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Role of forest in household livelihood strategies in mountainous areas of Northwest Cameroon

Master Thesis

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Declaration

I hereby declare that this thesis entitled "*Role of forest in household livelihood strategies in mountainous areas of Northwest Cameroon"* is my own work and all the sources have been quoted and acknowledged by means of complete references.

Prague, 23 April 2015

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Bc. Kristýna Poláková

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Abstract

Forest resources provide substantial contributions to the wellbeing of many rural dwellers across tropical forest regions. Natural forests of importance to poor are mostly open access resources, and typically are found in remote areas with poor infrastructure and difficult market access. In recent years, there has been growing recognition that mutual forest-household interactions have becoming less sustainable, unfortunately to the detriment of the forest. The purpose of the thesis is to understand the importance of forest environmental resources for forest dwelling communities in unprotected montane forest in Bamenda Highlands, Northwest Cameroon. Data regarding to key socioeconomic characteristics of forest-dependent households and their attitudes to the forest resource utilization and conservation were collected through 63 semi-structured questionnaires. Furthermore, GPS mapping was included in order to carry out a spatial analysis of the relationship between livelihood strategies and the forest resources utilization. Data from questionnaires were analysed and evaluated using MS Office Excel and GPS data were processed using the ArcGIS 10.2.2. Results showed strong dependence of local household on forest resources for fulfilling their livelihoods objectives. There were identified three distinct livelihood strategies in relation to the level of forest use and the degree of reliance on forest environmental products. Factors that influenced the level of forest use among the identified groups included the altitude level, market access, off-farm opportunities and social factors. These findings contribute to overall understanding how specific household factors influence forest use and can contribute for conservation, environmental and development activities and further research in particular area.

Key words:

forest resource utilization, forest dependence, household survey, traditional knowledge, resource analysis, household analysis, spatial analysis, Tubah Upland Forest, Bamenda highlands, Cameroon

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List of Abbreviations

CBD	Convention on Biological Diversity
CFA	Central African Franc
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GIS	Geographic Information System
GPS	Global Positioning System
NGO	Non-Governmental Organization
NTFPs	Non-timber Forest Product
UNDP	United Nations Development Programme
USD	United States Dollar
WRI	World Resources Institute

1 Introduction

Forests play an important role in human societies since the beginning of a mankind. Humans have always exploited the natural environment to supply their basic needs, especially since the beginning of the Neolithic revolution (Mauro, 2011; FAO, 2012). People began, in many places on Earth, gradually, but radically transform the entire landscape. In doing so, the balance of nature, or ecological equilibrium, was altered. Reducing forest areas with the dawn of agriculture is often considered as one of the most significant changes that man remarked the nature (Upton, 1996).

In present days, approximately one third of the Earth's surface is covered by forest, out of which more than one third represents tropical primary forests (FAO, 2010). Definitions of forest resources slightly differ among each other, nevertheless, they usually describes forest as renewable and dynamic resource, providing multiple benefits such as sustaining natural life cycles, biodiversity and prosperity of human kind (Mertens, 2011; EPI, 2014). However, there is existing evidence of large changes in biodiversity as a result of anthropogenic alterations of forest ecosystems, particularly the conversion of forest land into agro-pastoral systems (Steffen *et al*., 2004; Foley *et al*., 2005**;** Kareiva *et al*., 2007; Ellis *et al*., 2013). Anthropogenic habitat modification in the tropics has generated intense concern, because these regions suffer the highest rates of forest loss, fragmentation, and degradation (FAO, 2010a). Therefore, the conservation of tropical forest is one of the most important challenges nowadays (Nasi and Frost, 2009) as tropical deforestation has become an issue of global environmental concern (Scrieciu, 2007). Any proposed solution of this issue will always face a challenge to employ a multidisciplinary approach, as most of the biologically rich and threatened forests around the world are home to some of the world's poorest and most vulnerable communities (Colchester *et al*., 2001; FAO, 2010).

For millions of rural dwellers living in forest environments, the forest form a dominant part of their physical, material, economic and spiritual lives. The forest provide a wealth of material outputs of subsistence or commercial value as well, which is the basis for livelihood systems based on hunting and gathering, and/or for rotational agriculture systems. Thus, this constitutes an integral part of the habitat and of the social and cultural

framework for those living near or in forest land (Byron and Arnold, 1999; Angelsen and Wunder, 2003; Sunderlin *et al*., 2005; Scrieciu, 2007; FAO, 2010).

Tropical African mountains in general support many rural people because they have more favourable climates than surrounding lowland areas, and therefore are more suitable for the establishment of agricultural systems (Blyth *et al*., 2002). However, at the same time these tropical highland regions are also among the most vulnerable areas (Simane, Zaitchik and Ozdogan, 2013). This typical example in Cameroon, a central African country that harbours a wide range of biological resources with a status to be the fourth most diverse country in Africa (UNDP, 2001; CIA, 2014). Forest resources are estimated to cover about 42% of the country (FAO, 2012) and forestry has been included in the country's poverty reduction strategy (Blaser *et al*., 2011). In Cameroon like elsewhere in the Congo Basin, both urban and rural populations depend directly and indirectly on the forest resources for their basic needs and well-being (Eyebe *et al*., 2012; Sonwa *et al*., 2012). Particularly the Northwest Region of Cameroon represents one of the few places in the world where tropical montane forest could be still found (Bubb *et al*., 2004; Ndenecho, 2005b; Cheo, 2011) and the natural habitat of the Bamenda Highlands, a part of that region, possess the largest remaining Afromontane forest in West Africa (DeMarco *et* al., 2001; Ingram and Nsom Jam, 2007). Recent estimations show that 80% of the original forest cover of the Bamenda Highlands was lost due to anthropogenic pressure (Ingram and Nsom Jam, 2007). Thus, a primary conservation challenge in the African tropical mountains is to document recent livelihood strategies in densely populated areas, which are strongly dependent on forest resources, but still suffer from poor human infrastructure and high levels of poverty (Burgess *et al*., 2007).

As the major constraint to potential use of forests in poverty alleviation is the lack of attention to the socioeconomic role of forests and also the lack of accurate and reliable regional or international data on forest dependent communities (SSC, 2000; FAO, 2014). Another issue is represented by the lack of effective action to ensure the involvement of the indigenous people and forest communities into the process of conservation in Cameroon (Dkamela, 2011; Gunilla, Olsson and Outtara, 2013). Due to these circumstances and the fact that the future of the forests around the world depends closely on a well-being of a large number of forest communities, there is growing demand for

studies documenting the relationship between forests and livelihoods (Pouliot and Treue, 2013; Porro, 2015). Therefore, the aim of the thesis is to document resources, household and spatial analysis as well as livelihood strategies of forest dwellers in the area of Bamenda Highlands, particularly in Tubah Upland Forest in mountains are Abongphen and village Big Babanki. Additionally, to document their present knowledge and attitudes about utilization of forest resources that surrounds them.

