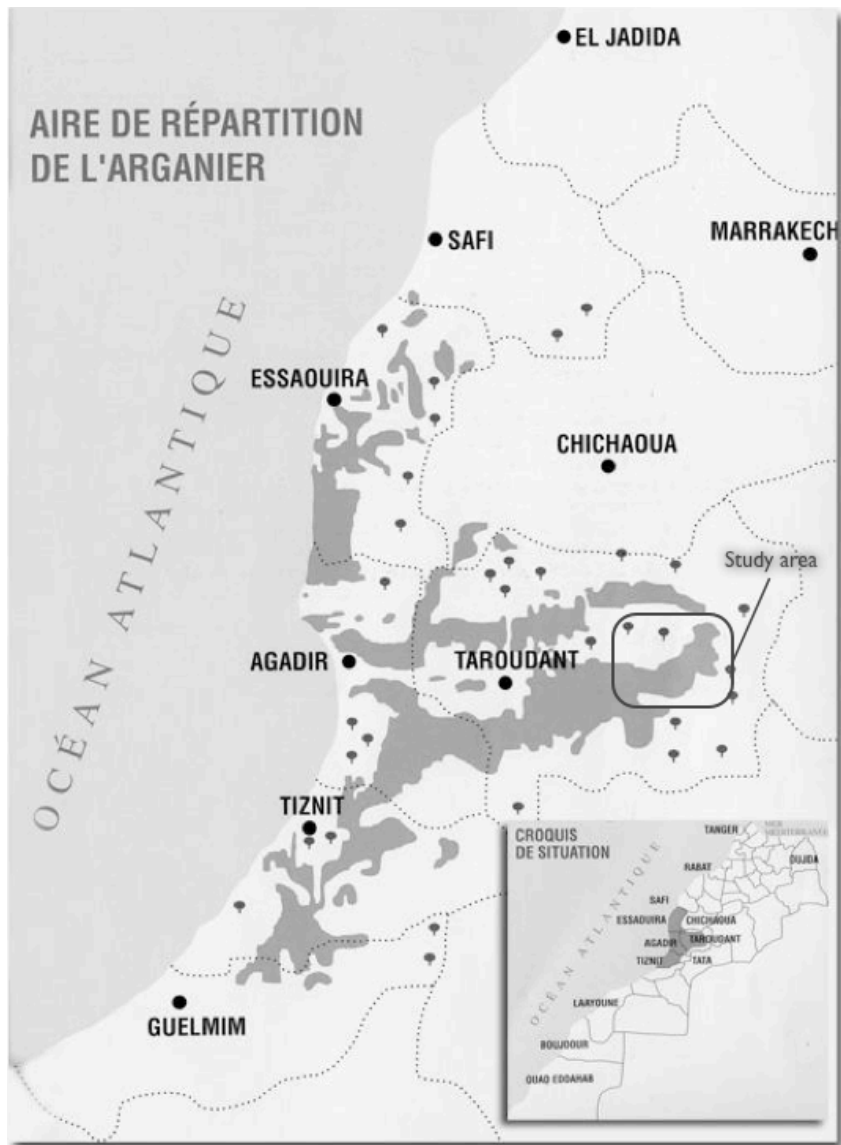


Figure 1.1.: The argan woodlands (adapted from M'hirit et al. 1998)

1.3. Case study

1.3.1. The argan woodlands

1.3.1.1. Physical settings and diversity

The argan tree (*Argania spinosa*) is endemic to Southwestern Morocco, where it covered about 950,000 hectares in 2010 (Lefhaili 2010; Figure 1.1.). The argan woodlands are part of the Mediterranean *Acacia-Argania* dry woodlands ecoregion (World Wildlife Fund 2001). They come in a variety of ecological associations and morphologies, depending on micro-climatic conditions and human use (Msanda et al. in Kenny 2007, pp. 87-106; Courcoux 2011; Genin & Simenel 2011; Simenel et al. 2009). Tree density varies from under 30 trees/ha to over 80 trees/ha. Argan trees occur in different sizes, from shrubs lower than 1 meter to trees over 5 meters high. They can be found at altitudes ranging from the sea level to 1500m, and in areas with rainfall levels from 150 to 400 mm/year. The tree's ability to survive arid conditions is in part due to its deep-reaching roots and its ability to defoliate and go dormant in case of severe drought (Msanda et al. 2007). Reproduction can be vegetative or by seeds, but natural regeneration by seeds has nearly completely disappeared from the region for reasons discussed in chapter 2. Pictures of the argan woodlands are provided in Appendix 6.

The argan region can be divided into several zones based on land cover and social dynamics. A distinction is usually made between the plains and the mountains, but there are substantial differences between mountainous regions too. Here I propose a tentative classification into four zones, taking into account current knowledge about land cover dynamics. The *Southern part* of the argan region, around the towns of Tafraoute, Tiznit and Lakhsass in the Anti-Atlas mountains, has a relatively low density of woodlands, and is an area of intense internal and international migration. This latter fact has shaped life in the region and is responsible for a sharp decline in land-related activities that may have caused a stabilization or even an increase in woodland cover - though this has not been measured yet. The *Northern part* of the argan region, between the cities of

Essaouira and Agadir, is also mountainous and has the densest woodland cover in the region. It is where argan oil trade is the most developed and where the argan boom originated. Though woodland cover there appears to be stable, the lack of regeneration may threaten the ecosystem in the long run. The *central part* of the argan woodlands is the Sous plain, a reservoir for agricultural and urban expansion since the 1980's that, though it reportedly harbored some of the densest woodlands in the past, has undergone the strongest density and surface decline in the region (see section 2.2.1. on this). It has also been an area of intense social change driven in part by the explosion of export agriculture and the rapid urbanization of the Agadir-Inezgane-Aït Melloul conurbation. Finally, the *hills and mountains bordering the Sous plain* (the Southern edge of the High Atlas and the Northern edge of the Anti-Atlas mountains) have medium to low woodland cover that has been decreasing in at least part of the region, for reasons analyzed in chapter 2. The region is also characterized by high rates of out-migration, albeit of more recent history than in the Southern part. It is in that region that the study area is located.

1.3.1.2. Multiple uses

Argan trees have traditionally provided multiple ecosystem goods and services, including the provision of fruits from which argan oil is produced; leaves and young shoots eaten by sheep, goats and camels; and wood for fiber and fuel (M'hirit et al. 1998). Argan oil has become famous in the last two decades for its cosmetic virtues as a moisturizer and anti-wrinkles treatment, and has been exported at prices up to several hundred dollars a liter to Europe, Japan and the United States (see Section 1.3.1.5.). The extraction of argan oil is a labor-intensive activity traditionally carried out by women, and involves cracking the hard shell of argan nuts, roasting the kernels, grinding them to produce a thick paste, and kneading this paste to extract oil (see Figure 1.2.). This transformation process takes two to three days' work per liter of oil, not counting the time needed for harvest. Goats and sheep eat the oil cake, a residue of the kneading process. Their manure is used as a fertilizer for cereal crops growing

in the shade of argan trees, and traditionally they functioned as nut collectors by eating fruits and defecating the nuts in the barns, although digested nuts have become harder to sell due to their stronger flavor. Argan wood has also been used traditionally for roofing, tool making, cooking and baking. Finally, old argan trees have a spiritual value and are frequently named after local saints, and linked to sacred places and religious festivals (Simenel 2004).

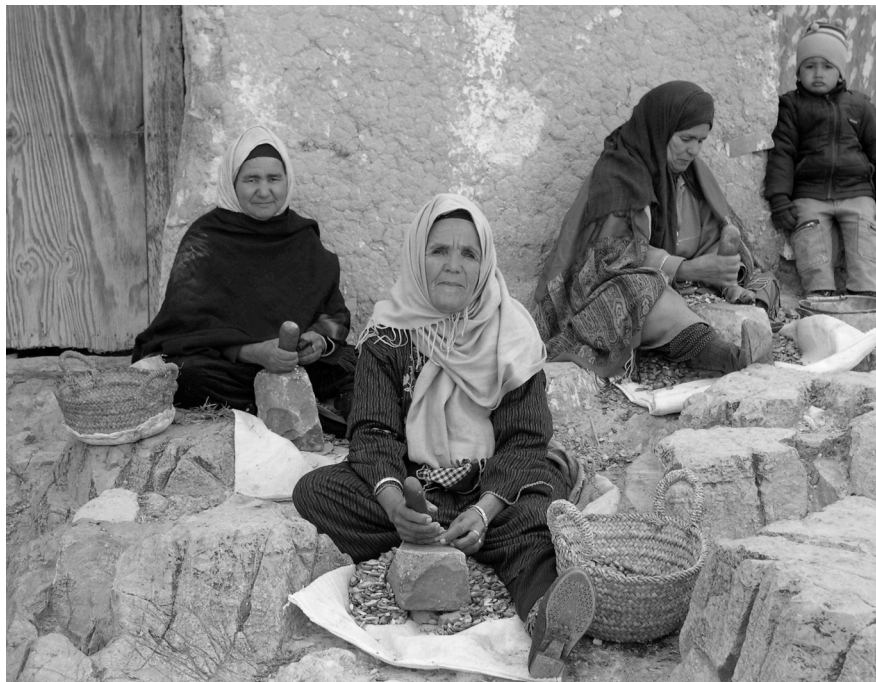


Figure 1.2.: Women cracking argan nuts

1.3.1.3. Tenure and management

The forest legislation enforced in 1925 by the administration of the French protectorate (1912-1956) and still in use today³ reflects these multiple uses of the woodlands: though trees are part of the state forest domain, usufruct rights are granted to local residents for the collection of argan nuts and dead wood, for the use of the woodlands

³ With some additions to the text in 1938, 1941 and 1983.

as grazing grounds, and for small-scale traditional cultivation under argan trees (conditional on the forest officers' approval). In practice, the ownership of argan trees falls into one of three spatially distinct categories (see Figure 1.3.): private (*melk*), semi-private (*agdal*) or public (*mouchaa*).

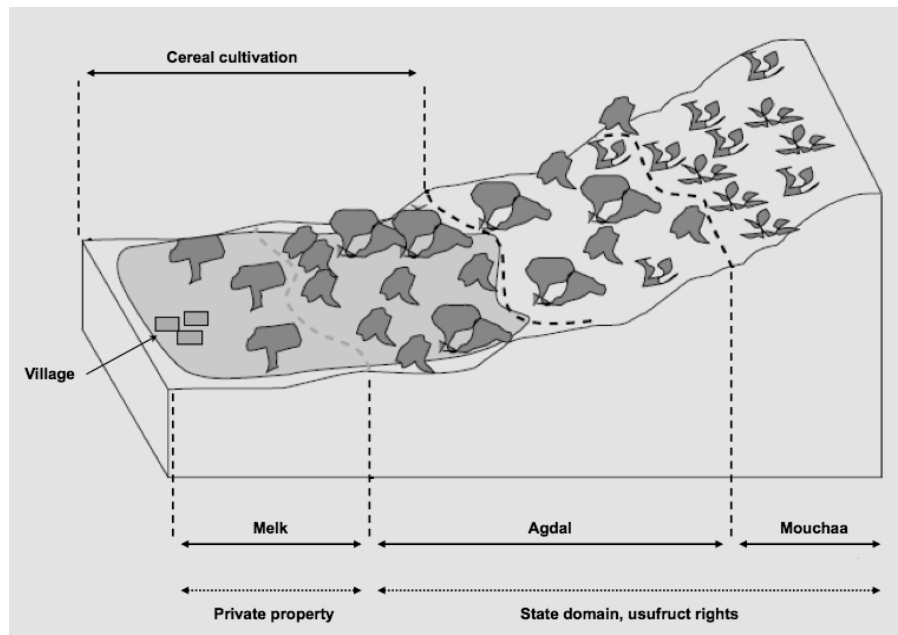


Figure 1.3.: Typical spatial repartition of land tenure categories in the argan woodlands (adapted from Bourbouze and El Aich 2005)

Melk trees may be used only by their owner. Trees in *agdal* areas, on the other hand, are semi-private in that they are normally assigned particular users or groups of users («assigns») through customary arrangements internal to the community. Variations exist in the degree of private appropriation of the trees, from cases where the access rights to a tree «belong» to a particular family and are inherited according to Islamic law, to cases where households appropriate trees anew every year by circling them with stones, or where all trees are common property and nuts are shared among villagers after harvest. *Mouchaa* land is public and unmanaged, basically a buffer for the other categories. Traditionally, during the

summer months, *agdal* areas will be closed to grazing in order to allow for fruit maturation, and a date will be decided by village councils at which they are open again and fruits may be harvested. The practice itself is also called *agdal*. There too, regional variations occur, and whereas some communities «close» *agdal* areas every year, others close them only «when there are fruits», as in my study area. This complex tenure system is pictured in Figure 1.4. Note that access rights to the trees may not be related to the land: in some instances the land under the tree may belong to another person than the tree itself.

The decision by the French protectorate authority to recognize usufruct rights was based both on the recognition of the particular character of the argan woodlands, and on past experiences of failure in other areas where state forestry was perceived as illegitimate. The argan legislation has been considered an example of successful and adaptive forestry law until recently. But while recognizing user rights, it still made the government the legal owner of all trees, which arguably discouraged investment on the part of users (Lybbert et al. 2002). It also did not prevent the expansion of commercial agriculture in the Sus plain (see section 1.3.1.5.). Today that legislation is contested on several grounds, some (especially forest officers) claiming that it leaves too much latitude to a local population that has more than doubled since its promulgation, and others claiming that only greater participation, and perhaps even full privatization, will allow for the conservation of the woodlands.

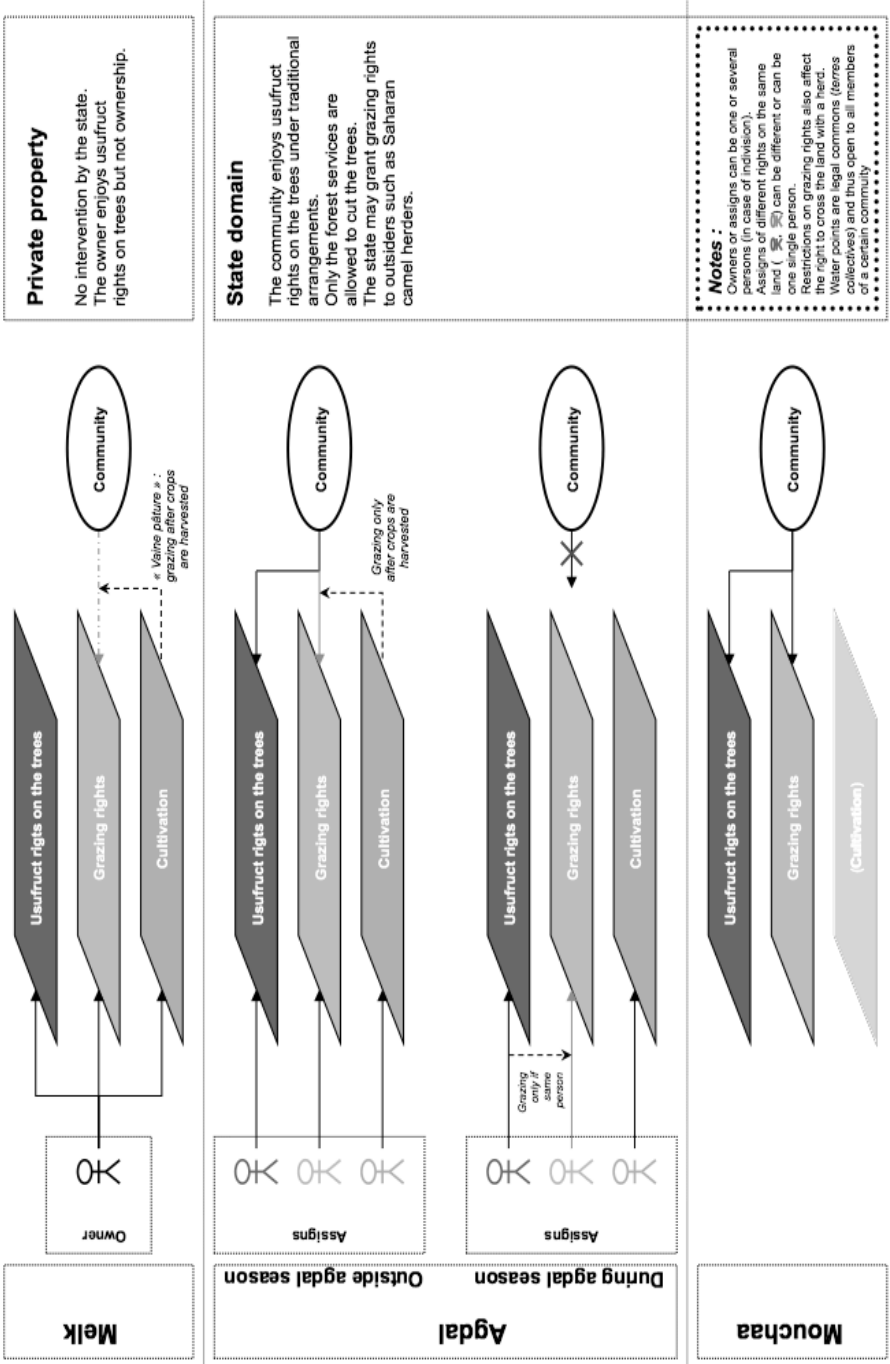


Figure 1.4.: Conceptual model of argan woodlands management

1.3.1.4. *The nature of the argan woodlands*

The question of what is natural and what is not is ubiquitous in geography (see for example Castree 2005). Much of the talk of degradation rests on the assumption that there is a natural state from which ecosystems are *degraded* to other, non-natural states for various reasons. The dominant view on the argan woodlands is that they are natural forests with which humans used to live in some sort of equilibrium or harmony that has been disrupted, mostly due to population growth (the *population* interpretation mentioned above). The woodlands are thus seen as existing independently from human activity, although their contribution to livelihoods is acknowledged.

Only recently have some researchers begun to openly question this view of a natural forest threatened by human overuse, claiming that the inhabitants of the argan woodlands have actually always played an active role in their management. For example, Genin & Simenel (2011) showed how management practices have shaped the woodlands at tree, stand and landscape level, increasing landscape diversity. Others have emphasized the way marketing of argan oil as originating in «natural» woodlands actually masks the role of local populations in their management (Simenel et al. 2009; Courcoux 2011). Indeed the classification of the argan woodlands as «forests» in the legislation reflects more an intention - that of exerting state control over the resource and territory (see Davis 2006) - than the real nature of the ecosystem. But acknowledging the role of local populations in the maintenance of the woodlands would amount to recognizing the importance of taking their views into account for future management policies. For this reason, the (re-)production of an image of the woodlands as natural is a political choice, whether it is made consciously or not.

1.3.1.5. Social and ecological change

Commercial agriculture. The Sus basin is an area of fast agricultural expansion, and the origin of a good part of the oranges and tomatoes Europeans find in their supermarkets in winter (Figure 1.5.). This expansion has been the main source of woodland decline in the plain, though in mountain areas it has played no direct role. Massive conversion to irrigated agriculture started in the 1980's, when the interdiction to conduct large-scale cultivation in the woodlands was levied to allow smallholders to grow barley, in order to compensate for the crop failures of previous drought years. Investors, arguing that the local population did not have the technical means to exploit this land, proposed to rent it, which was accepted by the government at the condition that argan trees be preserved. This condition, however, was not respected, and to this day argan woodlands are being clear-cut to make room for irrigated agriculture and greenhouses, while the water table is dropping to historical lows. Though not legally the owners of the land, large agricultural investors nowadays are treated as such in land planning discussions, and common land converted to intensive agriculture is implicitly assimilated to private land (Chiche 2007). In a recent address at a congress on the argan woodlands in Agadir⁴, the president of the regional division of agriculture made it clear that the Sus basin was intended as reservoir for the expansion of intensive agriculture, and that extensive uses of the argan woodlands, including conservation, would have to be restricted to the mountains.

⁴ Congrès International sur l'Arganier, 15-17 December 2011, Agadir.

Social and Ecological Change in the Argan Woodlands

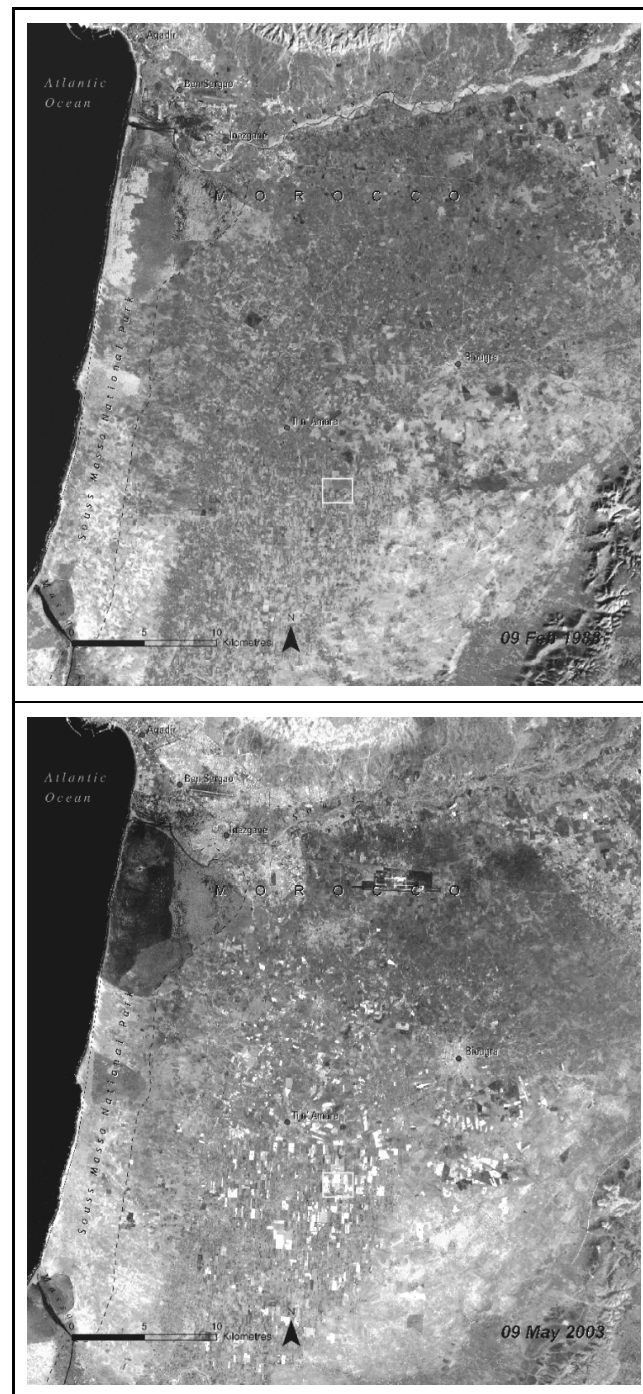


Figure 1.5.: Greenhouses expansion in the Sus 1988-2003 (source: UNEP)

Migration. Migration, both internal and international, has a long history in the Sus region. Seasonal migration patterns existed already before the French Protectorate. With the French colonization of Algeria, *colons* farms became an important destination for seasonal migration. During World War I and II, large numbers of Moroccans were recruited for the French army, industry and mines, predominantly from the Sus region. Booming coastal cities attracted large numbers of migrants throughout the second part of the 20th century. Recruitment campaigns for the Western European mines and industries in the 1960's, prompted a boom in international migration, and by 1972, an estimated 300,000 Moroccans were living in Europe. Despite the closing of European borders in the aftermath of the 1973 oil crisis, emigration continued mainly through family reunification and illegal entries. Destination countries also diversified to include Southern European countries and, increasingly, Libya and the Gulf countries (de Haas 2007). The inhabitants of the Western Anti-Atlas around Tafraoute were early participants in internal and international migration. By the mid-20th century the majority of valid men in the region were away from their village: in 1966 43% were engaged in temporary migration inside Morocco, and 15% outside the country, or over 20% of the total population for some districts (Noin 1970: 189-195). This extreme migration pattern is, however, not representative of the whole argan region: in other parts of the region systematic migration started only later, as we will see in chapter 4.

Urbanization. Two phenomena are of interest regarding urbanization: the expansion of existing cities such as Agadir, Tiznit, Taroudant, or Essaouira; and the creation and growth of rural towns. The expansion of existing cities, particularly of Agadir, was as much the cause as the consequence of internal migration: economic development and population growth created new employment opportunities (for example in construction and retail), and the influx of migrants supported urban sprawl. This sprawl is still going on, partly at the expense of woodlands. In an attempt to curb rural outmigration in the mid-1970's, the government supported the creation and expansion of small rural towns, hoping it would create

employment locally. Awluz is an example of such a center, actually an agglomeration of villages that has become a regional service hub. Numerous such centers have subsequently become destinations for return migrants (de Haas 2006).

The globalization of woodland management. The widespread support to argan cooperatives by foreign donors (see below) and the creation of a UNESCO Biosphere reserve in 1998 at the initiative of the German development agency GTZ (the *Réserve de Biosphère Arganeraie*, RBA) illustrate the growing role of transnational actors in the argan region over the last two decades. Though the Biosphere reserve originally implied the definition and implementation of a zoning plan, with A-, B- and C-zones corresponding to varying levels of management and tolerance for human activities, this zoning has not materialized on the ground. The failure to adapt and implement transnational law (the RBA framework, as well as the PAN/LCD⁵, an offspring of the UNCCD⁶) at the local level led donors and development organizations to favor direct intervention in the region, bypassing the state (Turner 2005, 2006 and 2009). Direct support to local associations, cooperatives, clubs or small-scale infrastructure projects was seen as «an appropriate means of transmitting the ideology of sustainability and western perceptions of the environment» (Turner, 2006). In effect, this support embodied the growing influence of transnational organizations on local-level land use. This in some cases led to conflicts, for example when some donors tried to revive moribund *agdal* customs as «good traditions», ignoring the reasons why such traditions were being abandoned (Turner 2005). With the recent promulgation of the Green Morocco Plan⁷ in 2008, another type of actors, namely private investors, may yet come to play a greater role in land management in the argan region. Indeed the Plan set as one of its main principles the aggregation of smallholders through contract-based production, a scheme in which private investors provide the market access and technical investment in return for exclusive trade relationships with

⁵ Plan d'Action National pour la Lutte contre la Désertification

⁶ United Nations Convention to Combat Desertification

⁷ See http://www.ada.gov.ma/en/Plan_Maroc_Vert/plan-maroc-vert.php last consulted 27/04/2012.

groups of users. The Green Morocco Plan also legitimates the widespread practice of leasing (actually selling) village commons for commercial agricultural exploitation.

The argan boom. In recent decades, argan oil, from a local staple, became one of the most expensive cosmetic oils on world markets. The oil had always been used locally for cooking, light, skin care and medication, and had a role in religious ceremonies. Argan trees, due to their resistance to drought, grew where olive trees could not, so that argan oil was in a way the olive oil of the drylands - though much more demanding to produce, it was still a valuable source of fats. There is evidence that it was already being produced a millennium ago, and that there existed a regional trade already long ago, though likely much less than that of olive oil (Ruas et al. 2011). An observer in the 19th century noted that argan and olive oil had approximately the same market value⁸: Only during the 20th century did the oil start to be traded internationally, and gain a higher price than substitutes.

The traditional argan economy is gendered⁹. Women are in charge of the harvest of argan nuts and of the production of argan oil, whereas men take care of the commercialization. Production is often carried out in groups for conviviality, but the product is not shared among the women. Income from argan oil normally accrues to women, who may use it for their personal needs, but it can also be used for the household, in which case it is managed by the men. The oil is also commonly used as a gift for migrant family members or friends, often as a way of keeping ties to a source of remittances, in an economy of gift and counter-gift.

In the mid-1990's, during the first phases of the *Projet de Conservation et Développement de l'Arganeraie* (a plan that led to the creation of the Biosphere Reserve), the GTZ began setting up women's cooperatives for argan production. These cooperatives were meant to provide more efficient marketing channels to an

⁸ French protectorate archives (Nantes): «Renseignements géographiques fournis par le nommé Mohammed ben Ahmad se disant Cheikh de la tribu de Tizenit de la province de Souss», Oran, 15/05/1885

⁹ The remainder of this section on the argan boom is based to a large extent on Turner, *unpublished manuscript*.

already existing market, making use of the women's skills at argan oil production and formalizing their habit of gathering for production. While the model intended to fit as closely as possible to what was understood as traditions (which implied, among other things, sticking to a manual mode of oil extraction), it actually failed to integrate certain dimensions of the traditional argan market, such as the flexibility in access to fruits, and the role of men in commercialization. In parallel to this model emerged another type of cooperatives, created by Moroccan activists and based on the introduction of modern technology for oil processing, which decreased the amount of work on the part of women, but also allowed for a higher productivity and quality. Whereas the GTZ-model cooperatives were created in a «participative» fashion typical of development agencies, cooperatives of this second type were created from the top down, in a way more similar to private enterprises, and with less emphasis on ecological sustainability. Based on the example of these two types of cooperatives, unofficial, independent cooperatives emerged in large numbers during the 2000's, sharing some of the concerns associated with the original cooperatives (fairness, sustainability) or just benefitting from their positive image. The establishment of cooperatives also paved the way for large-scale commercial exploitation of argan oil by introducing new technology and by advertising argan oil as fair and sustainable to Western consumers. While there had been a small profit-oriented export market before, the volume of the commercial argan market exploded (and so did the prices) in the 2000's, when new investors entered the market in order to provide the western cosmetic industry with large amounts of high-grade argan oil. This created new forms of competition and conflict within the market, with private producers complaining about the subsidies enjoyed by the cooperatives, and cooperatives and small producers complaining about the market loss induced by the entry of large investors. Figure 1.6. provides a schematic view of the argan commodity network in its current state.

Over time, from a few disparate initiatives, the argan market evolved towards an overwhelmingly complex network of institutions forming changing alliances and overlapping in their motivations and

competences. I will briefly summarize the main lines of this evolution here¹⁰. The first structure dedicated to the argan *filière* was the Union des Coopératives des Femmes pour la production et la commercialisation de l'huile d'Argane (UCFA), originally set up by the GTZ in 1999 with the objective of centralizing orders and marketing for the existing cooperatives. A similar function was performed from 2005 by regional Groupements d'Intérêt Economique (GIE's) that grouped producers, including cooperatives, and served as an interface for contractual agreements with large-scale buyers. At state level, cooperatives came under the control of the Office du Développement de la Coopération (ODCO). In 2002, the Réseau des Associations de la Réserve de Biosphère Arganeraie (RARBA) an umbrella organization designed to link actors in the whole argan region, was founded. The next year, the Projet Arganier, came into being, with support from the European Union. This project centered on the creation of argan cooperatives, the setup of modern processing plants, and the creation of commercialization units bringing cooperatives together. The Projet Arganier now links up the various unions, including the UCFA and the GIE's, under a common umbrella. The Association Nationale des Coopératives d'Argane (ANCA), an NGO that was created with the aim of taking over the Projet Arganier at its end (2010), acts as yet another umbrella organization with overlapping competences. The Fondation Mohamed VI pour la Recherche et la Sauvegarde de l'Arganier (FM6), an NGO close to the state and to some private investors, competes with some of the above actors in its development and conservation initiatives. In 2008, the concern to protect the argan oil market from international competition and to keep production at home led to the creation of a geographic indication by the NGO AMIGHA, a coalition of various agents, including industrial companies and cooperatives. Finally, in 2009 the Agence Nationale pour le Développement des Zones Oasiennes et de l'Arganier was created, seemingly with the objective of conciliating the two pillars of the Plan Maroc Vert, namely the development of productive agriculture and the reinforcement of a solidary economy, in these two regions under the status of UNESCO Biosphere reserves. One objective pursued by

¹⁰ Greater detail on the history and organization of the argan market will be available in the forthcoming text by Turner (*unpublished manuscript*).

members of this new agency is to group households in nut production cooperatives with self-managed storage depots, in order for them to be able to counter private speculation and keep some of the added value once oil production becomes completely mechanized¹¹.

The argan commodity chain from a household perspective

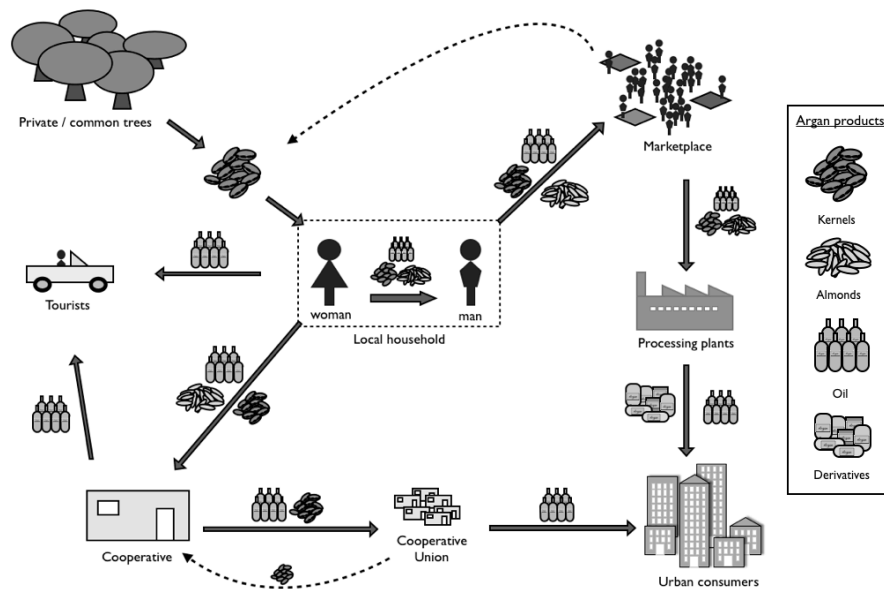


Figure 1.6.: Argan commodity chain

1.3.1.6. Agents and perspectives

Multiple agents coexist and shape decision-making in the argan woodlands, each with their own perspectives on the woodlands, their utility, and their future. This section provides a tentative characterization of these agents, their role in the woodlands, their representations, their normative goals, and their management preferences, based on discussions and interviews, on the literature

¹¹ This statement is based on discussions with an official from the ANDZOA at the Congrès International sur l'Arganier, 15-17 december 2011, Agadir.

and on my own experience. The list is not exhaustive, but covers the most influential agents (see Table 1.1. for a summary).

Forest Officers. Forest Officers are mandated by the State to manage public forests, a category under which most of the argan woodlands fall. They may cut or plant trees, grant exploitation permits, or enclose areas. They may fine users for activities considered illegal, such as firewood sales or grazing in enclosed perimeters. In practice, however, local forest officers are often in a delicate position, torn between their duty and the need to get along with the local population. Not respecting their mandate may mean losing their job, but ignoring local interests can put them into other kinds of trouble – there are numerous reports of popular violence against forest officers, including in the study area. They consider the argan woodlands as a natural forest that in its present condition needs to be managed by scientific forestry if it is to be sustained on the long run. Traditional users are tolerated only as long as they comply with the management schemes set by the forest department, and they are commonly blamed (along with their herds) for the degradation of the woodlands (see Box 1.1.). The main goal of forest officers is the stabilization of woodland cover, or even for some the restoration of woodlands to a purported «original» state in which they covered much wider parts of the country (Davis 2005). It could be argued that a secondary goal for some is to maintain their grip on the management of the woodlands. Traditionally, for woodland regeneration, forest officers advocated clear-cutting perimeters and enclosing them for a number of years, excluding animals as long as was necessary for the trees to regrow. Since this option was very unpopular with the local population, and has increasingly become so with other agents as well, more and more energy has been put into re-planting saplings produced in commercial nurseries – although these efforts have not been particularly successful until now.

Box 1.1.: The role of forest officers: an insider's view.

