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BAMBOO HARVESTING FOR HOUSEHOLD INCOME GENERATION IN THE
ETHIOPIAN HIGHLANDS:
CURRENT CONDITIONS AND MANAGEMENT CHALLENGES

By

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B.S. Biology, Botany, Washington State University, Pullman, Washington, 2010

Thesis

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Bamboo harvesting for household income generation in the Ethiopian highlands: Current conditions and management challenges.

Chair: Dr. Stephen Siebert

Bamboo is a renewable resource that has been advocated as a means to alleviate poverty and foster rural development throughout the world. Ethiopia holds 67% of continental Africa's bamboo coverage and is gaining interest by international markets. Despite great speculation about Ethiopia's bamboo market potential, foundational information regarding household utilization and income reliance is lacking. To understand how bamboo contributes to rural Ethiopian households, a quantitative household assessment was undertaken in this study. A questionnaire census collected data from 371 households. A quantitative assessment of household incomes and assets evaluated what factors influence bamboo harvesting.

The contribution of bamboo to household income was most influenced by size of leased land area, number of household members and livestock ownership. Wealthier households had greater bamboo harvesting capacity, and harvested and profited more than poorer households. Income generated from bamboo harvesting was more important to low-income household livelihoods even though they harvested much less bamboo and earned less income overall. This study highlights the importance of wild NTFP resources to economic well-being, and the heterogeneity of bamboo harvesting and income among rural households. The census also found that bamboo harvesting exacerbates income inequality among households in the community. Households with more leased land area harvested more bamboo and had larger agricultural income profits, while poorer households relied greatly upon income from bamboo harvesting. Additional research should focus on the capacity of rural bamboo harvesters to improve their management, harvesting techniques and better integrate them with outside production and trade. Tenure security, by issued land leases for forest access, could incentivize local residents to sustainably utilize bamboo. If bamboo commercialization progresses in Ethiopia, native bamboo species should be prioritized to maintain the value and existence of current bamboo resources and to support the communities who rely upon them.

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Introduction

Bamboo is one of the world's most important non-timber forest products (NTFPs) and managed bamboo harvesting and marketing has been advocated for poverty alleviation in many regions (ILRI 2000, INBAR 2008, Singh 2008). The International Network of Bamboo and Rattan (INBAR) estimate that over 2.2 billion people benefit from bamboo through income generation and non-market domestic uses including food and housing (Xuhe 2003). Estimates of world trade in bamboo approaches \$7 billion annually (Midmore 2009).

In Ethiopia, bamboo is not considered a significant NTFP and is underutilized. Despite bamboo being multi-functional, highly renewable, durable and affordable timber is widely preferred in Ethiopia (Andargatchew 2008, Embaye 2000). Although Ethiopia contains 67% of continental Africa's bamboo forests, and is referred to as the "bamboo kingdom of Africa", little is known about the role and importance of bamboo to rural households, the amount of bamboo harvested and factors that constrain or encourage harvesting (Embaye et al. 2005, GBRA 2005). Documentation of local use and reliance on bamboo is necessary to improve understanding of the domestic and economic role of bamboo in Ethiopia (Andargatchew 2008, Kelbessa et al. 2000).

This research is a case study of the contribution that Highland bamboo provides to rural households, and the opportunities and constraints of managed bamboo harvesting at the local and state level. Specifically this research (i) quantifies the contribution of bamboo to household incomes in a case study village; (ii) identifies and explains differences in household bamboo harvesting rates by assessing entry barriers or assets required by households to harvest bamboo; and (iii) evaluates opportunities and constraints to sustainable Highland bamboo harvesting in Shedem, Ethiopia.

The focus of this research came about during the two years I lived in Adaba town, located on the NW slopes of the Bale Mountains, Oromia Region. My interest in Ethiopia's bamboo sector developed through numerous conversations with local natural resource experts, and reading scientific literature related to Ethiopia's landscape. Many individuals spoke of Ethiopia's bamboo resources, their availability and potential for profitable commercialization (Zewditu Alemu 2012, Chernet 2009). In Oromia region, foreign investors have inquired about harvesting from native bamboo forests and met with local rural communities and government bureaus. Investors are interested to assess existing bamboo forests in the Bale Mountains and make business agreements with locals to ensure a supply for their manufacturing facilities in larger Ethiopian cities.

Many Ethiopians I spoke with seemed eager for the economic opportunity, a seemingly simple transaction since bamboo is already a familiar resource that generates profits for locals (Sahlemariam Mezmur 2012). Investors proposed enhancing the bamboo commercialization, increasing the supply of raw bamboo culms and establishing more production and manufacturing facilities in Ethiopia to supply foreign buyers (McKenna 2013). Identifying an export market would increase demand and profitability for rural harvesters. Upon investigating the validity of such proposals, however, I found that assessments of household reliance upon native bamboo resources in Ethiopia were lacking. Without this information, how could developers ensure that they were not doing harm to locals who harvested, consumed, sold or traded the resource? My interest to begin this research was to ensure that this baseline information was available.

Documentation of local use and economic benefit from bamboo trade is necessary to understand the opportunities and constraints to bamboo harvesting, and how economically vulnerable these households were. This research will inform bamboo commercialization and market development

in the Bale zone of Oromia region. If rural livelihoods and sustainable management are prioritized, poverty alleviation and resource conservation are possible outcomes for bamboo market development in Ethiopia.

Chapter 1: Literature Review

1.1. Non-Timber Forest Products and their Contribution to Livelihood Security

Non-timber forest products (NTFPs) are crucial for meeting the food, housing and income needs of millions of household throughout the world (Ambrose-Oji 2003, Vedeld and Sjaastad 2014). Population growth and unsustainable forest management have resulted in deforestation and reduced availability of NTFPs in many regions (Dessie and Kleman 2007). Millions of people, particularly in developing nations, rely upon NTFPs each day for “food, fuel, health, and income security” (INBAR 2014). Of all NTFPs, bamboo and rattan are considered to the most important and widely used (INBAR 2014).

The underlying role and importance of NTFPs to rural households were synthesized by Belcher et al. (2005) in a comparative analysis of the literature. They found that: 1) NTFPs are widely accessible and crucial to the rural poor, 2) harvesting NTFPs is less ecologically harmful than timber harvesting, and 3) as NTFPs become more valuable, local harvester are incentivized to conserve resources to sustain the supply and future income earnings.

NTFPs directly and indirectly contribute to livelihood security by providing a variety of consumable or profitable resources (Arnold and Townson 1998, Babulo et al. 2009). Many on-farm livelihoods, such as crop cultivation or cattle rearing, require sizeable inputs such as money or land; households without these fundamental inputs cannot easily participate in such livelihoods. Instead, they rely on wild NTFP harvesting to provide crucial domestic/nonmarket and cash income resources. Harvesting NTFPs poses relatively few entry barriers and are often an important contribution to households that have limited income earning opportunities or few assets. NTFP harvesting often complements a multitude of other livelihood activities to ensure household needs are met year round (Babulo et al. 2009, Tesfaye et al. 2011). Without access to

NTFPs, it has been estimated that over a billion people in developing countries would be unable to survive (INBAR 2014). Therefore, sustaining forests and the NTFPs they support is crucial for social resilience (Belcher et al. 2005, Nygren et al. 2006).

Extensive research has documented the significance of NTFP harvesting among rural households, particularly in developing nations. These studies show that harvesting NTFPs is an essential livelihood activity for many rural Africans (Babulo et al. 2009, Cavendish and Campbell 2008, Nygren et al. 2006). Forest products are utilized both in the home or sold and traded as needed (Awadh 2010, Belcher et al. 2005). It has been argued that NTFP harvesting results in less ecological damage than timber extraction (Belcher et al. 2005) because many NTFPs regenerate quickly and/or reproduce vegetatively, and occur in the understory where their removal does not alter forest cover, structure or fundamental biophysical conditions and processes (e.g., nutrient cycling). Bamboo has great potential to be managed and harvested sustainably for benefit by rural households, much like rattan in SE Asia, as documented by Siebert (1995).

NTFPs are often managed as communal resources and are available to individuals as desired or needed. Babulo et al. (2009) states that forest resources help rural households meet their subsistence needs, provide a security net, and potentially alleviate poverty through increased and sustained household income. Many rural African communities rely on local NTFPs, but their contribution to individual households ranges widely (Arnold and Townson 1998, Shackleton and Shackleton 2004, Tesfaye et al. 2011). Cavendish (2000) studied the intensity and variation of forest product use among rural households in Zimbabwe and found that NTFPs are not relied upon and do not profit all households equally. Some research has documented that cash income from NTFP harvesting can reduce the income gap between the

poorest and better-off households in a community (Cavendish and Campbell 2008). These results are found when forest products are harvested by poorer households, but not as much by wealthier households as they have alternative livelihood strategies not accessed by the poor (i.e. formal employment, cash crop farming, migrant remittances) (Babulo et al. 2009). Also commonly noted in NTFP research is that wealthier households appear to harvest greater quantities of NTFPs, even though they are less dependent on that income for survival than poorer households (Cavendish and Campbell 2008, Godoy et al. 1995).

Understanding household extraction rates is imperative to ensure management of common property resources (Ambrose-Oji 2003). Additionally, identifying what influences individual and household interest in and capacity to harvest NTFPs helps bridge income gap disparities (Cavendish and Campbell 2008), increase livelihood security and income generation for rural households (Belcher et al. 2005), and facilitate sustainable resource management.

1.2. Bamboo: the “Green Gold” of NTFPs

Bamboo is a member of the grass family, Poaceae, and is the fastest growing plant on earth (Desalegn and Tadesse 2014, Lucas 2013). It grows natively in five continents and includes over 1,200 species in tropical and subtropical regions worldwide (Kleinhenz and Midmore 2001). Bamboo’s fast growth, wide availability, and diverse social, ecological and economic uses underlie its importance and popularity. Due to strong market demand and diverse uses (over 1,500 documented), bamboo is traded worldwide (Desalegn and Tadesse 2014, Lucas 2013) and sometimes is referred to as “green gold” (Singh 2008).

Bamboo habitat distribution overlaps with many economically impoverished developing nations (Kigomo 1988). Bamboo occupies about 1% of global forest land or approximately 40 million hectares (FAO 2005). Asia has the most bamboo coverage with 25 million hectares, an

area that continues to increase due to ongoing cultivation efforts. In Latin America, bamboo occupies 11 million hectares. Africa holds 3 million hectares of bamboo (Midmore 2009) with over 1 million hectares in Ethiopia (Embaye et al. 2005). Historically, African bamboo has not been widely exported, but commercial interest has recently increased and research has documented potential socio-economic benefits of African bamboo harvesting (Tadesse 2006).

The commercial bamboo sector in Africa is considered to be inefficient due to a lack of laborer skill sets, poor infrastructure, and weak and inconsistent market demand (Ingram et al. 2010). Government involvement in the commoditization process greatly influences the market's potential and benefactors. Restricted resource access and tenure insecurity also constrain market potential and encourage unsustainable resource extraction (Arnold 1993).

Studies from Kenya suggest how government restrictions can influence bamboo livelihoods. Awadh (2010) documented bamboo production and trade among urban micro-enterprise agents who have taught themselves how to manufacture bamboo into small household items and construct furniture. Although bamboo harvesting from native forests is illegal in Kenya, the trade is widespread due to household needs and market opportunities. Sigu (2006) estimated that 88% of bamboo harvested in Kenya was illegally extracted. Legal harvesting is not easy for poor rural households who must obtain a government issued license or own land to cultivate bamboo.

Entry requirements to harvest bamboo legally are more readily available to wealthy and politically powerful individuals or companies, and have led to the promotion and establishment of private bamboo plantations using native and non-native species for processing, product manufacturing and export. Foreign plantations are formalizing a bamboo market, but in doing so

they compete with and often exclude local residents who lack the political power, skill sets and assets to enter the legal bamboo market (Awadh 2010, Sigu 2006).

In Ethiopia, bamboo harvesting is legal, but the market is weak due to low quality products, and poor coordination among agents involved in the marketing chain (Andargatchew 2008). In addition, few incentives exist for sustainable management of native bamboo forests; degradation and land conversion have resulted in a significant loss of bamboo forests and resources throughout Ethiopia (Andargatchew 2008, Kelbessa et al. 2000). In Kenya and Ethiopia, two nations with the most bamboo resources in Africa, product marketing and demand is growing (Brias and Hunde 2009), but the market potential is restricted because local entrepreneurs and rural households have not been successfully incorporated into this emerging market (Awadh 2010, Sigu 2006).

The International Network of Bamboo and Rattan (INBAR) and the East African Bamboo Project (EABP) have been collaborating with the Ethiopian federal government agencies to promote bamboo as a renewable resource that can diversify rural household livelihoods and reduce poverty (Brias n.d., Chaomao et al. 2006). These organizations have knowledge about the African bamboo trade and cultivation (Tadesse 2006). They also organize and sponsor craftsmen workshops to teach cultivation and management techniques, and value addition opportunities (Brias and Hunde 2009, Chernet 2009). The East Africa bamboo market is projected to grow in response to international market demands (Brias and Hunde 2009, Chaomao et al. 2006) which suggests potential exists for Ethiopian households and communities with bamboo to utilize an existing renewable resource, generate jobs and potentially reduce rural poverty (Awadh 2010).

Bamboo offers Ethiopia the opportunity to utilize an abundant, renewable resource to generate local and state-level benefits (Desalegn and Tadesse 2014). Many stakeholders are optimistic about the potential of Ethiopia's bamboo market (McKenna 2013, Ogunjinmi et al. 2009). Well managed bamboo provides ecological and social benefits to strengthen household livelihoods (Brias and Hunde 2009), but documentation about rural household and community-level reliance upon native bamboo resources is lacking.