2 Literature Review

2.1 Importance of tropical forest ecosystem

Nowadays approximately 31% of the Earth's surface (around 4 billion hectares) is covered by forests, out of which more than one third represent primary forests, in particular tropical moist forests (FAO, 2010). Tropical forests represents the most ancient, the most diverse, and the most ecologically complex of land communities (Myers, 1992). Forests are a renewable and dynamic resource, providing multiple benefits to different users (Mertens *et al*., 2011). In general, forests play a critical role in sustaining natural life cycles, biodiversity and the prosperity for humankind as they provide a wide range of ecological services, stabilize climate, regulate water supplies via buffering floods and droughts or mitigate the adverse effects of greenhouse gases emissions (EPI, 2014). They also serve as a biodiversity harbour, hosting at least 60% of the terrestrial biodiversity (Myers *et* al., 2000; Dirzo and Raven, 2003) and contain about 82% of the terrestrial biomass (Randolph *et al*., 2005). At regional and global scales, tropical forests also have an enormous influence on the global carbon cycle (Laurance, 1999; Maginnis and Jackson, 2005; Moran and Ostrom, 2005), containing around 25% of the carbon in the terrestrial biosphere (Bonan, 2008). At the same time, tropical forests do far more than sustain biodiversity, they are also homes to indigenous peoples, pharmacopoeias of natural products, and provide vital ecosystem services, such as soil conservation (Laurance, 1999).

2.2 Population pressure versus forest ecosystems, deforestation and forest degradation

Over a period of ten thousand years, the human population has grown from a few millions to more than 7 billion (Moran, 2010). Namely recent decades have witnessed the most rapid population growth, which was nevertheless not equally distributed and around six billion people live in less developed countries (PRB, 2014). Human settlements, biological richness and environmental degradation have converged and it has changed significantly

the relationship between people and the environment (Williams, 2013). Over time, the interaction between humans and forests has changed in response to social and economic changes, unfortunately to the detriment of the forest (Moran, 2010).

All around the world we see evidences of environmental change (Moran and Ostrom, 2005). Periodic deforestation has accompanied population growth and development for thousands of years, throughout the world and the most pronounced is in tropical countries (Moran, 2010). Tropical forests are being cleared, burned, logged, fragmented, and overhunted on a large scale (Laurance and Bierregaard, 1997). Therefore, typical tropical forest landscapes we can see today are more likely to be a mix of primary forest, managed forest, secondary forest and degraded forest lands interposed with extensive areas of other, non-forest land uses (Maginnis and Jackson, 2005). Changes in land cover, most notably those affecting tropical forest ecosystems are occurring an unprecedented rates and forests continue to be converted at alarming rates (Goudie, 2002; Davidar *et al*., 2010) with the annually decrease of primary forest by 0.4% during the last ten years (FAO, 2010). The clearance and degradation of tropical forests account for about 20% of annual CO_2 emissions worldwide (IPCC, 2006). As a result, more than two billion hectares of forests worldwide are degraded (Minnemayer, Laestadius and Sizer, 2011) with approximately half in tropical countries (ITTO, 2002).

The population pressures are frequently cited as the main cause of deforestation. The general consensus is that the population growth increases the demand for food and the need for income, which in turn encourages the conversion of forestland to agricultural or other income generating uses (Scrieciu, 2007). There is existing evidence of large changes in biodiversity and loss of species as a result of anthropogenic alterations of global ecosystems (Foley *et al*., 2005; Kareiva *et al*., 2007; Ellis *et al*., 2013), particularly conversion of forests and savannahs into agro-pastoral uses (Steffen *et al*., 2004). Poverty and impoverishment of rural people who live in forests frontiers is one of the major causes of environmental degradation (Angelsen and Wunder, 2003) which converged to the fact that the most common immediate cause of forest conversion is to create space for commercial or subsistence agriculture (Angelsen and Kaimonitz, 1999; Hesperger *et al*., 2010; Hosonuma *et al*., 2012).

2.3 Forest conservation efforts

The conservation of tropical forests is one of the principle challenges in present-days (Nasi and Frost, 2009). The rapid deforestation and degradation rate spurs a sense of urgency to protect forests and tropical deforestation has become an issue of global environmental concern due to its likely substantial negative consequences upon world climate and biodiversity (Scrieciu, 2007). In recent times, the expectation for forest conservation, afforestation and reforestation is increasing and attracting attention of global conservation initiatives (Mauro, 2011). For example, the area of planted forest in 2010 accounted for 7% of total forest cover (FAO, 2010). Policymakers increasingly acknowledge the significance of forest ecosystems as scientists place greater emphasis on the role of forests as carbon sinks to combat climate change and in regulating the hydrological system (EPI, 2014). In this context, it had led economists to increase their efforts to explain the driving forces of deforestation and conversion of forests to other land uses (Scrieciu, 2007). Furthermore, governments, international donors and NGOs are increasingly looking for the forestry sector as poverty alleviation tool (Arnold, 2001; Sunderlin *et al*., 2008). As the major constraint to mainstreaming the potential use of forests in poverty alleviation is considered a distinct lack of empirically based knowledge and forest related data in household economies and rural development across the developing world (Oksanen, Pajari and Tuomasjukka, 2003; FAO, 2006; FAO, 2008; RECOFTC, 2009). This generally led to the underestimation of the forest sector´s importance to rural livelihoods and economic development and the real forest´s value and services are incorrectly attributed to other sectors or utterly omitted and potential of forests to alleviate poverty is largely unrealized (Vedeld *et* al., 2004; FAO, 2008; PROFOR, 2008).

One of the oldest conservation efforts is Hotspot concept, which was adopted by Conservation International already in 1989 as its central global conservation strategy (Conservation International, 1990; Mittermeier *et al*., 2005). Afterwards, this concept has become one of the major conceptual templates among conservation scientists (Roberts *et al*., 2002; Sechrest *et al*., 2002; Willis *et al*., 2006; Turner *et al*., 2012). Other international forest conservation initiatives including the UN´s programme on Reducing Emissions from Deforestation and forest Degradation (REDD+) (UNFCCC, 2006; Strassburg *et al*., 2009)

and the Convention on Biological Diversity (CBD, 2002). Many conservationists view strict protected areas as the only assured means of preserving the last remnants of the natural landscape from human encroachment and human-induced deforestation (Joppa, Loarie and Pimm, 2008). But this protectionist way generate social costs among the rural poor in developing countries who live in these zones (West, Igoe and Brockington, 2006; Adams and Hutton, 2007). There is also growing consensus that protected areas should be a part of the solution to poor people´s problems from these zones and not to create new ones (Abbot *et al*., 2001). For these reasons, there is a growing literature that endeavour to draw attention to the importance and challenges of biodiversity conservation in human-dominated, mixed-use landscapes (Marrs *et* al., 2007; Harvey *et al*., 2008; Perfecto and Vandermerr, 2008; Chazdon *et al*., 2009; Persha *et al*., 2010).