The novel «L'homme qui plantait des chênes» earned its author Moulay Youssef Alaoui, professor at the school of forestry in Rabat, the Hassan II prize for the environment in 2007. The book is an insight into the forest officers' traditional perception of their role in forest management. In a conversation between the main character - a forest officer - and a local hunter, Alaoui puts the following words in the latter's mouth:

« Mon père a été le témoin de la lente dégradation de la forêt. Il a vu les hommes mettre à exécution leurs basses œuvres en commençant d'abord par couper les arbres pour leur usage domestique ou pour les vendre au souk. Après avoir exterminé les arbres, ils se sont attaqués au sous-bois. Leur biotope ayant été détruit, un grand nombre d'animaux disparut. Puis ce furent les troupeaux de moutons et de chèvres se nourrissant de glands et de jeunes chênes qui compromirent le renouvellement de la forêt. [...] Plus tard, il m'arrivait souvent de repasser dans cette zone, nostalgique de la magnifique forêt d'autrefois. Mais grâce à vos reboisements, elle s'est reconstituée, et on observe à nouveau quelques bécasses. L'interdiction du pâturage a permis au sous-bois de se reconstituer. Cela n'a pas dû être facile de s'opposer aux éleveurs. Je vous en félicite ! » (Alaoui 2007, p. 169)

Mentalities are changing, however, and more and more forest officers of the new generation acknowledge the need to work with local populations, rather than against them. The ubiquity of the word «participation» in the current discourse reflects as much a fashion as a real concern for the fact that forest policies that do not take the people's interest into account have usually failed.

The ministry of agriculture. Agricultural planners have had a role in the development of intensive irrigated agriculture in the Sous plain, as well in the relative neglect of rainfed agriculture and argan products on marginal lands (see Swearingen 1988 on this). Today the Agence pour le Développement Agricole (ADA), a sub-section of the ministry of agriculture and fisheries, is the executer of the Green Morocco Plan (GMP). This plan is articulated around two pillars: the

development of high-value added agriculture in highly productive regions, and the development of «solidary» agriculture, mostly centered on traditional and niche products, in low-productivity regions. The Sous plain falls mostly under the first pillar, whereas the mountains of the argan region belong to the second pillar. It might be argued that in this way agricultural planners have to a certain extent perpetuated the colonial categories of useful versus useless Morocco (Maroc utile / Maroc inutile). However, this may be the first plan that has an explicit vision for the more marginal lands of the country. The representation of the argan woodlands by agricultural planners follows this dual pattern: the fertile plains of the Sous valley are a reservoir for agricultural extension, possibly including intensive argan orchards, but with no space for extensively managed woodlands, which will have to be restricted to the hills, where «solidary» agriculture will make sure the people can earn a living. The main tools proposed in the GMP for both are the privatization of commons and the aggregation of small-scale producers around private investors.

Social and Ecological Change in the Argan Woodlands

Agents	Role in woodlands	Representation of woodlands	Normative goals	Management preferences	Relationship to other agents
<i>Forest officers</i>	Mandated for woodland management by the government ; may decide on use by locals	Natural forest threatened by local over-use	Stabilization or increase of woodland cover, ideally to an «original» state ; keeping a hold on woodland management	Scientific forestry ; regeneration by clear-cutting and enclosure ; plantation of engineered strands	Frequent conflict with villagers ; moderate support from local authorities
<i>Ministry of agriculture</i>	Supports agricultural expansion in the plain ; may support argan trade through GMP's 2d pillar	Plain as reservoir for intensive agriculture ; mountains as the place of solitary agriculture in GMP's 2d pillar	Intensive argan orchards in the plains ; extensive argan production cum conservation areas in the mountains	Privatization of commons ; aggregation of small-scale producers by private investors	Conflicts with foresters over the prioritization of agricultural development over conservation
<i>Donors and development agents</i>	Initiate and/or shape development and conservation projects	Natural ecosystem ; broken population-environment equilibrium	Sustainable management of the woodlands ; human development ; gender equity	Commercialization of argan oil through cooperatives ; re-innovation of traditional management practices	Attempt to strike deals with state agents
<i>Villagers</i>	Main users ; daily practices may affect the state of the woodlands	Multifunctional and managed	Maintaining multi-functional usefulness	Hostile to scientific forestry ; traditional management practices (e.g. <i>agdal</i>)	Tend to consider other actors as intruders ; love-hate relationship with nomads
<i>Migrants</i>	Influence decision-making and support development projects	Multifunctional and managed	Maintaining multi-functional usefulness ; sustainable development	Argan oil commercialization ; traditional management practices	Same as villagers, but stronger link to development community
<i>Local decision-makers</i>	Selective support to other agents	Template for social relationships ; resource for tax revenue	---	---	Mediators ; electoral preferences may divide villagers
<i>Nomads</i>	Users of fuel and fodder	Grazing lands	Maintaining grazing productivity	---	Love-hate relationship with villagers ; supported by decision-makers ; disregarded by forest officers
<i>Consumers of argan products</i>	Shape production through quality and other requirements	Natural forest ; home to traditional berber population	Sustainable development ; quality production	---	Mediated by marketing companies
<i>Argan oil marketing agents</i>	Selective buyers of argan products ; influence decision-making	Source of argan oil	Increase in woodland density, possibly through plantations	Favorable to plantations	Commercial relationships with villagers ; lobbying at regional level

Table 1.1. : Agents and Perspectives

Donors and development agents. As mentioned in the part on the argan boom, there are a number of transnational donors and development agencies implied in the management of the argan woodlands, from the World Bank to the German cooperation agency GTZ (now GIZ) and the European Union. These often work in collaboration with Moroccan state agencies that are partially funded by them – for example the Agence de Développement Social (ADS), the Institut National pour le Développement Humain (INDH). Donors have an impact on the management of the woodlands in that they selectively support projects that fit their priorities, or impose conditions for loans. This has local-level, but also region-wide implications, as in the case of the Argan Biosphere Reserve, supported by the GTZ and the European Union (see Turner 2009). Donors and development agencies do not carry a uniform vision of what the argan woodlands are or should be, but they do meet on the concern for «sustainable development», and on a vision of the woodlands as natural, and under threat from local overuse, rather than actively managed by the local population (Simenel et al. 2009), except that it is often considered that the latter used to manage the woodlands sustainably in the past, and might do so again provided they are given the right support. These agents also tend to focus on the production of argan oil and neglect other traditional uses such as grazing and firewood collection (Turner, *unpublished manuscript*). The concept of sustainable development in the argan woodlands usually translates into two things: the stabilization and increase of woodland cover, and the improvement of living conditions for the local populations (particularly women) through the commercialization of argan products. The valorization of these products, along with education schemes, is seen as an efficient way of simultaneously creating incentives for conservation and improving living conditions for the local population. Another favored theme is the re-invigoration of traditional management practices such as the *agdal*.

Villagers. Villagers have no legal ownership of argan trees (except usufruct rights), but consider themselves as the rightful owners of the woodlands, dispossessed by the state during and after the colonial period. For them the woodlands should keep their multiple

uses: grazing, fuelwood collection, argan oil production and cultivation, as well as cultural and religious roles are all important. Depending on their main activity some may emphasize one of these uses over the others. Large livestock breeders may dislike long *agdal* periods, whereas women engaged in an argan oil production cooperatives may complain about goats climbing trees appropriated by their families. But in general the tree is considered as inherently multifunctional, as exemplified by one villager's reaction to a local development initiative, reported by Turner: «Can you imagine, they wanted us to reduce the size of our herds just in order to harvest more argan fruits? Isn't this crazy?» (Turner, *unpublished manuscript*).

Villagers unequivocally value the presence of argan trees on their land, and they usually regret the decline of woodland density, which most attribute to fuelwood harvesting and drought (at least in my study area). Attitudes as to their exploitation, however, may differ widely. Three main positions can be observed among villagers, depending on socio-economic categories and the use of the woodlands:

- Those whose livelihoods depend, at least to a certain extent, on the argan woodlands, and have relatively low socio-economic status. Some of these livelihoods may harm the woodlands (such as fuelwood trade) but they may have little choice for alternatives.
- Those whose income (from remittances or local employment) allows them not to depend on the woodlands. They may use gas stoves rather than firewood, collect only parts of their argan nuts harvest, and have few or no goats - usually not out of concern for the woodlands, but rather for practical reasons.
- Those whose social and economic status allows them to exploit the woodlands more intensely, some for their own use (such as those households who use large amounts of firewood bought from others), others for profit (such as those who exploit firewood on a large scale or invest in large herds).

Villagers are generally hostile to scientific forestry, which they consider inappropriate and illegitimate (see Box 1.2. for an example). Actually, they have traditionally managed the woodlands themselves by selecting, pruning, and planting trees (see Section 1.3.1.4.). The imprint of traditional land zoning is visible in the landscape: trees in these different land use categories have different morphologies (Genin & Simenel 2011). The temporary closure of parts of the woodlands (*agdal*) is one example of their management by locals. Today, some of these management traditions are being eroded, or lost altogether, as will be seen in chapter 4 with the abandonment of *agdal* practices in two villages.

Migrants. Long-term migrants often have a rather different approach to the woodlands than residing villagers. For them the woodlands are no longer so much a place of production as a place to go home to, a link to one's roots, thus potentially requiring different characteristics than for non-migrants. Migrants influence management through migrant associations, through selective support for village projects, and through participation in decision-making on community issues. Affluent migrants typically embrace and reproduce ideas of sustainable development carried by transnational donors. One example of the role of migrants in the management of the woodlands is that of the association «Migrations et Développement» (M&D), created to channel international migrants' efforts at modernization and development of their home villages, and which has supported the setting up of some argan oil cooperatives¹².

Local decision-makers. Local decision-makers include members of the customary hierarchy (*qaid*, *chikh*) and members of the local political scene (president of the commune, local representatives). Their main interest is in keeping good relationships with the population, and in avoiding conflict within the population. For some this may mean maintaining patronage relationships in order to stay in power. The woodlands are interesting to them mostly to the extent

¹² This association is very well known locally and has been the subject of much literature. See for example Lacroix (2005), Iskander (2010) and Daoud (1997, 2005).

that they serve these goals. They may embrace the development and conservation schemes proposed by donors if these are likely to provide benefits to the population. But they may also oppose forest legislation in order to gain support from voters. This was the case of the president of El Faid commune, who used the promise that he would let people use argan trees «as they like» as an argument in his election campaign in 2009. Communal authorities have also had an interest in promoting (authorized) logging: a 1976 law states that 80% of the income from logging should accrue to the commune. While originally designed to ensure more equitable sharing of benefits between forest officers and the population, the law also provided an incentive for logging (Bourbouze & El Aich 2005). Being mostly mediators between other agents in practice, they are relatively agnostic as to normative goals and management preferences for the woodlands.

Box 1.2.: A contested project.

In the mid-2000's, the forest officer in the study area launched a project of «pasture amelioration» on the territory of one of the study villages. The idea behind the project was to plant productive species alongside existing argan trees, so as to provide alternative sources of fodder for goats and sheep, and thus release some pressure from argan trees. He hired workers to plant *Atriplex* and prickly pear (*Opuntia ficus-indica*) on some 30 hectares, including land belonging informally to several families in the village, and fenced off the area so as to let the trees grow for a few years. From the accounts of villagers, I gather that the project was perceived at best as obscure and incomprehensible, and at worst as a vicious attempt to dispossess them from their land. Some villagers actually tried to start an action against the project, but failed to gain sufficient support in the village. Within the fenced perimeter, while the grass is tall and the *Atriplex* appear to be growing, several trees have been cut, and many *Opuntia* plants have been damaged. The forest officer regrets that villagers have misinterpreted the project, blaming this on the fact that «they are illiterate». Villagers, on the other side, feel they have not been consulted and have not received sufficient information on the project.

Nomads. Nomads using the argan woodlands come either from the East (Ouarzazate, Errachidia, etc.) or from the South (Western Sahara). They have long used the argan woodlands as grazing lands, and some Saharan nomads have even settled in the Sous plain in recent years. Though there are restrictions on the land they can use and the duration of their stay, some of these nomads have notably been protected by political elites so that they are relatively free to move or stay (Turner 2008). Since they use the argan woodlands as grazing lands, their primary interest is in the abundance of argan leaves, which serve as fodder, and in the quality of the grass under argan trees. However, more and more nomads have reportedly started collecting nuts where they pass, in order to sell them and benefit from the booming argan market; some also complete their income by making argan charcoal, especially in the South of the argan region. Although they have a clear interest in the persistence of the argan woodlands, they also have no legal incentive to protect them, and are commonly blamed for their destruction by both the local sedentary population and forest officers.

Consumers of argan products. Consumers may influence land use dynamics in the woodlands through their consumption choices, relayed by intermediate buyers in the commodity chain. For instance, the increase in demand for argan oil has probably caused a more thorough collection of argan nuts, as well as an increase in nut harvests on trees (Lybbert et al. 2011). Consumer preferences also manifest themselves through labels, such as protected geographic indications (IGP), organic, or fair trade, all of which have the potential to shape production patterns. The vision of argan woodlands that is communicated in the argan oil market is one in which the woodlands are a natural ecosystem, under threat from overexploitation, and home to a Berber population fixed in ancestral traditions (Simenel et al. 2009). Consumers are assured that, by buying argan oil, they contribute to sustainable development, because they provide an income to poor producers, and therefore also an incentive for those considered responsible for the degradation of the woodlands to protect them. But by setting quality standards and by expressing quality expectations through the use of labels, the argan market also has the potential to change the nature of production itself.

Argan oil marketing agents. These include private companies, individual traders and cooperatives. Though very different from each other, these agents share a focus on argan oil over other uses of the woodlands, and participate in the active construction of a marketing image of the argan woodlands as natural and home to exotic Berber traditions. They have a role as selective buyers of oil or of raw material and as employers, but also increasingly as players in the institutional scene, by influencing decision-making at the regional level - private companies are represented in the AMIGHA and in the ANDZOA for instance (see Section 1.3.1.5.). They are generally favorable to plantations, but share no clear management preferences otherwise.

1.3.2. The study area

The study area corresponds to the rural *commune* of El Faid in the Awluz district, Taroudant province (Figure 1.7.; see also Figure 1.1 for a detailed view of the location of the study area within the argan region). Five villages were selected in this area to conduct the household interviews. The rationale for the selection of the area and the villages are explained in section 1.4.1.

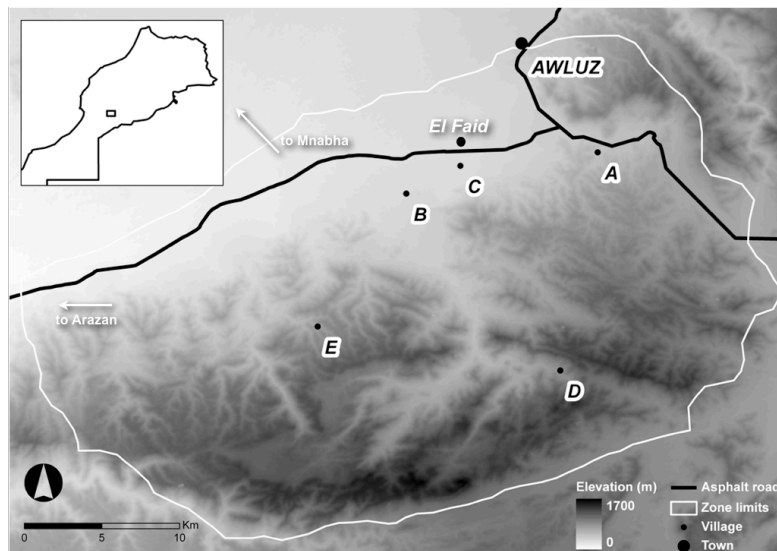


Figure 1.7.: Study area and study villages

1.3.2.1. General features

The area monitored for the study of woodland cover changes (cf. the white line on the map) covered 1100 km², or about 12% of the entire argan region. It is located on the northern fringe of the central Anti-Atlas mountain range, facing the High Atlas range on the other side of the Sus plain (Figure 1.8.). Argan trees there are scattered (mostly under 30 trees/ha) and almost the only tree species in the area, apart from a few acacias (*Acacia gummifera*) on slopes, and jujube bushes (*Ziziphus lotus*) on wad terraces. Argan trees occur in various morphologies, from low shrubs to tall trees. Their height rarely exceeds 5 to 6 meters, but their crown can reach diameters of over 10 meters. The bedrock consists mostly of dolomites, covered with quaternary silts in the plain. Soils can be deep in valleys but are thin or inexistent on slopes, where rocks and gravel dominate. Annual grasses cover most of the area after the rains, and some persist in the shade of argan trees. The area receives about 300 to 400 mm precipitation per year on average.



Figure 1.8.: A mountain village in the study area. The Anti-Atlas is in the foreground and the High Atlas in the background; the Sus plain can be spotted in the middle.

The administrative center of the commune is at El Faïd, and the main market center is at Awluz, a town of 5800 inhabitants (in 2004, center only) where market is held on Wednesdays, Saturdays and Sundays. In the western part of the commune, villagers also frequent the markets of Mnabha and Arazan. The next city of influence is Taroudant (80 km), the province center, followed by Agadir (150 km).

1.3.2.2. Study villages

Village A is a village of 86 households, 8 km from the market center Awluz on an asphalt road. The village territory is about 2300 ha. It has relatively dense woodland cover for local standards (23 trees/ha), and a fair share of flat land (36% or 828 ha under 10% slope), but had no permanent water until the construction of a water tower in 2006. The closest permanent source is at a 5 km distance. The main crop is barley, although a few almond trees can be found, as well as Barbary fig (*Opuntia ficus-indica*). Some wheat is also cultivated on the better land. There were about 1600 shoats (0.7/ha), in 2009. The primary school was built in 1998, and there is electricity since 2007.

Village B is a village of 44 households, located 17 km from Awluz and 2.5 km off the asphalt road. It has few trees around it but its territory extends to the hills where density is higher, which makes for an overall tree density of 11 trees/ha. It has a primary school since 2003 and electricity since 2007. It has a good quantity of flat land (total area 1350 ha, of which 83% or 1120 ha under 10% slope), but never had permanent irrigation water, except for a few plots located close to Village C. Instead, channels were built to divert rainwater. As a result, only a few can cultivate some maize and vegetables besides wheat and barley. As of 2012, although a water tower had been built, it was not functioning, and people were still relying on rainwater and underground cisterns. The nearest permanent spring is about 10 km away. There were about 400 shoats in 2009 (0.3/ha).

Village C is a village of 60 households, 12 km from Awluz and 1 km off the asphalt road. It has a very low to inexistent tree cover around the

village, but as for village B the village territory (1550 ha) extends to the hills to the South, so that the total average tree density is 14 trees/ha. Villagers enjoy a good share of flat land (70% or 1085 ha under 10% slope), but most importantly, until recently they diverted some water from the Sus river, which allowed, besides domestic use, for the cultivation of some vegetables and olive trees for those owning water rights (only 16 households theoretically, but there appears to have been arrangements between villagers)¹³. Apart from that, the main crops were barley and wheat. There were about 800 shoats in 2009 (0.5/ha). The water tower, built in 2006, provides water to most houses in the village, albeit at a very low rate of flow. The nearest permanent spring is 5 km away. The primary school, as well as the college, is located 2 km away from the village. There is electricity since 2001.

Village D has 21 households and about 500 shoats (0.4/ha), and is located 22 km away from Awluz, of which 15 on an asphalt road and the rest on a relatively bad dirt road. It has modest tree cover (15 trees/ha on average for a territory of 1300 ha) and a spring that allows for the irrigation of small vegetable plots, but very marginal land, with only 16% (208 ha) of it under 10% slope. The spring water in 2009 was used mostly for domestic needs as pipes had been laid to bring it inside the village. The village's primary school was built in 1994, and electricity was installed in 2008.

Village E, a village of 15 households, has no proper dirt road leading to it, and is located an hour's walk from the next village accessible by dirt road, or 3 hours from the asphalt road (11 km). From there it is another 8 km on a dirt road to the next market (Mnabha), or, alternatively, 32 km to Awluz or 22 to Arazan. The village territory, about 1000 ha, has a fairly dense tree cover (30 trees/ha) but virtually no good land (16% or 160 ha under 10% slope as in village D) and no water besides rainwater. With about 600 shoats (0.6/ha), they have largely more animals per household than the other

¹³ This has virtually stopped since the completion of the Awluz dam in 1992, after which the El Faïd commune was deemed non-priority zone and water became available only in case of surplus – which has happened twice since.

villages. The closest permanent spring is 12 km away in the mountains. Electricity was installed in 2011 but as of early 2012 only half the village was connected, and there was no plan of improving water access there. The primary school was built in 2004.

1.3.2.3. *Elements of local history*

This section provides basic information on the history of the study area that may be relevant to the understanding of present-day dynamics.

Tribe and origins. Most of the population of the study area belongs to the *Inda Ou Zal* tribe, believed to have originated in the legendary city of Tamdult n Uqqa, around present-day Akka (230 km south of Awluz). They would have been expelled from the city and settled in the central Anti-Atlas about a thousand years ago¹⁴. They are believed to have been present in the study area at the time of the great religious and political leader Ibn Tumart (1080-1130), who reportedly put them under the authority of the neighboring Hargha tribe (Montagne 1930). The tribe was noted as «large and powerful» by Charles de Foucauld, who visited the area in 1883, and who noted that, though in peace at the moment he visited, it had been ridden by internal strife between supporters of two different leaders (de Foucauld, 1888, p. 334). Subsequent French visitors equally noted this tension (Hérisson, 1917), which might have been used in a «divide and rule» strategy by the French conquerors, who gave Ahmad Ou Malik, one of both leaders, authority over the whole tribe under their own command when they subdued it¹⁵. At Ahmad Ou Malik's destitution for illegal ownership of weapons in 1932, the tribe was divided in three parts under the rule of different *qaid*s, laying the foundation for present-day administrative divisions.

¹⁴ French protectorate archives, Igherm *Bureau*, «Fiche de tribu des Inda ou Zal du Tiouti» (unknown date, before 1932)

¹⁵ French protectorate archives, *ibid*.

Foundational histories¹⁶. The five study villages have very different foundational histories, reflecting their varied geographical settings. *Village A* is located closest to the Tizi-n-Sus pass (see *Economy* below), and that location along an important trade route must have been a prime reason for the first inhabitants to settle there (along with, perhaps, the protection offered by the hills of the Anti-Atlas): in terms of natural resources, with no water and little flat land, it does not have much to offer. The village is constituted of three parts founded at different moments, all in the distant past. A more recent wave of immigration from territories to the East dates from the beginning of the 20th century, possibly as a consequence of the French conquest (see Hoffman 2007, p. 186). *Village B and C* share a foundational narrative of having come down from a mountain refuge nearby, to which they retired in times of conflicts. The refuge in question is a series of caves, still visible today alongside ruins of former storage rooms and a cemetery. Legend has it that during unsafe times people lived in the caves and cultivated the land in the plain, and when the plain became safer, they came to inhabit the villages close to their fields permanently. An important part of village C, however, has different origins. A number of families, perhaps a third of the village population, came in the late 19th century from the regional pilgrimage site of Imi-n-Tatlt (about 110 km SE of Awluz), with which people from village C appeared to have particular ties. These people are still called *igurramn* (i.e. descendants of the Saint). Others came to the area because of a renowned Islamic school and pilgrimage center located in the village territory, and around which a new village nucleus emerged, probably during the 19th century. The reason for people to settle at what is today *village D*, apart from a small spring that allowed small-scale irrigation, must have been the existence of an alternative trade route to the Tizi-n-Sus going through that village, as attested by the existence of an old trade control post and by the fact that most families were reportedly involved in caravan trade until the mid-20th century. The most curious location is most certainly that of *village E*. With no water, almost no cultivable terrain, and barely any grass even after the rains, the only resource there is argan trees. People say there used to be renowned blacksmiths in the village long ago, in which case the presence of a

¹⁶ This section is based on open interviews.

large amount of wood may have been an argument. But protection from warfare was probably the most decisive reason to settle in such a rugged canyon – indeed the village was quite invisible, and remains so to this day.

Economy. At least since the 19th century, people from the Inda Ou Zal tribe have been sedentary (de Foucauld 1888), though agriculture and cattle raising were probably always «mediocre» in the plains as in the mountains¹⁷. Shoats were not moved over long distances, but were led to summer pastures on common grounds close to the villages¹⁸. While the plain villages (villages B and C) must have originally fared relatively well in agricultural terms because they could divert some water from the Sus River or from temporary wadis rushing down the mountains, the mountain population was probably never completely self-sufficient in food. An important economic asset for the tribesmen was the aforementioned Tizi-n-Sus pass, located along a major trade road linking the Sus plain with oases to the East and Southeast (Ouarzazate, Zagora, Tata), and controlled by the Inda Ou Zal (de Foucauld 1888). There were reports of banditry at the pass (de Foucauld 1888; Hérissou 1917), and trade control posts may have provided tax money to the region. Apart from that, part of the population at the beginning of the 20th century – and possibly a much greater part still before that - was involved in caravan trade between the *Haouz* plain of Marrakech, the Sus, and the *Lqblt* oases of the Southeast (Zagora, Tata and others). This trade declined under the protectorate and disappeared around the time of independence. Migration, though a dominant feature through much of the Sus region, was relatively minor in the study area until the 1960's (see chapter 4). Finally, a number of artisanal activities existed, including smithing (still practiced by some people), woodcarving, weaving, and the making of some traditional products such as juniper tar.

¹⁷ French protectorate archives, Igherm *Bureau*, «Fiche de tribu des Inda ou Zal» (unknown date, before 1932)

¹⁸ French protectorate archives, Igherm *Bureau*, «Fiche de tribu des Arghen» (unknown date, around 1930)

People and land. The population of the study area grew considerably during the 20th century, in part due to the diminution of warfare and the introduction of vaccines at the time of the French conquest (Table 1.2.). It is likely that it had already been growing before, albeit at a lower rate, due to the successive waves of immigration described above. Population growth placed increasing pressure on scarce land resources, a pressure that was only exacerbated by political factors. Indeed, the French protectorate, by relying on key customary leaders to represent their administration in the South, gave some of these individuals enormous power and indirectly supported large-scale land seizures. There are reports of such land seizures by local delegates of the *Glaoui*¹⁹ in village A for example, and the *qaïd* of Awluz reportedly (over-)exploited the argan woodlands as his private property during the protectorate period (Boudy 1958). Water rights fixed at the time of the protectorate excluded recent users, limiting to 16 families the legal use of irrigation water in village C, a source of dissent up to this day. Later, the diversion of irrigation water to the commercial farms of Sebt Guerdane in the 1990's deprived that village of their main source of water, a clear sign of the government's priorities at that time, and a blow to local subsistence agriculture. Finally, the combination of the government protection of Sahrawi nomads settling in the Sus plain (Turner 2008) and of the increasing encroachment of commercial farms may have increased nomad pressure in the study area.

¹⁹ See Maxwell 2004 on this particular leader.

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Village	1936	1962	1971	1994	2009
A	128	331	397	503	422
B	60	149	157	250	220
C	124 (?)	390	490	652	325
D	66	131	177	186	105
E	?	61	85	116	113

N.B.: All data from national censuses except for 2009, based on my own censuses. Uncertainties for 1936 arise from villages or parts of villages changing names or not being mentioned. The apparent population decrease between 1994 and 2009 may be due to migration or to the reporting in 1994 of migrants as part of the village (for 2009, only people actually living in the villages most of their time are reported).

Table 1.2.: Population changes in the study villages 1936-2009

1.4. Fieldwork and data

Fieldwork was conducted in four phases. The first phase (June 2009) focused on identifying key issues, defining a study area, and getting introduced in the first study villages. Most of the data was collected during the second phase (September 2009 to February 2010). The third phase (February-March 2011) allowed for the verification of some information, and for more open interviews. The fourth phase (December 2011-January 2012) allowed for further open interviews, in addition to conferences where I communicated my results. I thus spent a total of about 8 months in Morocco, of which about 6 in the study area.

1.4.1. Study site selection

The selection of the study area was done in two steps. The first was to select a part of the argan region undergoing social and environmental change, and with sufficient between-village variability in the exposure to the argan market. The area should also be relatively homogenous in cultural, ethnic and administrative terms. This selection was done on the basis of discussions with experts and of field visits. Researchers, development workers and forest officers working in the argan region were consulted, first by means of a written questionnaire, sent by regular mail, and then directly during my first visit to the region. The questionnaires and the interviews concerned the extent and causes of social and environmental changes in the different parts of the argan region. On the basis of the answers, I selected a broad area (the central Anti-Atlas), which I visited with an interpreter, going from village to village by car (we visited 35 villages). Basic interviews on land use and livelihoods in these villages allowed me to get a sense of the degree of exposure of these villages to markets, particularly that of argan oil. The El Faïd rural commune, a single administrative and ethnic unit, spanned from the plain to the highlands, and offered a broad range of levels of market exposure, which made it suitable for my objectives.

The second step was to select villages along a market integration continuum, ideally from very integrated to very isolated. The first visit allowed me to choose villages at both ends of this continuum (villages A and E). The other villages were selected during subsequent fieldwork among a range of possible villages. In the process of doing the fieldwork, I realized that exposure to migration was going to be another important criterion since migration was playing such an important role in livelihoods, so I selected villages with different levels of exposure to migration as well. The selection was done incrementally because «entering» a village normally implied making connections with key informants prior to going there, which could take time and necessitated continued presence in the area. I was actually refused access to some villages when trying to bypass this (see section 1.4.7.).

1.4.2. Observation and conversations

An important part of the fieldwork consisted in day-to-day observation in the villages and informal conversations on aspects of life important to the villagers. To make this possible, I made sure to live in the villages most of the time (I rented a room in village A and alternated between that room, a room in Awluz, and private houses in other villages) and I learned the basics of the local language *Tashelhit* (though not enough to dispense with an interpreter). Additionally to the five study villages, I visited the majority of other villages in the study area, and had informal discussions there (see Figure 1.10. for visited villages). I also conducted open interviews with local authorities, forest officers and people at the regional office of agriculture. Conversations and observations were noted down daily, and sometimes recorded. All the notes from the four fieldwork periods were then compiled to one file so as to facilitate analysis.

Direct observation and conversations informed my research at several levels. Firstly they were a preliminary step to designing household questionnaires, in that they allowed me to identify relevant indicators of wealth, livelihoods and land use, and manners in which these should or should not be discussed. Secondly, they gave me insights into the locals' perspectives on the research questions, such as the extent of woodland cover change, its causes, and the role of different activities, including argan oil production, in their lives. Thirdly, they formed the main input of my analysis of long-term trends of livelihoods (in chapter 4), for which little hard data exists.

Learning from observation and informal conversations was an incremental process. Each piece of information recorded about a certain topic was fed into a general picture, taking into account the social position of the informant and his or her possible biases. This general picture or understanding formed the basis of further discussion with other informants, so that every piece of information was confronted and questioned. Contradictory information was re-discussed until satisfactory explanations were found. In this way I

could make a difference between opinions, beliefs, interpretations, and historical facts.

1.4.3. Formal interviews and questionnaires

I used several types of formal interviews during fieldwork. A series of 86 *retrospective household interviews* (Table 1.3.) based on a formal questionnaire provided information on livelihoods and land use (see Appendix 1). These interviews were held in Tashelhit, with the help of an interpreter, and were conducted between November 2009 and January 2010. In each village a local collaborator helped me to contact households, with an explicit concern for maximizing diversity in livelihood and economic status in the sample. Interviews were conducted with the household head (always male in this region) if available, or his wife (12 interviews) or oldest son (19 interviews) otherwise. Questions on production included the cereals, argan nuts, almonds and olive harvests of 2009 and 1996 (1996, a particularly good agricultural year, was a convenient reference point), and the number of animals in the herd at present and since the creation of the household. Work and migration history were approached using timelines representing employment periods and locations for all household members (Figure 1.9.). For assets, the number of items owned and the date of introduction of each item into the homestead were asked (or the date of building or renovation for houses). Income sources were estimated by asking respondents to sketch their household budget, and by checking with them its coherence with previous answers on livelihoods.

Village	# household interviews	# households (total)	Sampling rate (%)
A	26	87	30
B	20	44	45,5
C	20	60	33,5
D	10	20	50
E	10	16	62,5

Table 1.3.: Sampling rates for retrospective household interviews

Social and Ecological Change in the Argan Woodlands

Household censuses in each of the five villages covered basic assets and livelihood indicators. They were done sitting outside with a group of men and enumerating houses and people living in them. They provided information on the total population, the main livelihood activities, and the distribution of land and animal ownership among households, and therefore allowed for a crosscheck of the representativeness of the household sample.

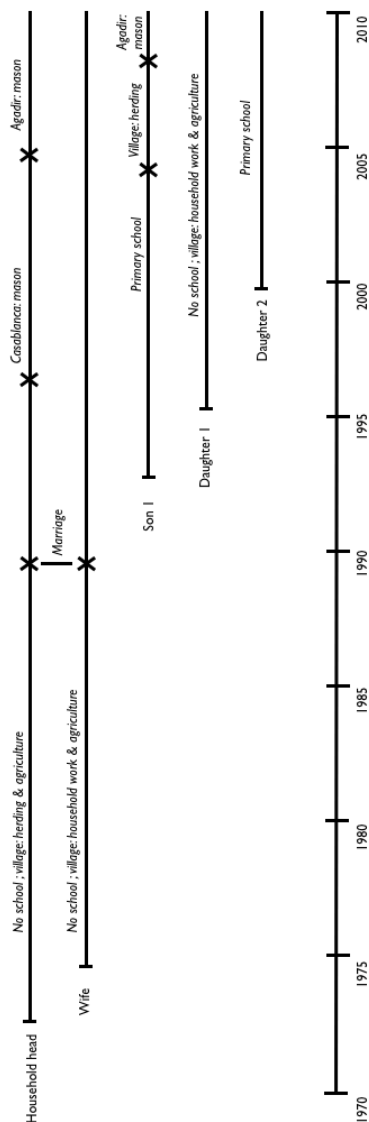


Figure 1.9.: Household timelines example

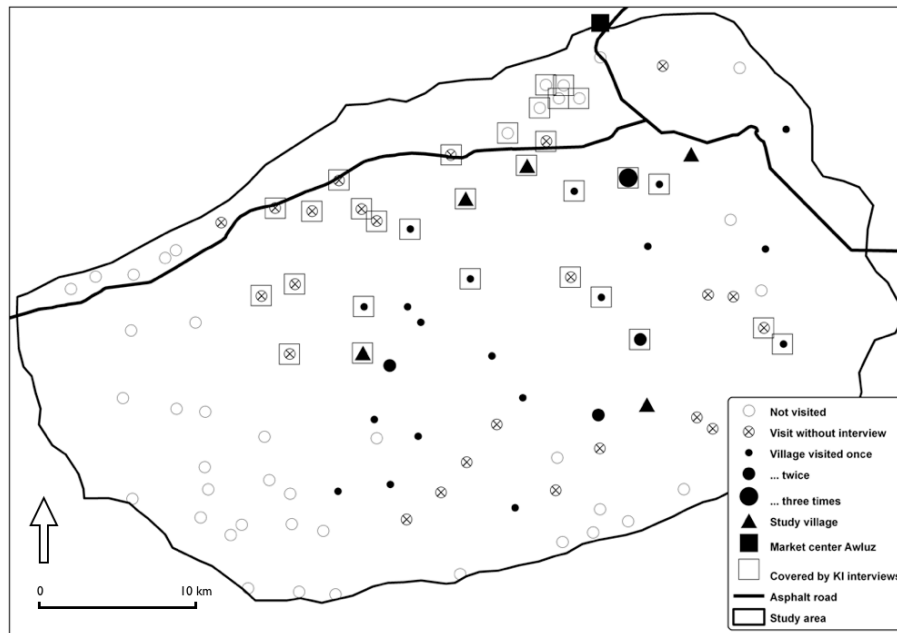
Key informant interviews covered village-level information for a greater number of villages. A first series of interviews (19 interviews, see Table 1.4.) was conducted in the study villages and covered the history of good and bad harvests, woodland cover change, land use and livelihoods, including some opinion questions (see Appendix 2). These were done with villagers selected for their good knowledge of community matters. A second series was conducted in Awluz with customary leaders (6 persons), and included basic livelihood, land use and infrastructure information for 42 villages of the El Faid commune (see Appendix 3).

Village	# key informant interviews
A	7
B	5
C	4
D	1
E	2

Table 1.4.: Key informant interviews in the study villages

Finally, *interviews with association leaders* provided complementary information on civil society activities and on external funding of local development projects (see Appendix 4). Figure 1.10. shows the villages covered by the different types of interviews.

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N.B.: Villages in which I conducted open interviews are indicated as «visited», otherwise they are marked as «visited without interview».