1.3. Common Property Resources

Many NTFPs, including bamboo, are managed as common property resources (Beck and Nesmith 2001). This management system does not imply a particular type of tenure; common property resources (CPRs) can occur regardless of what tenure system exists (Ostrom et al. 1999). Common property resources, as defined by Ostrom et al. (1999) are subtractable, (i.e. the use of one user reduces the availability for another user), and are difficult to exclude others from using them (e.g. water, air, forests, grazing land). CPRs are particularly important to poor and rural communities because they are naturally occurring, harvestable goods from nature that provide food and income throughout the year (Arnold 1993). Beck and Nesmith (2001) concluded that CPRs in West Africa and India contribute more to poorer households, equalizing rural incomes because poorer households utilize CPRs more than by the better-off. Bamboo is an important rural livelihood activity and is a subsidy from nature, much like the Babassu palm as studied by May et al. (1985).

Common property resources are especially important for communities in countries with nationalized resources or a large population of low income households (Beck and Nesmith 2001). As described by Bruce (1999) common property resources provide communities a sense of assurance and encourage more long term investment; however, these communities often

struggle because many lack sufficient organization and legal authority to manage their CPRs. Successful CPR management, as documented by McKean (1992) includes the following attributes: a balanced distribution of resources to community members, use that is self-governed by all community members, rules that enforce sustainable management, and members that are attentive to the natural environment and evidence of resource degradation or overharvesting. These attributes are rarely achieved in Ethiopia, resulting in unsuccessful CPR management (Mamo et al. 2007, Reynolds et al. 2010).

Households whose needs are sustained largely from NTFPs are especially vulnerable to over-exploitation of CPRs (Bruce 1999). For all CPR users, social regulations that sustain resources are important, but this is especially true for poor households who are more reliant upon the continued availability of CPRs. In Ethiopia, all land and resources are nationalized and cannot be privately owned. Administrative governance exists to regulate resource use but their capacity to enforce and monitor forest activity is low (Crewett and Korf 2008). As a result, resource use resembles more of an open-access regime, rather than a socially regulated CPR management type. The failure of local regulatory or management control has resulted in resource exploitation because individual users have no long-term assurance of resources access; consequently they seek to maximize immediate gains instead.

CPRs management schemes are as varied as the resources they involve, and entail many different management approaches (e.g., seasonal restrictions, controlled harvest volumes, etc.) as desired and upheld by the community of users (Beck and Nesmith 2001). Although a CPR management system gives users equivalent privileges, harvesting opportunities are not the same among all members because of different capacity and interest between harvesters (Beck and Nesmith 2001). Various constraints such as available time and labor differ among households, as

do household livelihood strategies. This research documents the heterogeneity of households in a community and what influences their capacity to extract native bamboo, an important CPR in Ethiopia.

1.4. Ethiopia and Rural Livelihoods

Ethiopia is the second most populous nation in Africa, and one of the world's poorest countries (World Bank 2014). In an attempt to encourage economic development and decentralize authority, Ethiopia has undertaken extensive land reforms in the last 40 years during multiple political transitions (World Bank 2014). During the monarchies, prior to 1975, land ownership was primarily limited to wealthy absentee landlords. The tenure system was highly insecure and most of the population worked as land tenants. After the Marxist *Derg* regime overthrew the Monarchy in 1975, all land was nationalized to better distribute the nation's environmental resources to the majority of the population (Crewett and Korf 2008). Ethnic clans were modernized into management association groups, *kebeles*, to better govern the people and the resources. In 1991, the Ethiopian People's Revolutionary Democratic Front (EPRDF), replaced the *Derg*, but maintained the policy that all land and resources were nationalized. Some adjustments regarding land leasing and inheritance allowances were made, but individual land ownership is still not possible and leased land could be usurped as the government desires (Deininger and Jin 2006).

Since 1975 with the fall of the Monarchy until present, much of Ethiopia's land is managed under usufruct tenure, with common property resources available to the surrounding community (Crewett and Korf 2008). The local Peasants' Associations (PAs) regulate the land leases in their village. Leases can be granted to farmers who apply with proof of permanent physical residence, and are not charged for a plot of cultivatable land (Deininger and Jin 2006).

Harvesting CPRs in nearby forests is possible for local residents who pay a one-time fee of 120 ETB to the Peasants' Association (Yosan Abdulkadir 2013). Forest and grazing areas are utilized openly by the local community, and minimal regulation or use restrictions are in place (Deininger and Jin 2006).



Figure 1: Topography and location of Ethiopia

A landlocked nation in the Horn of Africa; Ethiopia is bordered by Eritrea to the North, Djibouti and Somalia to the East, Kenya to South and Sudan and South Sudan on the western border (Figure 1). The total area of Ethiopia is 1,104,300 km² making it the ninth largest nation in continental Africa. Inhabiting this spacious area is a rapidly growing population, currently estimated to be 96 million (CIA 2014). The US Central Intelligence Agency (2014) reported that 73% of Ethiopia's inhabitants live in rural areas, and 80-85% of the rural population classify themselves as agriculturalists (Bigsten et al. 2003). Cash crop farms often grow wheat, barley, corn, teff, cotton and chat (Mamo et al. 2007). Many households grow small plots of subsistence

crops including potatoes, sorghum, ensete, onion, beans. Almost all Ethiopian agriculture is rain-fed (Chernet 2009).

Ethiopia's economy has been unstable in previous decades and is currently booming; all the while it remains dependent on agriculture which comprises over 47% of the country's GDP (CIA 2014, Koehn and Cohen 1978). Inflated agricultural prices and variable market demands make income security a challenge for the nation's rural population (Yemiru et al. 2010, Zewde and Pausewang 2002). Average national per capital income is \$470, or \$1.29 per day (World Bank 2014). As Ethiopia strives to boost its economy and reduce poverty, the government has development plans to diversify and increase production from agriculture and industrial sectors (World Bank 2014). Formal manufacturing of bamboo products is a recent development in Ethiopia's economy (Kelbessa et al. 2000), but the small-scale bamboo trade in rural areas has a long history (Tadesse 2006). The International Network of Bamboo and Rattan (INBAR) works with various Ethiopian government bureaus to promote bamboo enterprises for economic, social and ecological benefit (Chernet 2009, Tadesse 2006).

1.5. "The Bamboo Kingdom of Africa"

Two species of bamboo are native to Ethiopia - *Yushania alpina* and *Oxytenantera abyssinica*. The extent of bamboo coverage in Ethiopia is unknown, but estimates exceed 960,000 ha (Endalamaw et al. 2013). Most of the data on Ethiopia's bamboo resources are based on an assessment done by a German organization "LUSO consult" years ago (1997); remote sensing data was used to estimate the total land area coverage and random sampling plots assessed the quality of natural bamboo thickets. The inventory provided estimates of total biomass, growth rate and quality of natural stands for both Lowland and Highland bamboo (LUSO 1997).

This research focuses on the later species, Highland bamboo, which covers about 300,000 ha or, 20% of Ethiopia's total bamboo area (Desalegn and Tadesse 2014). It is an Afromontane bamboo species that grows between 2,200 – 3,500 masl in Ethiopia, Kenya, Sudan, Tanzania, Cameroon, Zaire, Rwanda, Burundi, Malawi and Uganda (Sigu 1994, Wimbush 1945). Highland bamboo has a straight, hollow stalk, called a culm, which on average grows to 12-20 m tall and 8-20 cm thick (Desalegn and Tadesse 2014). It is monopodial bamboo (grows from a single point), and spreads through an extensive rhizomonous root system connecting several culms in a clump; under ideal conditions Highland bamboo can grow very rapidly and produce 6,000 culms/ha (Desalegn and Tadesse 2014, Wimbush 1945). Highland bamboo grows best on fertile, well drained volcanic soils with heavy rainfall (above 800 mm annually) where average annual temperature ranges between 10-20°C (LUSO 1997).

Culm growth begins at the start of the rains and reaches its full height and girth in the first growing season which occurs during the 3-6 month duration of the rainy season (Desalegn and Tadesse 2014, Wimbush 1945). The remainder of the year, when the climate is dry, culms will not grow in height or girth, instead they convert sugars into lignin, making the culm stalk stronger and less susceptible to pest and herbivorous predators (Brias and Hunde 2009). No additional gain in culm diameter or height will occur after the first year (Wimbush 1945). Between 3-5 years of age most Highland bamboo is mature and suitable for harvesting. Culm color indicates age and is used by harvesters to identify the best culms for extraction (Embaye et al. 2005, Wimbush 1945). After maturation, culm health declines and decomposition begins between 5-7 years. Harvesting some mature culms and removing old, decaying culms facilitates efficient growth of a bamboo clump by making space for new culms and allowing root energy

storage to be used for new culms, instead of sustaining older, deteriorating culms (Wimbush 1945).

The Bale Mountain range contains the largest Highland bamboo forest coverage in Ethiopia with 56,851 ha (Andargatchew 2008). The eastern side of the mountains, known as the Bale zone, contains approximately 15,000 ha of bamboo forest. Inside the Bale zone, the Goba worda contains 11,904 ha of bamboo, 2,217 ha of it lies within the Shedem kebele area (Van der Wal et al. 2012). Bamboo is an important local resource as it supplies food and habitat for local wildlife, including the endemic Bale Monkey (Mekonnen et al. 2010), and greatly contributes to the local economy (Andargatchew 2008, Tadesse 2006).

Raw bamboo culms in Ethiopia are often harvested and exchanged for cash or traded. Value can be added if it is processed into furniture, woven into mats or fencing, or used to make charcoal (Desalegn and Tadesse 2014). Value added processing showcases the diversity of bamboo uses, and potential for income generation opportunities (Brias and Hunde 2009). Individuals living in bamboo growing regions are often the focus of bamboo projects, such as craftsmanship workshops (Kassa 2009). Bamboo is a significant income source for rural Ethiopian households, and also reduces harvesting demands on other more limited forest products such as timber (INBAR 2008). Where it is locally available, bamboo is an important NTFP that provides more regular income to harvesters than most agricultural crops which give only seasonal or annual income (Andargatchew 2008, Kelbessa et al. 2000, Sertse et al. 2011).

Highland bamboo plays an important ecological role in Ethiopian forests and reduces deforestation pressures (Mekonnen et al. 2010, Sertse et al. 2011). The Ethiopian government has implemented regulations to reduce access and reliance on timber products due to widespread deforestation; however these regulations are rarely enforced due to lack of resources and

curroption (Amede et al. 2001, Yemiru et al. 20010). Bamboo has been advocated as a means to supplement timber production and can be used for charcoal (Chernet 2009, Embaye et al. 2005). Additionally, it can help control soil erosion, declining soil fertility, reduced water availability and the loss of endemic wildlife habitat (Kigomo 1988, Sertse et al. 2011). Bamboo also helps restore forests and provide an important carbon sink (Assaye et al. 2014).

A robust Highland bamboo forest requires culm thinning to encourage high quality and efficient stand growth. Culm management not only facilitates bamboo clump growth, but provides a product for local people to consume as construction material, fuel or for trade (Embaye 2000). Bamboo is a desirable resource for both ecological and social benefits; it warrants more research and management attention to realize its development potential and to ensure its long term viability (Sertse et al. 2011, Tadesse 2006).

Ethiopia's bamboo resources are managed by the Ethiopian federal government according to national forest regulations (EFAP 1994). The federal forest action plan priorities natural resource management actions that ensure sustainable harvesting through consideration of potential economic, social equity and ecological outcomes. To achieve this, a support network exists that ranges from local administrators at the Peasants' Association, to federal bureaus at the regional and national capitals (EFAP 1994). Traditionally bamboo is used for fencing, flooring, water pipes, furniture, beehives, construction and handicrafts in Ethiopia (Embaye 2000, Sertse et al. 2011). Most of the bamboo used for these products is extracted from natural stands and sold at local markets. Market prices are typically low because the quality is poor and it is not high in demand when compared to timber products. Nevertheless, bamboo provides year round income for harvesters that live in bamboo growing areas (Andargatchew 2008, Brias and Hunde

2009). Bamboo is an important, highly renewable resource, but its growth rate and quality are influenced by biophysical conditions and harvesting techniques.

At present, bamboo and individuals who rely on it are threatened by unpredictable economic conditions and environmental degradation (Embaye 2000, Kelbessa et al. 2000). While Ethiopia is one of the world's poorest nations, it has recently had one of the fastest growing economies in Africa (CIA 2014, Reynolds et al. 2010). The Ethiopian communities that utilize bamboo are generally isolated, not integrated with potential markets and their natural bamboo habitats often lack management (Andargatchew 2008, Kelbessa et al. 2000, Levang et al. 2005). Sustainable bamboo harvesting and management could enhance the quality of bamboo resources, improve prospects for sustainable harvesting, and increase economic benefits for user groups (Brias and Hunde 2009). For harvesting actions to be sustainable they must not harmfully disrupt the ecology, economy or social equity of the natural resources or individuals involved.

In addition to poor management, several other factors threaten Ethiopia's bamboo resources; of these, deforestation caused by agriculture and livestock expansion is the greatest pressure (Brias and Hunde 2009, Embaye et al. 2005). Ethiopia's bamboo is considered by the government to be a minor forest product and management techniques are not widely understood or practiced (Brias and Hunde 2009). Many Ethiopians consider bamboo to be inferior to wood, even though studies have shown that treated bamboo is comparable in strength, and sometimes more durable than some timber products (Brias and Hunde 2009, Kassa 2009). Low quality bamboo products often result not from the original raw material, but from poor harvesting techniques, inadequate storage and failure to protect culms against biological and physical deterioration (Desalegn and Tadesse 2014). With proper management techniques bamboo value

and the prospects for sustainable harvesting can be enhanced, which will improve both forest conditions and household incomes (Brias and Hunde 2009, Endalamaw et al. 2013).