2.4 Forest dependent people

Evidence for climate change, loss of biodiversity, rapid deforestation in the tropics and impending crisis in availability of potable water during the last decades has resulted in the rapid development of research on the human influences on global environmental change (Moran, 2010). The interconnected relation between human and natural systems in recent times attract the attention in wide society and has led to a greater focus on the interactions and multi-scalar relationships between social and ecological outcomes (DeFries *et* al., 2007; Chazdon *et al*., 2009). Almost all of the world's remaining natural forests tend to be concentrated in areas which have been and still are traditionally used and inhabited by indigenous and rural communities (Colchester *et al*., 2001). It is a common fact that people living in remote areas are dependent on natural resources which are available around them (FAO, 2014). Remoteness also limits opportunities for some alternative employment or income due to the long distances from markets, government services and other urban amenities (Sunderlin *et al.,* 2005; Belcher, Achdiawan and Dewi, 2015). These factors also influence the forest use and therefore people living in or near the forests are the one who are the most dependent upon forest for their livelihood (Angelsen and Wunder, 2003). There are a lot of case studies which demonstrate that "forest dependency" is higher in the areas with high forest cover in comparison with the areas with less forest resources (Coomes, Barham and Takasaki, 2004; Fischer, 2004; Kamanga, Vedeld and Sjaastad,

2009; Zenteno et al., 2013). According to Chao (2012), the term "forest people" refer to the people who are "*traditionally live in forests and depend on them primarily and directly for their livelihoods."* These communities have customary rights to their forests and based on traditional knowledge, practices, rules and beliefs have developed ways of life that are attuned to their forest environment (Chao, 2012). These populations usually include the most disadvantaged, vulnerable, and often the politically weakest parts of the society and therefore the forests are their main means of meeting contingencies and mitigating risks from unforeseen events (FAO, 2010). It is known that there is the lack of attention to the socioeconomic role of forests and also the lack of accurate and reliable regional or international data on forest dependent people, their numbers, livelihoods and circumstances (SSC, 2000; FAO, 2014). Existing data on numbers of forest people worldwide differ among each other. For example, World Bank (2001; 2004) estimates that about 1.6 billion people around the world are dependent to some degree on forest for their livelihoods and in developing countries, about 1.2 billion people rely on agro-forestry farming systems. There are an estimated 500 million forest-dependent people of which 300-350 million people are highly dependent on forests and live within or adjacent to dense forests of which they depend for their subsistence and income. Roughly a quarter of the world´s poor and 90% of the poorest depends substantially on forests for their livelihood. According Chomitz *et al.* (2007), approximately 805 million people worldwide live directly in the tropical rainforest.

2.5 Role of forest in livelihood strategies

Following Angelsen and Wunder (2003), there are distinguished three major roles of forest income in rural livelihoods: (i) supporting current consumption needs, (ii) providing safety nets in response to shocks and gap-filling of seasonal shortfalls (Shackleton and Shackleton, 2004; McSweeney, 2005; Paumgarten, 2005), and, (iii) providing means to accumulate assets and therefore serve as a pathway out of poverty. Case studies from different parts of the developing world confirm that the environmental income play a critical role in rural livelihoods and show forest products contribution to total household income ranging between 22% and 40% (Mamo, Sjaastad and Vedeld, 2007; Vedeld, 2007; Angelsen *et al*., 2014). Although there are methods that may be used to assess the economic importance of forests to household livelihoods (Campbell and Luckert, 2002),

according FAO (2008), there is generally institutional failure to collect forest-related income data across developing world and therefore there is significant underestimation of the forest sector importance to rural livelihoods and economic development.

According to Chambers and Conway (1991), livelihood can be defined as a capacity of people to maintain a living or by broader definition from Warner (2000), "*livelihood comprises the capabilities, assets and activities required for a means of living."* Livelihood strategies denote the range and combination of activities and choices that people make to undertake ways of combining and using assets in order to achieve their livelihood goals (DFID, 1999). Rural households across developing world pursue a wide range of livelihood strategies. Some households rely on one or few activities, while most of them typically have a wide livelihood portfolio, encompassing a range of activities (Cavendish, 2001; Babulo, 2008). According to Ellis (1998), livelihood diversification is defined as "*process by which rural families construct a diverse portfolio of activities and social support capabilities in order to survive and to improve their standards of living.* " Livelihood diversification increasingly becoming a livelihood strategy throughout the developing world and there is an evidence showing livelihood diversification as a key concept not only to greater wealth but to reduce vulnerability, minimize risk exposure and strengthen livelihood system (Barret, Readorn and Webb, 2001; Block and Webb, 2001; Niehof, 2001; Smith *et al*., 2001). Many researchers suggest livelihood diversification to be a strategy for simultaneously promoting poverty reduction, economic development and environmental sustainability in poor regions with fragile ecosystems (Pichon, Uquillas and Frechione, 1999; Ellis, 2000; Angelsen and Kaimovitz, 2001; Lee and Barrett, 2001).

There are strong evidences that forest environmental resources provide a substantial contribution to the well-being of many rural dwellers and it is clear that forest and forest products are important in current livelihoods across the developing world both for regular subsistence and as a source of income improvement (Ruiz-Perez *et al*., 2004; Vedeld, 2007; Babulo, 2008; Poulito and Treue, 2013; Belcher, Achdiwan and Dewi, 2015; Porro, Lopez-Feldman and Vela-Alvarado, 2015). Forest can fulfil various roles in the livelihoods of the millions of rural dwellers who live in and near forests in the form of food, fuel, forage, NTFPs, timber, building materials, medicines, access to fresh water through the watershed function of forests and other resources taken from the forest or produced on

recently cleared forest soil (Byron and Arnold, 1999; Angelsen and Wunder, 2003; Sunderlin *et al*., 2005; Scrieciu, 2007).

Both wealthier and poorer households rely on forests resources. Although wealthier households tend to extract greater quantities of forest products, there is strong evidence that poorer household are more dependent on forest resources for their livelihood (Cavendish, 1999; Angelsen and Wunder, 2003; Mamo, Sjaastad and Vedeld, 2007; Sunderlin *et al*., 2008). Particularly rural people in remote mountains areas where off-farm income opportunities are limited and access to capital is major constraint (Hogarth *et* al., 2013; Fang *et al*., 2014) rely more on forest resources, are more dependent on forest products and have higher shares of environmental income (Byron and Arnold, 1999; Angelsen *et al*., 2014). There is also discussion whether forests are critical for supporting the well-being of the poor because of their unique functions and resources that provide or only for the reason that they usually tend to share the same place with the poor because high poverty rate is characteristically found in areas of high forest cover (Sunderlin, 2008). Also forest dependency may put local households into a poverty trap, because poverty causes forest loss and therefore lower supplies of forest in the future (Scherr, White and Kaimowitz, 2003; Shively, 2004; Maginnis and Jackson, 2005; Sunderlin, 2005).