Figure 1.10.: Study area coverage

1.4.4. Remote sensing data

The detection of woodland density change in El Faid rural district was performed on a series of 1970 black and white aerial photographs at 1/30000, and SPOT and Quickbird images from 2007 at respectively 2.5 and 1 m resolutions (color composites, both consulted in Google Earthtm). The ASTER 25m resolution Global Digital Elevation Model (GDEM) was used in the geocorrection process and in the calculation of topography-related variables.

1.4.5. Transects and field validation of remote sensing data

I observed cuts on trees along 300m transects whose origin and azimuth were generated randomly with a constant density of 1/1.5

km². Each transect was divided into 10 equal-sized plots for which we noted the presence of cuts and of “green rocks”, or small argan trees that were cut in the past and developed close to the ground under grazing pressure. Additionally, trees were counted for the ground validation of density change measurement in 38 sample zones randomly located within the territories of the five study villages. Topographical features were used to delineate spatial units, resulting in zones of various sizes ranging from 0.8 to 23 ha ($\mu = 4.2$ ha, stdv. = 4.78 ha). The larger zones correspond to low tree density areas.

1.4.6. Other data

Temperature and precipitation data (1950 to 2005; 5° x 5° grid) used in chapter 2 come from the Climate Research Unit (University of East Anglia, UK)²⁰. The Palmer Drought Severity Index values (see the Methods section) are from Dai et al. (2004; 2.5° x 2.5° grid)²¹. Data on contraventions for illegal wood transport and sales between 1972 and 2007 were provided by the forest officers’ registers for 40 villages. The data includes the date of every offense, the name of the forest domain within which it took place, and the origin of the contravener. Forestry registers also provided the woodland zoning plans and descriptions of the various massifs, their population and their livestock, for the years around 1970.

1.4.7. Notes on the vagaries of fieldwork

Before finishing with the data section I find it worth mentioning a few examples the role the *unexpected* in fieldwork, because I believe much of the actual outcome of fieldwork is in fact determined by factors and events outside the control of the researcher, something that may not be apparent in usual descriptions of data and methods.

On the positive side, I happened to fall upon the right people in several occasions, people without whom things would have been a

²⁰ Data available at <http://www.cru.uea.ac.uk/cru/data/>

²¹ Data available at <http://www.cgd.ucar.edu/cas/catalog/climind/pdsi.html>

lot more difficult. Right after deciding to focus on the El Faid *commune* I met a very active association leader who later provided me significant logistic support and introduced me to key local agents. A local authority member happened to be a geographer who let me conduct my research in spite of the official authorization being stuck in the pipe somewhere else in the country until a week before my departure - this would not have been possible with many others. Without really looking for additional academic support, I chanced upon Jeanne Chiche, who in the end provided considerable intellectual input, taught me how to do proper fieldwork, and introduced me to an excellent interpreter. Interviews also could take surprising directions. Meeting informally with a young man from one of the study villages in a town outside the study area, I ended up interviewing him in depth about the history of illegal logging, an activity that people are extremely reluctant to talk about.

Which brings me to the negative side. Information is power, and in the study area this meant that asking questions was often disapproved of - particularly about logging, but there was a general susceptibility as to anything that had to do with land and ownership. Whether people were willing to share information depended on how they perceived the researcher and his motives - something that was often beyond my grip, though hard I tried to make my research goals clear to them. Getting introduced in a village required enormous patience, and small mistakes could be difficult to correct: in two instances I was simply refused access to a village I had intended to study - there was «nothing to see there». I could actually come back to one of these villages later and conduct interviews, once properly introduced (village D). Finally, the local police did not approve of my presence there and did what they could to make my research more difficult - from blocking my research authorization during several months to making me or my interpreter come back from the mountains at random times to check in at the office for «controls».

These few examples may seem very anecdotal – they are –, but they should make it clear that a good deal of luck was involved in the making of this thesis.

2. The extent and causes of woodland cover change

Adapted from: le Polain de Waroux, Yann, and Eric F. Lambin. 2012. "Monitoring degradation in arid and semi-arid forests and woodlands: The case of the argan woodlands (Morocco)." *Applied Geography* 32(2):777-786.

Abstract

Arid and semi-arid forests and woodlands (hereafter called «dry woodlands»), in spite of their ecological and social importance, have received little attention in land change studies. Growing evidence shows that these woodlands have been receding at very high rates in many places, suggesting a need for a better understanding of the processes and causes of change in dry woodlands. Changes in the extent of dry woodlands are debated in part because estimates of forest and woodland areas in drylands are uncertain. Causal explanations of the degradation tend to draw on the literature on desertification and tropical deforestation, and to emphasize either local or remote, and either social or biophysical drivers. This study contributes to a better understanding of dry woodland degradation as a basis for conservation policies. Firstly, we argue that monitoring arid and semi-arid forests and woodlands using area estimates may lead to an underestimation of the severity of change because tree density change often exceeds area change. Secondly, we argue that the analysis of degradation processes in these multifunctional landscapes should integrate both local and remote, and both social and biophysical factors. We use a case study of degradation in the *Argania* woodlands in semi-arid to arid Southwest Morocco to test these two claims. We used gridded tree counts on aerial photographs and satellite images to estimate woodland change between 1970 and 2007, and we tested several possible causes of change on the basis of original socio-economic field surveys and climatic and topographic data. We found that woodland density declined by 44.5% during this period, a figure that is significantly underestimated if woodland area change is used as a measure of degradation. Increasing aridity and, to a lesser extent, fuelwood extraction were related to woodland decline. No effect of grazing by local livestock was found.

Keywords: drylands; degradation; deforestation; Morocco; remote sensing

2.1. Introduction

Deforestation in tropical forests and land degradation in drylands have been studied extensively. However degradation processes in arid and semi-arid forests and woodlands (hereafter called «dry woodland») have received far less attention (Grainger 1999). We mentioned in the introduction (section 1.2.1.1.) that monitoring change with classical tools was difficult because dry woodlands are often not included in national forest inventories, and surface change estimates may not reflect actual biomass and productivity changes. We argue that surface estimates may lead to an underestimation of the severity of change in dry woodlands because, in many of these woodlands, density is decreasing faster than their area. Indeed, unlike in dense tropical rainforests, the main modes of exploitation of dry woodlands (i.e., fuelwood harvesting, grazing, agriculture) do not lead to a complete clearance but rather a thinning of the woodlands (Grainger 1999).

As for the causes of dry woodland degradation, we showed that four interpretations coexist, each emphasizing more local or distant, or more socio-economic or biophysical drivers: the neo-Malthusian, the climatic, the economic and the political ecology interpretations (section 1.2.1.2.). These four interpretations may have more or less relevance depending on the geographic and social environments considered, but in many cases their shortcomings are obvious, and there is a case for a more integrated understanding of the degradation processes. Dry woodlands are highly complex, multifunctional landscapes. We argue that change in dry woodlands transcends these categories and can only be understood by taking into account both local and remote, and both biophysical and social drivers.

The objective of this study was to use the case of the argan woodlands in Southwest Morocco to test the claims that: (1) surface change values underestimate the degradation of dry woodlands (understood here as the decrease in tree cover); and (2) changes in dry woodlands can only be understood by taking into account both local and remote, and both biophysical and social drivers. We first

constructed an integrated conceptual model of degradation in the argan woodlands based on the literature. Woodland change was then estimated by gridded tree counts on aerial photographs and high-resolution satellite images. Thirdly, household surveys and key informant interviews conducted during fieldwork in 2009-2010, along with climatic and topographic information, were used to estimate the contribution of fuelwood collection, grazing, and aridity to woodland decline.

2.2. Background

2.2.1. Woodland change

Reports on woodland decline in the argan zone are not new, but evidence for it has been scarce. Rocher (1926), Boudy (1958) and Monnier (1965) reported widespread woodland clearing in the first part of the 20th century, mostly attributed to fuelwood demand from the rapidly growing coastal cities and from Europe during the two world wars. McGregor et al. (2009) found a decrease in argan pollen concentration in sediments close to the Atlantic coast since the late 18th century, after a strong increase since 1700 AD. Forest Officers reported a 1.16% (11100 ha) decrease in the extent of the argan woodlands between 1990 and 2005, or 740 ha/year, but provided no information as to how this was estimated (Lefhaili 2010). El Yousfi (1988, cited in M'Hirit et al. 1998), comparing aerial photographs, showed that middle- and low-density woodlands were opened to cultivation on 45% of a 22000 ha study area in the Sus plain between 1969 and 1986. A recent report however found that only about 9% of a wider study area of 55000 ha, including the former 22000 ha, were cleared for cultivation between 1969 and 2006 (TTOBA 2007), suggesting that not all the areas opened to cultivation were actually cleared of trees. This same report also found that 5% of the area was cleared for urbanization, and 32% of the area underwent some woodland density decrease between these two dates.

2.2.2. Causes of change

Woodland decline in the argan region results from a combination of lack of regrowth and loss of trees, which are in turn controlled by biophysical and social factors (Figure 2.1.). The lack, if not complete absence, of natural regrowth across the region has been acknowledged by many observers (M'Hirit et al. 1998; Tarrier & Benzyane 2003; Nouaim 2005; Bellefontaine 2010). It may have been caused partly by grazing, as animals eat new saplings (M'Hirit et al. 1998; Nouaim 2005; Naggar 2005; Aafi 2007). Enclosure experiments in two areas (Culmsee 2005; Taleb 2007) found that regrowth does occur if grazing is excluded. Grazing may also damage soils, remove understory and cause erosion (M'Hirit et al. 1998; Aafi 2007). Some authors also argue that excessive browsing by goats and camels damages the trees (M'Hirit et al. 1998; Nouaim 2005; Aafi 2007), whereas others suggest that moderate browsing may stimulate fruit production (Bourbouze & al. 2005). Seed harvesting for the production of argan oil may become unsustainable if no seeds are left on the ground to germinate, as is the case in some places (M'Hirit et al. 1998; Benghazi 2007). Increasing prices for argan oil have probably led to an intensification of fruit collection since the 1990's (Lybbert 2002).

Increasing aridity, reported at a regional scale by Esper et al. (2007), may also have adverse impacts on germination and seedling survival (Nouaim 2005; see also Stour & Agoumi 2009). Indeed a high degree of hydric deficit was shown to prevent germination (Bouzoubaa & El Mousadik 2003). Aridity was also shown to increase developmental instability, which amounts to decreasing resilience, so that trees exposed to higher aridity are more likely to succumb to other stresses (Alados & El Aich 2008). Excessive hydric stress during long and severe droughts may increase mortality in tree stands, especially those on slopes and with high sun exposure (El Abidine 2003). Increasing aridity can be due to climate variability or change, or to a change in micro-climatic conditions prompted by the clearing of trees and understory (M'Hirit et al. 1998; Nouaim 2005). Droughts may exacerbate grazing pressures on existing resources (M'Hirit et al. 1998).

Social and Ecological Change in the Argan Woodlands

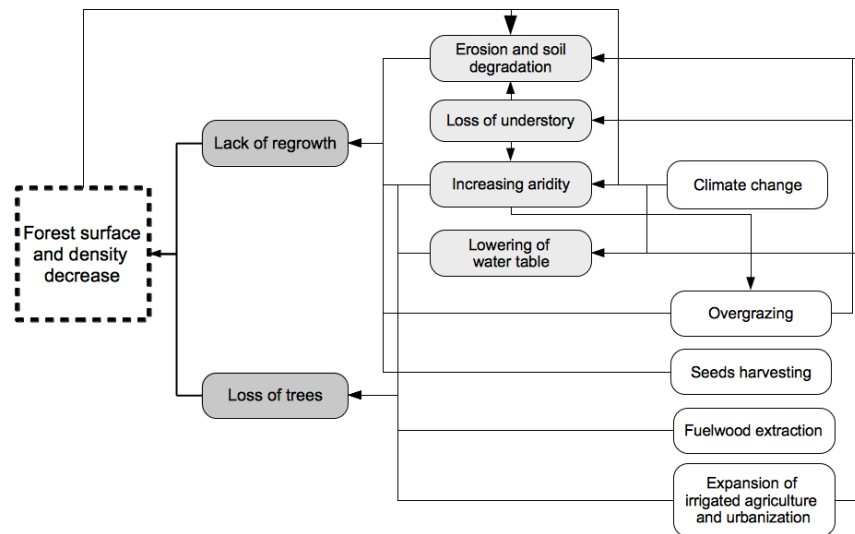


Figure 2.1.: Conceptual framework

Clearing of trees and understory also causes erosion that, along with soil degradation (in the form of salinization and loss of organic matter, mostly in irrigated areas), may render some soils unfavorable for germination (Bani Aameur & al. 2001; Nouaim 2005; Aziki 2008). Cities such as the Agadir-Ait Melloul conurbation, as well as smaller administrative centers, have been expanding into the argan woodlands (M'Hirit et al. 1998; Nouaim 2005; TTOBA 2007). Irrigated agriculture has likewise expanded into the woodlands, mostly in the Sus plain (El Yousfi 1988; TTOBA 2007). An indirect adverse effect of the expansion of irrigated agriculture is the lowering of the water table through over-pumping, which may increase vulnerability of trees to drought (M'Hirit et al. 1998; El Abidine 2003; Nouaim 2005; TTOBA 2007). Finally, excessive fuelwood extraction, by the forest authorities and villagers, for trade and local consumption, has long been considered as an issue in the region (Monnier 1965; M'Hirit et al. 1998; Bourbouze & El Aich 2005; Nouaim 2005; Faouzi 2005; Aafi 2007; Abourouh 2007).

Many of the causal links depicted above are still partly hypothetical. Their relative importance is not known. Some might prove to be insignificant whereas some others may have been ignored. This

model should thus be seen as a roadmap to the current understanding of the degradation of the argan woodlands rather than as a definite explanation of its causes. Figure 2.1. shows that both biophysical processes (increasing aridity, erosion) and social drivers (wood harvesting, grazing) may be involved. Several causes have both a local and a remote component – e.g., grazing by local or nomad herds, fuelwood consumption for local needs or for the market. While elements of the four interpretations mentioned in the introduction can be found in the literature on argan woodlands, the neo-Malthusian interpretation dominates, with most authors and decision-makers putting the blame on unsustainable firewood collection and overgrazing.

Our case study provides a measure of tree density and woodland area change in a subset of the argan woodlands, and an estimation of the effect of three of the factors mentioned above, based on original field data: grazing, fuelwood extraction, and aridity. Concerning the other factors, either we could not collect biophysical data to analyze them (erosion, understory loss, lowering of the water table), or they were not detectable or irrelevant given the scale of the study. It is the case for the over-harvesting of seeds, which is a recent issue and whose effects will not be visible on aerial photographs. The expansion of irrigated agriculture and urbanization are nearly inexistent in the study area and occur mostly in places devoid of trees.

2.3. Data and methods

The sources of data used are described in detail in section 1.4. Table 2.1. summarizes the data used in this chapter.

Variables	Scale	Method	Source
Woodland density change 1970-2007	District: 1 circle/km ² (n = 1067) Village: 8 circles/km ² (n = 622)	Visual counting in stratified random sample on aerial photographs and satellite images	Aerial photographs: 1/30.000 images from 1970 mission, ANCFCC Digiglobe (1m, 10/29/2007) and SPOT (2,5m; 5/30/2007) (images (from Google Earth™))
Number of goats and sheep per village (1975 and 2009)	Village	Interviews of local customary authorities (n=6)	Field work 2009-2010
Contraventions for illegal wood extraction (number, location and origin of contravener)	Village	----	Data from Taroudant Service Provincial des Eaux et Forêts registers
Wood consumption (donkey loads per month)	Household	Household interviews (n=86)	Field work 2009-2010
Woodland standing volume and natural increment	Whole argan region (aggregate values)	----	FAO FAR Country report, Morocco (Lefhaili 2010)
Elevation, slope, aspect	District	----	ASTER Global DEM
Precipitations, temperature (1950 - 2005)	Aggregate values at 5° x 5°	----	Climate Research Unit global dataset
Palmer Drought Severity Index	Aggregate values at 2.5° x 2.5°	---	University Corporation for Atmospheric Research

Table 2.1.: Data summary

2.3.1. Woodland change

Aerial photographs were geocorrected using the ILWIS program with the ASTER 25m resolution Global Digital Elevation Model (GDEM). The geocorrection was done using the differential rectification method with 20 ground control points (GCP's) per image. The residual Root Mean Square Error (RMSE) on GCP's was 5 to 41 m depending on the image ($\mu = 15.7$ m, stdv. = 11.2 m). Trees were counted at the district level using a set of sample sites (circles 100 m diameter) that were located randomly within the meshes of a grid, with a density of ~ 1 circle / km^2 , excluding built-up areas and oases (1067 circles). A tighter, village-level grid, with a density of ~ 8 sites/ km^2 , was used additionally within the territory of the five villages in which the fieldwork was done ($n = 622$; sampling locations are visible on Figure 2.2.). The sample distribution was identical for the two dates. Topographic variations in some areas caused a slight misalignment of the circle borders, yet the radius of the sample circles was defined to ensure a $>90\%$ overlap on average between the areas covered in 1970 and 2007, given the RMSE. The number of trees within each circle, C_{1970} and C_{2007} , was counted visually. Trees on the edge of the circles were counted if their center fell within the circle. Given the partial overlap of the 1970 images, counting was done on the images for which the residual error on the geocorrection control points within a 1500m radius of the sample circle was lowest. The difference D between the 1970 and the 2007 values for each circle is the woodland density change (Figure 2.3.).

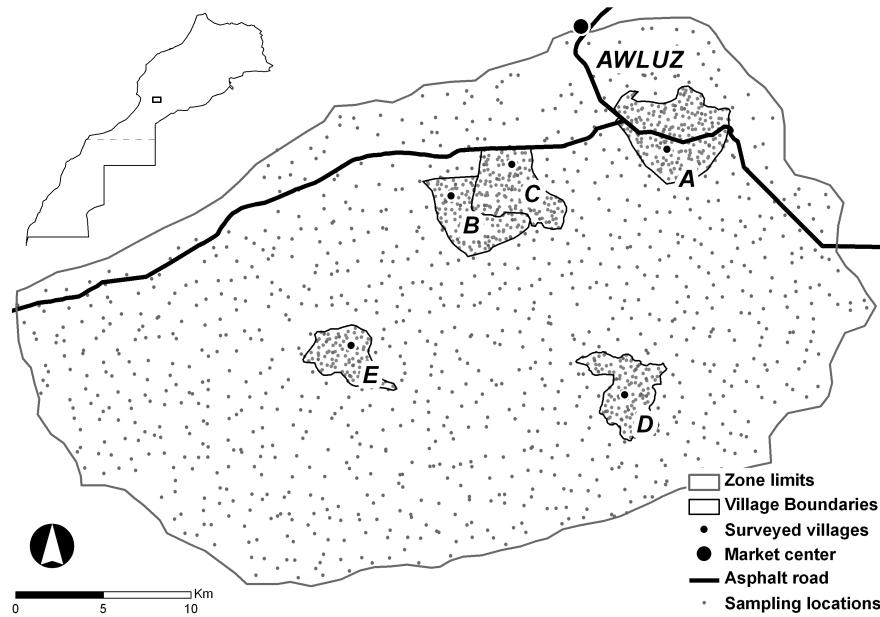


Figure 2.2.: Study area and sampling

Given the resolution of the SPOT images, it is possible that some trees, especially smaller ones, did not appear clearly on the images and were missed while counting (this was less likely to happen with Quickbird images and aerial photographs, which both have a higher spatial resolution). In order to validate counts on SPOT images, we compared tree counts on the image with on-field tree counts from the 38 sample zones using a linear regression. The regression parameters were then used to correct values counted from SPOT images over the whole area. The corrected value is thus $C_{c,2007}$, and the corrected count difference D_c .

The uncertainty on density change values can be expressed as the sum of several error factors. The geocorrection error (GE) is due to the residual error after geocorrection. To estimate it, we created a spline interpolation surface on 1970 count values and we computed the slope, which is the maximum gradient value, for each cell. The GE for each sample circle was then computed as the product of that slope with the error value of the closest GCP, assuming that this

value is similar to the error value at the circle location. The measurement error ($ME = ME_{1970} + ME_{2007}$) is due to inaccuracies in the process of counting the trees on images (some trees may be missed while counting, or several trees close to each other may be mistaken to be only one) and was estimated at 10% of counted values. The correction error (CE) is due to the linear regression used to correct values measured on SPOT images. It was estimated using $CE = a * (C_{c,2007} + ME_{2007})$, where C_{2007} is the 2007 count value, and a is a factor equal to half the 90% confidence interval of the regression coefficients. The total measurement uncertainty can thus be expressed as $U = GE + ME + CE$.

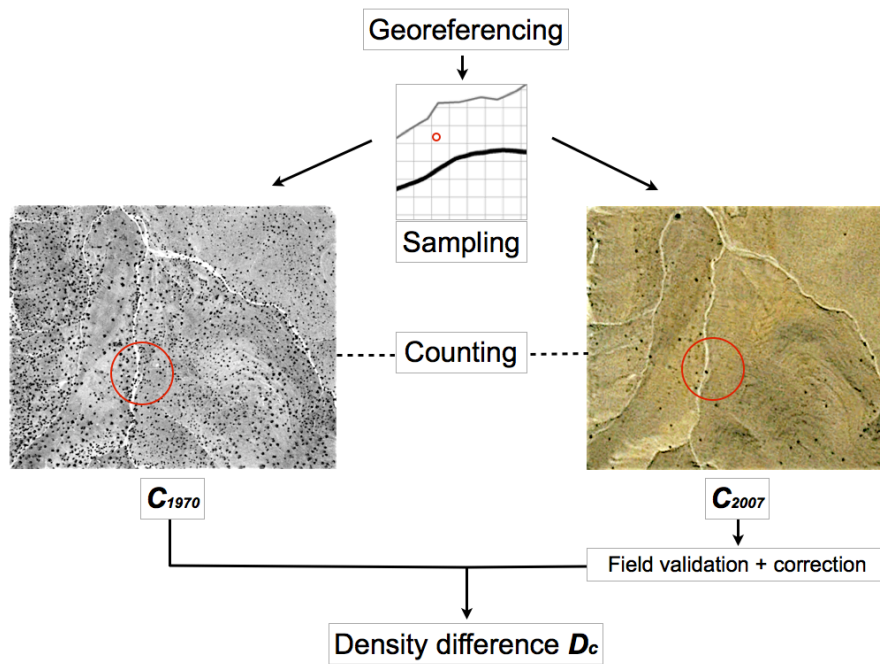


Figure 2.3.: Counting method.

To measure the extent to which changes in area estimates reflect degradation as measured by a decrease in tree density, we classified sites as woodland or non-woodland according to various density thresholds. We then measured the number of sites switching from

«woodland» to «non-woodland» for each threshold value, and compared the results to estimates of woodland density change.

2.3.2. Causes of change

We focused on three main proximate causes of woodland cover changes: fuelwood extraction, grazing and increasing aridity. The fact that data on different causes were not available at a single spatial scale and for the same observation units did not allow us to conduct a multivariate statistical analysis, although it might have provided interesting insights as to the relative weight of the various causes. Aggregating all the data to the lowest common resolution would have caused a loss of information. We therefore analyzed each factor successively, at the resolution at which each data set was collected.

The relationship between fuelwood extraction and woodland density decline was tested in two steps. Firstly, we evaluated to what extent domestic consumption might account for the observed decrease in woodland density. For this we compared, on one hand, percent change in woodland standing volume as predicted on the basis of the rate of domestic wood consumption to natural woodland increment to, on the other hand, observed percent woodland change $D_{c,\%}$ for the five sub-sample villages. The predicted percent change in woodland standing volume for each village was estimated as:

$$D_{p,v,\%} = (100/V_{1970}) * (2007-1970) * (I_v - W_v)$$

where V_{1970} is standing volume in 1970, I_v is yearly natural increment, and W_v yearly wood consumption (see box 2.1. below for details on the calculation and consideration of alternative methods of measurement). A sensitivity analysis was conducted, estimating $D_{p,v,\%}$ with a change of $\pm 50\%$ in the parameters for initial woodland standing volume and natural increment. Secondly, we calculated the correlation between D_c in 40 villages and the number of contraventions for illegal wood transport and sales by people from these villages.

Box 2.1. : Details on the calculation of domestic wood consumption, and notes on alternative measurement methods

Total wood consumption per village between 1970 and 2009 was estimated by extrapolating household means to the whole population, taking into account population changes and changes in the fuel mix between the two dates (wood consumption before the adoption of butane was increased proportionately to the quantity of butane used today). Initial wood volumes in the forest were estimated using the 1990 mean standing volume for the argan forest (18m³/ha) as published by forest officers (Lefhaili 2010). It was assumed that the 18m³/ha value reflected the 1990 mean for the five villages. This value was augmented to reflect the average change in forest density from 1970 to 1990, assuming a linear change from 1970 to 2007. The resulting value was then multiplied for each village by the deviation from the mean forest density, so as to reflect local differences. Natural increment was estimated at 0.3m³/ha (Lefhaili 2010) and adapted in the same way. As for the forest change values at village level, village territories were given the mean of the forest density values for the sample circles falling into them. Village boundaries were delineated using Voronoi diagrams (Voronoi diagrams have edges that are at equal distance between each point and the next closest point, which is similar to reality, because village borders are normally at approximately equal distance from neighboring villages). There were on average 13.3 sample circles in each village territory (stdv. = 6.3).

This study thus uses an indirect way (i.e. declarations on fuelwood consumption) to estimate the extent of fuelwood extraction. The approach has two main weaknesses. First, estimations of fuelwood consumption by the household members may be biased. This might be the case if providing an average value is difficult (for example if trips to collect wood are very irregular), or if the respondent has an interest in giving a biased value (e.g. downplaying the amount consumed for fear of denunciation). Second, there is no separation between dead and live wood, which means we do not know to what extent the fuelwood used has an actual impact on the woodlands. Other researchers (e.g. Benjaminsen 1997) have used a more direct approach, weighting the wood stock and measuring changes from day to day, which allows controlling the amount of dry wood in the stock and avoids biases in declarations.

The effect of grazing was estimated based on the correlation coefficient between, on one hand, the mean number of animals per hectare during the period 1970 to 2009 at village level μ_{GD} and, on the other hand, woodland change D_c for the 22 surveyed villages.

To investigate the effect of increasing aridity, we first analyzed temperature and precipitation data, as well as the Palmer Drought Severity Index (PSDI) for the 1970-2005 period. The PSDI is an index of meteorological drought created by Palmer (1965) based on a supply-and-demand concept of the water balance, and using surface air temperature, precipitation and available soil water content. It has positive values for wet months and negative values for dry months, with values lower than -4 usually considered as a sign of «extreme drought» (details on the computation procedure can be found in Palmer 1965 and in Allen 1984). Monthly values were averaged for years between 1970 and 2005. An increase in aridity would have mostly impacted areas with a low altitude and a high sun exposure, given that these are already subjected to higher aridity on average. We therefore also tested the relationship between woodland density change D_c , and sun exposure and elevation on the 1067 sample circles by means of a multivariate, linear regression. Sun exposure was assessed using the Solar Radiation Index (SRI):

$$SRI = \cos(\text{latitude})\cos(\text{slope}) + \sin(\text{latitude})\sin(\text{slope})\cos(\text{aspect}^*)$$

where aspect^* is equal to $(180^\circ - \text{aspect})$ (from Keating et al. 2007). We controlled for the effect of initial density by including it as an independent variable in the regression.

2.4. Results

2.4.1. Woodland change

Woodland density in the study area decreased dramatically between 1970 and 2007, from an average of 27.4 trees/ha (stdv. = 13.8) to 15.2 trees/ha (stdv. = 22.8), a change of -12.2 trees/ha, or -44.5% ($p < 2.2e^{-16}$; see Figure 2.4. and Figure 2.5.). The average uncertainty

range on the difference was of 5.7 trees/ha, or 20.1%. The regression of counts on the SPOT image against counts in the field yielded an $R^2_{\text{adj.}}$ of 0.84 and a significant estimate (est. = 1.31; $p < 0,001$). Figures of percent surface change were much lower than figures of density decrease (Figure 2.6.). Unsurprisingly, the maximum change value (26.3%) occurred when the threshold was set as the average tree density (27.4 trees/ha), as more plots were close to this threshold and were thus more likely to cross it.

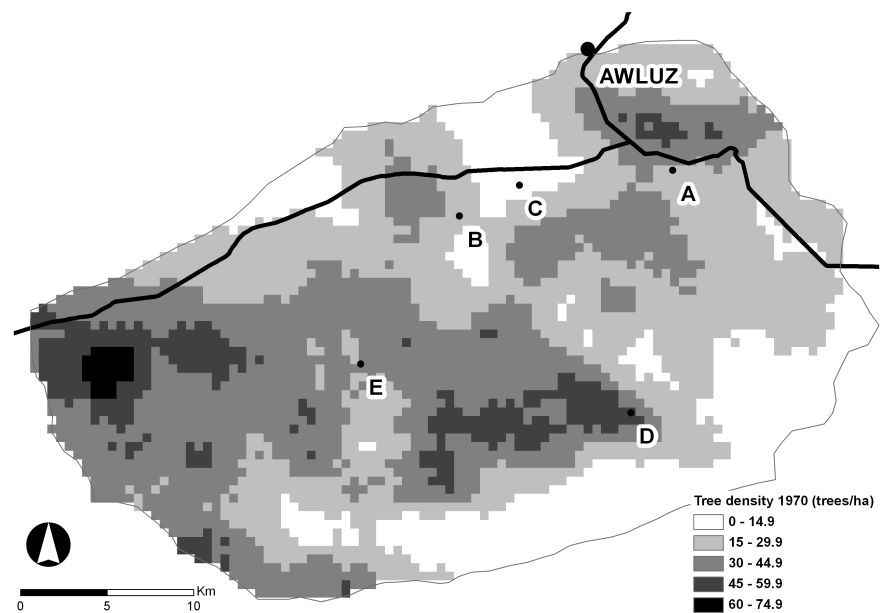


Figure 2.4.: Woodlands density in 1970

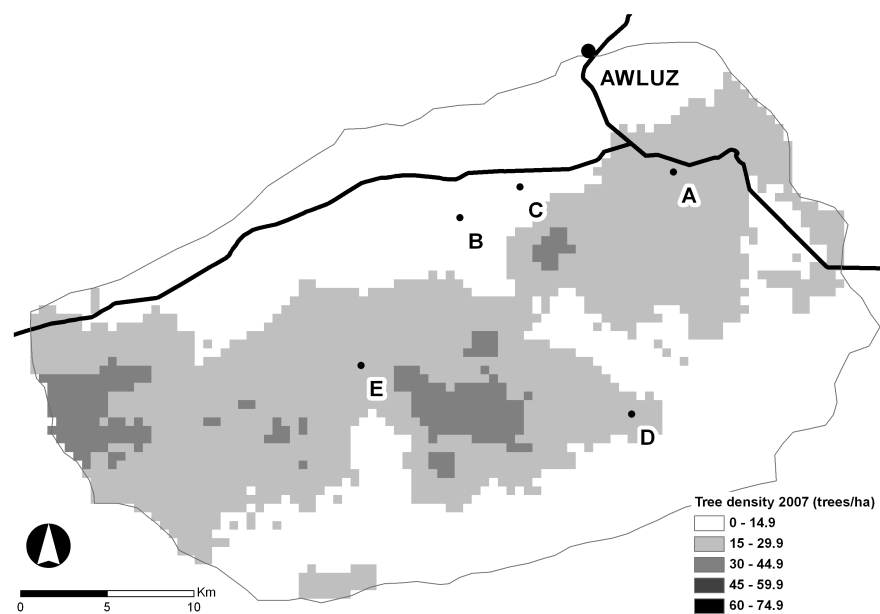


Figure 2.5.: Woodlands density in 2007

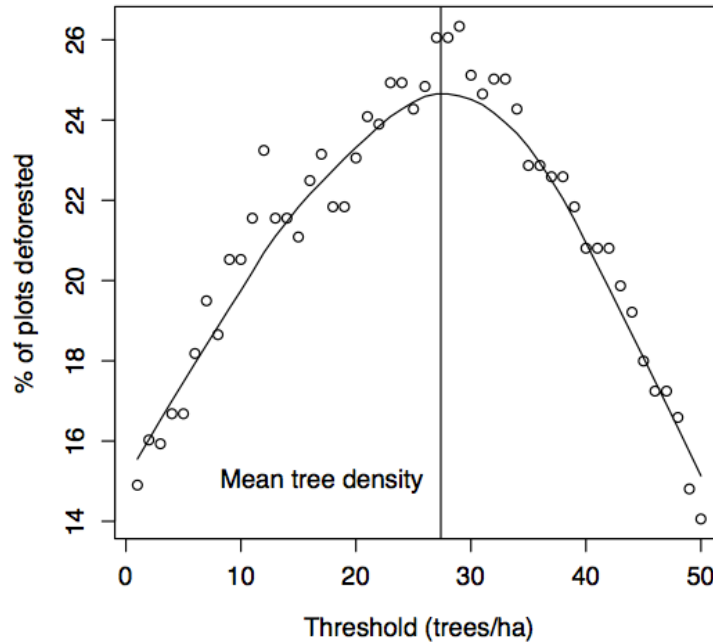


Figure 2.6.: Deforestation as a function of woodland definition.

2.4.2. Causes of change

All interviewed households used firewood for baking, and 80% also for cooking. The average fuel mix for the total sample was 4.6 on a 10-point scale, ranging from 0 (only wood) to 10 (only butane). Predicted changes in woodland standing volume based on domestic consumption $D_{p,v,\%}$ were positive for three out of five villages, meaning that consumption exceeded regrowth only for the other two villages. $D_{p,v,\%}$ was above $D_{c,\%}$ in all cases except for one (Table 2.2.). Trends were not sensitive to modifications of parameter values for woodland standing volume and natural increment by $\pm 50\%$. Predicted values for village E remained positive for all modifications. Values for villages A and D (1.40% and 3.41%) remained higher than observed values. The value for village B (-29.41%) remained negative and the value for village C remained below observed values in all

cases. This shows that domestic wood consumption cannot alone account for the observed decrease in woodland density, but that it may have played a role in conjunction with other factors. The correlation between contraventions for illegal wood transport and sales, and woodland density change D_c was not significant ($c = -0.27$; $p = 0.096$; see Figure 2.7.)²².

Village	Mean yearly wood consumption per household for 1970-2009 (m^3)	Predicted woodland standing volume change (% 1970)	Observed woodland density change (% 1970)
		$D_{p,v,\%}$	$D_{c,\%}$
A	14,27	1,4	-27,99
B	10,64	-29,41	-37,42
C	16,22	< -100,0	-26,51
D	14,86	3,41	-49,09
E	11,01	54,5	-15,03

Table 2.2.: Predicted and observed change based on domestic wood consumption.



Figure 2.7.: Woodland density change and contraventions

22. For correlations, p indicates a Spearman coefficient, and c indicates a Pearson correlation.

There was no significant correlation at the village level between browsing intensity, as measured by the average goat and sheep density per village between 1975 and 2009, and woodland density change D_c ($\rho = 0.22$; $p = 0.38$). Change in sheep and goat density between 1970 and 2009 at the village level was not related to woodland density change either ($\rho = 0.21$; $p = 0.38$).

There was a significant increase in yearly mean temperature from 1970 to 2005 of about one degree Celsius (regression on z-scores: $c = 0.059$; $p < 0.001$; Figure 2.8.). There was no significant trend for yearly or monthly precipitations (Figure 2.9.). The PDSI decreased significantly from 1970 to 2005 (regression on z-scores: $c. = -0.037$; $p = 0.018$; see Figure 2.10.). A linear regression of SRI and elevation against woodland density change D_c yielded significant parameter estimates for both variables and an $R^2_{adj.}$ of 0.044 ($n=1067$). In the most exposed locations, woodland density decrease was up to 15 points higher than in the least exposed ones. The effect of elevation was less pronounced, with one point decrease of D_c per 100 m elevation increase. The regression including initial woodland density had a much higher $R^2_{adj.}$ (0.6359) and the parameter estimate for initial woodland density was positive and significant, which means that denser woodlands were thinned more than others in absolute terms. While the introduction of this variable changed the magnitude of parameters for SRI and elevation (dividing it by two for the first, and by three for the second), it did not change their sign nor affect their statistical significance (see Table 2.3.).