1.6. Opportunities and Constraints to Bamboo Harvesting in Ethiopia

The below discussion will follow research done by Salafsky et al. (1993) and Nygren et al. (2006) to evaluate existing ecological, socioeconomic and political opportunities and constraints that surround sustainable bamboo market development in Ethiopia. For bamboo to be a sustainably harvested environmental product that continually provides social, economic and ecological benefits, the following should be considered.

1.6.1. Ecological factors

Density of Exploited Species

The area of Ethiopia's bamboo forests and their quality and quantity are not well known. Estimates of Ethiopia's total bamboo forest coverage are around 1.1 million (Embaye et al. 2005, Kelbessa et al. 2000), but no recent inventory has been undertaken. Estimates frequently cited are from "LUSO consult" and were completed in 1997. Many of the bamboo areas in Ethiopia have been subsequently exploited and not thoroughly assessed since.

Temporal Availability

As with all bamboo species, *Y. alpina* should not be harvested during its growing season. *Y. alpina* grows rapidly during the rainy season from February through September. Harvesting bamboo culms during the rainy season, or when they are too young, results in reduced growth efficiency for the entire clump. Furthermore, culms harvested during the growing season are more vulnerable to pests and deterioration due to their high sugar content. Culms should also not be harvested until they are mature, after 3 or 5 years (Wimbush 1945). Compared to cultivated crops, or other NTFPs locally harvested in the Bale Mountains, such as coffee, which are

harvested once annually, bamboo has a long temporal availability, 8 months out of the year.

Bamboo harvesting can be done when other livelihoods activities are not demanding. Due to the lack of irrigation, major agricultural crops are harvested once annually; the most lucrative NTFPs are also harvested less frequently than bamboo, wild coffee yields one harvest per year and forest honey is harvested once or twice annually (Andargatchew 2008, Wimbush 1945).

Product and Ecosystem Sustainability

Well managed bamboo clumps have great potential to be sustainably harvested because it grows rapidly and reproduces vegetatively. Resources are simultaneously acquired and competed for by bamboo culms in a growing clump. Diversity of culm ages should be maintained for maximum growing efficiency. Young culms grow vigorously for the first 3-5 months and depend upon older culms to produce enough photosynthetic nutrients to support new culm growth (Embaye et al. 2005). In contrast, culms older than 7 years are slowly deteriorating and less productive; if left in the clump they will compete with the more viable, young culms for light, space and nutrients (Embaye et al. 2005, Wimbush 1945). Clumps with unfavorable age diversity produce thinner and shorter culms (Brias and Hunde 2009).

Culm cutting should be done between the 1st and 2nd nodes, below the first branch of leaves (Brias and Hunde 2009). If a culm is cut at a higher node the culm will branch from the severed site, producing a poor quality culm and reducing the overall growth efficiency of the clump. When a culm is cut low enough, it signals to the plant that the culm is finished growing and energy should be reallocated elsewhere. All cut culms should be dried and treated to avoid decay or insect predation (Brias and Hunde 2009).

1.6.2. Socioeconomic Factors

Resource Tenure and Conservation Incentives

Tenure insecurity is a major constraint to sustaining Ethiopia's forest resources and enhancing livelihood security (Crewett and Korf 2008). At present, all forest products are the property of the state, and accessible to livestock, herders and NTFP collectors. According to the Ethiopian Forestry Action Plan those who harvest goods from national forests must obtain approval and a permit (Tadesse 2006). At the village level however, regulation of resource extraction in state forests is poorly enforced due to weak local governance (Embaye et al. 2005). The Oromia regional government grants lifelong usufruct land rights upon request. Non-agricultural areas are often CPRs, which can be accessed by locals who pay 120 ETB for a lifetime harvesting permit. User rights can be revoked or altered suddenly in lieu of alternative development initiatives by government or private interests (Crewett and Korf 2008, Harrison 2002). Unregulated use of natural bamboo stands has resulted in depleted bamboo resources (Kelbessa et al. 2000).

Given that the majority of Ethiopian households have agrarian based livelihoods, insecure land tenure is an enormous constraint to household food and livelihood security, and few long-term investments are made to improve or sustain resources (Deininger and Jin 2006); soil erosion and soil nutrient depletion are common (Amede et al. 2001). Insecure land tenure and lack of regulation makes CPRs, such as bamboo, highly vulnerable to overharvesting and unsustainable management practices (Arnold and Townson 1998). Competition for limited resources coupled with insecure land tenure, has contributed to Ethiopia's high deforestation rates (McKenna 2013).

Kelbessa et al. (2000) studied multiple communities in southern Ethiopia where residents cultivated bamboo near homes and had access to natural bamboo forests. His research indicates

that small household plots are more sustainably managed than bamboo areas that are managed as common property resources. In addition, households with cultivated bamboo relied on agriculture for their main income source; bamboo products were of secondary importance and were used for household consumption and supplementary cash income. Bamboo cultivation near the homestead was practiced by long-term residents; often their family had a long history of cultivating bamboo. Individuals harvesting from natural stands were recent settlers, and probably were not able to secure an individual lease due to lack of available land. When interviewed all but one household (n=74) said that their household was highly dependent on bamboo for household fuel and construction purposes (Kelbessa et al. 2000). Tenure security or the ability to exclude others incentivizes bamboo management. Kelbessa et al. (2000) concluded that household level bamboo cultivation, as a more tenure secure option for rural Ethiopians, is the foundation to enhancing a sustainable bamboo industry at the national level.

Physical and Social Infrastructure

Currently, Ethiopia's bamboo market is mostly limited to subsistence uses, minimal value addition and local markets (Endalamaw et al. 2013). Bamboo groups and trading networks exist, but are not politically powerful. If the commercial bamboo market expands, it will be important for local actors to be well organized to exert control over pricing and profits. Increased demand could result in greater prices and profits for farmers and traders. Endalamaw et al. (2013) suggest facilitating the commercialization process through value adding steps, including improved management to produce higher quality raw culms, chemical application to enhance color and reduce deterioration post-harvesting, and product development of crafts and furniture.

Market Demand

The domestic market in Ethiopia is weak because value-chain agents are not well connected and overall demand is low and inconsistent (Kelbessa et al. 2000, Tadesse 2006,

Wang 2006). Since Ethiopia's bamboo export market opened in 2012, foreign development interest has increased (McKenna 2013). Bamboo will be a more profitable NTFP if market agents were better networked and the export market grew. A more reliable demand and lucrative market could also encourage sustainable extraction or reforestation of bamboo thickets, but could also result in rapid resource exploitation if unregulated.

Ethiopia has been advised by private investors and INBAR to enhance the domestic supply chain to improve their potential for export (McKenna 2013). Capacity building to improve Ethiopia's bamboo supply includes agents at various levels, including the rural farmers who manage the native forests, the roads that are required for reliable transportation, and the manufacturing facilities (McKenna 2013). Ensuring all levels of Ethiopia's bamboo trade are efficient will facilitate the commercialization and trading process (Andargatchew 2008). Inclusion of local level harvesters is also important to ensure that extraction benefits are socially equitable, thereby enhancing its potential to be a sustainably harvested resource.

While increased profitability may have several positive outcomes, it could also make bamboo harvesting less sustainable and restrict access for local households in the adjacent rural community. Potential outcomes of expanding bamboo markets should be anticipated to minimize adverse effects to rural households and communities. Bamboo dependent households have little capacity to overcome limited access and should be intentionally incorporated to benefit and help sustain the resources they depend on. Under ideal circumstances, a more robust bamboo market demand could promote sustainable harvesting by instilling incentives for enforceable harvesting and management regulations, value added processing, and product development to benefit rural household livelihoods.

1.6.3. Political Factors

Political Power of collectors

Individually, harvesters have little political power over legal rights concerning CPRs. At the village level, the PA oversees the local use and collective power of harvesters, harvesters own capacity to maintain control or access to CPRs is questionable. Harvesters' access to the natural bamboo forests is unregulated and their land leases are also insecure. Households that cultivate bamboo on their leased land, rather than gather bamboo from local open-access forests have more power to exclude others from harvesting their cultivated bamboo (Assaye et al. 2014, Kelbessa et al. 2000).

Pressure for Alternative Land Uses

Land conversion for agricultural or grazing use is the leading cause of deforestation in Ethiopia (Amede et al. 2001, Brias and Hunde 2009). Currently in Ethiopia, the low market value of bamboo is trumped by more profitable commodities which include cash crops and livestock. Deforestation presents the largest threat to Ethiopia's bamboo forests (Embaye et al. 2005).

1.7. Research Objectives

Given the information available about native bamboo in Ethiopia, this research informs some remaining literature gaps. This case study documents the role and importance of bamboo to rural households, and the opportunities and constraints to bamboo harvesting and management. Specifically it: (i) quantifies the contribution of bamboo to household incomes in a case study village; (ii) identifies and explains differences in household bamboo harvesting rates by assessing entry barriers or assets required by households to harvest bamboo; and (iii) evaluates opportunities and constraints to sustainable Highland bamboo harvesting in Shedem, Ethiopia.

To fully assess the economic potential of bamboo resources in Ethiopia, influential elements of the current bamboo trade will be discussed. Additionally, the associated

opportunities and constraints for bamboo harvesting in Shedem will be reviewed using the parameters provided by Agrawal and Gibson (1999) and Nygren et al. (2006). The scope of discussion will include an evaluation of the ecological, socioeconomic, and political factors underlying the potential bamboo resource availability, production potential and market in Shedem, Ethiopia.

Chapter 2: Research Site and Methodology

2.1. Site

This research was completed over the course of my 26 month residence in Ethiopia. During this time, I lived and worked in Adaba town in the northwestern Bale Mountains (Figure 2), and became familiar with the local people, language, culture and resources. My research with bamboo in Shedem began half-way through my time in Ethiopia when I became interested in bamboo and the communities who rely on it. This study was conducted over the course of three months, from December 2012 to February 2013, in Shedem village, south central Ethiopia.

Located far from paved roads or a major town, Shedem is a rural highland village in the eastern Bale Mountains (Figure 2). Shedem is southeast of Goba town, the capital of the Bale zone. Goba is approximately 445 km from the nation's capital Addis Ababa. Shedem kebele is 20-35 km SE of Goba, around 6-8 hours by horse.

Shedem is well known for a large bamboo forest area that is utilized locally (Figure 3). The village contains 2,217 ha of bamboo forests and is the largest harvestable Highland bamboo area in Ethiopia (Van der Wal et al. 2012). Adjacent to Shedem is Bale Mountains National Park which also has large areas of bamboo, but because of the parks conservation status, park regulation restricts any resource use outside the park boundaries (FZS 2007). Goba town also hosts the major bamboo market in the region. Many people in this surrounding area, including Shedem kebele are engaged with the bamboo trade (Andargatchew 2008).

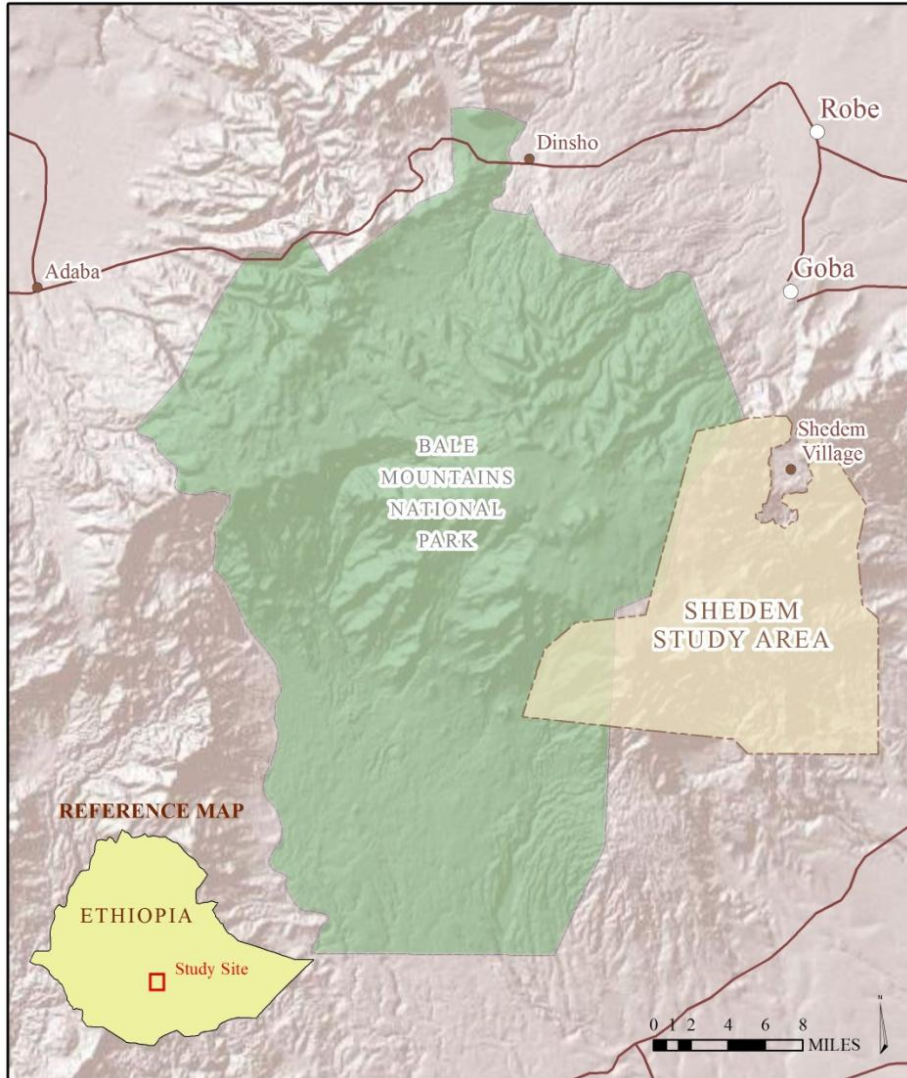


Figure 2: Map of Shedem village with neighboring land areas and adjacent towns

Current estimates of available bamboo resources in Goba Woreda are 11,904 ha (Van der Wal et al. 2012). Much of the region's bamboo resources are in the Bale Mountains National Park which is available for local use, but not for sale (FZS 2007). Some bamboo areas are inaccessible due to steep slopes or lack of road access and remain relatively undisturbed (Van der Wal et al. 2012). The forests in Shedem kebele and those nearby, contain large areas of bamboo thickets (Figure 3); previously thought to be undisturbed, the present condition of these bamboo forests has yet to be thoroughly assessed (Van der Wal et al. 2012). Legal and social

regulations exist to monitor Shedem's bamboo, but they are rarely enforced and as such do not effectively control or ensure resource sustainability. An example of this is the harvesting permits issued by the PA leaders. Permits are given to permanent residents who apply and pay a one-time fee of 120 ETB, but not all forest users have a permit and these users face no consequence for their actions (Yosan Abdulkadir 2013). Despite legal documents or permission, lack of regulation or restricted access has resulted in Shedem's bamboo being an open-access resource, available as desired by locals.