2.6 Forest and livelihood in sub-Saharan Africa with special regards to Cameroon

Most of the forested regions of sub-Saharan Africa share common characteristics - they are extremely diverse, support a tremendous amount of biodiversity and endemism, store huge amount of carbon and at the same time possess high levels of poverty and population densities (Marrs et al., 2007). The forest of sub-Saharan Africa (see Figure 1) cover an area of 585 million hectares (Dieng et al., 2009) with an alarming rate of deforestation - 2.8 million ha per year, particularly in Afromontane areas the decrease is estimated to be 3.8% annually (Eva, Brink and Simonetti, 2006). Most immediate reasons for forest losses include the expansion of agriculture into forest lands, population growth, poverty, high dependency on natural resources for subsistence and income, and economic pressures to increase exports of agricultural produce, timber and minerals (Geist and Lambin, 2002;

Brink and Eva, 2009; Dieng et al., 2009). Also development of roads and railroads increased settlements and provided access to previously inaccessible forest interiors (Marrs et al., 2007). Globally, most of the remaining suitable and as yet unconverted land is located in sub-Saharan Africa (Burgess et al., 2007).

The population of sub-Saharan Africa has doubled in the past 25 years and is the only major region in the world where the rural population is projected to grow until the 2040s (Dieng *et al*., 2009). Rural households across sub-Saharan Africa commonly diversify their livelihood activities to generate income and meet their livelihood objectives and thus largely depend on environmental resources (Ellis, 2000; Barrett, Readorn and Webb, 2001). Except their renewability, environmental resources differ from other economic activities also in terms of their spontaneous occurrence and the fact that they are often held under communal tenure. As a result, these considerable sets of resources are effectively provided free to the households and they might be termed as the "supermarket of the wild" (Cavendish, 1999). An estimated 65% of the population of sub-Saharan Africa is rural and interact with forests and woodlands daily, whether as nomads or sedentary farmers (Dieng *et al*., 2009) and thus forest and forest resources are critical for the livelihoods as they provide a range of products, services and functions, e.g. food, fuelwood, medicine, building materials, shelter, fuel, timber, honey, gum, fodder and cash income (Kaimowitz, 2003; Mamo, Sjaastad and Vedeld, 2007; Temesgen *et al*., 2007; Dieng *et al*., 2009). Overall, the current literature shows that vast majority of people in sub-Saharan Africa earn substantial part of their cash income from forest (Oksanen and Mersman, 2003) and case studies from sub-Saharan Africa show forest products as an important source of income contributing to household income ranging between 27% - 57% (Harris and Salisu, 2003; Fisher, 2004; Mamo, Sjaastad and Vedeld, 2007; Babulo *et al*., 2009; Yemiru *et al*., 2010; Tesfaye *et al*., 2011; Abebaw *et al*., 2012; Schaafsma *et al*., 2014). Forest also play an important roles in maintaining clean and healthy watersheds that sustain forest-dwelling people and urban population alike (Dieng *et al*., 2009). Despite the accumulating evidence on the importance of forest and environmental incomes to rural households in Africa, very few quantitative studies have been conducted in sub-Saharan Africa (Pouliot and Treue, 2013).

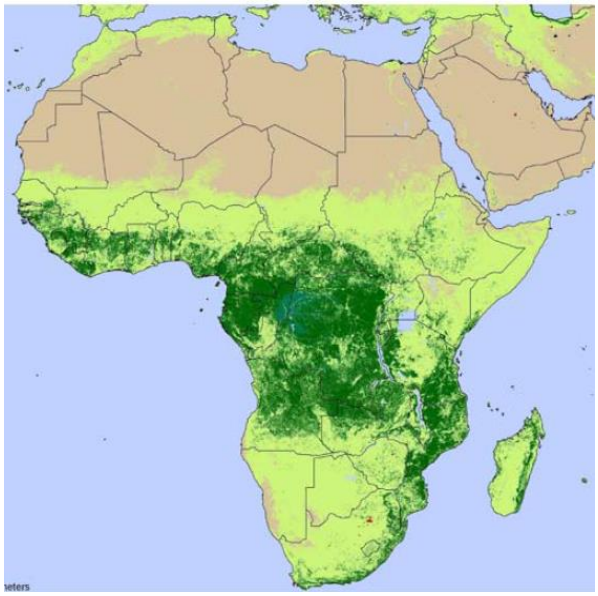

Figure 1 Forest cover in sub-Saharan Africa, Source: Dieng et al. (2009)

Cameroon is the Central African Republic with a land area of 472,710 km^2 located north of the equator. It is bordered by Nigeria to the west, Chad to the northeast, Central African Republic to the east, and Congo, Gabon and Equatorial Guinea to the south (see Figure 2). Population of Cameroon is about 23 million people with population growth rate of 2.6% annually. Cameroon has relatively young population with 62.5% of the population under 25 years old, so dependency ratio is high – 85.1% (CIA, 2014).

The country harbours a wide range of biological resources such as petroleum, bauxite, iron ore and timber and it is fourth most diverse country in Africa after Democratic Republic of Congo, Tanzania and Madagascar (UNDP, 2001; CIA, 2014). Cameroon is endowed with a myriad of vegetation types and diverse terrain (WRI, 2015). Climate varies with terrain, from tropical along coast to semiarid and hot in the north (CIA, 2014). The southern part of the country constitutes part of the Congo Basin forest which is considered as the second largest intact tropical rainforest hot spot in the world after the Amazon Basin in Latin America (Pokam and Sunderlin, 1999; Mayuaxn *et al*., 2004; FAO, 2005; Ndoye and Awono, 2005; Hoare, 2007; Wasseigre *et al*., 2009; Cheo, 2011 Epule *et al*., 2011).

Anglophone Cameroon - the Northwest and Southwest Regions are one of the few places in the world where tropical montane forest systems are found. These are particularly

important centres for plant and faunal endemism, particularly among birds and vascular plants (Bubb *et al*., 2004; Ndenecho, 2005b; Cheo, 2011).

Figure 2 Geographical map of Cameroon

Source: http://www.un.org/Depts/Cartographic/map/profile/cameroon.pdf

The northern part of the country is dominated essentially by tropical grasslands mixed with some arid trees. In the Adamawa region and Extreme north region predominantly savannah

vegetation can be found (WRI, 2015). Persistent and recent problems in Cameroon include environmental degradation, deforestation, poverty, unequal access to resources and benefits, low productivity of land and labour and a weak policy and institutional framework for managing the forest resources (Ndoye and Awono, 2005).

Forests are estimated to cover about 20 million hectares, which constitutes about 42% of the country (FAO, 2012). According to national forest inventory conducted in 2004, primary forest comprised about 18% and degraded primary forest nearly 50% of total forest cover (Blaser *et al*., 2011). Tropical rainforest in Cameroon contain trees of economic importance such as *iroko*, *mahogany*, *obeche*, *ebony* and many others (Cheo, 2011) and the Cameroon is the 6th main exporter of tropical wood in the world (Lebedys, 2004; Epule *et al*., 2014). Forest and forest products play a vital role in the economy of Cameroon and the contribution of the forestry sector to the country's GDP is in the range of 6-10% (CBFP, 2006; MINEFI, 2006; Alemagi and Kozak, 2010; FAO, 2012). About 220,000 ha of the forest are lost each year which is equivalent to about 1.0% of annual forest cover loss (FAO, 2010b, c). Compared with other tropical countries it is quite low, but it is among the highest in the Congo Basin (Blaser *et al*., 2011).