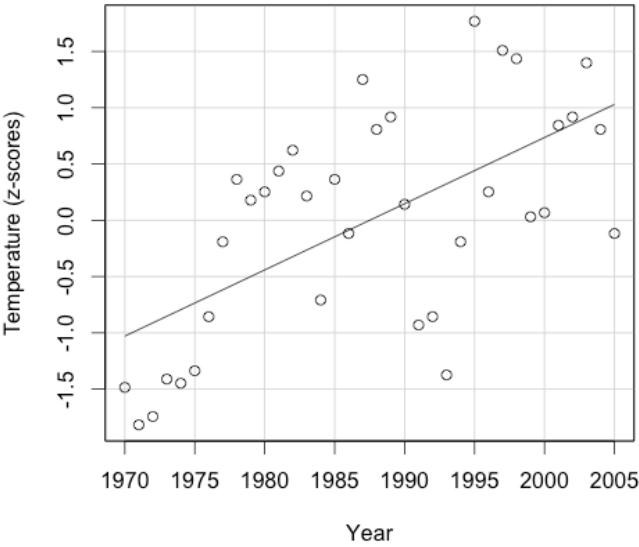


Figure 2.8. : Increasing temperature

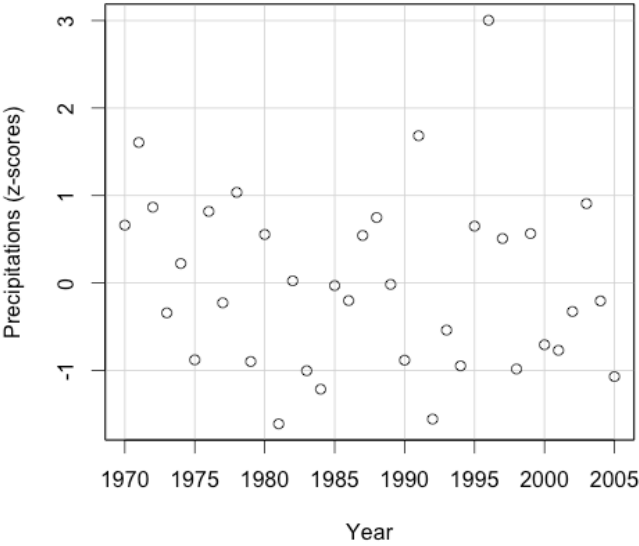


Figure 2.9. : No clear trend in precipitations

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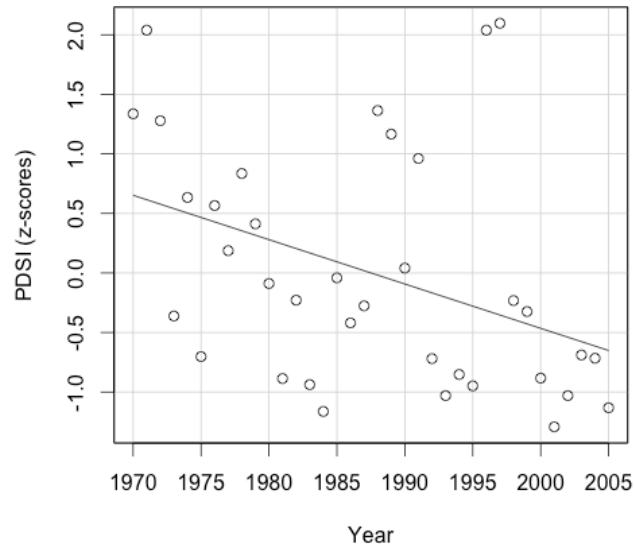


Figure 2.10.: Increasing drought

Variable	Estimate	p-value
Intercept	8,1	0,0039 **
Elevation	0,003	0,0035 **
SRI	-8,12	0,0009 ***
Initial density	-0,79	<2e-16 ***

** = significant at a 1% threshold; *** = sign. at a 0.1% threshold

Table 2.3.: Regression results

2.5. Discussion

2.5.1. Woodland change

Our analysis shows that the argan woodland in the study area underwent significant density decline between 1970 and 2007. This validates our first claim, that measuring degradation as a change from woodland to non-woodland systematically underestimated change, with highest deforestation rates just over half as high as density change values. This reflects the fact noted by Rautiainen (2011) that woodland cover change detection based on surface measurements is not accurate in cases where tree density is changing. If, as it seems to be the case in many open woodlands (Grainger, 1999), density is declining in dry woodlands, forest inventories thus likely underestimate change in these areas.

2.5.2. Causes of change

Fuelwood extraction for domestic use did not exceed regrowth in three out of five cases. However, even in these three villages, the quantities extracted are hardly insignificant and they may have played a role in woodland decline in the long term in conjunction with other factors. Actually, over 40% of the district population living outside the woodlands, and people from the nearby market town and from villages on the southern edge of the woodlands, rely on fuelwood from this area. While gas bottles are increasingly used for cooking, they did not appear in the area before 10 to 20 years ago, and they still provide only part of the energy used. The lack of a significant correlation between contraventions and woodland change should be interpreted with caution. It may mean that wood trade has had little or no impact on woodland decline, or else that contraventions are not directly related to wood trade intensity. The latter might happen if local forest officers control some areas more strictly than others, or have particular arrangements with locals and traders. What is more, contraventions report the origin of the contravener, not the place where the wood was extracted, which may in some cases be different. Informants acknowledged that most

villagers were involved in wood trade until the late 1990's. In dry years, wood sales were the main source of income for many poor households until remittances replaced them as a buffer resource. In the 1980's, wood trade intensified and traders came to the region with pick-up trucks and lorries to supply the cities with wood and charcoal. It would be surprising if this had no impact on the woodlands. Most locals themselves acknowledge that the cutting has been responsible for part of the woodland decline. The relatively low number of contraventions (less than 16 per year on average for the whole study area) suggests that most of the trade was overlooked. No better quantitative index for illegal wood extraction, however, is available. Chapter 4 provides more information on the history of wood consumption and trade in the area.

The absence of any correlation between livestock density and decline in woodland density suggests that, contrary to widely-held views, the direct damaging effect of browsing on trees may not be significant compared to other stress factors. Locals also do not seem to believe that browsing has any direct effect on the trees. Our data however does not take nomad herds into account. Saharan nomads and, more recently, nomads from Eastern provinces have used the less mountainous parts of the study area intensively. Their herds are often greater than those of the local communities. Unfortunately there are no statistics on nomad movements and their herd size in the area. Likewise, the effect of grazing on regrowth and on soil and understory degradation could not be evaluated directly. We saw no saplings in the area during fieldwork. When asked about it all informants, including older people, replied that they had never seen argan saplings growing to become mature trees. Some acknowledged that the few saplings that did grow were eaten away by goats, but others said that regrowth solely depends on rains.

Temperature increased during the study period, and while there appeared to be no trend in rainfall, the Palmer Drought Severity Index decreased significantly, suggesting a regional increase in aridity. This is consistent with other studies that have highlighted an abnormally dry period since the 1980's in the region (Esper et al. 2007; Touchan et al. 2010). Low and exposed surfaces were impacted

most, as trees disappeared at rates much higher than on other surfaces. This supports the hypothesis that aridity impacts trees, and that part of the observed decline is to be attributed to increasing aridity. It is not clear whether local human activities such as grazing have had any influence on the vulnerability of trees to drought, as posited in the conceptual model. It is not clear either whether increasing aridity is to be attributed to human-induced climate change or to long-term climatic oscillations such as the ENSO (as argued by Esper et al. 2007). Prospects of an increasingly arid climate in North Africa in the 21st century (IPCC 2007) give reasons for concern.

It is clear from this analysis that social and biophysical, and local and distal drivers all play a role in woodland density decline and cannot be viewed in isolation in the argan woodlands. This validates our second claim, on the need for an integrated approach to the understanding of causes of dry woodland degradation. The difficulty inherent to this type of systems is that of measuring the relative weight of these drivers. As we have shown, data on drivers of change are difficult to acquire and analyze at a single scale. Moreover, these causes act in a synergistic rather than in an independent manner. We suggest that more research is needed to design methodologies that can make good use of available data to analyze interactive causal clusters of changes in dry woodlands while explicitly addressing the multi-scale nature of these processes.

2.6. Conclusion

We argued that dry woodlands are undergoing high rates of change that make it necessary to build a better understanding of the dynamics of land-cover change in these ecosystems. This was confirmed in the case of the argan woodlands in Southwest Morocco, which underwent a dramatic density decline of over 40% between 1970 and 2007 in our study area. We demonstrated that monitoring woodland change based on area estimates, as done for tropical forests, is inappropriate for dry woodlands, because density change may be more important than surface change. Indeed, in the case of the argan woodlands, surface data strongly underestimate change, independently of the density threshold used to distinguish woodland from non-woodland. As for the causes of change, we argued that causal explanations derived from the understanding of tropical deforestation or desertification, and emphasizing either local or remote, and either social or biophysical drivers, cannot satisfactorily account for processes involved in dry woodland degradation. Our case study showed that degradation processes transcend usual categories of explanation: the decline in woodland density can only be explained by a combination of factors, including increasingly dry climatic conditions, fuelwood demand from both local villages and remote markets, and possibly, grazing pressures by the herds of nomads, even though this latter factor could not be evaluated based on our data. Both social and biophysical drivers are at play, and most of these drivers have remote as well as local components. Livelihood choices for instance, such as selling wood or increasing the size of goat herds, are influenced by the availability of alternative livelihood sources. Chapters 3 and 4 will show that migration, remittances and non-farm opportunities have shaped the development of local communities. These factors are in turn determined by higher-level political choices and economic opportunities.

The fact that aridity seems to be a major driver of tree density decline in the argan woodlands has important policy implications. Firstly, although it may be necessary to impose tighter restrictions on woodland use, including firewood harvesting, this may not be sufficient to prevent woodland decline. Indeed, the IPCC has

predicted an increase in aridity over the 21st century in North Africa (IPCC 2007), which would imply a corresponding decline in woodland density. If there is a feedback loop between loss of density and worsening local-level aridity, as suggested in Figure 2.1., increasing density over a certain threshold by planting and protecting new trees might reverse the trend, making micro-climatic conditions suitable again for germination and sapling survival. This remains to be tested however. Secondly, the role of aridity raises questions as to the sustainability of woodland-based livelihoods. There has been much hope in the last decade that the high prices for argan oil would allow poor households in the region to improve their living conditions and that argan oil production, particularly through women cooperatives, would become the new sustainable livelihood. However, argan harvests depend on rains and on the quality and density of the woodlands. Many surveyed households reported that they had not benefited from the boom because woodland density had decreased and their harvest had been negligible in times of high prices - as with any market commodity, prices are highest when the resource is scarce. Prospects for continuing woodland decline and increasing aridity should temper excessive optimism on the contribution of argan oil to local rural development on the long term.

As for any case study, our findings have limited validity outside their geographical scope. However, this study suggests three conclusions of general interest. Firstly, as shown in other case studies reviewed in the introduction, dry woodlands may be receding in places at rates comparable to some tropical forests. A consistent picture emerges from the accumulation of local case studies that call for greater attention to processes of degradation in arid and semi-arid forests and woodlands. Secondly, although standard monitoring methods tend to be used to estimate change in dry woodlands, the methods currently used are probably inappropriate and need to integrate changes in woodland density. In this study, we implemented a simple and inexpensive method for monitoring woodland density that could easily be applied to other regions. Thirdly, explanatory frameworks derived from the literature on desertification and tropical deforestation are not perfectly appropriate for dry woodlands. A more integrated understanding of the causes of dry woodland

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degradation needs to be developed, taking into account the full complexity of these multifunctional landscapes, including biophysical and social, and local and distal components.

* * *

After looking at the extent and proximate causes of woodland density change it is time to turn to livelihood changes and material development, the second dimension of this study. The following chapter will do so through a particular angle, that of a globalized commodity chain – argan oil trade – and of its impacts on poverty alleviation. It will show the potential implications of the development of such commodity chains worldwide, and assess its local impacts. In the process, it will investigate the other determinants of material development in the study area over the last decade.

* * *

3. Contextualizing the contribution of argan oil to rural livelihoods in Morocco

Adapted from: le Polain de Waroux, Yann, and Eric F. Lambin (forthcoming). Niche commodities and rural poverty alleviation: Contextualizing the contribution of argan oil to rural livelihoods in Morocco. *Annals of the Association of American Geographers*.

Abstract

Integration of many remote regions into the global economy has brought an increasing array of exotic products from rural areas in the developing world to the plates and cupboards of wealthy consumers. This article contributes to the growing literature that looks at the role of global consumers in social and environmental governance. We examine a set of global commodities that, due to their high value, retail at prices well beyond usual agricultural products, giving wealthy consumers great influence over livelihood and land use choices in producer regions. Growing expectations assert this kind of commercialization will alleviate rural poverty. We identify necessary conditions for this to happen in general, and consider the specific case of argan oil, produced in Morocco and sold abroad for prices above US\$400 per liter. Using a livelihood approach drawing on geography and related fields, we test the claim that niche commodity trade alleviates poverty in this specific setting. We find that argan oil commercialization has played a relatively minor role in household budgets and assets accumulation while nonfarm work and remittances play a greater role. Our results show the importance of a livelihood approach in contextualizing commodity chains. We conclude that the poverty alleviation effects of niche commodity marketing are context-dependent and influenced by agro-ecological conditions, resource scarcity, resource ownership regime, and characteristics of the value chains.

Keywords: Niche products; Rural development; Argan; Morocco; Livelihood analysis.

3.1. Introduction

Recent market trends linked to global economic integration are increasingly recognized as reworking social and environmental governance to give consumer choices greater influence over livelihoods and land use (Hartwick 2000; Hughes 2001; Lambin and Meyfroidt 2011; Raynolds 2004). The awareness of this increasing connectedness and of the opacity of links between consumption and production has led to calls for a reconnection of consumers and producers (Hartwick 2000; Lyon 2006). This reconnection is central to the emergence of “alternative” economies and products, which have become an object of inquiry in economic and political geography (Bryant and Goodman 2004; Hartwick 2000; McCarthy 2006; Watts, Ilbery and Maye 2005). Attempts to harness the power of consumers, (e.g., through environmental and social certification), have also been studied (Baird and Quastel 2011; Hughes 2001; Klooster 2006; Taylor 2005). In order to better understand how production and consumption are related in a globalized world, tools such as actor network theory, commodity chains, and commodity networks to represent trade have been applied. (Challies 2008; Coe, Dicken and Hess 2008; Whatmore and Thorne 2004). Key questions have been raised concerning the relevance of market-based tools of governance (Goodman 2004; Guthman 2007), the benefits of certification schemes (Klooster 2006; Lyon 2006), and the effects of consumer influences on livelihoods and land use in places of production.

This study addresses the call for empirical studies of this reworking of governance (Goodman 2004) combined with “criticism of marketing claims regarding the environmental and social benefits of certain products” (Liverman 2004, p. 735). We look at the livelihood impacts of trade in particular commodities that we call biological-resource-based niche commodities (defined below). These commodities convey very high added value (some retail at prices upwards of several thousands USD per kilogram), increasing the influence of a few wealthy consumers on rural livelihoods and land use in (often poor) developing regions. Such commodities are expanding in urban markets due to producers diversifying away from traditional agriculture into more lucrative activities, the growing demand from

wealthy consumers for “alternative” products, the quest for new and profitable commodities by private companies, and the search by development actors for ways to alleviate rural poverty. The objective of this study is to examine the potential of biological-resource-based niche commodities for poverty alleviation.

We use a livelihood approach to assess the impacts of argan oil trade on poverty in southwestern Morocco. Livelihood studies address the complex ways in which people engage with different activities and organize themselves to earn a living (Ellis 2000). The livelihood concept, originally created in an attempt to re-emphasize agency in development studies (Scoones 2009), has been used in a variety of fields, including studies of human-environment relationships (e.g. Zimmerer 1997) and of migration, diversification and the dis-intensification of land use (e.g. Bebbington 2001; Zimmerer 2007). In our case, the concept allows for integrating the study of a niche commodity into the complex web of activities in which its production takes place, effectively contextualizing the commodity chain, as advanced in Challies (2008).

3.2. Background

3.2.1. The argan boom

Argan oil production dates back to over nine centuries, but until the late 20th century, its trade was essentially restricted to Morocco and it had a relatively low market value. In the 1990s, when cosmetic firms and the German development agency GTZ took interest in this resource and women-led cooperatives were created, demand for argan oil exploded, and prices rose accordingly (see section 1.3.1.5.). From the beginning of the boom, argan oil marketing has been promoted as a solution for conservation and development. The recent Green Morocco Plan has put the development of argan oil production (with other niche products such as roses, saffron, cactus oil) at the center of the Sus region rural development strategy²³.

²³ See <http://www.ada.gov.ma/en> (last accessed 17/04/2012). While this move may seem innovative, a closer look at the Plan suggests that it is

Recently, the conservation and development claims have come under increasing scrutiny. Early research in the northern part of the argan region found that, given the current property rights, people had little economic incentive for conservation and «most of the gains appear[ed] to have accrued to non-locals able to overcome capital and infrastructural constraints to entry into the mechanized, high-end market» (Lybbert et al. 2002). Subsequently however, Lybbert et al. (2010) showed that households that had harvested more argan kernels in 1999 had also accumulated more goats by 2007, suggesting a positive influence of argan oil marketing on assets but a negative impact on the woodlands. Our case study uses original data from another region to test the claim that the argan oil trade has benefited inhabitants in production zones. First, however, we examine the potential impact of niche commodities on poverty alleviation and conservation.

3.2.2. Theoretical framework

3.2.2.1. *Definition and typology*

Argan oil is an example of what we call biological-resource-based niche commodities (hereafter BNC), in other words, niche commodities that are derived from natural or agricultural ecosystems. Niche products are specialized goods and services, sold to a limited number of consumers at prices generally higher than those of close substitutes. They have been the subject of a growing number of studies over the last decade, particularly with respect to food markets (e.g. Ilbery & Kneafsey 1999; Lee et al. 2010; Watts et al. 2005). In fact these products can be split into a number of distinct categories. They can be services (e.g., ecotourism) or goods. They derive their value from the manufacturing process involved (e.g., Japanese cast iron teapots) or from the raw material being used. The

quite in range with the philosophy of past agricultural policies in Morocco. Indeed, its focus on privatization and on the aggregation of smallholders in partnership with private firms perpetuates a well-established tradition of trying to deal with rural poverty without engaging in redistributive land reform (Davis 2006; Swearingen 1987).

latter can be mineral (e.g., Himalaya salt) or biological²⁴. We use the label BNC to refer to this last segment of niche products (Figure 3.1.). The main criterion of a BNC is its market properties (i.e., a product sold in small quantities and at high prices). Its biological origin (agricultural or not) is a sub-criterion. The concept overlaps with, but is not equivalent to, other categories such as organic (Raynolds 2000 and 2004), fair trade (Raynolds 2000; Taylor 2005), or Non-Timber Forest Product (NTFP) (Belcher et al. 2005), which are defined based on their production characteristics. For example, a NTFP for local markets and with low bulk value is not a BNC, but may become one after a commercial boom (e.g., açai berries). Additionally, a BNC can be produced or extracted either in or outside forests (e.g., saffron or cashmere fiber). Similarly, fair trade or organic products may or may not be BNC (e.g. organic sunflower seed oil vs. organic cosmetic argan oil), and BNC need not be organic or fair trade. BNC are often associated with endemic species or unique terroirs, hence their limited global availability. They can be produced as for domestic crops, (e.g., specialty coffee), or harvested as products gathered from the wild (e.g., *kopi luwak*, civet coffee). In many cases, supply is partly controlled, either because it is a mixture of wild gathering and controlled production (e.g., vicuña fiber), or because only some aspects of production are controlled (e.g., semi-domesticated species such as shea and argan trees). Several BNC, including narcotics and wildlife body parts, are illegal commodities. Others are sold both legally and illegally (e.g., vicuña fiber). Since BNC are by definition scarce, they are often heavily regulated to prevent over-extraction. Our focus here is BNC produced in rural areas of developing countries for export to richer regions.

²⁴ Biological and mineral resources have different production and extraction rhythms: whereas mineral resources are non-renewable stocks, biological resources are renewable, thus providing better prospects for sustainable income generation.

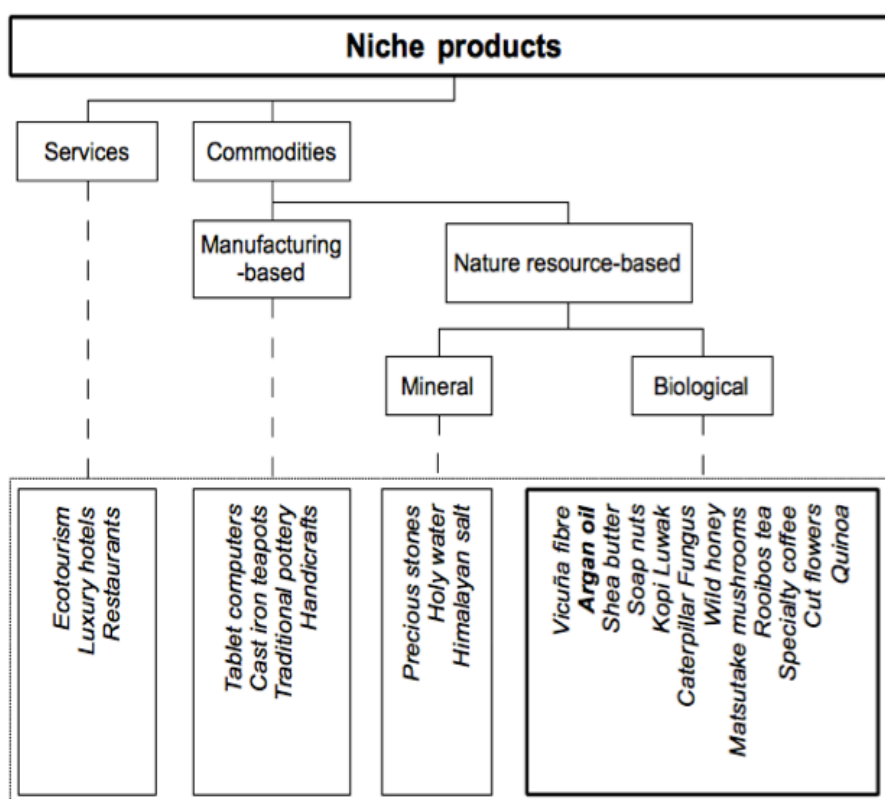


Figure 3.1.: Niche products and BNC

3.2.2.2. Emergence of BNC

One pathway of emergence of BNC is the creation of a niche product via bio-prospecting. In other words, a product that was originally restricted to local use is made suitable for international markets, targeting specific user groups such as the cosmetic industry or consumers of exotic fruits and juices. Another pathway is the differentiation of a mainstream resource within an existing international market, as in the case of specialty coffee or fair trade cacao. This differentiation may be based on quality (production method, raw material selection), environmental (organic), social (fair trade), or geographical (origin) characteristics. A third pathway is the

expansion of established high-value product chains due to increase in global demand driving prices up (e.g., caterpillar fungus and saffron).

3.2.2.3. *Reasons for engaging in BNC commercialization*

While private firms are driven into BNC trade to generate profit, the motivations of producers, consumers and development agencies deserve some discussion.

Producers engage in BNC trade for two main reasons. The most obvious one is the perspective of increased margins. To the extent that the high retail prices for BNC are transferred to producers, they will have an interest in producing them, especially if traditional agricultural commodities offer low returns. Seizing market opportunities early on may create a competitive advantage for pioneers at later stages. Secondly, producers engage in BNC trade as part of a diversification strategy. Diversification reduces the vulnerability of farmers to price and climatic cycles if the activities in which households engage are complementary. BNC trade may help generate the cash needed to set up or sustain other activities (e.g., buying a motorbike), complement irregular income (e.g., unskilled wage labor), or simply add income.

Consumers may buy BNC for five reasons, which are embodied in the narratives accompanying BNC marketing. Care for nature or environmental awareness influences the demand for organic products and for products claiming to benefit nature (Bryant and Goodman 2004). Numerous BNC are marketed with a narrative of conservation-friendly extraction practices, such as vicuña fiber (Lichtenstein 2010) or argan oil (Lybbert, Barrett and Narjisse, 2002). Certification includes organic labels, as well as other sustainability claims. Care for others or solidarity also motivates consumers. Increased awareness of the socially unfair conditions under which commodities may be produced, has led a growing number of well-off consumers to purchase fair trade products (Bryant 2004). A gender or empowerment of women narrative is also associated with several BNC. Care for oneself or beauty and health is another motivation.

Premiums for some non-western “natural” medical or beauty products can be extremely high. For example the caterpillar fungus (*Cordyceps sinensis*), with alleged aphrodisiac value, is sold for US\$1750 to 7500 per kg on the Chinese market (Winkler 2008). Marula oil is sold for US\$350 to 600 per liter for its moisturizing and antioxidant properties (Schreckenber 2003). Quality and taste also justify high premiums. Gourmet products can reach skyrocketing prices, for example civet coffee is sold for US\$700—1300 per kg (Marcone 2004), and edible bird’s nests for up to US\$10,000 per kg (Marcone 2005). Finally, tradition is part of narratives associated with most BNC. “Traditional” products associated with ancestral indigenous practices of a community represented as living in harmony with nature can attract high prices. Some places, such as the Amazon rainforest (e.g., açai berries), or the Himalayas (e.g., goji berries), have strong evocative power. Geographical indications or designations of origin provide consumers a guarantee that their products originated in a specific terroir – a place whose character determines the particular qualities of the products (Gade 2004). Seemingly consumer price rises when more of these five narrative components of BNC marketing are fulfilled (Table 3.1).

Social and Ecological Change in the Argan Woodlands

Product	Main origin	Conservation narrative	Organic certification	Development narrative	Fair trade certification	Tradition narrative	Designation of origin / GI / trademark	Gourmet / quality product	Health narrative	Volume international trade (T/year)	Export price (range, US\$/kg or l)	References
Argan oil	Morocco	+	+	+	+	+	+	+	+	1000-2000	100-400 ^e	Cunningham 2011 ; online retailers 2011
Kopi Luwak (civet coffee)	Indonesia	-	+	-	-	+	-	+	-	< 0.25 ^d	700-1300	Marcone 2004 ; online retailers 2011
Jamaican Blue Mountain Coffee	Jamaica	-	+	-	-	+	+	+	-	~1700	80-120	Walker 2009; Online retailers 2011
Caterpillar fungus (<i>Cordyceps Sinensis</i>)	Tibetan plateau, Himalayas	-	+	-	-	+	-	-	+	80-180 ^e	1750-7500 ^f	Winkler 2008
Matsutake mushrooms (<i>Tricholoma matsutake</i>)	Southwest China, Korea	-	-	-	-	+	-	+	+	2000-3000	150-400	Yang et al. 2009
Shea butter	Sudan-Sahel	+	+	+	+	+	-	-	-	~2800 ^g	20-250 ^h	USAID 2002 ; Elias 2004 ; Greig 2006 ; Cunningham 2011 ; online retailers 2011
Soap nuts	India, Nepal	-	+	+	-	+	-	-	+	no data	20-50	online retailers 2011
Vicuña fiber	Andes	+	+	+	-	+	-	+	-	~5	250-1000	Lichtenstein 2010
Fair trade rooibos tea	South Africa	-	+	+	+	+	-	-	+	>6000	20-65	Raynolds 2010, Gerz 2006 (in van de Kop 2006)
Edible bird's nest	South-East Asia	-	-	-	-	+	-	+	+	~2	2000-10000	Marcone 2005
Quinoa	Bolivia, Peru	-	+	+	+	+	-	-	+	~10500	7-30	Caceres in Raynolds 2007 ; Jacobsen 2011 ; online retailers 2011
Saffron	Central Asia, Mediterranean	-	+	+	-	+	+	+	-	~200	3000-12000	Ghorbani 2008 ; online retailers 2011
Marula oil	Southern Africa	+	+	+	+	+	-	-	+	29	350-600	Cunningham 2011 ; Schreckenberg 2003 ; online retailers 2011

Table 3.1.: BNC examples, narratives, volumes and prices

Table 3.1. footnotes:

- (a) Also frequent claims of organic production without certification.
- (b) Also frequent claims of working according to fair trade standards, or of other beneficial arrangements without certification.
- (c) Depending on whether edible or cosmetic oil.
- (d) For Indonesia before 2004; it is likely to have increased since civet coffee is now on offer from other countries such as Vietnam and the Philippines.
- (e) For the Tibet Autonomous Region, China, in 2004.
- (f) Prices in Tibet Autonomous Region, China in 2005; retail prices can be expected to be higher.
- (g) For West Africa in 2001.
- (h) Depending on whether for cosmetic (high prices) or other uses.

Development agencies²⁵ have facilitated the emergence of BNC through value chain interventions (Humphrey and Navas-Alemán 2010; Nill and Böhnert 2006), through support for the marketing of non-timber forest products and the creation of labels and geographical indications (Belcher, Ruiz-Pérez and Achdiawan 2005; Belcher and Schreckenberger 2007; van de Kop et al. 2006). Recent policies have targeted BNC more explicitly (FAO 2010; GTZ 2003). Given that a large fraction of the world's poor are rural dwellers for whom conventional agriculture offers little economic expectation, differentiation and niche marketing seem to create unique opportunities to "make the market work for the poor". In some cases, including for argan oil, nature conservation is another motivation. Arguably, win-win market solutions are easy to promote among donors and aid organizations.

3.2.2.4. *BNC and poverty alleviation*

The commercialization of BNC holds the potential to generate significant income for the poor, provided that several conditions are met (Figure 3.2.). First, the quantity that can be marketed by the

²⁵ By development agencies we mean any organization with a development agenda (including, for example, the British DFID, the FAO or the World Bank).

poor must be sufficiently large to significantly increase their income. Overall per capita production must be significant, and the poor must own a fair share of the production. Second, the price paid to poor producers must be sufficient to cover costs (mainly the opportunity cost of labor and transport costs) and generate profit. This entails high retail prices, sufficient price transfer to producers, and access to BNC distribution channels and markets by the poor (meaning that barriers of entry are inexistent or easily overcome). High retail prices may be achieved when the resource is scarce relative to global demand and when some of the conditions for consumer premiums mentioned above are met. This condition of global scarcity does not conflict with the condition of sufficient per capita production; indeed global scarcity need not mean low per capita production if production is spread among few producers. Price transfer to producers and market access depend on the value chain and on household attributes. Development agencies often argue that these conditions cannot be met without external intervention. Where the conditions do ensure a significant income for the poor, to sustain that income over time both sustainable resource extraction and sustained consumer demand are required.

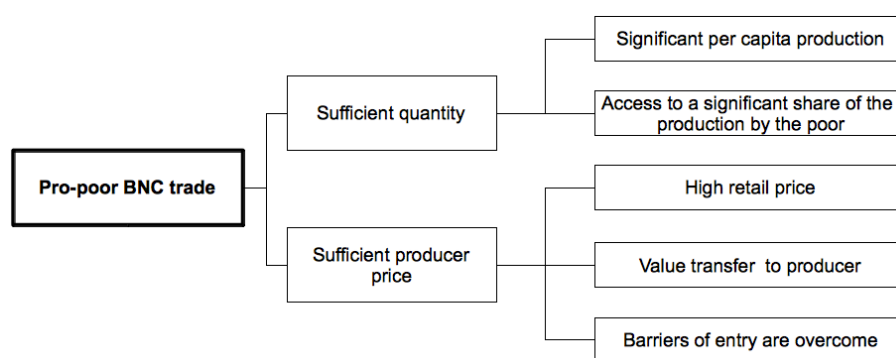


Figure 3.2.: Conditions for pro-poor BNC marketing

3.2.2.5. BNC and conservation

The effects of BNC trade on conservation depend on the effect on increased extraction or conservation measures. The high value of BNC may lead in some cases to over-extraction and resource depletion. For example, crops may expand into marginal lands, seeds

may be harvested to a point that affects regeneration, or animals may be overhunted. Alternatively, BNC trade may encourage the regulation of exploitation and the adoption of conservation measures. The outcome largely depends on resource property regimes and resource institutions. It may also depend on the transfer of norms and values from consumers or national institutions (e.g. through production standards and certification schemes).

3.2.3. Case study

The case study tests the claim that BNC commercialization improves smallholders' livelihoods in a situation apparently favorable to all parties, and has been promoted as such by development agencies. Argan oil meets several of the conditions for success. Retail prices are very high, in part due to the global scarcity of the raw material - argan trees are endemic to Southwest Morocco. The five conditions for consumer premiums are also met: 1) part of the production is certified organic, and the rising market value of oil is thought to encourage ecosystem conservation by producers; 2) it is associated with a gender empowerment and rural development narrative; 3) it has desirable health properties both as cosmetic and edible oil; 4) it is used as a gourmet seasoning in high-end western restaurants; and 5) it is associated with an "Edenic" narrative (Bryant and Goodman 2004) emphasizing Berber identity and tradition. Several women's cooperatives have been created to stabilize prices and provide technology and market access. Recently, fair trade criteria have been set by the Fairtrade Labelling Organization and argan oil has been protected by a Geographical Indication. In spite of large differences between local and retail prices, local market prices for homemade argan oil and for unprocessed kernels have risen to very high levels. One can thus expect that the argan boom has had some benefit to the poor.

Traditional livelihoods in the area are based on barley and wheat cultivation under argan trees, animal husbandry, argan oil production, and wood and charcoal extraction. Recently, they have increasingly given way to nonfarm work and migration. Argan oil

trade is probably the only activity based on natural resource that has been increasing. One of the study villages (village A) was selected in 1995 as «test village» for the «Argan region Conservation and Development Plan», a joint project of the Moroccan Government and the German Technical Cooperation. The village hosts one of the first argan oil production cooperatives in the argan region, created in 1998. It delivered 7150 liters of oil annually in 2004-2007, providing an income of about 2100 MDH (Moroccan Dirhams) or US\$265 (1 US\$ = 8.5 MDH) per woman*year. Production halted in 2009 due to management issues, but it had resumed, albeit at a lower pace, when we visited in 2011 and 2012.

3.3. Data and Methods

3.3.1. Data

The data used are described in section 1.4.3. We used the household interviews for all household-level information, including production and livelihoods. Information on prices, wages, and village history was obtained through key informant interviews, informal conversations and direct observation.

3.3.2. Income

To compare the income from argan oil we estimated the monetary value of five income categories: agriculture (cereals, olives, and almonds), animal husbandry (sheep, goats, and manure), forest products (argan oil and wood), local non-farm activities, and remittances. The monthly income from animals and manure sales, argan oil sales, local non-farm activities, and remittances were asked directly in the household interviews. The value of argan wood gathered for domestic uses was estimated as the number of donkey loads of wood times its price. The value of self-consumed argan oil was considered equivalent to the same amount of olive oil, which is widely purchased locally. The value of cereal production was computed as the quantity of flour produced times its local markets

price, minus production costs²⁶. The value of almonds and olives was estimated as the price of buying the same quantity of almonds or olives on the local market.

3.3.3. Regression on asset index

We used regression analysis to estimate the relative effects of argan oil production, non-farm work and remittances on wealth in 2009 and on wealth difference between 1999 and 2009, as estimated by means of an index representing assets (e.g. housing and domestic equipment). Relevant independent variables were tested individually along with a set of control variables in intermediate models. Variables with significant parameters at a 90 percent level in these models were then cast together in multivariate regression models to control for interactions.