Shedem Village

Shedem village (*kebele*) was selected for a study site based on the community's high reliance upon local bamboo, and my familiarity with the Bale region. The village area contains the large areas of harvestable Highland bamboo, estimated at 2,217 ha (Andargatchew 2008, Kelbessa et al. 2000, Van der Wal et al. 2012). Bamboo is harvested by the majority of households in Shedem; much of it is sold, twice a week, at the market in Goba town (Andargatchew 2008, Van der Wal et al. 2012).

Surrounding Area

Located to the southwest border of Shedem, is the Bale Mountains National Park (BMNP) (Figure 2), a large and important conservation and tourism hub. Individuals within existing settlements are allowed to live inside the park if they were established residents before the park boundaries were demarcated. New settlements and timber extraction is prohibited. Non-timber forest products are allowed to be harvested, but only for household consumption, not for sale (FZS 2007). This selling restriction in BMNP reduces market competition and affects income opportunities for those living outside the park.

On the eastern side of Shedem is a controlled hunting area (Figure 3) which is managed by the Oromia Regional State Forest and Wildlife Enterprise bureau. It is not common for people

to reside here due to land use regulations and restrictions by the Oromia government. Local Oromia Forest and Wildlife officials from the Goba offices estimate that three Mountain Nyala are hunted annually, and the hunters are international tourists (Ashanaffi Mengistu 2013). Due to the wildlife habitat on either side of Shedem and the forest area inside the village, wildlife is likely to frequent Shedem; this was confirmed during data collection. Due to the adjacent controlled wildlife sites, government authorities are present in the area, but do not interfere with Shedem residents or resources (Yosan Abdulkadir 2013). The controlled areas on either side of Shedem (Figure 3) restrict the growth of the community and add pressure on natural resources within the community since residents cannot migrate to adjacent areas, and any population growth will increase the competition for existing resources.

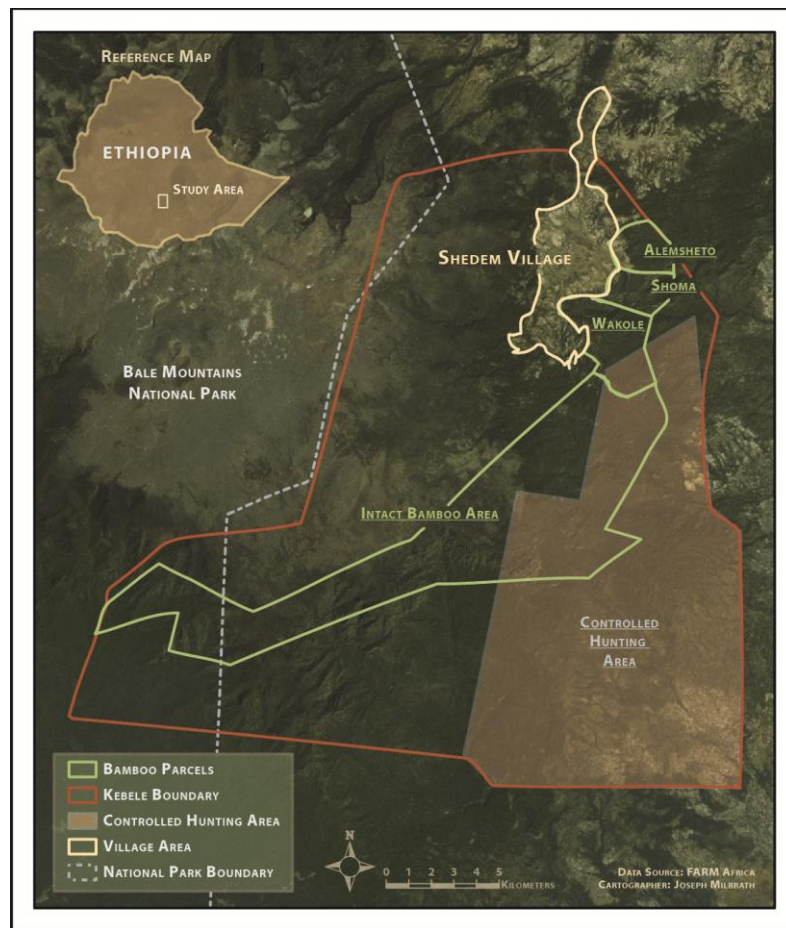


Figure 3: Map of Shedem village area with bamboo parcels

Local Governance

The “Peasants’ Association” (PA) is the recognized legal form of local governance. All communities throughout Ethiopia have this authority structure (Crewett and Korf 2008). The PA is an administrative cabinet made up of elected local residents who receive instruction from outside governing officials, and are expected to disseminate information and technology (e.g., agricultural seed, fertilizer, etc.) (Zewde and Pausewang 2002). The PA officials are often native to the village they represent, and are commonly affiliated with a well-known and influential family that has been in the area for many generations (Gobeze Abegaz 2013). These officials keep track of farmers’ land holding (and have the authority to grant more land leases), and the local agricultural productivity (Zewde and Pausewang 2002).

Nine parcels divide forest areas within Shedem. These unmarked territories were established to help local officials monitor forest use and govern residents in Shedem. Each parcel has five managers who report to one Peasants’ Association director who leads the entire community. Residents are encouraged to harvest from the bamboo parcel near to their home, but are not restricted; exact boundaries are not well understood or agreed upon by community members or outsiders (Benabaru Abera 2013). Three of these parcels: Shoma, Alemsheto and Wakole are highlighted in Figure 3 as they contain the majority of Shedem’s bamboo (Van der Wal et al. 2012). Timber extraction is illegal, and although haul animals were actively carrying fuel wood out of the forest and timber was a popular construction material for homes and fences, households dishonestly reported that they did not harvest or sell wood.

Informal user-groups are assigned to designated areas. Any household who wishes to harvest bamboo for home consumption or sale must first agree to the terms of the Forest Association and pay a one-time fee of \$6.5 (120 ETB) (Yosan Abdulkadir 2013). This membership allows the PA to record the number of households harvesting bamboo, and bill

harvesters since all land and resources belong to the state (Tadesse 2006). The money is used for general PA supplies purchased from Goba (e.g., seed, seedlings, fertilizer, pesticide, etc.) (Yosan Abdulkadir 2013).

Governance in Shedem is multi-layered; it spans local and regional territories and the state level. Figure 4 illustrates the Ethiopian government administrative organization in Shedem village. Generally, the most contact the community has with outside officials is from the Goba woreda authorities, but due to the difficult access into Shedem these visits are infrequent. Goba officials spoke of this challenge being a concern for public health, giving the example of transporting vaccines in a timely manner, but also how communicating and organizing meetings with Shedem residents during these visits is difficult to arrange. As a result, little outside governmental oversight, enforcement or support has been given due to Shedem's rural setting and isolation (Gosa Jebessa 2013).

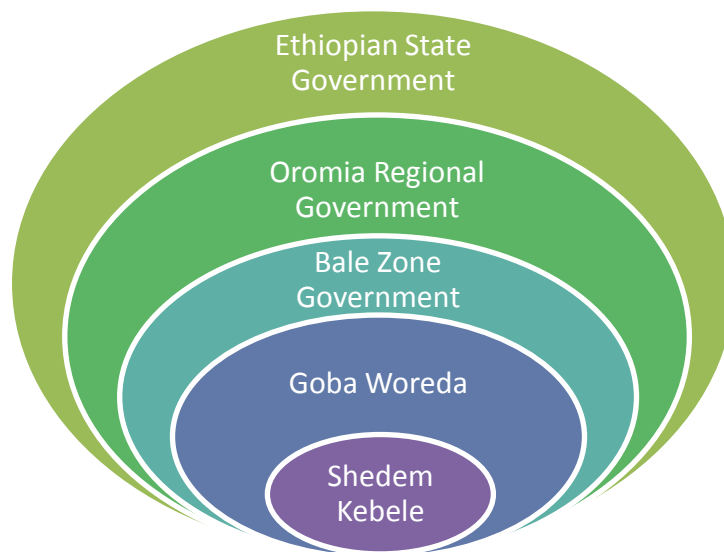


Figure 4: Ethiopian government administrative hierarchy

Household Characteristics and Livelihoods

Shedem community consists of approximately 442 households, all of whom consider themselves agriculturalists. Major income sources include livestock, agricultural production and bamboo harvesting from the community’s forest. Minor income activities include trade, renting land or livestock, timber (wood and bamboo) sales and migrant remittances. Popular agricultural cash crops grown are barley, garlic, potato and cabbage. Less lucrative, but commonly grown crops include carrots, onions and tomatoes. In addition to bamboo, other NTFPs that grow naturally in the Shedem’s forests include coffee and honey. Both are harvested in the wild and yield a good profit for harvesters throughout the Bale region. However, they are not major livelihood activities because their availability is limited and they are not as profitable compared to bamboo and cultivated crops.

Bamboo compliments income from agricultural crops as shown in Table 1. Barley, the main cash crop, is harvested once annually due to lack of irrigation. Bamboo can be harvested eight months out of the year, during the dry season, when the bamboo is not growing and is least vulnerable to pests and rapid decomposition (Andargatchew 2008). The production cycle of NTFPs and cultivated crops is determined by the rainy season.

Table 1: The seasonality of barley and bamboo in Shedem, Ethiopia

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Barley												
Bamboo												
Rainy season												

	Sowing time
	Harvesting
	Growing time
	First rain season
	Main rain season

Most agricultural products and NTFPS are traded or sold between individuals in the community and between villages. Unlike honey or coffee which is expensive and more commonly found outside Shedem, bamboo is not frequently traded between or within the community because it is abundant and readily available. Bamboo is only sold in Shedem if an individual is unable or does not want to transport it to market. An individual can sell to a middle-man in Shedem for a lower profit, rather than take it to Goba market directly if there is a need for income on a non-market day, or if a household does not have enough livestock to haul bamboo to market in addition to other items they are transporting. A middle-man can purchase the bamboo from Shedem residents, and use his animals to transport it to Goba where the profits are marginally higher.

Goba markets occur twice weekly and residents from all over the Bale zone attend to buy, trade, and sell goods. For individuals who reside in the highland villages outside Goba, such as Shedem residents, access to the largest regional market in Goba is a challenging five hour walk and an even further distance for other communities. South of Goba, no paved roads are found for nearly 100 km (Figure 2). A paved road is currently under construction, but for Shedem residents now, as in the past, the journey to the Goba market is arduous. During the rainy season it can be treacherous, as the clay-mud makes the trail slippery and dangerous for animals and people.

A government worker collects a tax of 1 ETB (\$0.05 USD) for each animal load brought to the Goba market (Andargatchew 2008) and helps monitor bamboo extraction rates. Tax collection is likely the only formal NTFP regulation enforcement found at this level of the bamboo market. Land use and NTFP extraction are poorly regulated due to financial constraints at the town level. Stand management, inventory assessments or thorough oversight of harvester activity is beyond the local government capacity.

2.2. Data Collection Methods

Personal Interviews

To gather more information about Shedem village and the greater Bale Mountains we interviewed individuals from various woreda offices and NGOs in Goba. Interviewees had full understanding of the research objectives and how their comments would be utilized. All individuals interviewed consented that their comments could be used for this research.

Household Census

Data collection involved door-to-door interviews for a village census. The census captured various social and economic characteristics of Shedem households. General demographic information and data previously collected by Goba government officials was used to design the census. A previous trip to Shedem also gave insight about the community and what major livelihood activities residents participated in. One field assistant, employed to conduct the census, grew up in Shedem and visits his family there periodically. He currently works full time for the zonal government in Goba, and assisted in developing the census questions. Other local officials facilitated the census design so it would be easily understood and relevant to the community. In addition to household demographics, assets and livelihoods, the census documented bamboo extraction quantities and utilization types. The census also collected information on household assets and livelihood activities that reveal why differences exist in household bamboo harvesting rates, interest and capabilities.