In the context of Cameroon, the key proximate direct and indirect causes of deforestation according these authors (Cheo, 2011; Blaser *et al*., 2011; Eyebe *et al*., 2012; Sonwa *et al*., 2012; Epule et al., 2014) are following: (i.) population growth and high human densities, (ii.) development of agricultural activities - both slash and burn subsistence agriculture and cash crops, (iii.) illegal exploitation of timber, (iv.) fetching/gathering of fuelwood, (v.) cattle stock (overgrazing) and (vi.) development of mining sector (bauxite, cobalt).

Arable land in Cameroon covers about 13% of total land area and agriculture employs about 70-80% of the Cameroonian population, accounts for more than 50% of exports and about 30% GDP (DSCN, 2002; Shackleton *et al*., 2007; Jones *et al*., 2013). Major agricultural produce in the country include maize, cassava, banana, sorghum, rice, millet, wheat, sugarcane, cocoa, coconut, coffee and rubber (Shacleton *et al*., 2007; Ackom *et al*., 2013). According Leakey (2012), farmers in Cameroon are often trapped in poverty, because they are unable to gain fertilizers and other chemical inputs. As a result, their farmland becomes impoverished and the yields of crucial staple food crops decrease.

In Cameroon like elsewhere in the Congo Basin, both urban and rural populations depend directly and indirectly on the forest ecosystem goods and services for their basic needs and well-being (Eyebe *et al*., 2012; Sonwa *et al*., 2012). Poverty in Cameroon is overwhelmingly concentrated in the rural areas. Approximately 56% of the country's poor are rural (Ngwa and Fonjong, 2002). Forests provide about 80% subsistence to most rural communities that fetch fuel wood, farm, hunt animals, gather medicines and NTFPs and breed animals. Forests also have a major spiritual value for many ethnic groups (Ngwa and Fonjong, 2002; MINEFI, 2006; Blaser *et al*., 2011). At the household level, forest directly provides about 8 million rural and poor Cameroonians with traditional medicines, important complements to the staple diet, domestic energy, construction material and income (Topa *et al*., 2009). Demand for fuelwood is the heaviest in the small towns and rural areas, where there is less potential for fuelwood substitution (Sonwa *et al*., 2012). During periods of crop failures, forest foods are most extensively used to help meet dietary shortfalls (Shackleton *et al*., 2007; Nkem *et al*., 2010). Forestry has been included in the country´s poverty reduction strategy (Blaser *et al*., 2011).

It has been revealed that Cameroonians are aware of the problems of forest loss in the country but nevertheless it remains a non-salient issue and they have greater concern for their immediate survival than to the survival of the environment. The people's low concern for government policies and practices can be attributed to the lack of trust and credibility of the government. This is also related to the fact that Cameroonian people are not given enough opportunity to participate in policy making processes (Mbatu, 2009). The indigenous people have not always respected forest legislation, especially when their livelihood or interests are threatened, and also because in most cases, the establishment of protected areas often ignore the socio-economic and cultural situation of those whose survival depend on the forest and is conducted before prior consultation. This approach often provoked social tensions and conflicts which usually undermine the possibility of implementing and achieving sustainability objectives (Ndenecho, 2005b). There is general consensus among several authors, that there is the lack of effective action to ensure the involvement of the indigenous people and forest communities into the process of conservation of the forest in Cameroon (Dkamela, 2011; Gunilla, Olsson and Outtara, 2013). According Eyebe *et al*. (2012), participatory approaches to conservation are sustainable only if communities who remain major stakeholders perceive a benefit from

their actions and in Cameroon, communities living around protected areas do not receive any significant benefits from conservation and has not fostered attitudes that are supportive of conservation practices. Therefore government's overall approach is to encourage local participation in biodiversity management and Pouliot and Treue (2013) attributed that if forests in all sub-Saharan Africa should be conserved, they must be made more valuable to rural people.

2.6.1 Bamenda Highlands

Tropical African mountains in general support many rural people because they have better climates than surrounding lowland areas, and thus permit the establishment of permanent agricultural systems (Blyth *et al*., 2002). Tropical highland regions are also among the most vulnerable areas to climate change and furthermore highland populations are often poorer and marginalized groups (Simane, Zaitchik and Ozdogan, 2013). A primary conservation challenge in the African tropical mountains is therefore finding solutions to the livelihood needs of dense rural populations that are dependent on agriculture and forest resources, but still suffer from poor human infrastructure and high levels of poverty (Burgess *et al*., 2007).

The Bamenda Highlands are located in central part of the Cameroon Highlands ecoregion in Northwest region of Cameroon. It occupies an area of 18,100 km^2 with altitudes varying between 1,000 and 2,300 metres with Mount Oku as the highest point (3,010m) and the second highest mountain in the West Africa after Mount Cameroon (4,095m) (Abbot *et al*., 2001). The mountains are volcanic in origin and comprise of several mountain ridges (Prinz and Rauch, 1987; Cheek *et al.*, 2000; Kampang *et al.*, 2010). Topographically, it is varied relief of soaring mountain peaks, plateaux, upland watersheds, valleys and flood plains in intermontane basins (Ndenecho, 2009; Ndenecho, 2010b). It is a hilly region with green hills scattered by rock formations, trees and grasslands (Ngwa and Fonjong, 2002).

Bamenda Highlands as other mountain regions worldwide due to high spatial heterogeneity of the abiotic environment provide a mosaic of many different habitats that facilitate the existence of different biological communities, which are often fairly isolated from the other similar habitats (Mutke *et al.,* 2011). The natural habitat of the Bamenda Highlands

possesses the largest remaining Afromontane forest in West Africa (DeMarco *et* al., 2001; Ingram and Nsom Jam, 2007). These montane forests belong among the Earth´s biologically richest and most threatened terrestrial ecosystems and have been identified as a biodiversity hotspot of global significance (African conservation, 2014; Mittermeier *et al.,* 2005; Mittermeier *et al.*, 2011). Bamenda Highlands are characterized by a high level of endemism across all groups of organisms (Ingram and Nsom Jam, 2007; Blackburn *et al.*, 2010 Ndenecho, 2010a; Morgan *et al.*, 2011).

This area possesses the highest number of vascular plants species in the continent including taxa with extremely limited covers (e.g. *Alchemilla fischeri* and *Newtonia camerunensis*) (Barthlott *et al.*, 1996; Cheek and Csiba, 2000; Cheek *et al.*, 2001; Ingram and Nsom Jam, 2007). These mountains are well known for their richness in birds (Ingram and Nsom Jam, 2007; Reif *et al.*, 2007; Sedlacek *et al.*, 2007), with several endemic species, including the Banded wattle-eye (*Platysteira laticincta*) and the Bannerman´s turaco (*Tauraco bannermani*) (McKay and Coulthard, 2000). In the remaining forest patches of sub-montane and afromontane forest of Bamenda Highlands live Nigeria-Cameroon chimpanzees (*Pan troglodytes ellioti*) (Grubb *et al.*, 2003; Morgan *et al.*, 2011; Doumbe, 2013) which are among the most endangered subspecies of chimpanzees known throughout Africa and live only in a few places in Nigeria and Cameroon (Oates *et al.*, 2008). There is also a high level of endemism in reptiles (Hermann *et al.*, 2005; Gonwouo *et al.*, 2010), amphibians (Zimkus, 2009) and butterflies (Tropek and Konvicka, 2010).