3.3.3.1. Asset index

In the absence of complete and accurate consumption expenditure data, wealth can be measured through a polychoric principal components analysis (pPCA) on assets variables (Kolenikov and Angeles, 2004). This method is a type of principal component analysis based on polychoric correlations that deals with both continuous and categorical variables, and takes into account the ranking of

²⁶ Thus, the value of self-consumed cereals is:

$$V_{sc-cer} = p_{sc} * [Q_{cer} * (c * P_{flour} - P_{mill}) - (T_{plowing} + T_{threshing}) * P_{tractor}] \quad (1)$$

with p_{sc} the proportion of cereal production kept for self-consumption, Q_{cer} the cereal production, c the amount of flour given by one unit of cereals, P_{flour} the price of flour, P_{mill} the cost of grinding cereals, $T_{plowing}$ and $T_{threshing}$ the amount of time that a tractor was used for plowing and threshing, and $P_{tractor}$ the cost of hiring the tractor. For households using donkeys instead of a tractor, plowing and threshing costs were considered negligible. When sold, the cereals are not ground to flour but are sold as whole grain. The value of cereals sold is thus:

$$V_{s-cer} = (1 - p_{sc}) * [Q_{cer} * P_{grain} - (T_{plowing} + T_{threshing}) * P_{tractor}] \quad (2)$$

where P_{grain} is the price of grain.

categories within variables, the frequency of occurrence across the population of the categories, and the frequency and ranking of the other categories. The first eigenvector of the pPCA captures the greatest variation in the sample and can be used as an asset index. We selected ten asset variables that best reflected wealth differences according to our observations and discussions with residents during initial fieldwork (see table 3.2.), and used their 1999 and 2009 values as inputs for the pPCA. The first axis was used as the asset index after standardization. For any household, A_{2009} is the asset index in 2009 and A_{diff} is the difference between the 1999 and 2009 index.

Variable	Type	Description
House type	Ordinal	Index reflecting construction materials used : 0 = only stone and/or earth ; 1 = stone and/or earth partly covered with cement ; 2 = mainly stone and/or earth with parts in cement bricks ; 3 = mainly cement bricks with parts in stone and/or earth ; 4 = only cement bricks
# Rooms	Ordinal	Number of rooms in the house
Guests room	Ordinal	Presence of a room dedicated to events and guests (taddwarit) (0 = no such room, 1 = room without and 2 = with foam seats)
Ceilings	Binary	Presence of ornamented plaster ceilings
Toilet	Binary	Presence of a toilet
Kitchen	Binary	Presence of a kitchen with gas cooker and sink
Fridge	Binary	Ownership of a fridge
Mobile phone	Ordinal	Ownership of mobile phones (0 = none, 1= one, 2= more than one)
Video equipment	Ordinal	Ownership of a television, DVD-player and satellite antenna (0 = none to 3 = all three)
Vehicle	Ordinal	Presence of a vehicle (0 = none, 1 = motorbike, 2 = car)

Table 3.2.: Variables used in the assets index

3.3.3.2. Variables

Control variables were variables potentially influencing the assets index, but outside the focus of the study. Land holdings, traditionally a determinant of household wealth, were represented by a proxy variable based on average cereal production for the years 1996 and 2009 (direct information was not available as plot size was usually

unknown to respondents and plots were fragmented, making area estimations difficult). Cereal production, when categorized, can be considered as a reasonable proxy for land holdings because most of the productive agricultural land is still cultivated, and production factors differ little among households (no chemical fertilizers or pesticides are used). For herd size, another important productive asset, we used the 1999-2009 average (or since the first year data were available). While herd size may influence wealth, the reverse is not always true as animal husbandry is one of several possible livelihood strategies: some households may invest in animals, but others steer away from livestock breeding. We therefore do not consider this variable as endogenous to wealth. Workforce, measured as the number of workers, may influence production and the potential to diversify. Education of the head of household may influence wealth through skills and better access to employment. Travel time to the market was also included as a proxy for accessibility.

The existence of an association between argan oil production and wealth was tested using the harvest of argan nuts and sales of argan oil²⁷, for both 2009 and the 1996-2009 average value to account for the variability of production between these two years. A dummy variable was included for households that had sold argan oil through the argan cooperative²⁸.

²⁷ Because harvest data were more reliable than oil production data, we estimated argan oil sales (S) as:

$$S = H * c * PS \quad (3)$$

where H is total harvest, c the number of liters of oil for one unit of nuts, and PS the proportion of argan oil produced that was sold by the household (as declared in the interviews). Lybbert et al. (2011) report an increase in unprocessed kernel sales during the last decade in their study area. In our sample, however, all but two households reported having sold no kernels in 2009 and 1996.

²⁸ Ownership rules of argan nuts were not taken into account in the analysis because: 1) they are defined at the village-level and thus indistinguishable from other village-level effects, and 2) their complexity makes it difficult to identify any direct causal relationship. Differences in ownership at the household level are reflected in the harvested quantities.

We also included variables related to non-farm work and migration, such as the time spent working in a specific activity or abroad. Timelines from the interviews were used to generate aggregate indicators of activities of the household. For any activity (e.g., “work in the transportation sector”), we computed a “percent working time” variable representing the relative amount of male labor put into that activity or location at the household level between 1999 and 2009. For example, the variable work in transportation corresponds to the number of years spent working in the transportation sector by male household members during the last 10 years, divided by the number of years worked in total. Women were not included in these variables because, in our study area, they invariably work in the village, engaging in household and farm activities such as firewood collection, argan oil production, cooking, weeding, and more. Table 3.3 provides a summary of variables used in the regression analysis.

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Variable name	Variable type	Meaning
<i>Control variables</i>		
Land holdings	ordinal	Index of land holdings based on average cereal production of the years 1996 and 2009 (for households without data for 1996, the 2009 value was used) : 0 = no production ; 1 = up to 100 abra ; 2 = 100 to 200 abra ; 3 = 200 to 300 abra ; 4 = 300 to 400 abra ; 5 = over 400 abra (1 abra amounts to about 13 kg of grain ; 200 to 300 abra are needed annually to feed the average household).
Animals	numeric	Average number of goats and sheep between 1999 and 2009 (where information did not extend back to 1999 we used the average for the available period)
# Male workers	ordinal	Average number of male workers in the household between 1999 and 2009
Education	binary	Formal education of the head of household: 0 = no education ; 1 = primary or koranic school (no case of education higher than primary school for heads of household)
Travel time to market	binary	Travel time to the next market town, in minutes, using the transportation available to villagers (single value per village)
<i>Tested variables</i>		
Argan nuts harvest	numeric	Argan nuts harvest in 2009
Argan nuts harvest (average)	numeric	Average argan nuts harvest in 1996 and 2009
Argan oil sales	numeric	Argan oil sales in 2009
Argan oil sales (average)	numeric	Average argan oil sales in 1996 and 2009
Cooperative	binary	Involvement in the argan cooperative: whether the household has sold some argan oil through the argan cooperative
% Time outside village	numeric	Percent total working time spent working outside the village (but in Morocco) over the last 10 years by household members (pondered mean)
% Time abroad	numeric	Percent total working time spent working abroad over the last 10 years by household members (pondered mean)

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% Time non-farm	numeric	Percent total working time spent working in the non-farm sector over the last 10 years by household members (pondered mean)
% Time in various activities	numeric	Several variables representing total working time spent working in the following activities over the last 10 years by household members (pondered mean) : Trade, construction, services, transportation

Table 3.3.: Regression variables

3.4. Results

3.4.1. Income

Income was dominated by remittances, which represent 35 percent of total income on average (Table 3.4.). Activities associated with natural resources accounted for less than half of households' income, taking into account the subsistence value of self-consumed products. Income from argan oil averaged 83 MDH (US\$10) per month or 4.1 percent of total income (sd = 9.3) for the whole sample. Most of the argan oil income however was earned in village A, with an average of 208 MDH (US\$25) per household*month, or 11.8 percent of household income in this village (sd = 14.1 percent), as compared to 29.9 MDH (US\$3.6; 1.2 percent of total income; sd = 3.8 percent) for the remaining villages. Eleven Households got more than 10 percent of their income from argan oil, among which nine were in village A. Important variations between villages were also found in the share of farm-related income, from 30.9 percent in village D to 56.7 percent in village E. At 2009 prices, producing argan oil in the study area provided lower returns on labor than working as a wage worker on a commercial farm: about three days of work were needed to produce one liter of oil sold ~150 MDH on the market, which amounts to ~50 MDH per day, whereas the local daily wage for agricultural workers was ~100 MDH.

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Sector	Mean %	Standard deviation
Agriculture	13.1	10.4
Animal husbandry	16.8	22.4
Forest products	13.6	12.0
of which argan oil	4.1	9.3
Local non-farm	21,5	28.8
Remittances	35.0	30.0

Table 3.4.: Percent of income from various sources

Argan oil income varied interannually due to price and climatic variations. To project the potential income for a higher level of production (i.e., for years with better climatic conditions than 2009), we computed the budget share of argan oil on the basis of the declared 1996 production level (an exceptionally good year), assuming that all production would be sold at the average market price in Awluz in 2010 (100 MDH per liter, US\$12), a very good year. We obtained a “best case” average share of 8.0 percent (sd = 10.7) of household budget derived from argan oil, or 13.9 percent (sd = 14.6) for village A and 5.5 percent (sd = 7.5) for the other villages. The households with the highest proportion of income derived from argan oil sales were mid-range households, with asset levels around the sample mean (0.43) (Figure 3.3.).

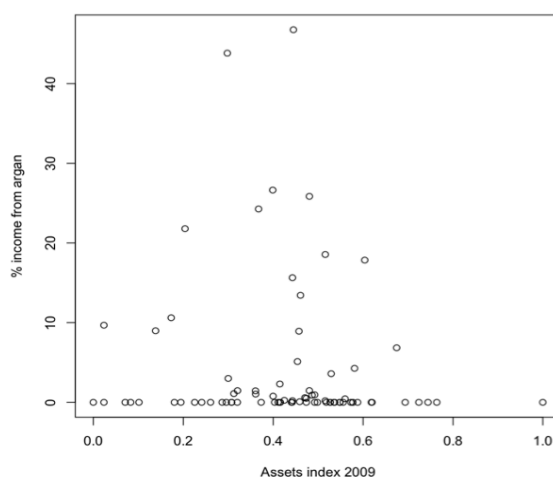


Figure 3.3.: Argan oil income and assets

3.4.2. Regression on asset index

The proportion of the variance in the sample explained by the first axis of the polychoric PCA, i.e. the asset index, was 53.7 percent. There were wide differences in assets (significant at a 95 percent level) between villages C and E, and the other villages in 2009 (Figure 3.4.). All variables included were positively associated with the index (Table 3.5.).

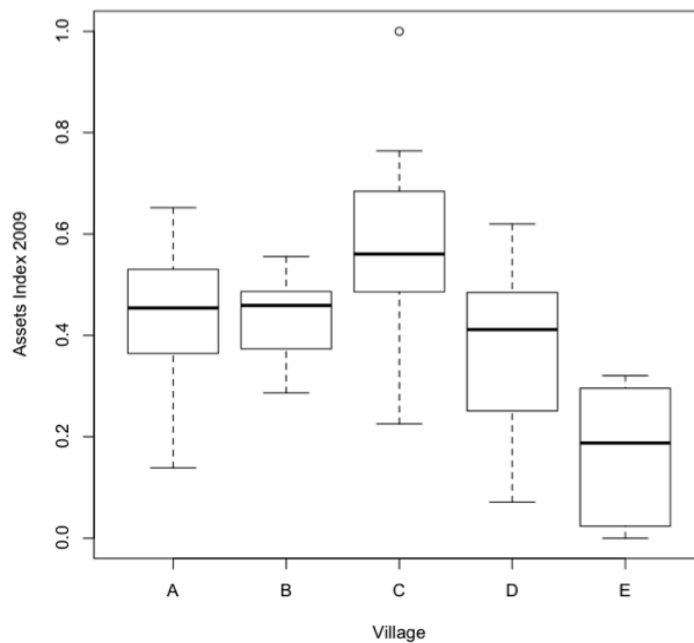


Figure 3.4.: Assets Index (normalized, by village, 2009)

3.4.2.1. Intermediate models

In the intermediate models (Table 3.6.), argan oil sales in 2009 were negatively associated with A_{2009} (the asset index for 2009) and harvest of argan nuts was also negatively associated with A_{diff} (the ten-year difference in asset index), but these effects disappeared in the multivariate models. Participation in the argan oil cooperative had no significant impact on assets. Time spent in Moroccan cities

and abroad was positively associated with A_{2009} but not with A_{diff} , for which only one non-farm sector (construction) was significant. Over 80 percent of the male labor was allocated to non-farm activities between 1999 and 2009. The service sector was most important in terms of work time (35.1 percent of total work time) followed by the construction sector (26.3 percent).

Variable	Level	Weight	Variable	Level	Weight
House type	0	-0.454853	Kitchen	0	-0.305962
	1	-0.114537		1	0.228228
	2	0.16751	Fridge	0	-0.166267
	3	0.393453		1	0.331376
	4	0.609951	Mobile phone	1	-0.324689
# Rooms	---	0.238058		2	-0.016489
Guests room	0	-0.37924		3	0.301305
	1	0.083302	Video equipment	0	-0.29676
	2	0.547261		1	0.01571
Ceilings	0	-0.072353		2	0.063062
	1	0.350445		3	0.335203
Toilet	0	-0.494456	Vehicle	0	-0.211251
	1	0.137594		1	0.18039
Variance explained: 0.537				2	0.470615

Table 3.5.: Variables weight in asset index

Variable	A ₂₀₀₉		A _{diff}	
	Estimate	p-value	Estimate	p-value
<i>Control variables (values when no other variable is cast into the model)</i>				
Intercept	3.42E-01	3.69E-08 ***	1.12E-01	8.89E-04 ***
Land holdings	4.96E-02	9.26E-04 ***	2.32E-02	1.36E-02 *
Animals	7.74E-05	8.34E-01	-1.60E-04	4.92E-01
# Workers	3.53E-02	3.01E-02 *	2.11E-02	3.87E-02 *
Education	1.32E-02	6.70E-01	-1.57E-02	4.49E-01
Travel time to market	-1.86E-03	2.21E-07 ***	-7.75E-04	2.23E-04 ***
<i>Added variables (one by one)</i>				
Argan nuts harvest 2009	7.32E-05	5.91E-01		
Argan nuts harvest (average)	6.55E-05	6.23E-01	-1.47E-04	7.27E-02 .
Argan oil sales 2009	-3.18E-01	5.47E-02 .		
Argan oil sales (average)	-6.39E-05	9.21E-01	-5.34E-03	1.51E-01
Cooperative	-9.52E-03	8.33E-01	-2.92E-02	3.10E-01
% Time outside village	8.37E-04	8.54E-02 .	-9.45E-05	7.63E-01
% Time abroad	3.41E-03	2.74E-03 **	6.64E-04	3.45E-01
% Time non-farm	7.99E-04	1.73E-01	2.57E-04	5.01E-01
% Time trade	1.02E-03	1.04E-01	-1.82E-04	6.94E-01
% Time transport	1.71E-03	1.22E-01	-1.07E-03	1.29E-01
% Time construction	-2.76E-05	9.54E-01	7.87E-04	6.16E-03 **
% Time services	-4.98E-04	3.35E-01	-4.89E-04	1.30E-01

Table 3.6.: Regressions on assets indexes with control variables and single test

variables

3.4.2.2. Final multivariate regression models

In the final multivariate model for A_{2009} ($R^2_{adj} = 0.566$), argan oil sales were unrelated to A_{2009} . The time spent abroad was highly significant both statistically and quantitatively, as the difference between households with the lowest and highest value of time spent abroad amounted to 0.28 units. The time spent working outside the village was likewise significantly and positively related to A_{2009} . Land holdings and accessibility were also significant – positive and negative, respectively – determinants of wealth in 2009 (Table 3.7.).

Variable	Estimate	p-value		VIF	min-max difference in A_{2009}
Intercept	3.08E-01	2.39E-06	***	---	---
Land holdings	5.08E-02	4.05E-04	***	1.43	0.20
Animals	1.84E-04	5.88E-01		1.21	---
# Workers	1.65E-02	2.87E-01		1.28	---
Education	1.97E-02	5.33E-01		1.37	---
Travel time to market	-1.71E-03	7.24E-07	***	1.53	-0.27
Argan oil sales 2009	-2.23E-03	1.57E-01		1.24	---
% Time outside village	9.84E-04	3.59E-02	*	1.2	0.10
% Time abroad	3.71E-03	9.73E-04	***	1.1	0.28

$R^2_{adj} = 0.566$; 73 degrees of freedom ; F-statistic = 14.2 p-value = 2.99e-12 ; RESET = 0.1076. p-value = 0.88

Table 3.7.: Final multivariate regression model on A_{2009}

In the final multivariate model for A_{diff} (R^2_{adj} of 0.397), harvest of argan nuts was unrelated to A_{diff} . The only significant variable apart from the controls was the time spent in the construction sector, which was positively related to A_{diff} and had an effect comparable in magnitude, but opposite in sign, to that of accessibility. Land holdings and the number of male workers were both positively related to difference in assets (Table 3.8.).

Variable	Estimate	p-value		VIF	min-max difference in A_{diff}
Intercept	6.78E-02	1.30E-02		---	---
Land holdings	2.55E-02	9.91E-03	**	1.33	0.10
Animals	-1.58E-04	5.41E-01		1.3	---
# Workers	3.08E-02	7.16E-03	**	1.19	0.12
Education	8.16E-04	9.71E-01		1.28	---
Travel time to market	-6.40E-04	3.67E-03	**	1.51	-0.10
Argan nuts harvest (average)	-1.09E-04	1.71E-01		1.06	---
% Time in construction sector	7.88E-04	1.51E-02	*	1.22	0.08

$R^2_{adj} = 0.397$; 60 degrees of freedom ; F-statistic = 7.289 p-value = 2.582e-06 ; RESET = 1.378. p-value = 0.26

Table 3.8.: Final multivariate regression model on A_{diff}

3.5. Discussion

3.5.1. Findings

«Those who left and worked outside the village for a long time, they earn money. The others stay poor.» A local villager (19 October 2009).

Both the budget and asset analyses show that argan oil plays a minor role in income, except for one village and under good price and climatic conditions. In normal years, it provides a significant income to few households. It cannot explain asset differences either among households, or over time. Involvement in the cooperative is equally insignificant in asset accumulation. Quite strikingly, the share of argan oil in household budgets for the year 2009 is lower on average than that of argan wood or livestock. We can thus not conclude that argan oil trade has significantly improved livelihoods in the study villages. This does not imply however that argan oil or its production has no other, non-monetary value. Indeed argan oil is prized by locals and migrants, as an object of pride or a connection to home. Its production is an important social activity for women, although it is not always considered enjoyable, as this remark made to us by the cooperative's young president shows: "Look at my hands, how bruised they are [from cracking the nuts with stones]! I keep cracking nuts all day! Fortunately I will soon be married in Marrakesh, then I don't have to make argan oil any more!" (26 February 2011).

By contrast, non-farm work and remittances are highly significant for income and asset accumulation. Households with a history of international migration and those with a greater level of external involvement were likely to be much wealthier than others in 2009, *ceteris paribus*. Over the last decade, the sector most favorable to asset accumulation was construction, from small family-businesses to large enterprises.

It is sometimes argued that migration is endogenous to wealth because leaving the village is costly. While this may be true for international migration, field evidence suggests otherwise since most

people leave as young adults, without much skills or money, start in low-paying jobs, and move to better positions (or not) as they gain experience and build professional networks. As for international migration, for nine out of fourteen households in our sample with at least one international migrant migration seems exogenous to wealth because either migrants started as miners in France (miners were not selected based on wealth but on abilities and strength), or they were sent abroad through professional networks, or they were poorer than average. Removing the five remaining households from the sample did not change regression parameters significantly.

Land holdings and accessibility explain a large part of the variance in wealth and its change between 1999 and 2009, while animal husbandry is insignificant. The importance of landholding can hardly be attributed to cereal production, which barely suffices for home consumption. Instead, we suggest that it reflects structures of social power and path dependence. Large landowners were traditionally from powerful families, who likely enjoyed better food, health, education and social networks, giving them an advantage over others. This was confirmed in discussions with elders. While animal husbandry contributed to past assets, today herds are increasingly decoupled from wealth. As for accessibility to the market, its significance may reflect the difficulty of engaging in income-generating activities in areas too remote for commuting; the increased cost of housing investments in remote areas due to the transport of material and rugged terrain; and the lack of access to technology, education and health care, which influences the finding non-farm jobs.

The argan oil trade has nominal impact on wealth for several reasons. Firstly, raw material is only available in a limited amount and its quantities are geographically and temporally variable. Apart from village A, low production of argan nuts is due to sparse occurrence and the dry climate of inland Southern Morocco. Decreasing woodland density over the last decades (le Polain de Waroux and Lambin 2012) has undermined production, and strong year-to-year climate variability makes it unpredictable (it was close to zero in some of the surveyed villages for 2008). Secondly, market prices

fluctuate: they have been highest in years of scarcity; and when nuts are scarce in the argan region as a whole, this is particularly so in its drier parts. Prices also fluctuate seasonally depending on the availability of kernels, which are thus subjected to speculation. As is commonly stated, “When we have nuts, the price is low; when the price is high, we have no nuts” (a villager, 19 October 2009). The price-stabilization role of the cooperative partially failed due to long delays in payments to women and to governance problems. Moreover, prices paid to cooperative members were below-market at times of peak demand. The costs of price fluctuations are thus borne primarily by producers, who complain, “the cooperative only helps its president” (who is a salaried worker). Thirdly, the poor cannot alone overcome the entry barriers into the high-quality export market. In the absence of efficient institutional support, private firms appropriate most of the margins from argan oil trade (Lybbert et al. 2002). Men are usually conscious of this, and we were frequently approached with requests for help in setting up “argan export business”. Some also rely on migrant networks to this end. Women are less informed about these differences, as they do not market the oil themselves. When asking a woman for the current oil market price, a common response is: “I don’t know, my husband sells it”. Referring back to the theoretical framework (Figure 3.2.), one could conclude that the conditions for a significant per capita production, market access, and value transfer to producers are not fully met.

3.5.2. Significance of our findings for the whole argan region

This study draws on a limited number of villages. Lybbert et al. (2010) analyzed household impacts of the argan boom using panel data from 96 households in the northernmost region, where the woodlands are densest and trade most developed. Using small livestock herd size as an asset indicator, they found that households that had collected more kernels in 1999 had increased their herds more than others by 2007. The presence of an argan cooperative in the surveyed villages did not influence change in herd size. While this

result may reflect an increase in investment, in our sample herd size was unrelated to other assets and wealth. Other ongoing research on household livelihoods in the region suggests that income related to argan oil marketing has been significant for some households but is indeed limited relative to nonfarm work and remittances²⁹. The argument that people have no economic incentive to plant and protect trees (Lybbert et al. 2002) probably holds, especially given tenure insecurity (argan trees are legally state property).

The argan trade has also had various social impacts. The creation of cooperatives has altered gender relationships, bolstering the social recognition and self-confidence of women, particularly those socially disadvantaged. However, sometimes it may raise suspicion on the part of other villagers and spur conflicts within households (Damamme 2011; Turner, unpublished manuscript). Finally, the cooperatives' agenda of promoting education may have increased school enrollment among girls (Lybbert et al. 2011). The boom has also prompted new tenure claims and contestations, and intensified competition over resource access (Turner, unpublished manuscript). It has arguably made argan oil an object of regional pride for residents.

Summing up, argan oil production is part of a diversified portfolio of livelihood activities that includes farm as well as non-farm activities. While the increase in local market prices witnessed over the last decade has probably provided a complementary source of cash to many households, the magnitude of these benefits in most cases does not compare to that of benefits brought by the increased work opportunities in rural non-farm activities and in cities. Better institutions (functioning cooperatives, fair trade certification or other) might help ensure a higher and more stable transfer of value

²⁹ Xavier Le Roy, Institut de Recherche pour le Développement, Montpellier, France (5 September 2011, personal communication per email); Jihane Bejbouji, Centre de Développement Forestier, Marrakech, Morocco (12 September, personal communication, per email); Romain Simenel, Institut de Recherche pour le Développement, Montpellier, France (21 September 2011, personal communication, per email) and Bertram Turner, Max Plank Institute for Social Anthropology, Halle/Saale, Germany (19 August 2011, personal communication, per email).

to the producers. However, they will not prevent cyclic resource shortages due to climatic stress and degradation, and the fact that only a limited amount of oil can be produced by households with current production methods.⁹ Commercializing argan oil may thus not on its own provide great hope for poverty alleviation. Other interventions targeting migrants and non-farm work opportunities, and improvements in the social security system, might be more efficient. These could include raising minimum wages, securing migrant remittances through an insurance-like mechanism, and improving access to professional education (Rigg 2006).

3.6. Conclusion

This study contributes to a growing body of literature on consumer influence on social and environmental governance as a consequence of global economic integration. We analyzed the rise of biological-resource-based niche commodities, or BNC, a set of commodities with very high added value and hence potentially high influence on land use and livelihoods. We proposed reasons for their emergence, and a typology. We identified basic conditions for BNC to benefit the poor and ways in which their trade might affect conservation. We then used a livelihood approach to analyze the poverty alleviation impacts of the argan oil trade, which has been promoted by development agencies as a solution for conservation and development in Southwest Morocco. Contextualizing argan oil production, we showed that while it has provided a complementary source of cash, its impact on overall income and assets has been marginal in the study area in comparison to other income sources. This suggests that the market claims referred to at the outset are overdone. It also shows the importance of using a livelihoods approach to complement commodity network analyses, which might overlook the context of production (Challies 2008). Other cases of BNC commercialization may nevertheless yield different results. There is evidence that benefits derived by producers of, for instance, caterpillar fungus (Winkler 2008) and açai berries (Brondizio 2008) can provide a significant share of household income. The poverty

reduction effects of commercializing BNC thus depend on a number of context-related factors.

With this in mind, we can now tentatively extend the theoretical framework proposed at the outset of this study (Figure 3.2.) by suggesting additional factors that may determine the poverty-reduction impacts of BNC trade (Figure 3.5.). Variability in agro-ecological conditions over time and space in cases where production is uncontrolled or partly controlled compromises *significant per capita production*, as shown by the differences in production between villages and years in our study. Resource depletion, whether through unsustainable use or external factors such as climate change, has the same effect of decreasing production. Ensuring *value transfer to producers* in cases where resource availability fluctuates and producers are price takers necessitates price-protection mechanisms, otherwise most of the margins are likely to be appropriated by middlemen or retailers who control marketing and produce the narratives associated with these commodities (Goodman 2004). In our study, the ratio of retail prices for the end-consumers to local market prices reached ten to one. If the value chain can be shortened, e.g. through cooperatives or migrant networks, then producers are more likely to capture a significant portion of the added value. Likewise, institutional support, whether in the form of cooperatives, access to credit, or extension services, is necessary to help producers overcome *barriers of entry* into trade infrastructure. Regimes of resource ownership are important in determining the share of production that is *accessible* to the poor. The commercialization of BNC produced on private land that is mostly owned by the rich cannot be considered pro-poor. Many BNC are common-pool resources, in which cases the definition of access rights is crucial. These regimes vary greatly from one region to another. Even within the argan region, multiple management systems of the commons co-exist. In cases where access is open and unregulated, technology and labor availability may limit access of the resource to the poor. Finally, the *high retail prices* of BNC are caused by the scarcity of the resource relative to the global demand. Maintaining some degree of global scarcity while keeping sufficient per capita production at the local level implies limiting the number of

producers, which may in some cases mean excluding newcomers to BNC trade. There is a tradeoff between the magnitude of (per capita) benefits from BNC commercialization and the number of its beneficiaries. The number of producers can be limited through the definition of geographical indications, which creates narrow market segments and thus artificial scarcity.

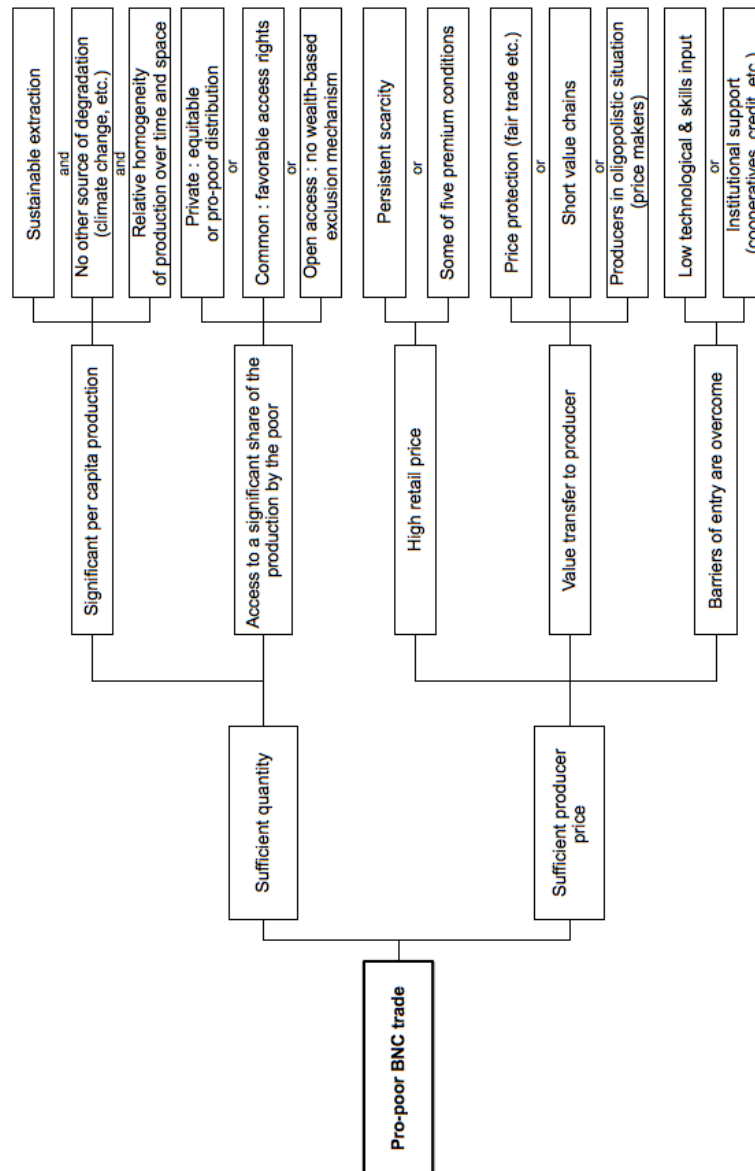


Figure 3.5.: Conditions for pro-poor BNC marketing - Extended

BNC provide an entry point to assess social and environmental impacts of consumption and development-conservation relationships, and as such they deserve more attention. Our findings provide a useful framework for research on the impact of BNC trade on poverty reduction. However, other dimensions of BNC not included in this framework should also be considered. These are for example the possibility of poverty traps, anti-poor development or increased vulnerability resulting from specialization, and indirect beneficial effects of BNC trade (e.g. job creation, strengthening of social networks, and stronger connection to markets).

In the introduction we questioned the relevance of market-based tools of governance. We argue that development agencies should consider supporting BNC commercialization only as one aspect of diversified livelihood portfolios, and should only do so after careful evaluation of the returns from BNC intervention as compared to other development actions. Attention should be given to the extent to which producers really can have sufficient control of the commodity chain to retain value. An important part of the BNC value lies in the narrative attached to it, which is often produced by intermediaries (Goodman 2004). The continued willingness of some development agencies to support market-based rural development (e.g. World Bank 2007), whether through bioprospecting, non-timber forest products, BNC, or improved crops, shows the power of win-win narratives (Oya 2009). These narratives imply that all actors - the poor, private companies and the environment - benefit from certain reforms, such as agricultural trade liberalization. The literature and our case study show that these benefits are usually not shared equally, and that win-win narratives are often overstated. Acknowledging this fact allows setting priorities for action. In the case of BNC commercialization, a set of conditions, including sufficient production, adequate price transfer and market access for the poor, must be met for it to alleviate poverty. The success of BNC marketing as a pro-poor strategy may necessitate interventions to support market access through education, credit and adequate technology, secure price transfers to producers, and monitor resource use to prevent depletion. Where these conditions are met, BNC commercialization may benefit the poor. Where they are not,

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other policy options, including non-market ones, may prove more efficient at poverty alleviation.

* * *

The two preceding chapters have examined the proximate causes of woodland degradation and of material development separately. However the aim of this thesis is, as stated at the outset, to gain an understanding of coupled human and ecological change. The next chapter accomplishes this task of coupling human and ecological change by taking a long-term view at their interrelations. In particular, it will examine the hypothesis that certain geographical settings - in this case a dryland region with little natural resources - determine certain outcomes in terms of development and degradation, and we highlight the possibility of a transition away from woodland use.

* * *

4. Market integration, woodland change and livelihood transition

Adapted from le Polain de Waroux, Yann, and Jeanne Chiche: «Market integration, livelihood transitions and environmental change in ecologically marginal areas: a case study from Morocco», submitted to *Human Ecology*.

Abstract

Rural areas all over the developing world have become increasingly integrated into the world economy through both production and consumption during the last decades. This growing integration shapes the development of rural communities and influences their relationship to the natural environment. In ecologically marginal areas where livelihoods are constrained by resource limitations and the productivity of labor in farm activities is low, economic integration may be expected to result in a shift to nonfarm activities, either locally or through migration. In such situations, this shift may be expected to contribute to improving wellbeing beyond the limitations of the natural environment. In cases where human activities had been putting excessive pressure on natural resources, it might as well relieve some of that pressure. The hypothesis of such a «win-win» development pathway, in which integration to a wider economic space leads to both material development and conservation through nonfarm diversification, deserves to be tested empirically, as it would have important implications for development and environmental policy. In this paper we use original qualitative and quantitative data to examine environmental and social changes that took place during the last half century in a rural area of Morocco, seeking evidence of such a pathway. While our case study supports the hypothesis that nonfarm diversification in a context of resource scarcity allowed people to improve their material living conditions to some extent, the effects of economic integration and nonfarm diversification on the environment were mixed.

Keywords: Morocco; globalization; livelihood transition; nonfarm; deforestation.

4.1. Introduction

It is now widely accepted that completely isolated, autarkic rural dwellings hardly existed any more during the last centuries, and that people nearly everywhere had long engaged in some form of exchange even before the industrial revolution. In some way or other, however, most rural areas in the developing world became more integrated to national and international markets during the twentieth century, particularly so during recent decades of market liberalization, infrastructure modernization and economic growth. This growing market integration resulted from the agency of local people and from the realization of exogenous projects, whether by private actors (e.g. seeking to extend the market for manufactured products or to tap a labor reserve), states (e.g. carrying out modernization plans) or donor agencies (e.g. combatting poverty). Examining how rural communities in different places of the world deepened their integration into the market economy over time matters if we are to understand the social and environmental determinants and outcomes of ongoing livelihood transitions. These transitions, to the extent that they form recurrent patterns in different places, may be understood and categorized as *pathways* of change, determined by driving forces and shaped by local contingencies. One such pathway described in many rural regions since the 1990's has been that of a shift away from land-related activities and towards more nonfarm activities and migration. While observed in very different settings, such a shift seems particularly likely to happen in ecologically marginal areas with no absolute advantage for primary production and a comparative advantage in nonfarm work. In such areas, a shift away from land resources might allow people to start a process of material accumulation that would have been otherwise impossible due to resources limitations. It might also be beneficial for conservation if it makes extractive or otherwise environmentally unsustainable activities less attractive due to rising labor costs. Furthermore, economic integration makes new goods available for consumption, some of which are substitutes for locally produced ones. In cases where local consumption exerts a high pressure on local resources, integration may provide venues for

relief. The possibility of a «win-win» pathway away from the land, in this perspective, seems only natural.

This chapter examines the possibility of such a pathway for a specific case, the argan region in Morocco. We saw in the introduction (section 1.3.1.5.) how the argan woodlands have become a favored intervention area for development- and conservation-minded transnational actors, leading, among other things, to the creation of the UNESCO Argan Biosphere Reserve. The idea of sustainable development carried by the UNESCO and other national and transnational actors in the argan region rests on the assumption that supporting argan oil production (through women's cooperatives) will both help lift households out of poverty, and create incentives for conservation (see for example Nill and Böhnert 2006, pp. 37-55; UNESCO 2011). As in other regions (Rigg 2006), developers see agriculture-based reform as a key to development and conservation. Yet while much of the argan region once was primarily (though never completely) agricultural, it is characterized today by a high prevalence of internal and international migration and of nonfarm activities among rural communities. The objective of this chapter is to show how, by taking advantage of new opportunities in the wake of market integration and economic growth, rural communities of the argan region actually managed to survive and develop *in spite* of their environment, and how their development affected the argan woodlands. For this purpose, we will investigate the hypothesis of a win-win outcome of market integration in this area, showing to what extent resource scarcity has led to a decoupling of livelihoods from the natural environment, allowing for simultaneous material accumulation and conservation of the woodlands. Before proceeding to the specifics, we will briefly examine the case for such a win-win pathway in the literature.