Ten local enumerators were hired for household data collection. They were selected with help from the Goba woreda employment agency office. Enumerators were all from Goba woreda, but not from Shedem village. Enumerators were proficient in English, Amharic and Oromiifa languages. Enumerators tested questionnaires for comprehension and ease of use, and they translated the census from English to Oromiifa or Amharic and back to English again to ensure a shared understanding between data collectors. To build trust and ensure respondent

information was honest and accurate, enumerators were trained to have a similar approach methods, to introduce themselves and the intention of the census.

To pre-test the census, five households were interviewed separately by two individual enumerators at different times to minimize discrepancy among enumerator's data collection. Community leaders from the local Peasants' Association identified houses for the enumerators to census, and an effort was made to sample as much of the community as possible. The "household" unit included all residents (family and co-residents) living within the established compound who depended upon the same financial and food resources. The head of household (either the man or woman who was available) answered the census questions.

The household census occurred in Shedem village from February 3 - 10, 2013. Informational interviews with community members were also held during this time. Interviews included individuals from the village Peasants' Association leaders, local merchants, health extension workers and various other community members. The research camp site was in the main area of the village where local residents' curiosity led them to approach the research team. Researchers capitalized on this attention by engaging locals in informal interviews and explaining their presence.

Door to door interviews collected census data on 371 out of an estimated 442 total households (84%) in Shedem. Enumerators selected households with the help of five local elders (some of them were PA leaders) led pairs of enumerators throughout the village to locate as many homes as possible. The census procedure strived to interview a minimum of 80% of all households in the community. Time constraints and vacant households prohibited a complete census of all households in Shedem. Excluded compounds were either vacant when enumerators visited (often multiple attempts were made) or had very remote locations on the periphery of the

village area. The main village area (Figure 3) is the center hub for access to school, the mosque, shops to buy basic goods, the health post, the PA office and the route to Goba town, the market center and woreda capital. Households that live far away from this village center, in more remote forest areas are unlikely to be wealthier households because their remote access indicates they are probably isolated and without much land for cultivation.

Enumerators returned their completed censuses twice daily, at lunch and again at dinner, whereupon they were reviewed by four research assistants who checked the completed censuses. Reviewers clarified any confusion immediately with the census enumerator by discussing unclear or missing data. Sometimes census data corrections were made at once; otherwise a research assistant relocated the house using previously recorded GPS coordinates, and completed a second census to check the accuracy of the original data.

2.3. Data Analysis

Household census data was entered into Microsoft Excel. From the original 371 census, 9 were removed (n=362) because they did not provide any information regarding household income, bamboo harvesting amount or revenue, or if the provided information seemed implausible (e.g. a household that reported large amounts of agricultural income but did not have sufficient leased land area, oxen or household labor to support or generate such profits). Censuses containing questionable responses were double checked by comparing items in questions (e.g., estimated agricultural income with leased land area) for validity. Also, one man had two wives, each a separate household and family living in Shedem; both of his households were removed so no overlap of assets and income would occur.

A summary of selected census information is displayed in charts and tables to illustrate relationships and trends. Because the census captured 84% of the total households in the community, the data was treated as a census. To understand the spectrum and discrepancies

between household incomes and assets, quintiles grouped households as used by Cavendish (2000). Although this research focused on income generation activities and cash crops, it did not account for the diversity of forest products that were seen in Cavendish's (2000) work in Zimbabwe. Instead, the Shedem census accounted for the most common livelihoods in the village to understand the contribution of each activity to overall annual household income.

Chapter 3: Results

3.1. Community Profile

Household incomes ranged from the lowest reported annual income (5,000 ETB) to the household with the highest income (203,154 ETB). The income range was divided into five quintiles, each group representing 20% of the total range. The first quintile (Q1) contains the lowest income group (Q1) ranges from 5,000-41,030 ETB, the quartiles increase by 20% up to (Q5) to highest income group which ranges from 162,624-203,154 ETB (\$1= 18 Ethiopian Birr (ETB)). Income groups were used to compare household assets (livestock, croplands, etc.) with income from bamboo harvesting (Cavendish 2003, Yemiru et al. 2010). Table 2 shows how many households constitute each income group, and what the average income is for each quintile.

Table 2: Description of household incomes in Shedem, Ethiopia

Quintile number	Income group	Number of households	Percent of village population	Average estimated annual incomes (ETB)
Q1	0-20%	306	84.5%	15,729.06
Q2	20-40%	40	11.1%	56,259.25
Q3	40-60%	11	3.0%	101,382.55
Q4	60-80%	3	0.8%	140,666.66
Q5	80-100%	2	0.5%	197,075.00

Background demographic and land holding information on all censused households are presented in Table 3. The vast majority of households were headed by males, but a few household heads were widowed females. Household incomes increased with the amount of land leased, number of hauling animals owned, education level, and number of household members. Also, the wealthiest households (Q5) have not lived in Shedem their entire lives, as is more common with lower income groups. The number of household members increased with annual

household income. The more household members, the more livelihood activities can occur simultaneously, increasing overall household production and profit potential.

The number of hauling animals owned has a positive trend with income. Livestock is grazed on communal pasture, and does not necessarily indicate that households with many animals have a large land area to hold them inside. Instead, land area leased by a household is more indicative of agricultural production, and does show a positive trend with per capita income (Table 3). Most households hold less than 1 ha (~6 ollies), while wealthier households own larger areas of land, approximately 2 ha on average. Most households have some leased land, on average just under 1 ha (Table 3), but many households have no leased land holdings (n=48) and others have 10 ha or more (n=89).

The household information from Table 3 and the overall data set reveal that family sizes are large and most household heads have little education, although the census suggests that educational levels are increasing, many children enrolled in school are surpassing their parents' education level. The data set also showed that only 5 household heads have a formal paid profession (i.e., teacher, shop owner, etc). Ninety-three percent of respondents said they were farmers. Few formal and reliable wage earning opportunities exists for households living in rural Ethiopia (Yosan Abdulkadir 2013). The government jobs that are available are based in the woreda center.

Table 3: Average assets and attributes for Shedem households, by income groups (n=362)

	Average household information					Total		
	Q1	Q2	Q3	Q4	Q5	min	max	mean
Age, household head	42.0	38.6	44.7	32.3	38.5	16	100	41.6
Years living in Shedem, household head	41.0	37.1	44.7	32.3	28.5	0	100	40.5
Education level, household head (years)	2.2	2.6	4.2	5.3	6.0	0	12	2.4
Number of household members	5.1	5.1	5.7	7.3	8.5	2	12	5.1
Land holding (6 ollies = 1 ha)	6.1	8.7	12.8	14.3	13.0	0	60	6.7
Hauling animals	5.84	7	5.47	5.36	6.43	0	35	5.9

Table 4 enumerates the number of households whose livelihoods involve the major cultivated crops or NTFPs. Seasonality, level of entry-inputs, and the associated constraints are some of the barriers households must overcome to participate in different livelihood activities. The “Number of households” column is based on whether census respondents said “yes” indicating their involvement, or gave an estimate of their annual earned income for the mentioned crop harvest. Households participate in a variety of income earning opportunities, bamboo (99%) and barley (98%) being the most important. Other major agricultural crops grown in Shedem include carrots, potatoes, and onions.

Cultivated crops, whether for home use or sale, are grown and harvested once annually. Their input requirements are generally much greater than wild NTFP harvesting. The honey, coffee and bamboo reported is wild, harvested from the forest and not cultivated. Beehives are frequently constructed and set in a tree canopy in or near the forest. Some honey is also be harvested from natural beehives. Compared to cultivated crops, livestock production and bamboo

activities, wild coffee and honey harvests are less frequent, and result in less income generation overall.

Livelihood activities in Shedem are diverse and depend upon a variety of resources. Households in Shedem rely upon all capable members to contribute labor as needed. Many adult men have multiple wives and households that collectively manage assets and contribute to labor demands. Most community members have lived in Shedem village their entire lives; migration into the community is rare and only happens if a woman marries a man from Shedem and moves to the village.

Table 4: Common goods cultivated or harvested in the wild by households in Shedem and their associated input requirements

Crop Type	Households involved/ % of total		Multiple harvest/ year?	Input	Constraints		
					Land	Haul animals	Laborers
Cash							
Barley	356	98%	No	High	X	X	X
Garlic	207	57%	No	Medium	X		X
Subsistence							
Cabbage	131	36%	No	High	X		X
Potato	143	36%	No	High	X		X
NTFP							
Honey	76	21%	Yes	Low			X
Coffee	11	3%	No	Low			X
Bamboo	359	99%	Yes	Medium		X	X

3.2. Bamboo Harvesting and its Contribution to Household Income

Bamboo is harvested by 99% (n=362) of censused households in Shedem village (Table 4), and barley is the most common agricultural crop. On average, agricultural earnings are the primary source of income, and bamboo income is secondary among Shedem households. Income from bamboo contributes more to lower income households, but they harvest less than

households in higher income groups. On average, the more annual income, the more bamboo harvested per household (Figure 5).

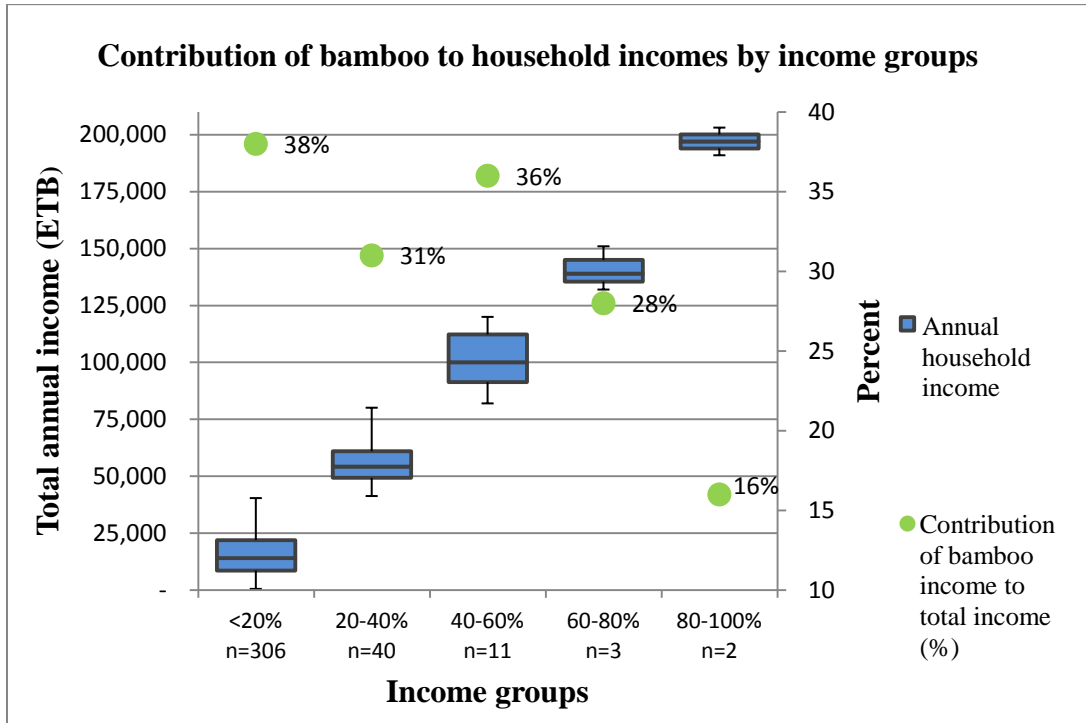


Figure 5: Percent of bamboo income contribution compared to total annual income estimates by income group

3.3. Household Assets and Bamboo Harvesting Rates in Shedem Village

Income generated from selling bamboo is positively associated with household ownership of hauling animals. Figure 6 illustrates that households with more cultivated land and hauling animals have greater agricultural income and are wealthier overall.

Non-bamboo incomes were predominantly farm activities (i.e. agriculture and livestock). Census respondents gave a “yes” or “no” response to what livelihood activities they participated in (Table 4) and estimated profits on market sales. Profits from specific crops were not always shared with the census data collectors. Because of this inconsistency in the collected data, it was

not possible to discern relationships between cash crop earnings and that from subsistence food crops.

The majority of households, 85%, were in the lowest income group (Table 2). These households had an average annual income of 15,728 Ethiopian Birr (ETB) (\$827.79). On average, the lowest income group (Q1) lease 6 ollies of land (~1 ha) (Table 3). The wealthiest households (Q4, Q5) constituted only 1% of the total population. These households, shown in Figure 6, can be characterized by leasing twice as much land (13-14 ollies/ ~2 ha) as did the lowest 20% income group (Q1). In addition, these wealthier households (Q5) own an average of 11.5 haul animals and have annual incomes of 168,871 ETB (\$8,887.95). The income disparity in Shedem is large (Figure 5); the wealthiest household income is nearly 400 times that of the poorest household in Shedem. On average, the two wealthiest households' incomes (Q5) are more than 12 times greater than 85% (n=305) of the community. Bamboo harvesting accentuates income inequality among village household, because wealthier households have more assets to assist bamboo harvesting and transportation (Figure 6).