It appears that the area of Bamenda Highlands has been continuously and relatively densely populated for thousands of years (Warnier, 1984). There is also archaeological and botanic evidence which indicates that the Bamenda Highlands were once densely covered by the forest and inhabited by forest-dwelling people (Nkwi and Warner, 1982; Cable and Cheek, 1998; DeMarco *et al.*, 2001). This area is due to cooler climate and high quality of volcanic soils that are rich in minerals and hummus quite suitable for agriculture (Olivry, 1986; Prinz and Rauch, 1987; Ngwa and Fonjong, 2002). Although, the mountain topography has been obstacle to the development of the area until recently (Fonjong, 2008), according to Ndenecho (2006) road improvements since the early 1990s have increased the agricultural value of the area also combined with increased market access and higher financial incentives for supplying urban markets (Morgan *et al.*, 2011).

Northwest region is the most populated region of Cameroon (1,728,953 inhabitants) with population growth of about 2.3% per year. Despite its mostly rural condition, this area also possesses some of the highest population densities in Cameroon with approximately 100-250 inhabitants per km^2 (Ngwa and Fonjong, 2002; Ndenecho, 2009; Morgan *et al.*, 2011). As the human population has grown steadily combined with declining economic condition, the deforestation and degradation of forest resulting from agriculture, cattle grazing, timber collection has been dramatic and widespread. It has been estimated that in about 40 years more than 80% of the original forest cover of the Bamenda Highlands has been lost due to anthropogenic pressure, mainly due to increasing demand for new farmland (Ingram and Nsom Jam, 2007). Drastically reduced coffee prices in the late 1980s also contributed to the land rush and sent many farmers further up the slopes for new land to plant alternate cash crops like beans and potatoes (DeMarco *et al.*, 2001).

Consequently, the landscape has changed considerably over the last century and what exist today are highly fragmented and increasingly isolated forests that hold only remnants of their previous primate assemblages (Abbot *et al.*, 2001; Morgan *et al.*, 2011; Ingram, 2014). Today's landscape constitutes of a complex mosaic of forest patches, trees and shrubs savannah, grass fields, grazing lands, farms and fallow fields derived from evergreen montane forest (Ndenecho, 2009; Ndenecho, 2010b). From original unique mountains cover of tropical rainforest only small isolated fragments remain, mostly preserved on steep slopes and along watercourses (Riegert *et al.*, 2007). The population had however re-afforested the area to some extent with plant species utilised mainly as a timer, such as *Eucalyptus sp.*, *Podocarpus milanjianus*) and fruit trees (*Cola acuminata, Dacryodes edulis, Persea americana, Mangifera indica, Canarium schweinfurthii, Spondia mombin, Citrus sp.,* etc. (Tankou, 2014). Figure 3 shows the decrease of forest that led to the area to be commonly called to as "Grassfields" (Warnier, 1984).

These factors also resulted in much more intensive farming systems and in the abandon of the traditional fallow periods that were used to restore soil productivity. As a consequence of it, the soil despite its original richness has become impoverished, crop yields have become poor and the continuous need for new arable land has led to more rapid forest clearings and to reduction in land available for grazing. Consequently, cattle range freely within montane forest and invade wild environment, which is also contributing to the

fragmentation of sub-montane and montane forests (Ndenecho, 2006). Overgrazing and burning have substantially affected the geographical features, exposing the soil to serious erosion (Doumbe, 2013). An intense weathering which is occurring in tropical areas deprives the soil of large amounts of nutrients and mistreatment can easily lead to degradation (Ndenecho, 2005a).

Figure 3 Bamenda Highlands, also called as "Grassfields", Photo: author´s archive (2014)

Over the past two decades there has been a noticeable decrease in the dry season water flow and many water catchments are being endangered by the destruction of the forest (Ndenecho, 2006). Another significant threat for the last remaining patches of forest in the Bamenda Highlands is the exploitation of wood for subsistence energy and for construction (Ndenecho, 2010c). The high degree of anthropogenic pressure (Tchatchouang *et al.*, 2012) has elicited a savannization of tropical montane cloud forests and a dramatic decreasing of biodiversity (Ndenecho, 2005a).

Although small, these remaining patches are recognized as globally important sites for conservation of biological diversity and at the same time, the forests are very important for the people living around them, as they supply water, fuelwood, medicines, honey and other products and have also cultural and spiritual importance (Gardner, 2011). Therefore, an urgent action is needed in sense of the rehabilitation, sustainable management of natural resources, conservation and monitoring of mountains in the region (Ndenecho, 2005b).

3 Objectives

The main aim of the thesis was to document and understand livelihood strategies of people living in the area of Tubah Upland Forest and their relationship to the forest resource utilization.

Specific objectives of the thesis were:

(i) to analyse household resources capacity and use;

(ii) to document present knowledge and attitudes of targeted households on forest resources utilization; and,

(iii) to provide spatial analysis of livelihood strategies in mountainous area of Abongphen.

4 Materials and Methods

4.1 Study area description

Research was conducted in Bamenda Highlands, in the Tubah Subdivision. This area represents one of the last remaining forest blocks of these mountains, Tubah Upland Forest, principally in mountainous area Abongphen and also in the village Big Babanki. Tubah Subdivision is part of Mezam Division and is located in the mountainous part of the Northwest Region of Cameroon about 15km north from Bamenda, the largest city of the Region (see Figure 4). It includes 4 villages: Bambui, Bambili, Big Babanki (Kedjom-Keku) and Small Babanki (Kedjom-Ketinguh) located between latitude 4°50'- 5°20'N and longitude 10°35' - 11°59'E (Focho *et al.*, 2009). Two other important communities, Sabga and Finge are variably recognized (Bragg, 2010). The Tubah has jurisdiction over an area of 363km^2 and the altitude ranges between 1250m and 2300m above sea level (Njoh, 2010; Kiteh, 2011).