4.2. Background

When integrating the market economy, it is expected that rural communities will specialize into activities in which they hold a comparative advantage. Comparative advantage may depend on a variety of factors, but it can be argued that it is primarily a function of agricultural potential, infrastructure and population density (Brons & al. 2004; Pender 2004). Depending on what their comparative advantage is in an extended economic space, communities may take a variety of development pathways³⁰ leading to different economic and environmental outcomes. In this perspective, the comparative advantage of many regions with high population density and low agricultural potential, as they open up – in part through improved infrastructures – to new spaces of economic growth, may not lie in farm production, but rather in the use of labor in other, more productive activities through nonfarm diversification³¹ (de Janvry and Sadoulet 1993). In that case, high population density and low agricultural potential may be understood as push factors for nonfarm diversification, and the development of infrastructure and more generally market integration, as an enabling environment activating pull factors such as new job opportunities. The role of natural resource constraints, low or falling agricultural potential, low and falling agricultural labor productivity, and land degradation and shortages in inducing nonfarm diversification has been recognized by several authors (Bryceson 1996, 1997, 2002; De Sherbinin et al. 2008; Haggblade et al. 2010; Matsumoto et al. 2006; Rigg 2006).

Where people are pushed towards nonfarm diversification by resource limitations, this movement away from land resources might be expected to open up new development possibilities (Adams 2002; Rigg 2006). Actually, the economic impact of nonfarm diversification depends on the extent to which the income from nonfarm activities compensates for or exceeds the value loss from labor in farm

³⁰ Development pathways can be defined as «common pattern[s] of change in livelihood strategies» (Pender 2004)

³¹ Indicating a movement towards more nonfarm activities, using Barrett et al.'s (2001) definition of *nonfarm* (except that we exclude charcoal-making), which includes both local non-agricultural activities and temporary migration.

activities - that is, on the *opportunity cost* of nonfarm activities (or conversely, of farm activities); on the *compatibility and complementarity* between farm and nonfarm income and activities; and on differences in *access* to nonfarm activities between people and households. Nonfarm activities are associated with higher income throughout Africa, in part because they play a role in improving income and wellbeing, and in part because wealthier households enjoy better access to high return niches within the nonfarm sector (Barrett et al. 2001; Lanjouw 2007). For that reason, they can be inequality-increasing (Brons et al. 2004) or -decreasing (Adams 2002).

The environmental effects of nonfarm diversification may be understood as resulting from the combination of two factors. The first is the reduction of the labor force available for farming - the *lost labor effect* (Taylor 1999). It is due to the rising opportunity cost of labor in a context of increasing demand, and may lead to a decline in labor-intensive farm activities (Radel and Schmook 2008). Where such a decline occurs, its effects will depend on whether the abandoned activities were ecologically unsustainable (e.g. overgrazing or excessive logging) or conservation-friendly (e.g. terraced cultivation, oasis agriculture). While for agricultural systems the results of a loss of labor may be ambiguous or even negative (cf. Holden et al. 2004, Morera and Gladwin 2006), for forests and woodlands, the lost labor effect is more likely to be beneficial because it may lessen extraction. One recognized pathway of forest transition (i.e. forest regrowth after a period of decline) for example involves a lost-labor effect (Rudel et al. 2005). Kull et al. (2007) observed that nonfarm diversification led to more land being left fallow in Costa Rica, allowing forest to regrow. Similar dynamics were found in Mexico (Schmook and Radel 2008) and Sri Lanka (Gunatilake 1998). The second effect of nonfarm diversification is that of *income* on consumption and investments. Increasing income may be used to purchase substitutes for locally produced goods (such as game or fuelwood), or it may be used to purchase more of these goods, depending on whether they are so-called inferior, normal or superior goods. Income may also be invested in conservation-adverse or in conservation-friendly technologies (e.g. chainsaws vs. drip irrigation;

see for example Iiyama et al. 2008). In El Salvador remittances were invested either in fuelwood or in alternative fuels, with opposite environmental outcomes (Gammage et al. 2002, cited in de Sherbinin et al. 2008), but at the national level remittances were positively associated with forest resurgence (Hecht 2007). In Costa Rica, expatriates purchased tracts of land for conservation (Kull et al. 2007). Acknowledging the context-dependence of these effects, we can however infer that nonfarm diversification is likely to be beneficial to the environment if it leads to the abandonment, due to a lost labor effect, of unsustainable practices or of land and resources whose maintenance does not require human intervention, or if it supports investment in conservation-friendly technology and consumption goods. Figure 4.1. integrates these various effects into a conceptual model.

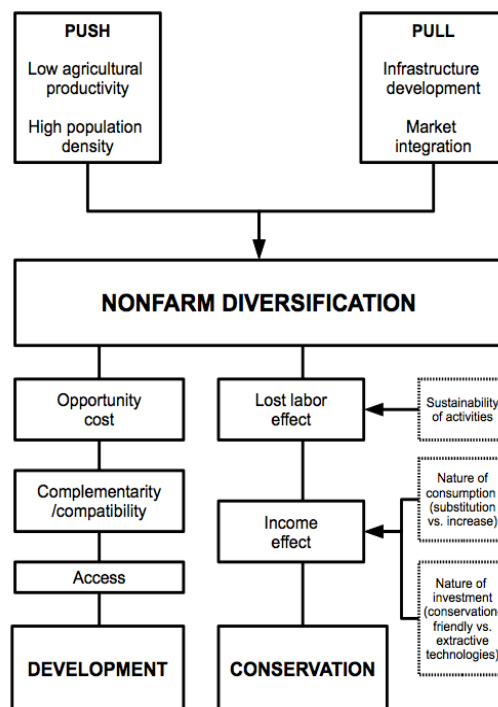


Figure 4.1.: Conceptual model

The remainder of this chapter is aimed at investigating the aforementioned hypothesis of a win-win outcome of market integration through the decoupling of livelihoods from the land in the case of the argan woodlands. In order to do this we analyzed changes in livelihoods, land use, wellbeing and woodland cover between independence and today. We then analyzed causal relationships between these trends.

4.3. Data and methods

This study relies on data from the previous two chapters, as well as on ethnographic data from extensive fieldwork, as described in section 1.4. Some archival documents were also used, e.g. descriptions of the argan woodlands by Boudy (1958), forest officials' reports, Noin's book on rural demography in Morocco (1960) and documents from the French protectorate archives (consulted in Nantes and Paris). Radar charts and the summary graph (see below), additionally make use of statistics on production and trade from the UN COMTRADE and FAOSTAT databases, and of data published by Office National de l'Electricité.

Open interviews and conversations provided the core material for the reconstruction of past events and trends. Whenever possible, we crosschecked information from several informants and from archival records to avoid biases (see section 1.4.2.). In order to understand changes in livelihoods we classified households into livelihood categories at the time of independence and at present (independence, besides being the beginning of a new period of opening and modernization, was also an easy landmark for people to remember). Informants themselves provided household categories for the past. Interviews provided insights as to past living conditions and lifestyles for each category. For present, we conducted a hierarchical clustering using a Ward method with Euclidian distances, based on 11 variables selected from the household interviews (see Table 4.1.). A combination of statistics from the household interviews and qualitative information from open interviews provided the

material for a description of the main characteristics of these categories.

Variable	Description
Assets index	Index based on 10 assets variables (see Chapter 2)
Cereal harvest 2009	Harvest of barley and wheat in 2009
Argan harvest 2009	Harvest of argan nuts in 2009
Herd size	Number of sheep and goats
% Time abroad	Percent of the time spent abroad over the last ten years (weighted average for all household members)
% Time in cities	Percent of the time spent in Moroccan cities over the last ten years (weighted average for all household members)
Local income	Monthly income from local activities
Remittances	Monthly remittances from household members working outside the village
Argan income	Monthly income from argan sales
Livestock income	Monthly income from animal sales

Table 4.1.: Variables used for the clustering procedure

Changes in land use and wellbeing were inferred by comparing accounts of past activities and living conditions with present observations and interviews. Quantitative figures mostly come from the household interviews. We restricted to measurable aspects of wellbeing, namely food sufficiency, water availability, housing, education and infrastructure.

Methods used to monitor woodland density changes between 1970 and 2007 are described in Section 2.3. In order to verify the consistence of woodland change trends before and after 1970, we compared estimates of woodland density for the study area made around the time of independence by Boudy (1958), with our own density estimates for 1970. Finally, a series of transects in the five study villages (see Section 1.4.5.) provided complementary data about woodland state and use.

In order to visually represent changes in market integration we created a series of radar charts displaying flows of people, money, food and energy for two villages (villages A and E). Each of these flows is displayed on one of the axes of the charts, and is represented by a proxy, respectively temporary labor migration, wages and remittances, cereals, and the sum of fuelwood, gas and electricity for domestic use (converted to MWh). The charts show the weighted average at village level of the distance covered by flows in and out the villages at three dates (1960, 1985 and 2009), with the quantities involved (per person and per year)³².

For example, assuming that half of the total energy consumed in a village is produced locally in the form of wood and charcoal, another fourth comes from an electricity plant at 100 km distance, and the last fourth comes as oil from a neighboring country at 1500 km distance, the average distance of inflows of energy would amount to $0.5*0 + 0.25*100 + 0.25*1500 = 400 \text{ km}$ ³³. For flows of labor, say for example that forty percent of the men in a village work locally, twenty-five percent work in Agadir (160 km) and the remaining thirty-five percent work in Casablanca (350 km). Assuming there are fifty percent women in the village, and women do not migrate, the average distance of outflows of labor would be $0.5*(0.4*0 + 0.25*160 + 0.35*350) = 81.25 \text{ km}$. Say in the example above that one fourth of the money flowing in the village is local wages, and the rest is remittances. Remittances were assumed to have the same spatial distribution as labor; they would thus be coming in part from Agadir (0.25 of the total 0.6 migrants, so $0.25/(0.25+0.35) = 0.42$) and in part from Casablanca ($0.35/(0.25+0.35) = 0.58$). The average distance of money inflows would then be $0.25*0 + 0.75*(0.42*160 + 0.58*350) =$

³² The average distance and the quantities involved are computed including zero-distance flows, i.e. quantities that remain within the villages, for example non-migrant population or self-consumed cereals. This is necessary so that the output value reflects the relative weight of flows in/out vs. within the village, but it implies some extent of double accounting in the quantities (e.g. local wages are included in both in- and out-flows of money).

³³ Though not shown here, we took into account the distance to origin of inputs for power plants (mostly coal) in the computations.

202.6 km. For cereals, gas and electricity, we assumed that the origin of items bought on the market mirrored the mix of production and imports at national level³⁴. So for example if we assume half of the cereals are bought on the market, and at the national level cereals available on the market are one half from Morocco (400 km to the main cereal production region), one fourth from France (2200 km), and one fourth from Argentina (8900 km), we would take the average distance of inflows of cereals to be $0.5*0 + 0.5*(0.5*400 + 0.25*2200 + 0.25*8900) = 1487.5$ km.

An additional summary graph shows a connectivity index derived from the connectivity graphs, alongside a wellbeing index and the woodland density for the two village territories. The connectivity index is the standardized (highest value = 1) logarithm of the area under the curves (IN and OUT flows are summed). The well-being index is a summary index at village level (different from the one used for the household clustering) based on five criteria: sufficient food, access to water, robust house, access to primary education, and road access. For each criterion, at a particular date, each village was given a value reflecting the number of people concerned: 0 (nobody); 1 (some) or 2 (most) (for road access, 0 meant no road, 1 a dirt road and 2 an asphalt road). These values were then summed and standardized to produce a 0 to 1 index.

4.4. Results

4.4.1. Livelihood and land use changes

Respondents generally agreed on the existence of three main categories of households in the past. *Small-scale farmers* cultivated barley or wheat, had a few goats and sheep, and some vegetables for those with access to water. They were in a situation of quasi-self-sufficiency in normal years, but were highly vulnerable to drought.

³⁴ Because of the high variability of national production and imports for cereals, we used a 5-years average rather than the value in a particular year (which was unavailable for 2009, the data extending only to 2007).

Although they stored cereal surpluses for use during dry years, storage was usually insufficient, and they had to buy grain from the market. In order to do this they sold argan wood or charcoal, sometimes also argan oil. Their diet consisted mainly of barley porridge – meat was rare. Their consumption of market goods was limited to grain, some vegetables, and tiny amounts of tea, coffee and sugar. Then there were a few *large livestock breeders* and *landowners*, constituting no more than 10-15% of households. Large landowners were often people belonging to families believed to be the first historical dwellers in the villages, but might as well in some cases have acquired land by force or through the legitimacy of holy ancestors in colonial and pre-colonial times. These people had sufficient food, could go on eating homegrown or market vegetables and meat during droughts, and consumed tea and sugar on a regular basis. Finally, there were a few *merchants* in each village, one in about ten households. These had dromedaries (no more than two or three per household), with which they joined caravans between Marrakech, the Sus plain, and the southern oases around Tata and Zagora, carrying olive oil, dates, and in some cases argan oil, salt or cereals. They too could afford meat and vegetables at all times. Yet caravan trade, however important it might have been for the region in former times, was only a relict at the time of independence, and the last camels soon disappeared due to the competition of trucks. In marginal numbers in the area were also public servants and migrants. The latter were very few at that time: in 1966, they were still only five to seven percent of the men in the region, of which one percent international migrants (Noin 1970). In a few villages there were also craftsmen, such as blacksmiths and basket makers. On the whole, the local economy, though by no means exempt of commercial exchange, was thus still primarily subsistence-oriented. The main marketable products of the area in terms of frequency and quantity were argan wood, argan charcoal, and small livestock. The main items bought from the market were cereals, vegetables and, increasingly, tea and sugar. Production factors as well as construction materials were locally based. Arid plows were made of argan wood and pulled by mules or donkeys, which also served to thresh cereals. Argan wood provided fuel for cooking, baking, and heating in the winter, as well as beams for traditional stone houses.

The clustering procedure for 2009 yielded four five household categories³⁵. The cluster tree shows the division of groups, and elements of interpretation (Figure 4.2.). We limited the analysis to four groups, named according to their main features. Some statistics are provided in Table 4.2.

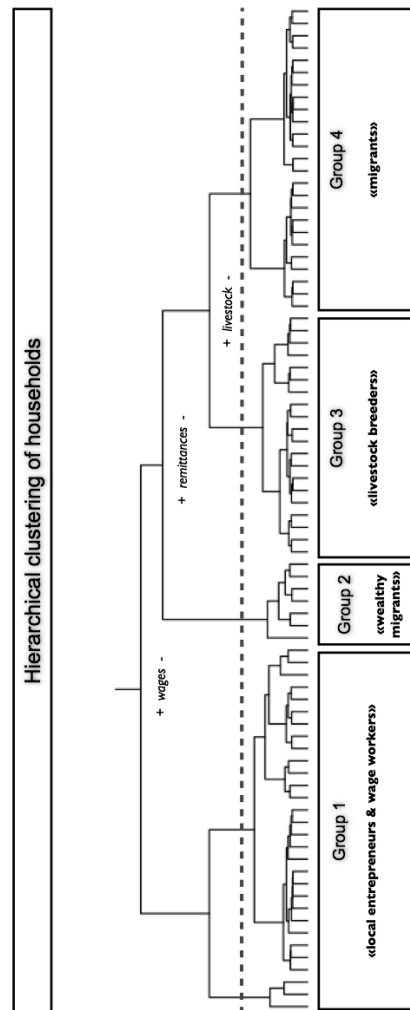


Figure 4.2.: Household clusters

³⁵ We excluded one household with extremely high income due to French retirement money and the ownership of a building for rent in Casablanca. Three households forming a separate category were re-grouped *a posteriori* with the «local entrepreneurs» category based on their high local income.

An important share of the households (29% of the sample) relied heavily on temporary migration – we simply call them *migrants*. The men in these households often had low-pay jobs in grocery stores or in restaurants, but some also managed to set up small businesses and to remit significant amounts of money to their family (1500 MDH/month or more for 4 households out of 25)³⁶. They usually had little land, but they continued to plow it; they had few animals, and no local income. *Livestock breeders* (23%), whether they had just a few animals or a large herd, combined income from the same kind of low-pay jobs with livestock herding, and spent less time in the city, and more looking after their animals. Those with more livestock were better off, because animal sales could generate a significant income (up to 2500 MDH/month). For the others, keeping a few animals may have been a way of coping with the variability of remittances. A small group of *wealthy migrants* (8%) had high amounts of remittances (2000-6000 MDH) that constituted the sole source of household income. High remittances were due to the involvement in international migration or in profitable businesses in town. If they did not leave completely for the cities, these people continued to plow the land, hiring labor if necessary, and focusing on land that could be plowed easily with the tractor. Argan oil, if produced, was usually sent to family members in the cities, cereals were self-consumed, and they had few animals, if any. Finally, some *local entrepreneurs and wagedworkers* (35%) earned significant nonfarm income in or around their village (from a minimum of 600 to 7000 MDH/month in an exceptional case). The former were for example truck drivers or construction entrepreneurs; the latter were mainly construction workers or unqualified workers employed for various tasks in the villages and around. Usually, some household members worked in the city, but less than in other households. Some also had animals – two of them even had a large herd of 200 animals.

³⁶ Moroccan Dirhams, 1 USD = 8.5 MDH.

Variable name	«Wealthy migrants» (n = 7)	«Local entrepreneurs & wage workers» (n = 30)	«Migrants» (n = 25)	«Livestock breeders» (n = 20)
<i>Variables used for the clustering</i>				
Assets index	0.53 (0.11)	0.42 (0.18)	0.40 (0.17)	0.41 (0.16)
Age of head of household	62.4 (16.3)	54.0 (12.4)	57.3 (14.8)	55.3 (14.9)
Cereals harvest 2009	188.0 (133.3)	189.8 (208.0)	107.3 (104.3)	193.9 (177.8)
Argan harvest 2009	0.3 (0.8)	45.4 (181.8)	12.6 (18.8)	11.9 (17.9)
Herd size	4.7 (6.5) ^{ab}	19.9 (50.2) ^{ab}	6.9 (11.4) ^a	46.2 (46.4) ^b
% time abroad	14.6 (17.39)	3.7 (9.0)	4.6 (14.4)	0.0 (0.0)
% time in cities	69.7 (22.4) ^{ab}	41.5 (32.7) ^a	80.7 (21.5) ^b	50.3 (38.4) ^a
Local income	0.0 (0.0) ^b	1573.3 (1324.4) ^a	38.0 (131.7) ^b	78.8 (146.7) ^b
Remittances	3528.5 (1314.0) ^a	403.8 (566.6) ^b	870.6 (493.8) ^c	523.8 (441.6) ^{bc}
Argan income	0.0 (0.0)	66.2 (148.12)	58.0 (161.8)	102.1 (167.4)
Livestock income	0.0 (0.0) ^a	259.2 (529.3) ^a	48.6 (83.1) ^a	1183.3 (558.7) ^b
<i>Activity variables**</i>				
% Time in transportation	0.0 (0.0)	9.5 (22.4)	2.7 (8.7)	0.9 (4.2)
% Time in trade	3.3 (7.2) ^{ab}	18.3 (30.6) ^{ab}	24.5 (35.6) ^a	1.3 (5.6) ^b
% Time in construction	58.0 (30.5)	19.9 (34.1)	30.14 (39.8)	18.0 (30.4)
% Time in services	30.2 (31.9)	38.0 (35.0)	31.3 (36.2)	34.3 (35.4)
% Time in livestock breeding	3.0 (8.0) ^a	6.7 (20.7) ^a	5.4 (13.9) ^a	33.1 (35.4) ^b
% Time in agriculture	2.9 (7.6)	5.7 (15.1)	2.4 (8.6)	6.6 (14.5)

*) Upper-script letters show significant differences an 90% or more between variables.

**) «% time in ...» variables are weighted household means of the time spent working in a particular employment sector as a first activity.

Table 4.2.: Group statistics

Nonfarm activities – including migration – had thus become a central part of livelihoods by 2009. On the whole, in the study villages, about two-thirds (67%; $n = 243$) of the men were working outside their village, mostly in the North of Morocco (39%), and especially in the economic capital Casablanca (27%). 64 households (74,5%) had an average income from remittances of 8933 MDH/year ($sd = 8820$ MDH). Although parts of the Anti-Atlas and the Sus plain had longer been engaged in a migration process, in the study area migration took off in the 1960's, when the first en-masse recruitments for the French mines and industries took place, and over 50 men from the study villages left for France. Once there, these men found employment for relatives, and over the decades an important number of men left for Europe, most of whom never returned home. More people also started leaving for Moroccan cities after the 1960's, but temporary internal migration took a systematic turn only in the late seventies for some villages, and in the early nineties for others. Some migrants took their wife and children with them to the city once they could afford it. Village censuses show that at least 186 households (or 80% as many as stayed in the village) had left the five villages by 2009, most of whom still owned a house in the village and visited once a year. But to many the only possibility was combining the advantages of the city (jobs and access to education) with those of the countryside (low expenses and identity or cultural references). A few migrants also returned to their village to practice a craft they had learned elsewhere, especially construction workers, who benefited from the housing boom in the villages of the region – a boom largely fueled by migrants themselves. The more affluent migrants employed relatives or other villagers to look after their house and their livestock or to deliver them wood. Some used the money set aside during migration to develop commercial activities, particularly in construction and transport. In this way, migration and remittances, along with increased mobility and the development of small towns, were important factors in the development of local nonfarm activities.

Partly as a consequence of migration, the importance of agriculture had declined. Marginal land was often no longer used, especially in those villages with an important number of international migrants.

By 2009, 41 households from the sample had stopped cultivating land with ard plow and donkey (average abandonment date 1997; sd = 8.1), and used only tractors (average adoption date 1992; sd = 10.2), meaning that they restricted to flat lands. Most households sold manure (72% of those owning animals), rather than spreading it on their fields as they used to do. Selling manure was profitable but risked undermining soil productivity in the absence of other fertilizers. New houses were built on valuable agricultural land, rather than on steep slopes as earlier. Some agricultural activities were also forcibly abandoned: following the completion of the Awluz dam in 1991, the water that had irrigated fields in villages B and C was redirected to commercial farms, and olive and almond trees died. Most households, however, still pursued cereal cultivation to some extent, and a few international migrants even planted olive trees and bought water and material for irrigation.

Livestock herding changed in nature. For example, the *agdal* practice had been abandoned in two of the study villages, and some mountain sheep-pens, in which shepherds used to leave herds during summer months, had been abandoned as well. But we found no evidence of a strong decline in livestock numbers, contrary to the opinion of local residents. In 1973, the forest service censored about 38 shoats per household in Inda Ou Zal massif, and 13 in Aït Yahya. Based on interviews with customary authorities, we estimated the average number of shoats per household in 2009 at about 23 for the former, and 13 for the latter. Although the figure is less than in 1973 for the Inda Ou Zal, the rate of decrease is roughly in range with that of population increase in these villages, suggesting that total livestock numbers probably did not change much between these dates. The fragmentation of herds among a greater number of users might explain the perception that livestock numbers decreased.

Likewise, residents generally shared the opinion that the number of nomad herds had increased. According to our estimates based on key informant interviews, the grazing pressure by nomad herds in recent times may have been more or less equivalent on average to that of local herds, albeit concentrated over specific periods. The use of trucks for moving animals around might have supported an increase

in herds from Berber nomads (Arab nomads from the Sahara came on foot). A few nomad households also appeared to have permanently settled in the area in 2012. Unfortunately, we have no sufficient data to check the validity of this opinion.

From a common small-scale activity conducted by households on an individual basis, wood trade seemed to have surged during the 1970's-1980's before declining dramatically from the 1990's. Though the trade was probably first limited to the villages of the plain that could be reached on foot (except for charcoal, which is easier to carry), as trucks became available after independence, the potential delivery area expanded. Some truck owners in the area were known to deliver wood as far as 100 km away. Coupled with increasing demand from developing market and administrative centers in the wake of the agricultural export boom of the Sus plain, this probably made for an intensification of wood trade. In the early 1990's, people in one village reportedly loaded one to two trucks per week with argan wood, in addition to daily sales on a mule's back. By the late 2000's, however, wood sales had become a residual activity: in most villages, only a few men – probably in less than five percent of households – sold wood on a regular basis, some to villagers from the plain, others to richer household in their own or a neighboring village. Charcoal making had all but disappeared. Actually, logging had always been a low-pay activity: still in 2012, a donkey-load of wood was worth 50-70 MDH only, so that a full-time worker, selling two of them a in day, would be only slightly above the local day's wage for unqualified workers (about 100 MDH/day). It was, moreover, physically hard and risky: trading wood was illegal, and although bribes had usually kept the forest services away, loggers were eligible for high fees if an officer happened to be less flexible. So from the mid-1990's, truck drivers found it more interesting and less risky to shift to other commodities (including wood from other, legally exploitable species) and stopped transporting argan wood. By the 2000's, as loggers grew older and could rely on their sons' remittances, the profession slowly declined.

As for local fuelwood consumption, although it had decreased, it was still significant. Though 91% of households surveyed used gas bottles

(four times more than thirty years earlier), with an average gas consumption amounting to 3801 kWh/year*household (sd = 2006), these same households also used 9.4 m³/year (sd = 7.1) of argan wood, the equivalent of 14000 kWh³⁷, or several times more.

4.4.2. *Changes in wellbeing*

The description of household categories at the time of independence has shown that, although the abundance of food varied from one category to the next, the average diet was basic and often even insufficient for the majority of households. Water was an issue as well: the reliance of villagers on rainwater in underground cisterns meant having to travel to a permanent spring, often several hours away on foot or mule, to fetch water in case of acute drought. At the time of independence, this reliance was being slowly relaxed with the increasing availability of cistern trucks and with dirt roads linking the villages nearest to the plain. But droughts could still sometimes transform into famines. People from the study villages reported two such cases: in the 1930's (probably the 1936-7 famine) and in the 1960's (probably the 1966-7 drought). Houses at that time were built of stone and earth, were often quite small and needed continuous repair. People moved around on foot or on mules and dromedaries, even for long distances, because traveling by bus was expensive, and cars were rare – dirt roads linked villages to the market in the plain only. There were no schools in the villages.

By 2009 three out of five villages had running water, and work was under way in the fourth – only village E still relied exclusively on rainwater and had no prospect of improvement in the near future. Plain hunger was no longer an issue, even for the poorer households, though wealth differences were still perceptible in the consumption of luxury foods, such as fruits, industrial foods (cream cheese, marmalade, lemonade, etc.) or meat. Traditional earth and stone houses had also become a minority. Most houses were a mixture of stone, earth, and cement, and a few were built in cement alone

³⁷ Assuming 1 stere = 330 kg (from Hansfort and Mertz 2011) and a standard calorific value of 4.5 kWh/kg wood.

(cement was a more stable material and offered a better protection against the rains). By 2011 most had electricity a toilet, and a few had a separate shower. Eucalyptus beams and steel doors replaced argan roofs and wooden doors. Almost everyone (over 90%) had a TV set and a mobile phone, and there was a fridge in every second house. All five villages had a primary school, which all children in age were attending, and 64% of boys (but no single girl) aged between 14 and 20 attended or had attended college. Dirt roads linked almost all mountain villages and there was a project of an asphalt road linking some of the mountain villages to the main road as well. Many people owned private transportation means: 70% of households had a moped or a motorbike, and 21% had a car. While the souk was still a favorite socializing platform, mobile phones had opened new venues for trade and allowed migrants to keep in touch with their families even over great distances.

4.4.3. *Land cover changes*

Boudy's (1958) estimates of woodland density for the late 1950's are relatively consistent with our 1970 density map (see Table 4.3.), suggesting, if anything, a continuous decrease in density.

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		~ 1956 (Boudy)	1970	2007
Aït Yahya	Mountains	30-40	22,8 (18,0)	14,8 (9,3)
	Plain	15-20	17,1 (11,2)	11,6 (8,5)
Inda Ou Zal	Mountains	30-40	28,1 (14,6)	18,8 (9,5)
	Plain	15-20	17,6 (9,2)	5,7 (5,8)
Arrhen	Mountains	40	27,5 (21,5)	16,2 (12,5)
	Plain	70	36,2 (16,4)	12,2 (8,1)
Bou Selloum		< 30 trees/ha*	24,2 (17,6)	12,3 (10,7)

*) no value given by the author, but described as «open and dying off»

Table 4.3.: Comparison of values reported by Boudy (1958) for the independence period, and average values from le Polain de Waroux and Lambin (2012) (standard deviations in parentheses)

	Density change (trees/ha)		% Plots with		
	Tree density 1970	Density difference	Recent cuts (all sizes)	Recent cuts (whole trees)	"Green rocks"
A	31,9	-8,92	32	2,7	20
B	17,7	-6,61	18,3	14,1	23,3
C	19,5	-5,15	18,2	15,2	49,3
D	29,5	-14,46	15,6	0	20,3
E	35,5	-5,33	28,6	1,3	11,3

Table 4.4.: Transects and remote sensing results (from Chapter 2)

In 1970, the density of argan woodlands in the area was 27.4 trees/ha (sd = 13.8), and in 2007 it was 15.2 trees/ha (sd = 22.8; see Figures 2.4. & 2.5. for maps). This represented a change of -12.2 trees/ha, or -44.5% from the 1970 density (significant difference at 99%). The figure varied from one village to another, from -5 trees/ha in village E to -15 trees/ha in village D (see Table 4.4.). Observations along transects showed abundant evidence of earlier logging (24 % of plots had «green rocks», i.e. cut trees whose regrowth is stunted by heavy grazing pressure) and recent scars on branches in all five study villages. Signs of whole trees cut recently were less, and none was observed in village D, although it had the strongest rate of decrease between 1970 and 2007, suggesting that logging had been important but had halted (see Table 4.4.).

4.4.4. Trends summary

Table 4.5. summarizes some changes that occurred between the two periods. The *radar charts* (Figure 4.3.) show an average increase in the distance covered by flows of people, money, food, and energy, taking place at different rates in the two villages. In both villages the average distance between people's labor place and the village increased as more people migrated for work in further places. The distance covered by money in-flows rose accordingly. The increasing distance to the origin of food consumed locally is linked both to the substitution of market flour for locally produced grain, and to the increasing distance of national cereal imports. As gas and electricity partly replaced fuelwood in the homestead, distance to the energy sources increased drastically. Meanwhile, the decrease in regional wood trade made for a decline in the distance covered by out-flows of energy and in their magnitude. The shape of the graphs shows a form typical for low-resource areas, with out-flows mostly of labor, and in-flows of most other things. The main difference between the two villages is that people in village E got involved later than village A in systematic temporary migration, and did not use significant amounts of gas and electricity until very recently. The *summary graph* (Figure 4.4.) shows that the increase in connectivity went along with an increase in wellbeing and a decrease in woodland cover, and

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highlights the differences in levels of and rates of change in connectivity, well-being and woodland cover between villages.

	Around Independence	Today
<i>Population (five study villages)</i>	1062 (1962 census)	1424 (own census, including men working outside) 1065 (own census, excluding men working outside)
<i>Dominant main occupations</i>	farm work and livestock herding	services, trade, construction work
<i>Main occupation of the wealthier households</i>	merchants and large landowners or livestock breeders	entrepreneurs and international migrants
<i>Farming</i>	cultivation of most available land, self-consumption and storage, market grain to cover shortages	cultivation of flat areas with tractors, abandonment of some marginal land, systematic reliance on market flour, manure sales
<i>Livelihoods & land use</i>	< 7%	~ 67%
<i>Men working outside the village</i>	--	~ \$780/household*year
<i>Remittances</i>	most households (hh) : animals, wood, charcoal some hh : argan oil, handicrafts, honey, cereals	most hh: manure some hh : argan oil, cereals
<i>Things sold</i>	the majority of households have to restrict their diet during droughts ; cases of famine	food is sufficient at all times
<i>Food security</i>	Only stone or earthen houses	Majority of mixed houses: increasing number of pure cement houses
<i>Housing</i>	No schools	Schools in all villages; accessible colleges
<i>Education</i>	Dirt roads in the plain only; rainwater only	Dirt roads to all villages, asphalt to some; running water in all but one village
<i>Infrastructure</i>	most hh : cereals, vegetables meat, tea, sugar	some hh : cereals, vegetables, meat, oil, tea, sugar some hh : industrial foods, fruits
<i>Things bought (food)</i>	--	most hh : TV-set, mobile phone, motorbike some hh : car, fridge, computer
<i>Things bought (non-food)</i>	--	--
<i>Woodlands</i>	~30 trees/ha	12.2 trees / ha
<i>Wood and charcoal sales</i>	most households	< 5 % households

Table 4.5.: Main changes between independence and today

Social and Ecological Change in the Argan Woodlands

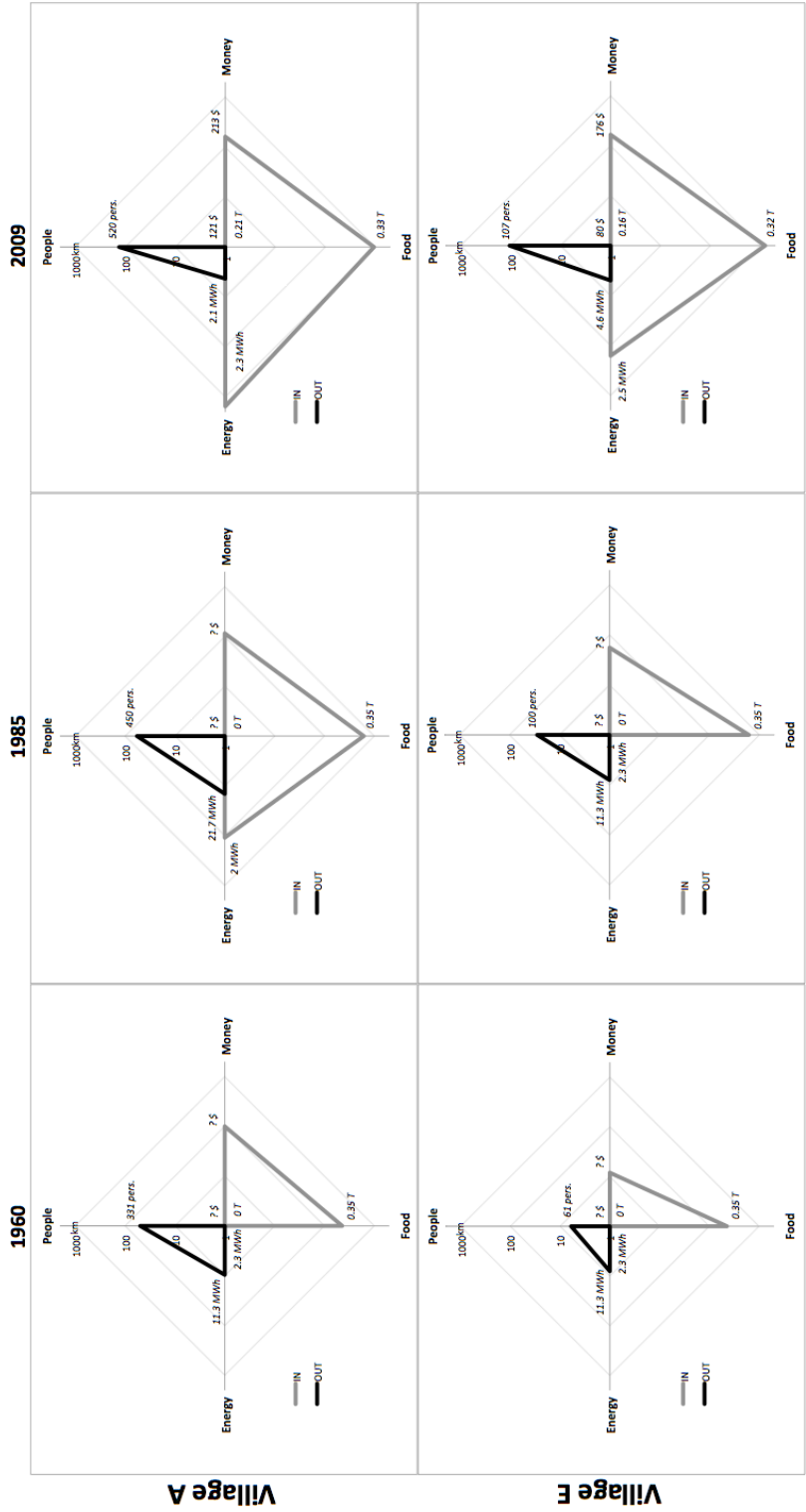


Figure 4.3.: Radar charts

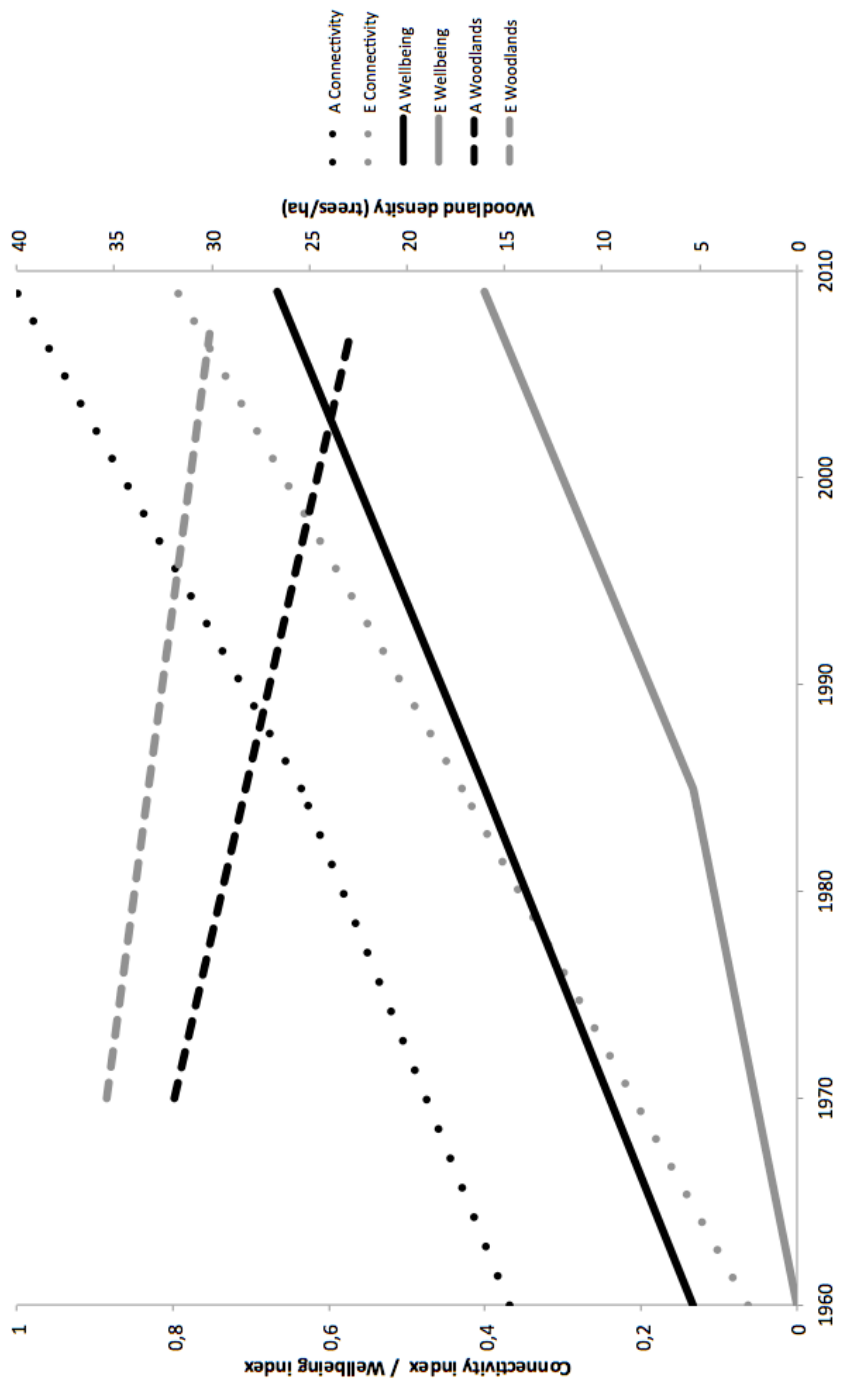


Figure 4.4.: summary graph

4.5. Discussion

The evidence has shown that livelihoods, land use, well-being and land cover all have changed dramatically during the last half-century. But does this story fit the «win-win» hypothesis of nonfarm diversification? From the point of view of material wealth, probably. From the point of view of woodlands conservation, less so. It is useful here to briefly review the evidence with respect to the different parts of the win-win hypothesis, and discuss its relevance for the literature.