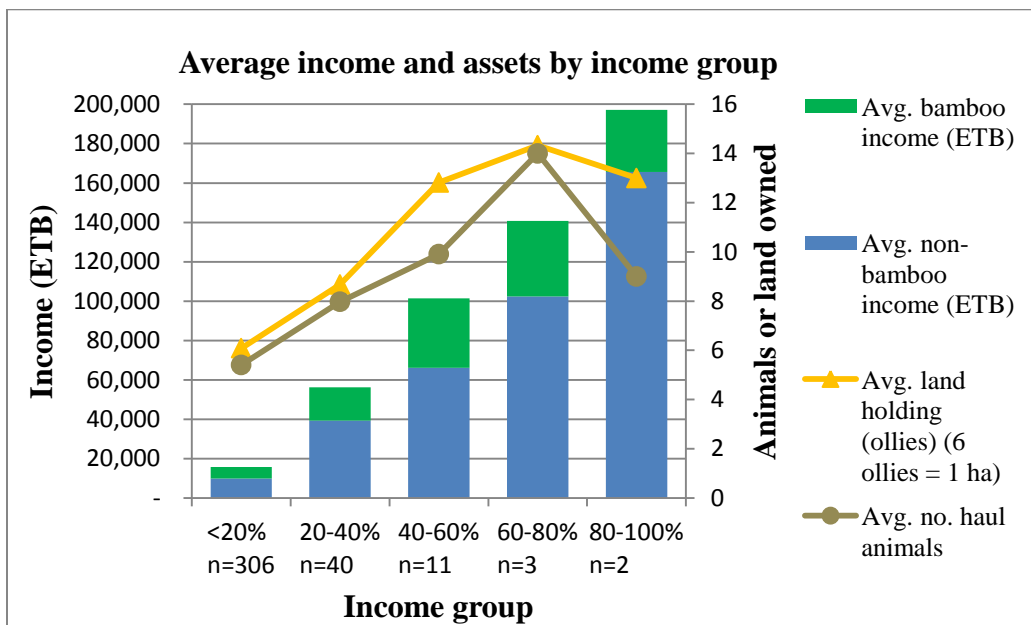


Figure 6: Bamboo income and assets that influence harvesting rates

3.4. Community Perception of Forest Condition

When asked about the condition of the forests, 35% of residents did not have a comment, while over half (52%) expressed concern over the condition of the forest (Figure 7). Concerned households offered explanations for the current forest condition, and are best summarized by the following comments:

“...because the forest law proclamation is not functional, there is forest destruction.”

This individual quoted above is the school director in Shedem, and has spent his entire 56 years living in the village. During his life, he has observed multiple government transitions and directly experienced several land reforms. This census respondent places the responsibility on national political powers, not necessarily his local PA or neighbors. Most of the respondents commented about their forest concerns didn't place the blame on a specific group, but implied that the community-level management and harvesting is concerning:

“(the bamboo) is almost finished because of improper utilization.”

“We are using (bamboo) unwisely.”

“Current bamboo use is not sustainable.”

Thirteen percent of censused households do not think the current forest condition is a concern. Frequent comments were along the lines of “good (forest) use due to cooperation” and those who said the forest condition was “good, but there is no management”. Both of the wealthiest households in Q5 commented that they thought the “forest condition is good” and “before it was a big problem, but now it looks good”. Their suggestions for forest management were “keep on” (i.e. maintain things as they are now) and “government and society have a responsibility to save the forest”. Contrary to the highest income households, all of the

households (n=3) in the second wealthiest income group (Q4) expressed concern about the forest condition:

“Bamboo is in danger. (It) must be managed.”

“The forest is being cleared. We must conserve our forest.”

“Our life is bamboo. We should use it sustainably.”

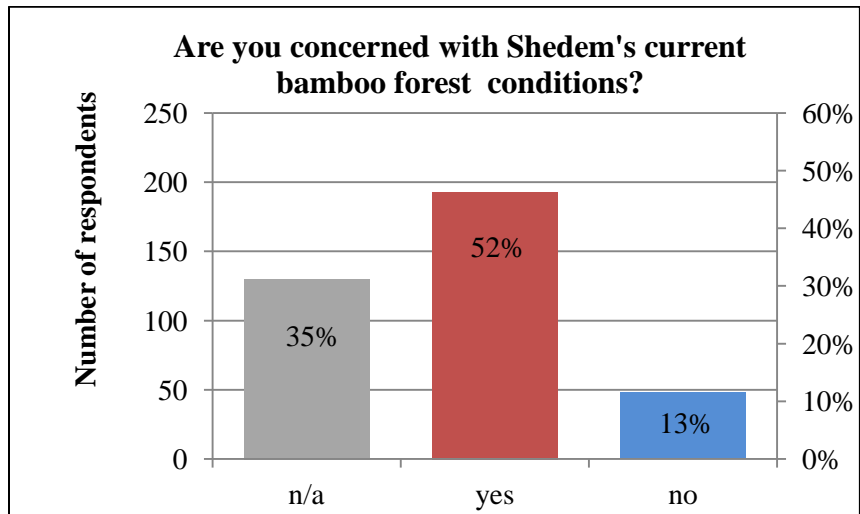


Figure 7: Census response to concerns of local forest conditions

Chapter 4: Discussion

4.1. Shedem Household Livelihoods

Household Incomes

The gap between the lowest 20% (Q1) and the highest 40% (Q4, Q5) household incomes was large. On average, the wealthiest households' (Q5) annual incomes are more than 12 times greater than the poorest households (Q1). When compared to the national average for per capita incomes (8,460 ETB/\$470) (World Bank 2014), the annual incomes of the poorest households in Shedem are substantially higher than the national average.

Previous research on livelihood activities and rural incomes in Africa has documented that wealthier rural households often surpass a threshold of assets or activities that provide security, and go on to acquire additional goods and cash income (Arnold and Townson 1998). Livelihood security and surplus of cash, food, and farming assets help households prepare for and overcome shock, such as drought or fluctuating market prices (Arnold and Townson 1998, Cavendish and Campbell 2008, Tesfaye et al. 2011). Wealthier households not only meet their needs and have surplus, but invest in technologies that increase their yield and reduce their input demands for the long-term (e.g., supplement animal grazing with nutritious fodder, acquire livestock breeds that are more productive, buy crop fertilizer, establish bamboo clumps near their home, etc.). Those who are in the lowest quartile (Q1) are in a more precarious position because they have limited means to pursue alternative livelihoods and are less able to handle shocks or respond to market opportunities (Arnold and Townson 1998). In contrast, households in Q4 and Q5 likely have surplus income and own abundant livestock and land area.

Household Assets

Households who do not have the means to accumulate surplus continue to participate in livelihood activities that are labor intensive and produce sufficient, but limited outputs. Many

households with low incomes or no leased land reported that they traded for goods rather than produced goods for sale, and used the cash profits to purchase desired items. Common traits of households in the <40% income groups (Q1, Q2) were that they leased small amounts of land, fewer livestock, and generated minimal income from any particularly livelihood activity.

The most significant assets that appear to influence income generation are amount of leased land and livestock ownership. These findings concur with a study done by Melaku et al. (2014) in southwestern Ethiopia, where household income increased with the number of livestock and leased land area. In addition, Mamo et al. (2007) found in central Ethiopia that forest dependence was negatively related to household income and leased land area.

The positive influence amount of leased land has on income generation is well documented in Ethiopia (Bigsten et al. 2003, Yemiru et al. 2010) and in other nations, including Zimbabwe (Cavendish and Campbell 2008). Discrepancies in land lease holdings are largely a result of political and social influences that have been maintained throughout generations (Crewett and Korf 2008). Households with small leased land holdings have little potential to increase land ownership and are more reliant on common property resources.

Households with more livestock were better off financially. Both animals and humans improve labor and transport efficiency, and provide a means of transporting goods from the forest and home to markets. Furthermore, households that do not own livestock or household members are less productive at cultivating crops or harvesting NTFPs, and are more constrained for time, labor availability and subsistence goods (Bogale et al. 2005). The same results were found in Ethiopia by Bigsten et al. (2003) and Bogale et al. (2005) and in Zimbabwe by Cavendish and Campbell (2008). Oxen and cows are important for agricultural work. Horses, donkeys and mules are primarily used for transportation of bamboo, people and packing goods.

Horses, mules, donkey and oxen are also leased between households for 50-100 ETB per animal a day. Census questions related to animal leasing received insufficient response (n=8) to understand precisely how common or profitable it is.

Aside from agricultural and bamboo income, households with higher incomes (Q4, Q5) own more livestock, leased more land, and have more household members. Noteworthy assets and income sources for the top 5 households (Q4, Q5) included income generation from leasing livestock, migrant remittances from household members working abroad or elsewhere in Ethiopia, and merchant sales. None of these income generation activities were shared by all of the wealthiest households, and were even reported by some households in lower income quintiles (Q1, Q2, Q3). Furthermore, these livelihood activities did not appear to substantially enhance annual incomes and therefore cannot be considered a common path to wealth accumulation.

Household Resource Access

Forest entry is influenced by household proximity and transportation feasibility (i.e., to the forest or market areas). In addition, the broader context of political land reforms (i.e., insecure tenure and common property resources) has a role in the contemporary forest management situation.

Distance to the forest and market influences forest dependence. However, such research elsewhere in Ethiopia was based on comparisons between villages (Assaye et al. 2014, Mamo et al. 2007, Yemiru et al. 2010) and are not comparable to this study which involves a single village. Shedem households can bring their bamboo harvests to the town center where another community member purchases the bamboo and transports it to market for sale and additional profits. Therefore, household distance to the nearby market was not thought of as a considerable constraint to bamboo harvest rates, and therefore not measured. Instead, the role of land tenure

and resource availability is a more relevant barrier, and was a popular topic among census respondents.

Private land ownership is not possible in Ethiopia (Crewett and Korf 2008), but households may apply to the PA for land leases free of charge. Property boundaries near the home are common in Shedem. Enforcement of boundaries is feasible because household land areas are typically small, and the perimeters are respected and not encroached upon by others. Claims of land leases in Oromia region are often given through inheritance. If a father has multiple sons to divide the land between, the holding for each generation is increasingly reduced until the inheritance is insufficient for anything more than subsistence agriculture (Crewett and Korf 2008). Leasing additional land is increasingly problematic due to lack of availability and a complicated bureaucratic process. Land leasing has become very difficult for younger generations as noted by a man who grew up in Shedem:

“Previously, especially in Bale, there was excess land. Farmers were not that much experienced, they destroyed the forest. Also if the family has more land, when the younger boy is ready to marry the father will give him land. If he did have he would give horses, cows, sheep and so on; or they would register with the PAs who would give more land. Now-a-days, they can rent land if the(ir) family can't give them land. (Instead) they rent (land) for 2-3 years from another farmer.” (Yosan Abdulkadir 2013)

Acquiring new land areas is increasingly more difficult, and less land is available for each generation to inherit. Land shortages coupled with increased education, encourages residents to move outside of Shedem in search of employment opportunities (Yosan Abdulkadir 2013). Also due to the land shortage and general gentrification trends across the country, little migration from outsiders into Shedem village was reported in the household census.

Competition for resources, a growing population and changing land management policies were noted by many community members. No specific information about Shedem's population was available; however Ethiopia's population has more than doubled since the 1980s (Reynolds et al. 2010) indicating that Shedem has likely experienced an increased population. Population growth further complicates the land tenure issues that have surfaced over the last four decades.

Since the fall of the Monarchy in 1975, the national government owns all land and resources in Ethiopia and private ownership is not allowed. Land leases and common property resources are accessible to Ethiopians, and are said to be socially regulated by the PA (Crewett and Korf 2008, Tedesse 2006). Cultivated leased land areas are smaller and involve fewer individuals than CPRs, making them easier to monitor and control. CPRs, however, are larger in size and utilized by multiple households in a community. These dynamics complicated enforcement and regulation by the PA. While on paper CPRs are managed by the local government officials, however on the ground these resources are open-access. Harvesters extract according to their capacity and little to no oversight exists to ensure sustainable management.

Since political shifts and their associated land reforms have all occurred in the last 40 years, many of Shedem's residents have directly experienced adjustments. A Shedem man recalled the differences between the past and present forest access: "At one time, people could expand land by clearing the forest. Now this is more regulated and restricted." Access and resource availability were identified as notable topics during the census and from interviews with Goba woreda government officials. To understand the local perspectives, the census used open ended questions to gather information regarding residents' concerns of the current forest condition and management recommendations.

4.2. Community Perception, Management Strategies and Recommendations

Perception on Forest Condition

Slightly over half of respondents expressed concern for Shedem's current forest condition. A smaller portion of the community, 13%, reported concerned with the forest condition or believe it is better than in previous times (Figure 6). When asked for their suggestions on changing the current forest condition or introduce management practices, some residents proposed intervention by authorities. Several respondents suggested that regional government oversight is necessary: "Government should solve (any problem)." Other respondents were more specific about how forest regulation should take place saying that a "forest guard should be present". Forest guards are currently only found inside National Parks, and were previously used during the *Derg* to restrict forest harvesting in designated community forests. Guards have not been effective due to corruption and lack of enforcement and agreement on the part of the public (Zewde and Pausewang 2002). Since weak forest regulation will likely not ensure long-term resource availability for Shedem another approach should be considered. As land leases have given residents a sense of tenure security for agriculture production, a similar approach may be effective for regulating bamboo forest use. Land leases allow households to hold themselves accountable for their parcel of land and not worry about other users reducing resource availability. Also, if forest areas are made into parcels available for lease, it may be more feasible to regularly monitor and inventory the bamboo forest.

According to the census, most respondents believe Shedem community members are responsible for forest degradation, and are also the solution to reverse the trend. This sentiment is best summarized by a respondent who said "Our people should unite and manage" and another who suggested "We need to manage and use planning". These comments were in line with other

respondents who expressed concerned about the forest condition and believed the community should reconsider how the forest is being utilized.