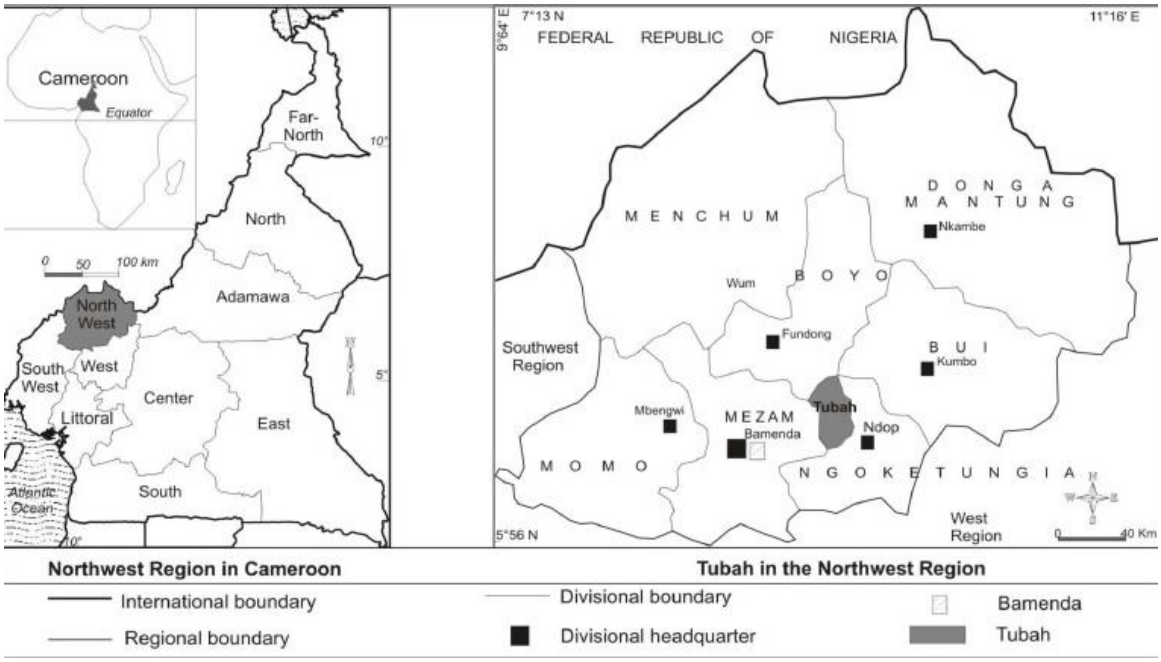

Figure 4 Location of the study area (Tubah Subdivision, Northwest Cameroon). Source: Focho et al. (2009)

The area experiences tropical humid mountain climate and it comprises two distinct seasons: a dry season from mid-November to mid-March and a rainy season which extends from mid-March to mid-November. Annual rainfall varies from 1780 to 2290 mm with most rainfall between July and September, when mists and low clouds occur frequently and December having the lowest rainfall. The mean maximum temperature is 20-22°C and the mean minimum temperature is 13-14°C with January and February registering the highest temperature and July, August and September registering the lowest temperatures (Focho *et al*., 2009; Ndenecho, 2011). Tubah comprise of undulating hills with large grasslands. The hills are broken by valleys, interlocking spurs and scattered by forest patches. The hills provide also important watershed for the area (Kiteh, 2011).

The population of Tubah is approximately 68,700 inhabitants with density almost one hundred people per km^2 (Ngwa and Fonjong, 2002; Lueong, 2009; Njoh, 2010). About 90% of the population is made up of Christians and the rest are Muslims occupying mostly Sabga (Tubah Council, 2014). The indigenous people of Tubah belong predominantly to Tikar ethnic group, which constitutes the largest ethnic group of the whole Northwest region. They probably originated in the North-Eastern Cameroon and according to historians, anthropologists and oral traditions they are believed to be the first settlers in the Bamenda region (Nyamnjoh, 2007; Nkwi, 2011). Another ethnic group are nomadic pastoralists Mbororo (Fulani), who entered the area during the British colonial administration in search for pastures. They principally came from Nigeria and former German Adamawa and about 1919 they started to migrate accompanied by their herds of cattle to the Bamenda plateau attracted by the grasslands in the mountains. A cattle rearing is their principal economic occupation as well as a way of life (Stenning, 1957; Nkwi, 2011).

On the economic domain, people rely mostly on semi-subsistence smallholder agriculture, animal breeding and handicrafts for daily life and as a source of income with slash and burn-shifting cultivation and cattle grazing being the commonest practices. Consequently upon that, most of the forest in the region have been degraded and transformed to farmland under intensive anthropogenic degradation (Innocent and Ge, 2008). The existence of rich volcanic soils in the area is very favourable for agricultural and enable the cultivation of a variety of crops. Main staple crops of this area are maize, beans, cassava, cocoyams, irish

potatoes, sweet potatoes, yams and plantains which are grown in most parts of the region. A lot of importance is also attached to the production of cash crops especially Arabica coffee and groundnuts (Nkwi, 2011). Other economic opportunities are few. There are no industries in the area apart from small bakeries, stores with local liqueurs and basic commodities. The only employment possibilities are limited to a few that can be employed in the small businesses with very minimal pay. Therefore, the area suffers a rural exodus with population drop between ages of 25-46 years moving to the city (Kiteh, 2011).

4.1.1 The Upland Forest in Tubah Subdivision

The Tubah Upland Forest (sometimes also called Babanki-Finge Forest) is an unprotected montane forest fragmented in several patches located in the northern part of the Tubah Subdivision about 17 km from Bamenda, the metropolitan town of the North West Region (Bragg, 2010; Doumbe, 2013).

It is situated in the heart of the Bamenda Highlands, in the area which is known for high levels of biological diversity and endemism and which falls within the West African Forest biodiversity hotspot (Myers *et al*., 2000; CAEPA CAMEROON, 2014). This montane cloud forest is unique in its composition of plants and animals, including plenty endemic species, particularly among plants, birds and amphibians (Ingram and Nsom Jam, 2007; Sedlacek *et* al., 2007; Zimkus, 2009). This forest is also represents one of the last sanctuaries and hope for conservation for the population of last remaining chimpanzees (*Pan troglodytes ellioti*) of the Bamenda Highlands (Morgan *et al.,* 2011; Doumbe, 2013).

Tubah Upland Forest is located on a plateau surrounding four villages: Bambui, Small Babanki (Kedjom-Ketinguh), Big Babanki (Kedjom-Keku) and Finge (see Figure 5). Babanki used to be one village located in the current site of Small Babanki, but less than 100 years ago, the village separated and there were established two villages: Big Babanki (Kedjom-Keku, *´People of the forest´*) and Small Babanki (Kedjom-Ketinguh, *´People of the mountain´*). Therefore the village borders inside the forest are not well determined. Even though the village borders inside the forest are not well determined, according to Doumbe (Doumbe, 2013), who created the first map of this upland forest in Tubah, the

upland forest is composed of three main ensembles which are Alegafor (belonging to Bambui), Abongphen (belonging to Small Babanki, Big Babanki and Finge) and Keffem including the patches surrounding Kedjom-Keku. Forest is situated between 1,500 and 2,300m and the landscape is punctuated by grasslands with alternating forest patches, grazing lands and farms (Doumbe, 2013). According Ndenecho (2010c), the Tubah Upland Forest originally covered and area of about 3950 hectares and today only 500 hectares of indigenous forest are left. Latest research of this forest conducted by Doumbe (2013) estimates the size of the remaining primary forest cover on 400 hectares.