4.5.1. The economic integration of an ecologically marginal area leading to nonfarm diversification.

We have shown how increasing integration into the regional, national and world economy allowed people in the study area to pursue activities off the farm and consume goods produced elsewhere. The dominant process of change was the reallocation of labor through the development of non-farm activities, whether locally or through migration. This livelihood transition went along with a gradual shift in consumption away from local natural resources. Together, the two processes made for a broad trend of decoupling from the natural environment and increasing reliance on exchange. The shift away from the natural environment did not, however, imply a sweeping and unequivocal deagrarianization. We noted above the decreasing importance of cereal cultivation, and indeed many people complained that it was not worth the while any more because taking all factors into account, it was cheaper to buy flour. But nearly all households still did practice it to some extent, and many hired a tractor to plow their land and paid the mill to grind their grain. Some wealthy migrants planted olive trees and bought irrigation water; some even rented land from others for cultivation. Probably as many people had sheep and goats as before, and these remained an important source of cash for some. Some international migrants invested in agricultural machinery, as found elsewhere in Morocco by de Haas (2006). The recent boom in argan oil price made the oil an important source of cash to some households, although on the whole it represented relatively little (see Chapter 3). Finally, many people

continued selling wood until recently, and as shown above some even capitalized on this trade to develop other trading activities. The persistence of farm activities had different meanings depending on the household considered: for some it was residual, for others it was part of a diversified livelihood and risk-minimization strategy, and for still a few others it was a means of speculation or investment. Yet there were very few for whom the land was still the primary source of value. These findings corroborate those of studies elsewhere that have found that even in cases of strong nonfarm diversification, households tended to maintain some degree of subsistence agriculture as an economic security net, a leisure activity, or for cultural reasons (e.g. Bryceson 2002; Jokisch 2002; Steward 2007).

4.5.2. Economic integration and nonfarm diversification leading to development.

It is safe to say that many improvements to the living conditions could not have happened had it not been for this decoupling. The land could not produce enough food for the growing resident population, let alone a surplus, so there was hardly any scope for material accumulation. The slow fragmentation of land holdings through inheritance, increasing aridity, and the degradation of the woodlands made the resource base even scarcer. The combination of new income-generating opportunities with increasingly available consumption goods made it possible to overcome these limitations, become less dependent on climate variability, and start a process of material accumulation that in turn stimulated the local economy. Most people in fact acknowledged that life in the villages improved «when people left». This may reflect the fact that departures «unburdened» the village from «surplus» population, but it also shows the growing role of remittances in livelihoods. Actually, more than half the economic value produced at household level in 2009 came from remittances and nonfarm work, and the amount of involvement in nonfarm activities and migration accounted for a good part of the differences in assets between households (see Chapter 3). Apart from sending remittances to their families, some migrants also played a role in setting up community infrastructure,

such as water towers, mosques and roads, whether privately or through village associations. These associations also acted as platforms for raising funds from national and trans-national agencies: according to our estimations, at least four million MDH (\$490.000) were invested between 1994 and 2009 into community development projects in the five study villages, half of which came from abroad (especially Germany, with about 40%). It is thus clear that on average, material conditions in the study area improved, be it from the point of view of food security, housing, infrastructure, or education, and that this improvement was permitted to a large extent by the participation of the local population to a wider economic space and the ensuing decoupling of livelihoods from local natural resources. This is consistent with other cases of nonfarm diversification (e.g. Cherdchuchai and Otsuka 2006; Haggblade et al. 2010; Estudillo et al. 2006; Matsumoto et al. 2006).

Referring to the framework in the background section, one could say that, as integration deepened, the *opportunity cost* of farm labor rose, because nonfarm activities had higher labor productivity than farm activities on average. There was a degree of *complementarity* between farm and nonfarm work because income from the one helped buffer variations of income from the other: economic cycles were different from agricultural ones, and people could rely on remittances in case of drought, and on small-scale livestock herding in case the flow of remittances went dry. Migration, especially international migration, fostered the local non-farm economy, as found elsewhere in Morocco (Belkadi 1998, de Haas 2006). To be sure, not everybody benefitted equally from economic integration, because not everybody had equal *access* to new opportunities. Access was a function of skills, education, social networks and endowments, all of which were unevenly distributed. As there had been a class of poor households highly vulnerable to drought and prone to famine, there was now a class of poor households vulnerable to both drought and unemployment – but unlikely to suffer from famine any more. Inequalities, still well present, were nothing new. Rather, the nature of poverty changed, much in the way described by Rigg (2006), who pointed to the appearance of a

«new» poverty, linked to job opportunities, contrasting with «old» poverty, linked to land ownership or access (see also de Haas 2006).

4.5.3. Economic integration and nonfarm diversification leading to conservation.

It was shown in Chapter 2 that increasing aridity and wood extraction had combined to cause a sharp decline of argan woodlands density in the area, of -44.5 % over 37 years, or 1.2 % per year. Urban spread and the expansion of irrigated agriculture, while important drivers of change in other parts of the argan region, were not present to any significant extent in the study area. Grazing, the most publicized driver of degradation, may have been a key factor in preventing natural regrowth, but its influence could not be tested empirically, and we found no significant association between woodland density decrease and livestock density at village level. Where some changes did occur was in wood extraction, both for domestic use and, especially, for sales. The effect of consumption changes was qualitatively important, because it implied a progressive shift to gas as the main domestic fuel source. But it was of minor quantitative importance, because fuelwood still was the predominant source of energy: indeed it was about twice as cheap as gas per kWh if bought from a local worker, and free otherwise. Actually, the most important change that took place was on the supply side. We saw that the situation evolved from one in which most households were involved in argan wood sales, to one in which hardly any was. But this change was recent, and before the decline, integration had actually expanded the market for argan wood and prompted accelerated degradation. In the end, however, the integration to a labor market did play out as posited in the win-win hypothesis, in that it made logging a comparatively unprofitable activity (besides making substitutes available for argan wood).

So to a certain extent, market integration promoted overexploitation of fuelwood, in that it linked local supply with more distant and growing demand. But fuelwood sales would probably have gone on as well had the integration level remained the same as prior to

independence: the mountains were always linked to the plain, and growing population in both would likely have spurred intense extraction because, at least since the decline of caravan trade, mountain populations had little else than wood to offer in exchange for grain. The arrival of trucks and the subsequent widening of the fuelwood market may just have accelerated matters a little. On the other hand, the presumed lost labor effect was only just recently showing itself at the time of our visits, and it was clear that fuelwood harvesting, being a low-status, low-pay activity, was no longer to be an important livelihood in the near future. In this respect, our findings support the lost-labor hypothesis and are consistent with other studies that found fuelwood and charcoal production to be an activity of poor households, often the result of a lack of alternatives (El Bashir 1997; Ellis and Freeman 2005; Arnold et al. 2006; Iiyama et al. 2008). But more extraction went on than the woodlands could support. A shift in consumption away from argan wood and towards gas and alternative building materials had only partially occurred. In some cases migrant households actually consumed more argan wood than others, and some of the larger houses built in the 1990s used argan beams. On the whole, therefore, there were signs of an ongoing transition of the sort posited in the hypothesis, but at the time of writing the actual effects such a transition were yet to materialize.

4.6. Conclusion

To a large extent this story is one of development away from land resources, in which the economic integration of an ecologically marginal area allowed people to maintain their communities in places with little (and decreasing) natural resource endowments. Such stories of people leaving in order to stay are recurrent in the developing world: in Morocco as elsewhere, populations of many remote and marginal regions have used nonfarm work and migration to maintain a foothold in their villages (Bebbington 2000). In this perspective, Hoffman (2007, p.5) proposes that we «conceive of mobility and movement not as indicative of the decay of the community [...], but as constitutive of its growth». In this case,

average living conditions improved following nonfarm diversification, and some people lifted themselves completely and durably out of poverty. Yet many others, though indubitably better off in material terms, were still faced with high uncertainty. These people really just coped as they had before, using nonfarm work as yet another safety net, but cannot be said to have completely escaped poverty. The effect of diversification on development, though real, must therefore be set in perspective: the area was still one of the poorest in Morocco³⁸. As for the effect of nonfarm diversification on conservation, a period of fast de-densification of the woodlands in part driven by its connection to a wider market through improvements in transportation, was followed by a decline in logging resulting in fine mostly from the availability of alternative livelihoods, so that integration can be said to have had opposite effects on conservation.

Figure 4.5. adapts the conceptual model proposed in the Background section (Figure 4.1.) for this particular case, providing a summary of the story told above. Low agricultural productivity and high population density, associated with infrastructure development and market integration, combine to drive nonfarm diversification. The shift to nonfarm activities is not complete, and the extent to which farm activities are maintained is influenced by factors such as cultural and identity ties, path dependence, and resource distribution (large land owners are more likely to maintain agricultural activities). The low opportunity cost of labor in farm activities and the complementarity of some nonfarm activities with some farm activities (e.g. working in the service sector and leaving a small herd with a village shepherd) make it profitable to switch to the nonfarm sector, although not all household are equally positioned to access the more profitable parts of that sector. On the whole, nonfarm diversification thus makes for an average but uneven improvement in living conditions, an improvement that is also supported by other factors that are more or less dependent on integration, such as the

³⁸ With 21.5% of the population under the poverty line of 3569 MDH/person*year, the commune belonged to the poorest fifth of all Moroccan communes in 2007 (<http://www.hcp.ma>, last accessed 2012/07/20).

availability of new consumer goods or aid money. As regards conservation, the lost labor effect causes a decline in logging but comes late, whereas income effects are mixed, with increased income prompting either substitution of gas for wood or increased consumption of wood, and some households investing in wood transportation. Any sign of conservation of the woodlands is therefore absent at present, though there is hope that a transition is ongoing, supported in part also by changes in regulation, donor projects or the valorization of woodland products.

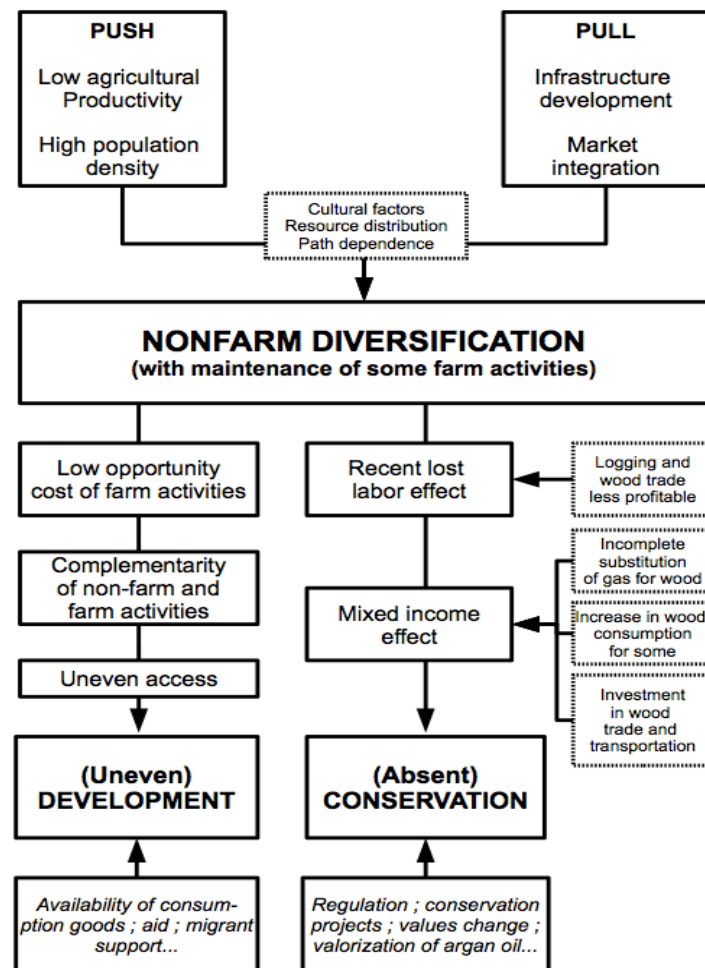


Figure 4.5.: Adapted conceptual framework for the case study

This chapter has outlined the possibility of a positive development and conservation outcome of market integration as one pathway of change in ecologically marginal areas. In the case of the argan woodlands this has in effect been true only for development. The study highlights a number of reasons for this, some of which are specific to this area, others of which may be valid for other areas as well. The theoretical framework used in this study is a useful, if incomplete, guide to exploring the determinants and outcomes of livelihood transitions away from farm activities. Doing so is important for two reasons. Firstly, pathways of change towards nonfarm diversification are increasingly common in the developing world, as identified by Bryceson (1996), Rigg (2005) and Haggblade et al. (2010). Understanding to what extent these trends are determined by resource limitations or by other factors is an important policy and scientific challenge. Secondly, many rural development and conservation policies still tend to downplay these trends, envisioning the rural South as predominantly agricultural. In the argan region, for example, whereas piecemeal development and conservation initiatives do address issues such as access to employment, logging or the diffusion of gas stoves, more integrated policies such as the Green Morocco Plan tend to focus on an agriculture-based pathway of development, seemingly overlooking the diversity of livelihoods in the area. A better understanding of the nature of the links between nonfarm diversification, conservation and development is needed if appropriate policies are to be designed, in Morocco as elsewhere.

5. Conclusion

5.1. Summary and main results

The objective of this thesis, as mentioned at the outset, was to «understand coupled livelihood and land cover changes in a globalizing dry woodland region». The first chapter set the context of this objective, and introduced the study area.

In the second chapter, addressing the question of land cover change in dry woodlands, I measured the extent of woodland density change in a part of the argan region, and analyzed the proximate causes of this change. I found that the argan woodlands in the study area had decreased by 44.5 % in terms of density, a figure that was strongly underestimated when change was measured in terms of surface. The main causes of change were found to be drought and fuelwood collection, both locally and for trade, whereas the role of grazing could not be confirmed. The analysis showed the need to acknowledge the multiplicity of factors in dry woodland change, both in terms of scales and in terms of drivers.

In the third chapter I looked at the emergence of biological-resource-based niche commodities (BNC) worldwide as an example of the reworking of social and environmental governance through globalization. I estimated the potential of these commodities for poverty alleviation, first theoretically, and then empirically for the case of argan oil. I proposed a number of conditions for BNC to have an effect on poverty alleviation, and I showed that argan oil had not benefited households in the study area as much as might have been expected, because some of these conditions were not met in the argan case. The analysis, on the other hand, highlighted the important role of non-farm activities and migration in assets accumulation. This showed the usefulness of contextualizing particular livelihoods within household strategies when analyzing the outcomes of global commodity chain integration, and the need to acknowledge that context in the design of development and conservation policies.

In the fourth chapter, I analyzed long-term livelihood and land use change in order to understand the social and environmental

outcomes of market integration in the study area. Based on the low agricultural potential of the region, I hypothesized a beneficial effect for both conservation and economic development following a transition to an economy dominated by nonfarm activities. While the integration to a national and international labor market had clear beneficial effects for the population, raising the average material living conditions (if unevenly), the effects of integration on the woodlands were less clear. I showed that the integration to a booming economic region may first have triggered more intense exploitation of the woodlands, but that it also alleviated logging pressure later on due to the availability of alternative livelihoods. This pointed to the need to better understand coupled livelihood and land use transitions in rural areas so as to inform policy.

In summary, the thesis has contributed to a comprehensive understanding of the dynamics of land-cover and livelihood changes in the study area, and more generally, in the argan woodlands. In particular, it has highlighted the complexity of causal factors of land cover change and the diversity and dynamism of local livelihoods, and identified key drivers of changes. It has also contributed to the understanding of processes of global relevance such as the degradation of dry woodlands, the emergence of BNC, and livelihood transitions.

5.2. Limitations

There are a number of limitations to this thesis. These can be structured along five themes: scale, timing, data, utilitarianism, and indicators.

Scale. The choice of a local case study, while it allows for in-depth understanding of land use and livelihood dynamics, makes generalizing more difficult. While I have tried as much as possible to draw relevant general conclusions from the case study without over-generalizing, a few weak points still can be found in this respect. First, by restricting the remote sensing analysis to a part of the argan woodlands, I ignored land use change dynamics in other parts of the

argan region where they are known to be different (i.e. land conversion to agriculture in the Sus plain, slow degradation of woodland cover in the Northern part, and possibly increase of woodland cover in the Western Anti-Atlas). This means that the case study cannot be considered as representative of the whole argan region. Likewise, the analysis of the impacts of argan oil trade was focused on a relatively small number of households and villages, and although I did consider the relevance of this case to the other parts of the argan region, the study would have benefited from a wider coverage using the same methods. Unfortunately this was beyond my material capacity for this thesis. Finally, in the analysis of long-term livelihood and land use transitions, a multi-scalar approach might have given more importance to structural drivers of change, which have admittedly not received much attention in this work.

Timing. Three issues related to time may be pointed out. First, that of the timing of observations for the remote sensing analysis. The use of only two periods for the remote sensing study masks the possible nonlinear dynamics of woodland cover change, for example the hypothesized increase in wood extraction in the 1980's, or its decrease in the 2000s. A finer-grained analysis would have revealed more as to the changing rates of decrease. Second, the use of retrospective interviews to reconstruct the past, even when done rigorously, carries the danger of ignoring or downplaying some events that slipped out of collective memory, while overemphasizing others. Crosschecking declarations may correct the facts only to the extent that respondents do not all share the same biases - as discussed for the case of past livestock numbers. That said, I believe that the process of crosschecking declarations, when combined with the use of archive documents, allowed in this case for a fairly correct reconstruction of past events. Third, the timing of observations with respect to that of phenomena of interest conditions the outcomes of the analyses. Concretely, both the decrease in extractive pressure on the woodlands, and the emergence of a high-value argan oil market are relatively new, i.e. about a decade old. This means that we are observing a «non-equilibrium» situation. While in practice there may never be any equilibrium, this still implies that unobserved effects and patterns may yet occur – for example, greater economic effects

of the argan boom, or woodland regrowth, could still happen. This issue might have been partially controlled for in the case of woodland regrowth by taking an area of older migration, such as the Western Anti-Atlas, as a point of comparison. It would not have been possible, however, in the case of the argan boom.

Data. In such data-poor settings as the argan region, one has to make use of whatever data is available, and construct indices to approximate the realities one wishes to observe. In many cases however these indices are rather inaccurate. For example, the estimation of shoaat density based on declarations by customary chiefs (chapter 2) should be seen as a very gross proxy of real numbers. The estimation of total wood consumption based on average harvest by household members and mean forest increment values (also chapter 2) likewise is very coarse. In chapter 3, the quantities of animals, and of argan and cereals harvested, are based on declarations in household interviews, and therefore subject to biases and imprecisions. Even official data are often inaccurate, such as the national population censuses, which are full of inconsistencies. Although I have tried to minimize errors by eliminating the least robust variables, constructing proxies, and conducting some sensitivity analyses, data quality remains an issue. For example, I could not use estimates of nomad population based on key informant interviews (too inconsistent), in spite of the importance of nomads as a woodland user group, and potentially as agents of woodland change. Finally, the nature of the data did not allow me to integrate the different drivers of woodland change in a single regression analysis (chapter 2). This is problematic, because it makes it impossible to estimate the relative weight of the different drivers.

Utilitarianism. This thesis has taken a resolutely utilitarian/materialistic approach to livelihoods and landscape change. While this approach has clear advantages for understanding drivers of change, it also misses out on some aspects. For example, cultural aspects of woodland use, changes in the perception of territory, and perceptions of the non-monetary value of different types of livelihood activities were largely ignored in the study design, in spite of their relevance to the understanding of livelihood and land

use changes. The social restructuring of the communities and the households in a context of migration was not addressed. Neither was traditional ecological knowledge given an important role in the research. Although I was attentive to the perceptions and knowledge of the respondents on the field in an informal, qualitative way, integrating them explicitly in the study design might have provided useful insights. This is relevant to the next point as well.

Indicators. In order to represent change, I chose some indicators over others. Any choice of an indicator implies that some things are left out. This is most apparent with two main indicators used in this study. The first is the density of argan trees as an indicator of woodland state or degradation. I gave reasons for this choice in Section 1.2.1.2. But choosing this indicator ignores other forms of ecosystem degradation present in the region, e.g. soil erosion, nutrient depletion (among others due to the sale of manure), or biodiversity loss (through hunting and over-harvesting of certain species, for example). The second is the asset index as an indicator of wealth. While it represents wealth differences in a satisfying way, it ignores other dimensions of wellbeing, such as nutrition, satisfaction, and health. It does not take into account subjective wellbeing either. Although it was not feasible to integrate all these elements in the study design, I believe they would have been worth investigating.

5.3. Perspectives

5.3.1. The future of argan woodlands

Chapter 2 showed that the decline in argan tree density in the study area was likely attributable to an increase in droughts and to fuelwood collection (which, as described in chapter 4, probably surged in the 1980's before declining during the last decade). Other parts of the argan region have had somewhat different dynamics, as mentioned in Section 1.3.1.1. Ongoing research in the northern part of the woodlands shows, rather than fast density decrease, a stagnation of woodland cover with slow qualitative degradation (Farid El Wahidi, unpublished work). In that case the main threat

remains the lack of regeneration. In some parts of the western Anti-Atlas, there has been talk of an increase in woodland cover, though this has not yet been measured. This area is the richest and the one with the strongest outmigration ratios in the region, and the abandonment of agriculture and herding is one of the factors responsible for this apparent increase in woodland cover. The plains, as mentioned in chapter 2, underwent strong density decrease due to the expansion of irrigated agriculture and to urbanization.

The extent to which woodland density will continue to decline in the future will depend on a number of factors, including policy orientations and social change. Here I briefly explore three alternative pathways with respect to their possible conservation outcomes: business as usual, Green Morocco Plan implementation, and grassroots change.

The *business as usual* pathway implies that there is no major change in the behavior of the various agents involved in woodland use and management. Even without a major policy or behavioral shift, the decline in wood trade seems likely to continue as long as other opportunities remain available for employment, because, as mentioned, wood trade is an economically inferior activity. Yet if locals continue to favor bread baked on wood or charcoal (*tunirt*) over bread baked on gas (*aghrum*), and *tajines* cooked on argan charcoal, domestic fuelwood extraction may remain over the woodlands' natural regrowth capacity, as appears to be currently the case. Supposing that the demand for wood and charcoal strongly declines (for example due to a change in consumer preferences towards cleaner fuels and greater cash availability) and that supply also decreases (for example due to the availability of other jobs), would the woodlands regenerate? At current grazing levels, it seems unlikely, because saplings have little chances of growing if left unprotected. Were grazing to decline (for instance due to outmigration), the question would remain whether there can be any regeneration at the current stage of woodland density. Clearly, in some areas there can, as shown in the studies by Culmsee (2005) and Taleb (2007). But given the prospects for a more arid climate and thus harsher conditions for germination, it is possible that in some

places where soils are degraded and woodlands are sparse, an ecological threshold has been crossed above which natural regeneration cannot occur by itself any more. So while the possibility of an evolution towards consumption of cleaner fuels, alternative jobs and abandonment of pastoral activities does exist, it is not the likeliest option under a business as usual pathway, and in itself might not even suffice to ensure the stabilization or regeneration of the woodlands.

The recent promulgation of the Green Morocco Plan (hereafter GMP) brings into existence an alternative future that I call *GMP implementation*. Indeed if the GMP is fully implemented, it will have a number of implications for the argan woodlands, many of which are yet unclear. By privatizing more land in the plain and aggregating producers around private investors, it might provide incentives for these investors to start large-scale commercial argan plantations. Though an explicit objective of the GMP for the Sous region, whether this really happens will depend, among other things, on the extent to which domesticated strands of argan trees can be developed in the future, and on the stability of argan oil prices. In the mountains, the possibility of private investments in plantations seems less realistic because it would be more costly and less reliable than in the plains. It also seems unlikely that the smallholder nut provision cooperatives envisioned by planners will provide them with any incentive to plant and protect or plant trees under the current legal status of the woodlands – this has not happened with argan oil cooperatives, so there is no reason to think it will be different.

A third pathway is what I call *grassroots change*. In such a pathway livelihood transitions towards nonfarm diversification, along with increasing wealth, growth of civil society, and mentality changes would concur to create a context favorable to locally based conservation initiatives. There are sign of such a trend, notably in conservation actions initiated by migrant associations. Migrants would have an important role to play, due both to their economic and political influence (through remittances, project funding and participation in decision-making) and to their often-stronger appropriation of the conservation discourse. Local people, as long as

they are no longer dependent on fuelwood trade for their livelihoods, might also find it worth engaging in conservation and intensification by planting argan trees, be it on a private basis (on their own land) or on a community basis (enclosing areas for regeneration, etc.). This pathway, however, would imply that residents are wealthy enough to choose conservation-friendly livelihood and consumption options, or that such options get sufficient support so as to direct choices. It would also imply revising the legal status of public land so as to make sure that people can reap benefits from investments made locally.

These pathways are neither exhaustive nor mutually exclusive. A partial implementation of the GMP with some extent of grassroots change, for example can easily be imagined. Though each pathway provides some scope for conservation, in none of them is it straightforward. This suggests that other options should be pursued if we want the woodlands to be preserved. A number of alternative options for conservation are discussed in Section 5.4.1. below.

5.3.2. The future of local livelihoods

Two questions seem particularly important to consider as regards the future of local livelihoods for people in the study area. The first is whether livelihood strategies based on remittances are sustainable in the long run. The second is whether sufficient nonfarm activities are being developed locally to provide local employment in the future. These two elements will determine to a large extent whether the villages in the study area will remain «hybrid localities» relying on both local and non-local employment, whether they will be abandoned, or whether, on the contrary, they will emerge as new centers of local economic activity.

The sustainability of remittance-based livelihoods is difficult to assess, especially because it intrinsically depends on the macro-economic conditions of the country, even of other countries. At the moment, the main activities of local residents in the cities are in construction, trade and services. As long as cities continue to grow

there should be employment in these sectors. In the case of an economic slowdown, however, urban growth might come to a (temporary) halt. The first affected would be the construction workers. Although there is growing demand for labor in construction in rural towns and villages, this demand would not be sufficient to absorb the masses of construction workers from the Sus working in the coastal cities at present. An economic slowdown would also affect unqualified workers in the other sectors. Not everyone would be affected the same way, however. Those who have diversified their activities at home or initiated larger businesses in trade or construction might be more resilient than others. The capacity of individuals to adapt and change sector would also play a role – as can already be observed, when some people change from taxi-man to baker to mason, for example (see the household histories in Appendix 5).

For those for which remittance flows prove to be unsustainable, the sustainability of livelihoods would boil down to the ability to diversify locally, which implies the development of nonfarm activities (or, alternatively, of profitable farm activities, but there is no sign of this in the study area as yet). Actually, a number of people have been developing profitable locally based activities. For example, a number of transport workers have bought their own trucks and can make a living off this activity - some are even relatively rich. Others have developed small-scale trade in agricultural products, food stores at the local market, or work as butchers, grocers or petty traders. Many of these activities were originally funded by remittances but can be sustained without any influx of remittances after a while. Agriculture-based development, on the other hand, does not seem likely to happen for the majority of households in the study area in the near future. Growing demand for goat meat might prove profitable to the household engaged in livestock herding, but growth prospects are limited by grass and water scarcity. Argan oil production or argan nuts sales may yet come to play a greater role, but at the moment they do not seem likely to become an important source of income.

The kind of places that these villages will become in ten or twenty years will depend to a large extent on these two questions. If the

reliance on remittances proves to be a good option on the long term, people may go on with «hybrid» livelihoods, with some household members in the city and others at home. Where employment in the city is secured, many will actually leave the village, as they have been doing already. There is thus the possibility of some villages becoming, like the typical Western Anti-Atlas village, shell villages, only inhabited during summer holidays. But others may stay and go on with this hybrid livelihood configuration, for two reasons. Either the employment in the city is not sufficient to cover the expenses of the whole family in the city and there is no other option but to keep the family where living is cheap. Or people do not want to be «uprooted» and prefer to keep their cultural and social ties to the village by remaining there. Though this second reason clearly exists based on what people told me, I am not sure whether it can actually exist independently of the first – whether it would be sufficient by itself to keep people in the village. If remittance flows fade away, or if they are re-invested into local nonfarm activities, the study area – particularly the rural centers of Awluz and El Faid – may also grow as a center of economic activity. Finally, in the case of a decrease in remittances without sufficiently stable nonfarm activities, a return to a more agrarian nature should not be excluded. This has been observed in cases of economic decline or stagnation elsewhere (Potts 1995) and there is no reason to believe that this could not happen here as well.

5.4. Policy implications

When considering the policy implications of this work, it is important to underline that, whatever the options taken, there will be tradeoffs and undesired consequences. Given the complexity of the human and ecological systems of the argan region, there is no one-size-fits-all, all-win policy option. Rather, I will try to evaluate the value of a few possible policy tools with respect to the desired outcomes. Let us assume that these desired outcomes are 1) that argan woodland density and surface increase, or at least stop decreasing; and 2) that all people benefit from stable and sufficient income. This in itself is already a rather restricted view. A more ambitious but less pragmatic

policy goal might include notions of biodiversity, ecosystem services and happiness. I will briefly examine some of the implications of meeting these outcomes.

An increase in woodland cover implies two things: putting to a halt the various forms of human-induced woodland degradation, and, given the current condition of the woodlands, actively replanting trees and protecting and nurturing them. In the plains, the choice was already made thirty years ago to favor intensive irrigated agriculture over argan woodlands, so there is no going back in that respect, except under the GMP implementation pathway (see above), in which argan orchards could provide a suitable alternative to thirsty orange orchards in the increasingly dry plain (though it is disputable whether this can be thought of as conservation). One point is the possibility of maintaining protected woodland parks in parts of the region. These would have an important recreation and touristic value. Such parks are already being implemented around Agadir.

In the mountains, however, there is scope for improvement. Halting human-induced degradation there probably implies aiming towards a ban on argan fuelwood use, at least for some time, however unsympathetic this may seem. At current density the woodlands can bear only very limited amounts of fuelwood extraction, and although villagers in principle are only allowed to use dead wood this is very difficult to control as people commonly let branches of fresh wood dry in the mountains before carrying them home. There are, however, several ways of working towards that goal without going into «command-and-control»-type policies. Firstly, some work can be done on the demand side: numerous bakeries, restaurants and Turkish baths in small towns still use wood and charcoal of uncontrolled origin. Supporting and enforcing a switch towards gas, electricity or controlled wood sources would cut demand for illegal supplies of argan and other woods. Many households also still find it too expensive to buy gas, as compared to wood, which is free. On the supply side, as shown in chapter 4, wood sales are principally the poor's job (excluding transporters, who have largely disappeared in the last decade). Ensuring that argan wood does not get traded then

amounts to ensuring that the poorest have access to profitable and stable employment alternatives.

Planting and nurturing argan trees, on the other hand, is a difficult task. Apart from the technical issues related to germination and seedling transplantation, the principal problem is that of access during closure periods (*mises en défens*). The forestry department has in effect been asking local populations to refrain from using their traditional land in exchange for a meager financial compensation. Thus, while the traditional users are legally dispossessed of the trees, which are state property, they are asked to protect them as their own. This is bound to fail, and so it does. Either the trees belong to the users, collectively or individually, and they may invest and protect them (or not). Or they are state property, but then it should not be expected that they be protected out of good will.

One possibility would thus be the recognition of traditional ownership rights over trees, perhaps coupled with a logging ban, so as to avoid that people or communities who are uninterested in managing their woodlands sustainably would simply log and sell the wood. This, however, is a very difficult and sensitive task. Defining who gets access to what parts of the woodlands, be it at the household or the community level, raises all sorts of issues regarding the distribution of resources among users, the history of in- and out-migration, and is likely to spur a large amount of conflict, not mentioning the fact that forest officers are unlikely to find this option attractive.