Forest management in Shedem is lacking and should be reformed since the PA is not able to effectively manage Shedem's forest areas, and harvesting permits do not ensure sustainable use. Lack of community support for PA leaders was expressed by some Shedem residents, which would explain the lack of compliance regarding harvesting permits. It should be noted that no public documents or information gathered from locals was able to elucidate any existing system of demotion or re-election to replace PA leaders. Considering that land leases for agriculture are well regulated, bamboo forest use can be enhanced if leases for blocks of forest were also developed. These leases would permit Shedem households to exclude other community members and give them control and security over some bamboo resources. This would also incentivize residents to improve their bamboo harvesting and management techniques to ensure long-term utilization. Currently, open-access use of Shedem's bamboo resources has resulted in resource degradation (Van der Wal et al. 2012), and also accentuated income disparity between households

The responses reported in Figure 6, and the entire array of census comments, indicate that Shedem community has no consensus regarding the current forest condition. To address management changes, there must first be a better understanding within the community about the bamboo forest condition and its ability to sustain local harvesting demands. If community members disagree about the forest condition there will not be a united effort to improve the quality of local bamboo areas and sustain growth and yield for emerging market opportunities.

Factors Influencing Bamboo Harvesting

Bamboo in Shedem is purported by the government to be a socially-regulated common property resource; in reality bamboo is an open-access resource, available as needed or desired.

Regulation by PA officials is ineffective and instead household assets and temporal availability are the primary constraints to bamboo harvesting. A crucial asset that determines bamboo harvesting capacity, as noted previously, is the number of the hauling animals owned. Households that do not have livestock are only meeting their domestic needs, and are likely not transporting goods to market unless they are leased. Households with many hauling livestock can support their domestic needs and extract surplus for sale and trade. Harvesting rates are also influenced by household distance to mature bamboo culms and the number of available laborers (i.e., household members). For all Shedem households, regardless of their household composition, or the number of hauling livestock they own, bamboo is either consumed for construction materials, fuel wood or for sale at market. The importance of bamboo to Shedem is best summarized by one gentleman who said, “Bamboo is the backbone of our community”.

Bamboo extraction in Shedem is an important livelihood activity for 99% of households censused, and the CPR management scheme is essential for poor households to access the resources they greatly depend upon. The PA oversees the CPRs in Shedem by giving harvesting permits, but its authority to enforce regulations or assess forest conditions is limited and ultimately not effective. From the household census, 97% of households said they remove bamboo from the forest, but only 85% of all households said they were members of a local forest association which gives them legal harvesting permission. This indicates that 45 households are harvesting bamboo illegally and are not adhering to local forest management rules. Perhaps these households do not respect the PA’s authority or they cannot afford the permit fee. Either way, this illegal harvesting is problematic for Shedem’s CPRs, and has resulted in an open-access regime, and will lead to an eventual break down of existing management structure or long-term availability of forest products.

Wealthier households harvested greater volumes of bamboo because they have more animals and laborers to remove and transport bamboo culms (Figure 6). A census completed by Cavendish (2000) reveal similar findings in Zimbabwe; that forest products contribute more to poor rural incomes, but wealthy households extract more NTFP resources.

Nearly all residents have the opportunity to exploit Shedem's forest resources since the forest is managed as a common property resource and harvesting does not require significant technical skill, only assets. Other NTFPs studies indicate that harvesting was often not lucrative enough to interest wealthier households (Belcher et al. 2005), resulting in only some community members harvesting NTFPs for income generation (Arnold and Townson 1998). Furthermore, some studies suggest that NTFPs act as an income equalizer between low and high income households in communities where forests are accessed more by poorer households (Angelsen et al. 2014, Babulo et al. 2009, Cavendish and Campbell 2008, Yemiru et al. 2010). However, in Shedem 99% of the community harvests bamboo and the wealthier households secure more profit than poorer households. As a result, bamboo harvesting does not equalize incomes in Shedem; instead, it accentuates the income gap between low and high income households. This was also found in household census done in Malawi by Fisher (2004) who determined that forest activities supplied crucial income for poor households, but also improved the standard of living for better-off households who generated income from high-return on-farm and off-farm activities.

Implications and Limitation of the Study

Ethiopia's bamboo sector is expansive and involves many actors throughout the country, including rural harvesters, federal policy makers, traders and exporters. This study is limited to one community and, therefore, is not be applicable to other rural villages in Ethiopia. The household heads who responded had difficulty recalling exact income earned for each livelihood

activity throughout the year, but gave their best estimates. Time constraints prohibited us from speaking to every household in the village, specifically to those who were not at home during the week when the census was conducted; 16% of Shedem households were not censused and it is possible these household had dissimilar livelihood strategies and utilized or relied upon bamboo differently.

The accuracy of data is based on how well the individuals estimated specific information regarding profits in the wet and dry seasons. The census also only addresses a single year and, therefore, does not reflect fluctuations in market prices, variable weather, or yields that occur from year to year. In addition, although much effort was made to build the trust of community members prior to the census, some confusion or mistrust by respondents could affect the quality or accuracy of the information provided. Enumerators spoke in the local language, Oromiffa, and were instructed to be friendly, clear and transparent about their intentions. Enumerators and researchers took necessary precautions to ensure honest and accurate data was collected from census respondents.

Generally, the community welcomes outsiders, but suspicion by residents of rural Ethiopian villages of outsiders lingers, and was confirmed by village elders who spoke with the researchers (Benabaru Abera 2013). Rural residents are continuously concerned about land reform changes or enforcement of timber harvesting restrictions. Although we had the support of the PA leaders, who went with the enumerators to each compound, and we worked alongside familiar Goba government officials, including one who grew up in Shedem, some households appeared to be skeptical. Most respondents appeared comfortable and trusting.

Local residents' skepticism of household enumerators was evident during data collection. Most households reported they did not harvest timber from the natural forests, although we saw

contradictory evidence on a daily basis of households gathering or utilizing construction materials and livestock hauling fuel wood from the forest. Respondents who denied their involvement with timber extraction likely mistrusted or misunderstood the enumerator. Perhaps respondents feared our household census data could inform the government of illegal forest activity and be used to enforce restrictions or additional taxes on forest resource use. Unlike bamboo, timber extraction in Ethiopia is illegal as deforestation has reduced the national forest coverage to less than 4% of its historic coverage (Embaye 2000, Reynolds et al. 2010). Despite being illegal, wood is commonly removed for use in construction, or as fuel wood and charcoal because there are little to no alternatives for most Ethiopians (Dessie and Kleman 2007). Aside from protected conservation areas, bamboo harvesting is legal in Ethiopia and is a timber alternative to reduce deforestation pressures.

Recommendations for Management Interventions in Shedem

If the bamboo commercialization process gains momentum in Ethiopia, Shedem will undoubtedly be affected. Potentially locals could lose resource access if the government prioritized the private industry or economic growth over rural livelihoods. A more holistic and beneficial outcome for Shedem would be to use the bamboo demand as an economic opportunity to initiate rural-development and enhance household livelihood security. Private bamboo interests and local NGOs, including FARM Africa, have already begun reconnaissance census and bamboo management workshops in Shedem (Van der Wal et al. 2012). Building the management and organizational capacity in Shedem with the objective of better forest utilization could help the community take advantage of an emerging bamboo sector.

A bamboo inventory should be completed to evaluate the quality and density of Shedem's existing bamboo forest. In addition, community information meetings, facilitated by

the PA and Goba woreda officials or supportive NGOs, should occur to involve and inform Shedem residents. Forest users should have current and accurate information about the forest condition, and be familiar with sustainability and harvesting techniques that help maintain resources over the long term. This information will only interest the community if proper incentives are in place, such as fear of losing resource use (due to degradation or exclusion), or by the opportunity to gain a lease permit for a parcel of bamboo forest.

More secure access to CPRs and land should be prioritized to ensure sustainable bamboo forests in Shedem. The current, open-access system threatens the long term availability of bamboo for Shedem residents. Lack of secure tenure or forest resource access has long been associated with intensified and unsustainable land management practices (Belcher et al. 2005, Godoy et al. 1995). Since Shedem is a remote, forest dependent community with few livelihood alternatives, securing tenure and resource access is crucial for local livelihoods. In addition, Shedem forests lie between two crucial wildlife conservation areas, further underscoring the importance of Shedem's forest for social and ecological benefit.

Any intervention into Shedem's forest management should prioritize the needs of current residents; increased regulation or outside investment in Shedem's bamboo forest (e.g. by private industries or NGOs) should ensure that crucial livelihood needs are met (e.g. forest product use for construction and income generation). As done with agricultural land, the PA can distribute leases for households to access designated forest parcels to promote tenure security and improved bamboo forest management. Without secure land or resource tenure, Shedem's bamboo will likely be increasingly threatened by over-exploitation because it is utilized as an open access resource. For a local market, or if the national or export demand grows, residents

will likely be incentivized to further exploit resources without consideration for long term sustainability.

The above recommendations for Shedem emphasizes the sustainability of their resources for local utilization, or to supply the international demand for bamboo. Linking rural bamboo dependent communities to a larger market has been discussed as a pro-poor market strategy for Ethiopia (Endalamaw et al. 2013, Tadesse 2006), but secure tenure and improved management and regulation should be in place first. If a more efficient, reliable and profitable bamboo market is in Ethiopia's future, local harvesters must balance their desire for income with sustainable harvesting techniques that are tailored to the bamboo production cycle (Chaomao et al. 2006).

4.3. Opportunities and Constraints to Sustainable Bamboo Harvesting in Shedem, Ethiopia

Previous research has summarized common threads of successful CPR management schemes around the world (Agrawal and Gibson 1999, Beck and Nesmith 2001, Ostrom 2000). These principals illustrate what makes CPR management successful at sustaining resources for local users (Ostrom 2000). Agrawal and Gibson's (1999) discussed general conditions that facilitate or constrain good community management of local resource. In the table below, their conditions were used to evaluate Shedem community's potential to best manage their local bamboo forests. Using these elements as a guideline, Shedem community demonstrates strong potential for successful community managed CPRs.

Table 5: Opportunities and constraints to good community management of native bamboo forests in Shedem

Opportunities	Constraints
<ul style="list-style-type: none"> • Users live in relative proximity to each other and are not too scattered • Community has shared norms and values including livelihood activities, religion, ethnicity and language • Users live near to bamboo resources facilitating management and observation of composition changes overtime • Only one resource of interest to manage for • Resource is not difficult to capture and draw boundaries around • Sustainable harvesting techniques are not complicated and require simple and affordable tools • Resource can be locally governed and simultaneously managed in agreement with larger government structures • Little mobility and migration of people coming into the community • Some leadership already exists 	<ul style="list-style-type: none"> • Regulation and monitoring of bamboo is difficult to enforce • Clear forest boundaries and user access/exclusion areas are not established or understood by community • Failure by PA leaders and users to regulate resource access and use • Role of resource users and PA leaders are not clear • No resource access restrictions exist • No consequences for rule breakers

To further detail Shedem’s potential, the below discussion supplements the earlier review of research done by Salafsky et al. (1993) to evaluate existing ecological, socioeconomic and political opportunities and constraints that surround sustainable bamboo market development in Shedem, Ethiopia.

4.3.1. Ecological factors.

Density of Exploited Species

Shedem's bamboo area is estimated to be 2,217 ha (Van der Wal et al. 2012). During the household census collection for this study, researchers, Wilg Van der Wal and Fabio Facchetti from African Bamboo PLC were ground-truthing the area and believed it to be considerably smaller than previous estimates (Wilg van der Wal 2013). No recent information has been published regarding the density of Shedem's forest. This information is crucial to inform any sustainable management strategy.

Temporal Availability

Highland bamboo is available year round, except for during the rainy season which lasts around four months. During this time agricultural production in Shedem is labor intensive, thereby complimenting the bamboo production cycle (Table 1).

Product and Ecosystem Sustainability

Reports estimate that in Ethiopia *Y. alpina* stands persist for 40 years before gregarious flowering and mass die-off occurs in all nearby bamboo clumps (Embaye et al. 2005, Kelbessa et al. 2000). After such time, if left undisturbed the bamboo clumps will slowly develop again, and be available for harvesting in 14-21 years (Wimbush 1945). This curious life-cycle is not well understood by rural bamboo harvesters. In Shedem, Andargatchew (2008) reported that residents fondly recalled a previous bamboo flowering episode where locals used the seed to make bread. Other accounts of bamboo flowering in Ethiopia, like those from Embaye (2000) and Sertse et al. (2011), were less positively received by the local community. Sertse et al. (2011) reported that many bamboo communities in western Ethiopia believe bamboo death was an abnormality caused by disease or infection and clumps will not re-sprout. To cope with the shock of having

temporarily lost bamboo income opportunity, many communities convert the recovering bamboo forest area into agriculture fields or grazing pasture (Sertse et al. 2011).

Local harvesters in Shedem need to be better informed about bamboo biology and management techniques that maintain age diversity and efficient growth. Also, harvesting techniques for proper removal, and understanding of bamboo flowering and regeneration cycles should be emphasized. Addressing these knowledge gaps will support sustainable bamboo management efforts.

4.3.2. Socioeconomic Factors

Resource Tenure and Conservation Incentives

Tenure insecurity and open-access use currently constrains sustainable bamboo use in Shedem village. Shedem's common property resources are not managed for sustainable-use and social regulation is non-existent. The local Peasants' Association administers user-memberships, but they do not monitor user activity, harvesting rates or management techniques; and as noted in this census 12% of village resident are not PA members. Minimal oversight or consideration of sustainable bamboo practices are understood by local harvesters or well enforced by the designated PA authorities in Shedem (Wang 2006). The failure of social regulation over Shedem's CPRs is likely due to lack of enforcement because PA leaders have insufficient influence over residents' forest use, and no consequences occur if residents disobey. The data indicates that Shedem forest users remove what they can to maximize personal gain. No current formal or informal regulations or incentives effectively control harvesting amounts to ensure sustainability or monitoring of the resource.