Another option would be for the state to define targets of afforestation, provide economic incentives to reach these targets, and give latitude to the local communities as to how to reach them, possibly with technical support from external experts. This would in effect be a *payment for ecosystem services* (PES) scheme. Economic incentives in such a scheme would have to be designed in such a way as to make it interesting for people to manage the woodlands sustainably. It would also need to acknowledge the role of traditional ecological knowledge – in some cases, locals may know better than experts how to plant and protect a tree in their particular

environment. Monitoring, reporting and verification procedures would have to be set-up region-wide, for example through the use of satellite imagery, to verify management claims, as in other PES schemes currently implemented or discussed, such as REDD+. Such a scheme would also create much-needed local employment. However, deeply embedded mistrust in the state would probably make it necessary to operate through intermediate, non-state partners, for example private investors or donors and development agencies. These could also provide the funding needed to support such actions, perhaps in exchange for the permission to operate in the region or for some other subsidies.

Ensuring sufficient and stable income to the local population can mean three things: stable employment in the city and sustained and sufficient remittance flows; stable and sufficient non-farm income locally; or stable and sufficient local farm income. The latter, while possible in the plains, is difficult to achieve in the mountains. Apart from the PES option mentioned above, another possibility would be strong investment in crop improvement, in order to develop robust and profitable crops. But the mountains of the argan region are highly vulnerable to drought, apart maybe from a few oases, and agriculture (including miracle products such as argan nuts) can likely never be more than complementary to other income sources. Non-farm activities in rural towns are developing fast by themselves, but they could be supported in several ways. Infrastructure improvements are actually already being implemented, such as the electrification of villages and the pavement of new roads. Improvements could be made in access to professional education and to credit, particularly for the poor, for example through micro-credit schemes. Finally, though it is difficult to act upon employment in the destination cities of migrants, raising the minimum wage could do much for rural households, by freeing more capital for remittances. Simple schemes might also aim at stabilizing remittance flows. For example, the government could provide a channel for remittances (as an alternative to the Western Union) that includes an insurance mechanism, setting aside a small percentage of transfers in exchange for continued payment in case of default on the part of the migrant – indeed a family dependent on remittances can experience

great distress if the migrant is not able to transfer money during a certain period, whatever the reason. Such a scheme already exists in other African countries, though it is implemented by NGOs rather than by the State.

These are but a few propositions, and naturally these should be investigated rigorously in order to minimize unintended consequences. But they provide a starting point for discussion.

6. References

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7. Appendixes

List of appendixes:

- Appendix 1: Household survey
- Appendix 2: Key informant interview grid
- Appendix 3: Association interview
- Appendix 4: Village-level survey
- Appendix 5: Short household histories
- Appendix 6: Selected pictures

7.1. Appendix 1: Household survey

Références : Duwar Ménage N° Date

QUESTIONNAIRE AUX MENAGES : activités et consommation

اسـتمارة للأسرة: الأنشطة والاستهلاك

1. **Arbre généalogique** : شجرة النسب 1 :
Commencer l'arbre au parent vivant le plus vieux et mentionner toute sa descendance. Pour chaque personne mentionner : 1. **état civil+ si chef de ménage** ; 2. **parti ou pas**. Noter si les terres sont **partagées**, entre qui, comment. Sur la frise chronologique (2.) reporter (une ligne par personne) : 1. **date de naissance** ; 2. **niveau d'éducation** ; 3. **activités successives depuis début de carrière et lieu d'activité**.

رسم شجرة النسب انطلاقاً من الأبوين إذا كانا على قيد الحياة إلى رب الأسرة والإخوة. ويشار إلى الحالة العائلية، وإلى مغادرة الدوار أم عدمها وتعدد الزيارات إلى الدوار، أما على الخط الزمني فيشار إلى: تاريخ الإزدياد، المستوى التعليمي والمهن المزاولة من طرف رب الأسرة وباقي الأفراد والتدرج الذي حصل في أماكن العمل.

Nombre de personnes dans le ménage : عدد أفراد الأسرة.....

MAX	Localité	Semé %	Dernière utilisation	I	Dernière irrigation	A	T	L	Z

Terres divisées ? O/N

Social and Ecological Change in the Argan Woodlands

2. Chronologie : 2 - " تاريخي خفي "

[illegible]

3. Activités économiques

الاقتصاديات

3 - الأنشطة

	Cette année في هذه السنة	Année passée العام الماضي	Période a. ¹ (bonne année) (الفترة أ) عام جيد	Période b. (bonne année) (الفترة ب) عام جيد
Quantité orge semée المزروع مقدار الشعير				
Quantité orge récoltée المشعير مقدار غلة				
Quantité blé semée المزروع مقدار القمح				
Quantité blé récoltée القمح مقدار غلة				
Quantité d'amandes récoltées المنتج مقدار اللوز				
Quantité d'olives récoltées المنتج مقدار الزيتون				

هل تستخدمون tractor؟
نعم / لا ؟

Utilisez-vous un tracteur ?
Du village ? O / N

De l'extérieur ? O / N

Depuis quand utilisez-vous le tracteur ?

Nombre d'heures de labour au tracteur l'année dernière :

السنة

Nombre de jours de labour à l'âne l'année dernière :

نصيب الأراضي المزروعة بدون tractor :

آخر مرة تم زرعها بدون tractor :

العام

Quantité d'heures d'irrigation l'année dernière :

Vendez-vous... ?	O/N	Part vendue 2009	Dernière vente	Part vendue dernière vente
Orge/blé				
Amandes				
Olives				

	Cette semaine هذا الأسبوع	Cette année هذا العام	L'année passée العام الماضي	Période a. الفترة أ	Période b. الفترة ب
Quantité taffiyich argan récoltée مقدار لوز الأركان الذي تم جري					
Quantité de taffiyich vendue (fréq.) مقدار أفياش (الأركان الذي تم بيعه)					
Quantité de tiznin vendus (fréq.) مقدار تيزنين (الأركان التي تم بيعه)					
#litres argan produits (fréq.) عدد لترات الأركان المنتجة					

¹ Les périodes passées sont notées a. (il y a dix ans), et b. (autour de 1975, Elmassira ou autre date-clé).
Trouver des repères propres au ménage (départ du fils...) si possible.

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Partie consommée (fréq.) عدد لترات الأركان المستهلكة					
Partie vendue au suq تم بيعه في السوق النصف الذي					

Avez-vous acheté des taffiyich récemment ? O / N هل تقومون بشراء أفياش؟
نعم / لا

Depuis quelle année ? / منذ أية سنة؟

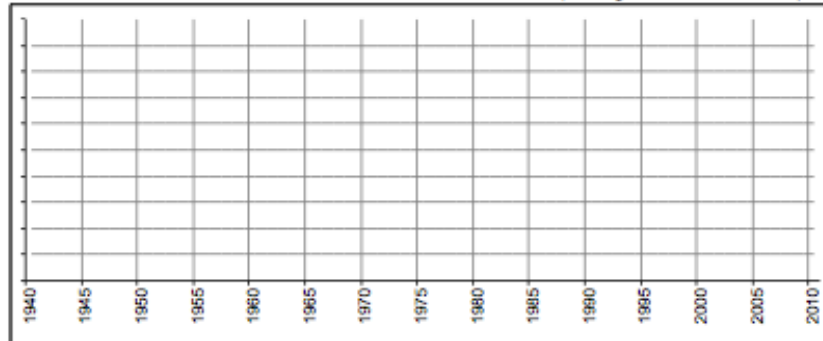
Combien avez-vous de bêtes ?

الماشى؟

كم تملكون من

# caprins /ovins.....	الأغنام / الماعز
# ânes.....	حمير
# vaches.....	أبقار
# poules.....	دجاج

رسم مبيان لتطور أعداد القطيع (الأغنام والماعز) (Effectif du troupeau (courbe))



	Présent في الحاضر	Période a. الفترة أ	Période b. الفترة ب
Proportion d'ovins إنتاج الأغنام			

(Si 0 capr./ov.) Comptez-vous acheter des bêtes pour reconstituer le troupeau ? O / N

هل تفكرون في شراء الماشية لتكويين قطيع؟ نعم / لا ؟

Vendez-vous le fumier de vos bêtes ?

O / N

؟ نعم / لا هل تبيعون سماد الماشية (الغبار

مادي السنة التي بدأت فيها بيع منذ سنة 1940

Si oui, depuis quelle année ?.....

الكمية هذه السنة.....

Quelle quantité cette année ?

Faites-vous garder vos bêtes par un berger extérieur au ménage ?

O / N

Vendez-vous des bêtes ?

O / N

A qui / où ?

لمن؟ أين؟

Quelles sont les zones où vous emmenez le plus souvent les bêtes ? (par ordre

d'importance)

مادي الأماكن التي يتم فيها رعي الماشية (الترتيب على

(حسب الأهمية)

1.

2.

3.

4. Alimentation.

4 -

التغذية:

Combien de fois par semaine mang(i)ez-vous les choses suivantes ?

انطلاقا من التغذية في الوقت الحاضر يمكن تكويين فكرة عن التغذية في الماضي

وذلك بطرح سؤال عن تردد استهلاك هذه المأكولات في الماضي.

كم مرة في اليوم تأكلون الوجبات التالية:

Aujourd'hui Période a. Période b.

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الفترة ب	الفترة أ	اليوم
Tagine مطاجين		
Couscous كسكس		
Fruits فواكه		
Pain et thé خبز وشاي		
Askif n Tumzin حريزة		
بالشعير		
Tagulla		
عصيدة		

Combien de pains produisez-vous par jour ?

لكم من الخبز تحضرون في اليوم:

الفترة ب	الفترة أ	أujourd'hui حالي
Pains (الخبز) تنتورت		

5. Consommation

5 -

الاستهلاك

منذ متى ؟	التردد	الكمية / العدد	Quantité/montant
Farine طحين			
Bouteille gaz Gd الكلبير قنينة غاز الحجم			
Bouteille gaz Pte قنينة غاز الحجم			
الصغير			
Thé شاي			
Sucre سكر			
Huile de table زيت			
المدادة			
Café قهوة			
Confiture مربى			
Miel du suq العسل			
Fromage جبنة			
Lait الحليب			
Viande rouge			
Poulet			
Biscuits بسكويت			
Piles بطاريات			
Vêtements neufs الملابس الجديدة			

Appendixes

	Cette semaine في هذا الأسبوع	Cette année في هذه السنة	Période a. الفترة أ	Période b. الفترة ب
Dépenses totales au suq (Dh) مصاريف السوق				

Contenu de la maison :

المحتوى

	O/N نعم/لا	Date introduction ? منذ متى؟	Origine de l'argent مصدر المال
Frigo ثلاجة			
Télévision تلفاز			
Antenne sat بيو انبول			
VCD/DVD			
Radio راديو			
Horloge ساعة جايكوية			
Montre ساعة يادوية			
Armoire TV الدولاب			
Armoire bois			
Fauteuils مقاعد			
GSM (nombre) (داتف) العدد			

Carte téléphone : Montant القيمة: بطاقة الهاتف Fréquence
التردد

Carte électricité : Montant القيمة: بطاقة الكهرباء Fréquence.....
التردد

Carte eau : Montant..... القيمة: بطاقة الماء Fréquence.....
التردد

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6. Bâti

المسكن/المنزل 6

Maison construite par.....من.....
المنزل بني من طرف

Docmicile passé :
المسكن القديم

Extensions/rénovations de la maison (y compris seconde maison en construction) :
Reporter sur la frise chronologique les **phases** successives de construction de la maison
(date de début et de fin, construction des murs, des premières pièces, etc.). Inclure les
autres maisons en construction si il y en a, et l'état de la maison du père s'il y a lieu.

امتداد إتمام بناء وإصلاح المنزل/المسكن: يشار إلى أي عمل على الخط الزمني.

Avez-vous **employé** des ouvriers dans les dix dernières années ?

هل قمتم بتوظيف عمال، حذيثا أو قدي الماضي؟

Origine.....	# Employés	عدد العمال
Maison	فني المنزل	
Agriculture	فني الزراعة	
Autres	أشغال أخرى	

Matériaux et infrastructures :

التجهيزات والبنىات

التحتية

Note : pour les murs, noter à droite l'ordre d'importance, de 1 à 3.

	O/N / لا	نعم / لا		O/N / لا	نعم / لا
Murs pierre	حائط		Porte en métal	باب حديدي	
Murs pisé	حائط		Plafonds en plâtre	مرفف ببال جبس	
Murs ciment	حائط		Pièce invités	(بيت الضيف)	
Structure ciment	بنية		Garage	(مراج)	
Finition ciment	ببال إسمنت		Cuisine		
WC	المرحاض				
Douche séparée	دوش				
Carrelage ds WC	مرحاض مبلط		# pièces total	عدد	
	(كولي)		الحجرات		
Hammam	حمام		# pièces avec électricité	حجرات مزودة	
			ببال كهرباء		

Citermes : Retracer l'histoire des constructions, rénovations, abandons. Noter si il y a indivision. (NB : type : 1 = traditionnel ; 2 = en ciment sans « couvercle », 3 = moderne en ciment avec plaque « couvercle »).

...يتم ذكر تاريخ الإنشاء، التجديد

°n	Capacité السعة	Type النوع	Date construction تاريخ الإنشاء	Dates rénovations تاريخ التجديد	Financement / Construction التمويل

Nombre de citernes acheminées par camion cette année (si partagées, slt pour ce ménage) :
 عدد شاحنات الماء التي تم شراؤها هذه السنة (يذكر في الأسفل إن كانت
 مشتركة)
 Nombre max acheté en une année / :
 Première fois que fait venir un camion citerne a leur famille ?
 أول مرة يتم فيها استعمال الشاحنة للماء
 الخزان؟

Chauffage et cuisine :

تدفئة و مطبخ

A quelle fréquence utilisez-vous les sources d'énergies suivantes ?

بأي تردد تستخدمون مصادر الطاقة المذكورة أسفله:

		Gaz غاز	Bois خشب
Cuisine مطبخ			
Pain خبز			
Eau prière ماء للصلاة			
Eau thé ماء الشاي			
Eau lavage ماء الغسيل			
Chauffage hiver التدفئة في الشتاء			

Bois : # chargements à ne :
 الخشب : عدد حملات :

الحملة

#chargements personne :
 عدد حملات :

الشخص

وسائل النقل

Possédez-vous des moyens de transport ? Lesquels ?

هل تملكون وسائل

للتنقل؟ مادي؟

	#	Date introduction تاريخ أول شراء	Origine de l'argent مصدر المال
Vélo دراجة هوائية			
Mobylette دراجة نارية			
Moto دراجة نارية			
Voiture سيارة			
Pick-up			
Camion شاحنة			

7. Budget actuel

7 - الميزانية الحالية

Faire ensemble un bilan sur base des informations récoltées plus haut (pour vérifier la cohérence avec les dépenses).

Rappel : Dépenses mensuelles :

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Souq Eau Electricité GSM Autres :

		Revenus mensuel المدخلات الشهرية	Transferts تحويلات
Ventes d'animaux المواشي	بيع		
Ventes d'argan بيع الأركان			
Ventes d'autres produits agricoles منتجات فلاحية أخرى	بيع		
Profit de l'entreprise مقولة ربح			
Salaires chef de ménage أجر رب الأسرة			
Salaires enfants dans le ménage أجر الأبناء			
Dons extérieurs en argent مقايضة	نقود (هبات)		
Dons extérieurs en nature هبات خارجية			

Quels enfants transfèrent de l'argent ? الأبناء الذين يرسلون
النقود

7.2. Appendix 2: Key informant interview grid

Village : Entretien n° : KI..... Date : .. / .. /
 Activité principale de l'informateur : Age :

Entretiens avec des informateurs privilégiés

Pouvez-vous nous dire quelles ont été dans le village les bonnes et mauvaises années pour les récoltes d'orge, d'argan, et éventuellement d'autres produits ? (++, +, -, --)

	Orge	Argan	Autre (préciser) :	Remarques :
2009				
2008				
2007				
2006				
2005				
2004				
2003				
2002				
2001				
2000				
1999				
1998				
1997				
1996				
1995				
1994				
1993				
1992				
1991				
1990				
1989				
1988				
1987				
1986				
1985				
1984				
1983				
1982				
1981				
1980				
1979				
1978				
1977				
1976				
1975				
1974				
1973				
1972				
1971				
1970				

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Combien de temps prennent les activités suivantes ?

Labour d'un champ avec l'âne : temps :/surface :

Récolte (nombre de personnes-jours par quantité) :

Couper et ramener un chargement de bois avec un âne :

Couper et ramener un chargement de bois sur le dos :

Ramener de l'eau des citernes (heures par jour) :

Temps pour produire un âbra d'amandes :

Quelles sont les activités faites en groupe au village (tiwizi) ?

1.....

2.....

3.....

4.....

5.....

6.....

Remarques :

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Si la forêt est fermée régulièrement, pensez-vous qu'elle est fermée...

trop longtemps / assez / pas assez longtemps ?

Si elle n'est pas fermée, pensez-vous qu'il serait bien de le faire ?

O / N

Appendixes

Pouvez-vous nous dire quand les nomades viennent et en quels nombres ?

Nombres de mois en hiver :

Nombre de mois en été :

Nombre de troupeaux de ovins+caprins :

Taille des troupeaux d'ovins+caprins :

Nombre de troupeaux de dromadaires :

Taille des troupeaux de dromadaires :

Nombre de troupeaux présents en même temps : C+O : DR :

Y a-t-il des conflits avec les nomades ? **souvent / parfois / jamais**

Si oui, quel genre de conflits ?

Remarques :

.....

.....

.....

.....

.....

.....

.....

.....

Quels sont les problèmes ou obstacles principaux au développement du village (par ordre d'importance) ?

	Problème / obstacle au développement
1	
2	
3	
4	
5	

Remarques :

.....

.....

.....

.....

.....

.....

.....

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Quels sont selon vous les cinq activités (accessibles par des gens du village) qui permettent le mieux de faire vivre sa famille ? (en commençant par le meilleur)

	Métier / activité
1	
2	
3	
4	
5	

Quand les gens ont-ils commencé à partir travailler à l'extérieur du village en grand nombre ?
Quelles ont été les périodes de départ et les destinations privilégiées ?

Début des départs :

Période	Destinations privilégiées
	
	
	
	
	

Quelles sont les difficultés principales liées au travail à l'extérieur ?

	Difficultés liées au travail à l'extérieur
1	
2	
3	

Remarques :
.....
.....
.....
.....
.....
.....
.....

Pensez-vous qu'il est possible pour un ménage de vivre confortablement sans que des membres du ménage travaillent à l'extérieur du village et envoient de l'argent ?

O / N

Pensez-vous que la vente d'huile d'argan contribue au développement du village ?

non / assez peu / un peu / beaucoup

Y a-t-il aujourd'hui plus ou moins de pauvres qu'autrefois au village ?

plus / autant / moins

Y a-t-il une plus ou moins grande différence qu'autrefois entre les personnes plus riches et plus pauvres du village ?

plus grande / pareille / moins grande

Y a-t-il plus ou moins de conflits aujourd'hui qu'autrefois entre les gens de ce village et ceux des villages voisins ?

plus / autant / moins

Y a-t-il plus ou moins de conflits aujourd'hui qu'autrefois entre les gens de ce village-ci ?

plus / autant / moins

Remarques :

7.3. Appendix 3: Interviews with customary authorities

FICHE DE DOUAR

Yann le Polain

Douar :

	1975	2009
Nombre de ménages		
Taille moyenne des ménages		

Nombre de **chefs de ménages** :

- qui travaillent à l'extérieur (Maroc) et ont une maison au village :
- qui travaillent à l'étranger et ont une maison au village :
- retraités d'un pays européen qui ont une maison au village :

Nombre de **ménages** :

- ayant quitté le village depuis 1975 pour s'installer à l'Etranger :
- ayant quitté le village depuis 1975 pour s'installer ailleurs au Maroc :
- ayant des enfants qui travaillent à l'étranger :

Transferts d'argent aux ménages (moyenne par ménage et par mois) :

Quels sont les **métiers** les plus courants pour les gens de ce village ?
(numéroter de 1 à x, du plus courant au moins courant) :

N°	Métier
	Agriculteur
	Artisan (ferronnerie, bois,...)
	Boulangier / pâtissier
	Chauffeur
	Commerce de produits fermiers (animaux, huile, etc.)
	Commerce de produits manufacturés (téléphones, etc.)
	Eleveur
	Mécanicien (voitures, mobylettes...)
	Ouvrier
	Ouvrier dans la construction de maison
	Plâtrier / plafonneur
	Services (café, restaurant...)
	Autres (préciser) :
	Autres (préciser) :

	1975	2009
Nombre de troupeaux		
Taille moyenne des troupeaux		

Proportion des ovins dans les troupeaux :

- ☐ Plus d'ovins en 2009 qu'en 1975
- ☐ Autant d'ovins en 2009 qu'en 1975
- ☐ Moins d'ovins en 2009 qu'en 1975

Quels types de maisons y a-t-il au village ? (1 à 4 par ordre d'importance)

N°	TYPE
	Maisons en pierre et terre
	Maisons en terre
	Maison en terre et ciment (moitié-moitié)
	Maisons principalement en ciment

- Nombre de boutiques : Téléboutiques :

- A quel souq les gens vont-ils faire leurs achats ? :

- L'accès au village se fait par une :

- ☐ Route goudronnée
- ☐ Piste carrossable
- ☐ Mauvaise piste

- Y a-t-il une école au village ? **O / N**

Si **OUI** :

Date de construction de l'école :

Nombre de professeurs :

- Nombre de mosquées : Nombre de fqih :

- Date d'arrivée de l'électricité :

- L'approvisionnement en eau se fait par :

- ☐ Des citernes
- ☐ Des puits
- ☐ Un forage avec pompe

- Nombre de tracteurs au village :

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Quel est l'*Amghar* du village ? :

Quel est le *Moqaddem* ? : où habite-t-il ?

Y a-t-il un *élu* au village (représentant à la commune) ? **O / N**

La forêt est-elle fermée ? **O / N** :

- ☐ Fermée plusieurs fois ces dix dernières années
- ☐ Fermée une fois ces dix dernières années
- ☐ Pas depuis 10 ans ou plus

Si **OUI**, la partie du territoire du village qui est fermée est :

- ☐ Plus de la moitié
- ☐ Moins de la moitié

Y a-t-il un gardien (*amcharddu*) ? **O / N**

Si **NON**, date de la dernière fermeture :

- Nombre de ménages vendant de l'huile d'argan :

- ☐ Plus de 2/3
- ☐ 1/3 à 2/3
- ☐ Moins de 1/3

- Les nomades :

- ☐ Passent beaucoup et restent longtemps
- ☐ Passent beaucoup mais restent peu
- ☐ Passent peu
- ☐ Ne passent jamais

- Les gens font-ils *tiwiza* (entraide) :

- ☐ Souvent
- ☐ Parfois
- ☐ Pas du tout

- Les gens font-ils plus ou moins de *tiwiza* qu'avant (1975) ? :

- ☐ beaucoup moins
- ☐ un peu moins
- ☐ autant
- ☐ un peu plus
- ☐ beaucoup plus

7.4. Appendix 4: Interviews with association leaders

Village : Entretien n°: A..... Date : .. / .. /
 Position dans l'association :

Questionnaire destiné aux associations

Pouvez-vous nous raconter la genèse de l'association ? Qui l'a créée, quand et dans quel but ? Quelles ont été les difficultés ? Comment l'initiative a-t-elle été perçue par la population ?

[noter la discussion sur une feuille à part]

Date de création : Créateurs :
 But original :

Pouvez-vous nommer les donateurs et partenaires de l'association par ordre d'importance en termes de volumes d'argent (sans oublier les donateurs privés) et mentionner l'ordre de grandeur des sommes données ?

	Donneur/partenaire	Sommes (ordre de grandeur)
1		
2		
3		
4		
5		

Pouvez-vous mentionner les principaux projets réalisés par ordre d'importance en termes de volume financier ?

	Projet	Sommes (ordre de grandeur)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Social and Ecological Change in the Argan Woodlands

Quels ont été les difficultés principales rencontrées par l'association ? (Par ordre d'importance)

	Difficulté
1	
2	
3	
4	
5	

Estimez-vous que les objectifs de l'association ont été atteints ? Etes-vous satisfait de la façon dont les choses se passent ?

très insatisfait / peu satisfait / satisfait / très satisfait

Remarques :

7.5. Appendix 5: Short household histories

This section aims at giving more of a «feel» for local livelihoods and lifestyles by depicting the livelihood histories of a few persons and households. I will try to provide short portraits of households from the very «successful» to the precarious. These few examples do not represent the full diversity of livelihoods, far from that, but they do provide a glimpse of different situations. All accounts will take the point of view of men - this is unfortunate, but it reflects the reality of my fieldwork, having had extremely limited access to women for discussions and interviews, and question on women being generally unwelcome.

7.5.1. Three successful households

B. is probably one of the most successful men in the area that has not migrated. He started small, as a seller of truck spare parts. In 1956, he bought an old truck and started-up a transport business. The sixties were a good moment to start, he says: there was a lot of freight but few transporters. Some people of the village had been renting trucks to transport freight, but buying his own gave him more latitude and allowed him to hire workers. In 1974 he bought another truck, a new one this time. His business boomed and he ended up with four trucks and over ten employees. He built a new house near the road, with storage space and garages for the trucks. His sons now run the business, and several of his former employees have bought their own truck and started their activity. One of his sons later became the leader of the village association.

A.'s family was one of the poorer families in his village in the old days. So when the French hired workers for the mines and industries in the 1960's, A. signed up and left, along with a good part of the village. He worked in France for 25 years, set money aside, and then came back to live in Casablanca. There, with his savings, he started up a construction enterprise. He was very successful and now has about 20 employees working for him in Casablanca and Agadir. Apart from a luxurious house in Casablanca, he has built himself a palace in

his home village, with dozens of rooms, several patios, and European-type bathrooms. A co-villager keeps the house, and his fields are tended by hired workers. He is now an active member of the village association, whose members all live in Casablanca.

J. is a construction entrepreneur. Coming from a family of landowners, he started as an agricultural worker in the village but soon left for Agadir, where he worked in construction and, little by little, developed his own company. Today he has several employees, and he takes contracts for building complete houses from the scratch. Profits from this enterprise have allowed him to renovate his house and build a second one next to his for his older son, also a construction worker, who had just married in 2012 at my last visit and was leaving for Casablanca. It also made it possible to fund his second son's studies. This son was studying economics at the university of Agadir, and simultaneously taking expensive private language lessons. The last time I met him he was applying for a test that would allow him to go and work in a supermarket in Saudi Arabia. If he passed, he would leave his studies and go.

7.5.2. Three average households

Old R.'s household is the richest in the village, but given the level of poverty in that village, it makes it a very average household for regional standards. The family is known for being one of large livestock herders - they have between 200 and 300 shoats today, and they reportedly had up to 400 in the recent past. R. always worked as a herder but now he is too old (about 80) and herding the shoats is one of his sons' permanent task. Another son is away from the village half of the time, and works in three regional markets where he rents small rooms in which he holds tea and food stands on market days. Yet another son left at the age of 20 to Casablanca where he works in a factory. The three last sons work as bakers, two in Kenitra and one in Casablanca, and send remittances. The combination of remittances, livestock sales and local nonfarm work makes the household relatively well-off, the only ones to have possessed a TV set even before electricity arrived, and the first to install electricity in

all the rooms of the family house. During my last visits they were extending the house and building new animal sheds. The status of the household is reflected in the fact that they are the ones to offer a roof and food to visitors.

A. comes from a large family: he has seven brothers – four in the village, two in Casablanca and one in France. He has worked most of his life in the village. At the age of 19 he married and then left for Casablanca, where he stayed two or three years, but then he came back. His wife gave him four daughters who are all married in other villages and one son who is now attending college. In the village, apart from tending the fields, he works as a construction worker. Recently, he started a small goats herd, which now counts 15 heads. In 2006 he renovated his house, adding three rooms and lavatories. He also bought himself a moped that helps him move between his work sites. His wages as a construction worker (about 1000 MDG per month, or US\$ 120) are the principal income source of his small household, with goat sales as an occasional complement. It is not much, but it is sufficient to get along.

H. started working at the age of 15 in bakeries in the North of the country (Sidi Kassem, Knitra, Meknes), and then switched to construction work in Casablanca after ten years. At the age of 30 he married a woman from his village, with whom he had three children, all still very young. After ten years in the construction business he tried his luck in Agadir as a taxi driver – that was a bad idea, he says: too much work for too little money. So after one year he resumed construction work, this time in Agadir. Recently, he found a working contract in Saudi Arabia through his company. He worked there a year to set money aside for his new house, a small but comfortable house with a mixture of earth and cement, then came back to supervise and assist with the construction. When I visited last time he was gone to Saudi Arabia again, likely because he lacked money to finish the house. But he would certainly be back soon: living in Saudi Arabia was too hard culturally, he said.

7.5.3. Three precarious households

K. started his career as a plumber and electrician for a company in Agadir. After fifteen years he bought his own tools and started as an independent worker. He married his first wife in 1978. At that time he traveled the whole Sus region and beyond for work. But in the late 1990's, he hurt himself – a slipped disc – and in spite of several surgical operations between 2000 and 2005 he lost the use of his legs. His first wife had given him no child, so he married a young woman from a neighboring village as a second wife. The young woman now lives in the 2-room house with her husband and his first wife. She gave birth to a girl in 2011. Since 2006 K. has been doing only small electricity and plumbing jobs in the village, as much as his crutches will allow him, which means he is always tight on money. His two wives are permanently cracking argan nuts and producing argan oil for the market, and they say that this is how they could buy a TV set and furniture.

R. always stayed in his village, tending the fields and keeping a few animals. He has little land, and what land he has is located mostly on steep slopes: in 2009 he harvested 11 bags (abra), which is to say hardly anything. At the age of 20 he married, and his wife subsequently gave birth to 7 daughters and 3 sons. None of the children went to school. Three of the daughters married, two in the village and one in another village nearby. The three sons started working in Casablanca around the age of 15, one as an unqualified worker in all sorts of businesses, and two in a factory. Their remittances, amounting to some 1500 MDH per month (about 180 \$US) are the main income source of the household. These have allowed them to build a two-room house in the plain, halfway to the market, so as to ease the commuting with the plain.

L. Always had petty jobs. At the age of 14 he started working as a servant in a private house, in a nearby city. Then around his 18th anniversary he married and started working in Awluz in a bakery. This is also the time when he started building his house – he did not finish it until 25 years later. At the time of the green march (the Moroccan conquest of Western Sahara in 1975), he went to Laayoune to work

for two years, as many others in the region. Then he came back and started trading vegetables on market days in Awluz, which he still does to this day. He and his wife had two daughters, who married in other villages, and four sons. Three of the sons work in cafés in Al Jdida and Marrakech, and one is apprentice in a grocery store in Knitra. Although they send remittances, these amount to little, and so does L.'s trading activities, which bring him around 800 MDH (US\$ 95) per month.

7.6. Appendix 6: Selected pictures

The following pictures have the same aim as the household portraits, namely to give a sense of the settings of this study. I propose a few pictures related to the main themes of this thesis, split into five categories: woodlands, housing, agriculture and herding, and nonfarm work, with an other categories for those pictures that do not fit in the latter categories.

Social and Ecological Change in the Argan Woodlands

7.6.1. Woodlands



Low density woodlands



Moderate-density woodlands



High density woodlands



Argan tree circled with stones as a mark of semi-private property (agdal)

Social and Ecological Change in the Argan Woodlands

7.6.2. Housing



*Typical migrants' houses: large, and using mostly cement (center-right: only earth;
center-left: earth and cement; gray house background-left and rose house
background-right: only cement)*



Traditional stone houses and a new mosque



Traditional kitchen (anwal) with hearth (center) and gas stove (left)

Social and Ecological Change in the Argan Woodlands

7.6.3. Agriculture and herding



Barley cultivation



Wheat fields, protected woodlands (left) and open-access woodlands (right)



Plowing the land manually



Marginal cropland on steep slopes (barley)

Social and Ecological Change in the Argan Woodlands



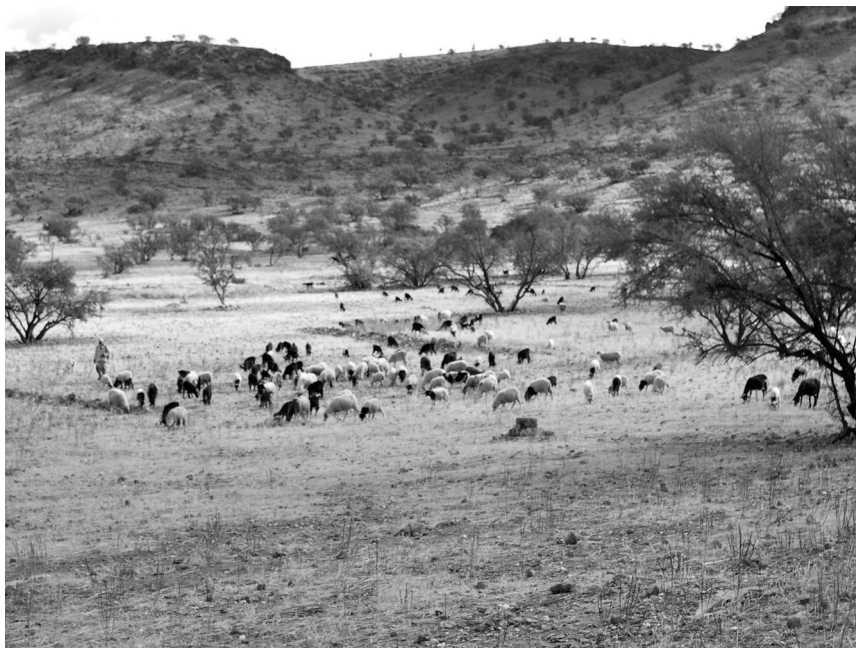
Threshing cereals the traditional way



Cracking argan nuts



Goats in an argan tree



Mixed sheep and goats herd grazing in the woodlands

Social and Ecological Change in the Argan Woodlands

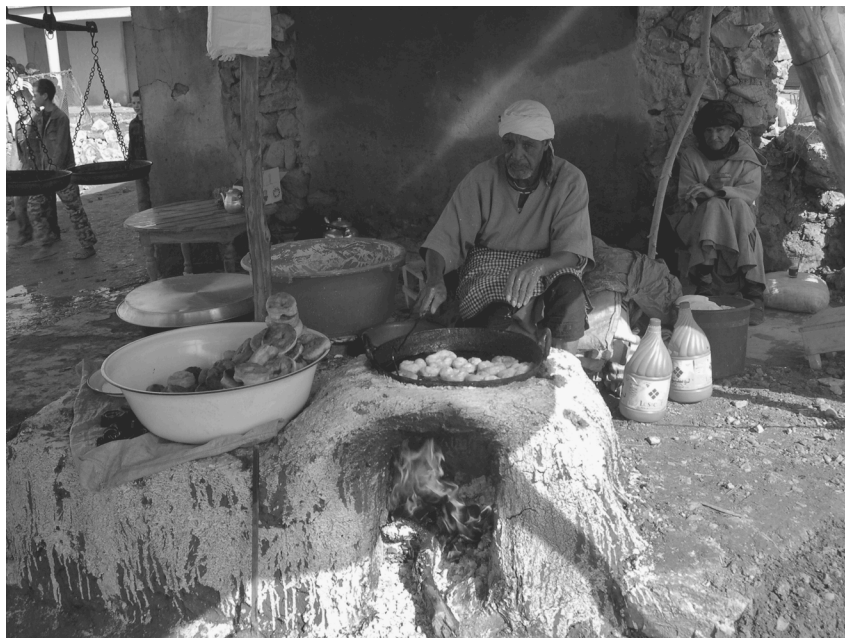


Dromedaries from a nomad herd browsing argan trees

7.6.4. Nonfarm work



Petty trade at the market



Food and tea stand at the market

Social and Ecological Change in the Argan Woodlands



A truck owned by a villager, parked in front of a village grocery store



A village grocery store: lemonade, tea and sardines



Taxis in the market town Awluz

Social and Ecological Change in the Argan Woodlands

7.6.5. Other



Unloading a truck in the village, back from the market



Selling argan kernels at the market



Conducting formal interviews (interviewer: Abdelhakim Bourahet)



Repairing a dirt road after the rains in an isolated village

Social and Ecological Change in the Argan Woodlands



Posing with my companions in the field