Land leases are currently only used for agricultural land, but given their success a similar approach could be applied to improve forest management. Household agricultural land leases are issued free of charge to permanent residents (Deininger and Jin 2006). In Ethiopia, these leases

are the best option for tenure security, allowing a household to use the same area of land year after year, and exclude others from encroaching on their leased land area. Often these leased land areas are used for agriculture, holding livestock and constructing homesteads. Land leases for forest parcels would give households the same sense of tenure security and allow them to be responsible for one area of bamboo, eliminating the temptation to harvest bamboo unsustainably, since their individual access will be more secure and incentivize techniques to encourage long term production.

Current open-access bamboo resources do not protect the community's existing common property resources because regulations and individual accountability are inadequate to ensure sustainable management. If marginal land continues to be degraded, Shedem households and the resources they rely on will become increasingly more vulnerable (Amede et al. 2001). Resource tenure reform is critical to conserving Shedem's remaining bamboo resources.

Physical and Social Infrastructure

Social infrastructure could potentially be strengthened through improving the efficacy of the PA system. Harvesters who do not have permission from the PA should be addressed to understand what prevents residents from joining the PA and harvest CPRs legally. If the regulation process is more transparent and inclusive maybe residents will be more likely to comply with management decisions. Furthermore, the PA could offer additional membership benefits including workshops to learn about value enhancement techniques and improved management. A demonstration plot of cultivated bamboo at the PA headquarters could show residents how to begin a household plot, and what preparation and upkeep is involved. Enhanced social capital in Shedem will help local-level market agents (i.e. harvesters) become more powerful stakeholders in the market; and empower households to improve resource management and their livelihood security.

Currently, one of the largest constraints to many households in Shedem is insufficient livestock to haul bamboo to market. Furthermore, for Shedem village and many other rural communities in Ethiopia, the lack of a road makes transportation slow and dangerous. Road expansion projects are underway throughout Ethiopia, but will take several years to complete. Reliable access and available transportation to carry market goods is imperative for supplying bamboo buyers and securing a reliable flow of products and revenue.

Market Demand

Increased profitability could make bamboo harvesting less sustainable and restrict access for local households in the adjacent rural community. Potential outcomes of expanding bamboo markets should be anticipated to minimize adverse effects to rural households and communities. Bamboo dependent households have little capacity to overcome limited access and should be intentionally incorporated to benefit and help sustain the resources they depend on. Under ideal circumstances, larger bamboo market demand could encourage sustainable harvesting, value added processing, and product development to benefit rural household livelihoods.

4.3.3. Political factors

Political Power of collectors

PA leaders are the recognized legal form of government in Shedem, but their effectiveness to monitor forest use by local residents is insufficient. Increased reinforcement of forest regulations and more individual accountability will improve forest management (Amente et al. 2006). Exclusive access to local resources by Shedem residents should continue, but increased tenure security and more formal training regarding management techniques would benefit all. Securing rights to utilize local environmental resources will empower local residents to manage them sustainably (Arnold and Pérez 2001).

All residents in Shedem have access to the local forests and most pay to legally harvest bamboo. Some households (n=45, 12%) harvest bamboo without legal permission, which indicates the fee is too high, making access exclusive, or that the PA and user regulation laws are not respected or agreed upon by all community members. Those who pay the fee are considered a forest association member, but their membership only grants harvesting rights, not political power to determine the prospects of their community's resources or their future livelihoods. Community-level organization and enforced regulations must occur if harvesting rates increase or prior to the establishment of larger bamboo processing companies. Politically strong community groups will have more clout to negotiate prices with outside commercial interests.

Outside pressures on bamboo dependent communities such as Shedem are in the early stages (McKenna 2013). Currently outside interests are scoping for areas with abundant bamboo resources. Towns with organized bamboo groups and road access are preferred because harvesting and transportation exist (Van der Wal et al. 2012) If the bamboo market expands in Ethiopia, local harvesters, such as Shedem residents, could lose their bamboo forest access to foreign interests because they lack political power and do not have secure, government recognized land or resource tenure.

Pressure for Alternative Land Uses

Shedem forests are threatened by land conversion to agricultural or grazing uses (FARM Africa 2008). Strengthening the market value of bamboo and empowering residents to be stewards of their local resources provides an incentive to maintain bamboo forests (Belcher et al. 2005). At present however, the profitability of cultivated food crops is greater than bamboo, which encourages bamboo forest conversion for agricultural use and grazing.

Converting forests or bamboo thickets to agricultural land requires high labor inputs. Maintaining bamboo thickets or cultivating new stands requires infrequent upkeep and

considerably fewer inputs. Households with low labor availability benefit from cultivating bamboo as it requires few inputs, is low risk, and easy to maintain. Additionally, native bamboo provides ecosystem services, including soil moisture retention, erosion control, and maintenance of soil fertility (Assaye et al. 2014). Alternative cash crops are generally more labor intensive than NTFP harvesting, but offer greater profit for Shedem households.

Unlike cash crops which are harvested and sold annually, or livestock investments which suffer from fluctuating market prices, mature bamboo stands could potentially provide income throughout the year (except during the raining season when culms grow). If market demand increases, bamboo profit potential will compete with alternative agricultural or off-farm livelihoods. Culm prices are between 4-6 ETB/culm (\$0.22-\$0.33); the price varies depending on the season and demand. A horse can carry two 24-culm bundles of thin bamboo for a profit of 48 ETB (\$2.67) or two 10-culm bundles of large bamboo that sell for 80 ETB (\$4.44). In Bale, this animal load is more profitable than potato or carrots, although most other agricultural crops such as garlic and barley are more profitable than bamboo.

4.4. Additional Research Needs and Recommendations

Growing foreign investments and interest in Ethiopia's bamboo suggest that this resource has the potential to help alleviate rural poverty (McKenna 2013). To achieve this endeavor, additional gaps in research and local understanding should be addressed. Due to the lack of information about bamboo in Ethiopia more research is needed to understand the cultivation of *Y. alpina*, and how it compares to exotic bamboo species that are proposed for plantation development. Furthermore, any research regarding household level use and reliance upon bamboo resource would better inform the growing Ethiopian bamboo market.

Few renewable natural resources have a robust international market demand and a demonstrated history of sustainable management (Singh 2008, Xuhe 2003). Many communities

in Ethiopia's bamboo growing regions already have experience and are invested in bamboo management (Assaye et al. 2014, Desalegn and Tadesse 2014, Endalamaw et al. 2013, INBAR 2005). I recommend that Shedem households cultivate native bamboo plots as a means to improve management and harvesting techniques while increasing bamboo production and overall livelihood resilience. Building upon social capital and native resources is arguably a better investment than introducing exotic species with unknown and unpredictable ecological affects.

In addition, a thorough inventory assessment of the native bamboo forest should be completed to inform local harvesters and to determine what measures are needed to improve and sustain production. Capacity building efforts also are needed to improve local management and enforce harvesting regulations. Sustainable management is unlikely to be achieved if there is community dissatisfaction or mistrust with PA leaders. Efforts to improve the relationship between Shedem residents and local government officials should be done with a more collaborate approach, that is transparent and provides residents compliance incentives and increased forest management and harvesting skills training.

The contribution of bamboo resources to Shedem residents, particularly among poorer households, underscores the need to involve them in bamboo resource management and market development. Failure to engage all households, particularly those most dependent on bamboo, in resource management and development efforts could destabilize the community and intensify unsustainable harvesting pressures (Belcher et al. 2005). Investing in Ethiopia's social and natural capital (i.e., native bamboo species) is likely to be more sustainable and more beneficial to poor rural households than introducing exotic bamboo species into plantation or training individuals who are largely unfamiliar with bamboo.

Chapter 5: Conclusions

This study has revealed that dependence upon and extraction of bamboo varies greatly among households in Shedem, Ethiopia. Censuses collected from 362 households (82%) exemplify how household assets can influence bamboo extraction and income generation. Livestock ownership, area of land leased and number of household members were all found to influence bamboo income earning potential. Bamboo income was of secondary importance for Shedem households; agricultural income contributed more income to households overall.

Bamboo is utilized by all households in Shedem, but is more significant to low-income residents; households in the two lowest quintiles (n= 346, 96% of total) are much more dependent on bamboo harvesting for income generation. The poorer households have less agricultural land, less livestock, fewer household members, and less education overall than better off households. Conversely, higher income households (quintiles 4 & 5, n=5, 1% of total) harvest more bamboo because they have more assets (e.g., animal and human labor) that facilitate harvesting and transportation to market, but are less dependent upon bamboo for household well being.

These research results are consistent with other studies that found poorer households are more forest dependent, but do not derive as much income from the forest as wealthier households (Cavendish and Campbell 2008, Godoy et al. 1995, Yemiru et al. 2010). However, unlike research that concluded forest incomes reduced the income gap between poor and better off rural households (Babulo et al. 2009, Beck and Nesmith 2001, Cavendish 2000), this research found that NTFP harvesting accentuates household income disparities because wealthier households secure much greater profits from bamboo than poorer households. Any efforts to develop

sustainable management recommendations must recognize that cost-benefit opportunities and constraints differ among households.

Bamboo contributes resources and income for many poor rural communities in Ethiopia; however, many of these harvesters lack sufficient land or resource tenure security, political power, resource management skills, and access to a stable market demand. Any decisions regarding bamboo as a CPR should be made with all harvesters to ensure equity and transparency regarding information distribution, decision making and delegation of responsibilities (e.g. residents holding each other accountable).

Economic, social and environmental benefits can potentially be realized through sustainable exploitation of native bamboo by rural Ethiopian communities. Individuals already familiar with bamboo harvesting may be able to supply the growing bamboo market by harvesting from natural forests and cultivating native bamboo. Overcoming barriers that constrain bamboo marketing could provide new opportunities for rural employment by linking urban market forces with rural livelihoods. Realizing the potential of Highland bamboo in rural Ethiopia requires attention to natural and human capital that have long been overlooked.

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Appendix A: Shedem Household Census

Date		Name Head of household			Member association (Y/N), if Y specify...		
Name of data collector:				GPS location			
1. Household overview							
a. Household composition							
Ref nr	Names of family members living in the household	Age	Marital Status (single/ married/ divorced/widowed)	Highest Educational Standard Obtained (grade...)	No. Of years living in the Shedem kebele	Illness (Y/N)	If Y, which kind of illness? (respiratory, water/food contact, animal contact, etc.)
1							
2							
3							
4							
5							
6							
b. Migration patterns							
Ref nr (household member)	Migrancy: Individual present (P) /absent (A)	If (A) absent: Where are they?	If (A), why are they there? (work, family, health, education, etc.)	Temporary settlements outside Shedem kebele (Y/N)	If Y, where?	If Y, which months are the temporary settlements inhabitant by (members of) your household ? (months)	
1							
2							
3							
4							
5							
6							
c. Labor patterns							
Ref nr (household member)	Occupation	Other skills/ trades	Where do you work?	In which months?			
1							
2							
3							
4							
5							
6							

2.. Household Income					
		Estimates per dry season/ rainy season (birr)		Remarks	
Employment					
Agriculture					
Bamboo					
Trade/household enterprise					
Handicraft of bamboo products					
Handicraft of other products					
Timber					
Migrant remittances					
Pensions					
Rent of housing and property					
Rent of livestock (e.g. horses)					
3. Household expenses					
		Estimates per month (Ethiopian birr)			
Food					
Clothing					
Energy sources (wood, charcol, electricity etc.)					
Education					
Health					
Others					
4. Household Structures and Assets					
	No.	Remarks		No.	Remarks
Home type (mud, wood, brick/corrugated iron, etc.)			Land Agri (plots/ ha)		
Shed for animals			Stove		
Latrine			Other,....		
No. Of chicken					
No. Of horses					
No. Of goats					
No. Of sheep					
No. Of cows					
No. Of donkeys					
No. Of mules					

5. Household Agricultural production							
a. Cash crops							
	grown yearly		crop rotation (identify seasons)		crop yield= agricultural output (good/medium/poor)	Own use (specify..)	Sale, specify (estimated income per year/ where)
	Y	N	Y	N			
Coffee (NTFP)							
Honey (NTFP)							
Cabbage							
Potato							
Tomato							
Green chili							
Garlic							
White onion							
Carrot							
B. Food crops							
	grown yearly		crop rotation (identify seasons, dry season/rain season)		crop yield= agricultural output (good/medium/poor)	Own use (specify..)	Sale, specify (estimated income per year/ where)
	Y	N	Y	N			
barley							
wheat							
maize							
beans							
peas							
oats							
Others, specify...							
c. Timber							
	Extracted from forest?		Monthly animal loads and estimated monthly income		Purpose		
			Loads	Est. monthly			
	Y	N	Loads	Est. monthly	Own use	Sale, specify (estimated	Exchange, specify (for

				income	(specify..)	income per year/ where)	what/where)
Bamboo							
Erica Arborea							
Juniper							
Others, specify...							

6. Household resource use

a. Energy sources

	Purpose (cooking, heating, isolation, construction etc.)		Used estimates per year (kg)	Remarks
	Y	N		
Charcoal, specify (which kind...)				
Wood, specify (which kind..)				
Dung				
Kerosene				
Solar power				
Generator				
Gas				
Others, specify...				

b. Water sources

	Purpose (cooking, heating, cleaning etc.)		Used estimates per day (liters)	Remarks
	Y	N		
Stream/ river				
Well/ borehole				

7. Comments

	Concerns about...	Solutions
Forest (bamboo, timber)		
Agriculture		
Road expansion		
Education		
Health		

Name and signature Supervisor.....

Name and signature Field researcher.....