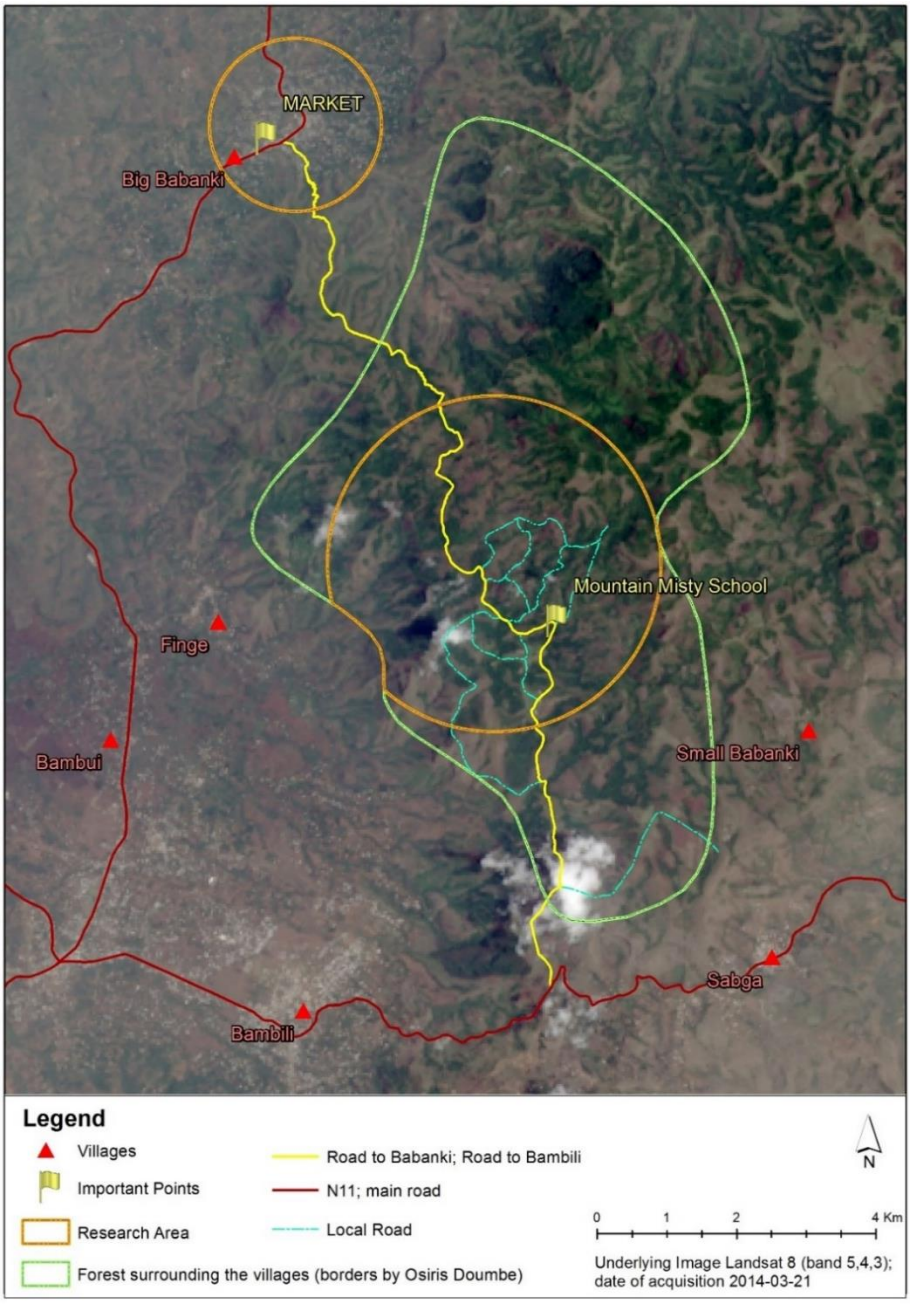

Figure 5 Location of the research area

The activities in the upland forest area are mainly concentrated in farming and grazing which causes massive fragmentation and significant area of former forest has been converted to grazing lands and farms. The grazing areas are consistently maintained by the Mbororo (*´those who live with cows´*) cattle grazers. An increasing number of their cattle browsing at the edges of established grazing pastures and enter the farms of Kedjom farmers which arouse the mutual conflicts and also invade wild environment, which is also contributing to the fragmentation of montane forest and expose the soil to serious erosion (Ndenecho, 2006; Bragg, 2010).

Farming is likewise a prominent activity and continues to expand. Most of the Kedjom farmers use slash and burn-shifting cultivation practises, which due to shortening of fallow periods have becoming unsustainable (Bragg, 2010). Advancing forest fragmentation has been confirmed by satellite images. Greatest reduction of montane tropical forest occurs near the densely populated villages (Chmelarova, 2012). Remaining forest is now almost exclusively restricted in valleys along streams and watercourses with mostly steep and precipitous slopes and it is dominated by trees such as *Carapa grandiflora*, *Ficus* sp., *Strombosia* sp., Calliandra sp. *Newtonia camerunensis*, *Vitex* sp., *Khaya ivorensis*, *Albizia sp.*, *Croton macrostachyus*, *Oncoba* sp., *Acacia* sp., *Cordia africana* and *Angaura salicifolia* (Cheek and Pollard, 2000; Cheek, Harvey and Onana, 2010; Ndenecho, 2010c; Doumbe, 2013).

Figure 6 Remaining fragments of mountain misty forest in Abongphen

Abongphen is the most fragmented ensemble of patches, but also the part of Tubah Upland Forest with the most important forest cover: 169.34ha, including 61ha of disturbed forest with the understorey farms. Abongphen has also the largest percentage of farms. Farmers from densely populated Small Babanki and Big Babanki seek fertile lands in the upland forest area to make new farms. Because of the very long distance to reach the Keffem, farmers from Babanki prefer to create new farms in Abongphen that are easier to reach from their homes (Doumbe, 2013). Tenure of the land in the upland forest is mostly based on sketchy proclamations and is generally awarded to those who make a request and contribution to respective village *fon* (chief) who controls the land in the area (Bragg, 2010). The Tubah Upland Forest is exceptionally rich eco-region and has not gain enough local or international recognition owing to the limited information available about this landscape (CAEPA CAMEROON, 2014). Nevertheless, despite its fragmentation and the anthropogenic pressure upon it, this forest remains one of the last viable montane forests of Cameroon (Doumbe, 2013).

4.2 Data collection

Data were collected in collaboration with local NGO Kedjom Keku[1] from July to September 2014 among rural households in Bamenda Highlands, particularly in mountainous area Abongphen and also in the village Big Babanki (Kedjom-Keku). As a result, different altitudinal levels, from low altitudes of about 1,220 m to high altitudes of about 2,121 m above sea level, were covered. A total number of 63 households participated in the study (see Table 1), while 48 occupied mountainous area Abongphen (see Figure 7 and Annex 1), 30 were Kedjom-Keku farmers, 11 Kedjom-Ketinguh farmers and seven were Mbororo (Fulani) pastoralists/herders Additionally, 15 respondents were farmers from Kedjom-Keku in village Big Babanki.

[1] The aim of this organization is to promote the sustainable development of the mountainous area of Abongphen and at the same time preserve the unique natural environment of the tropical montane cloud forest, which is for dedaces threatened by ill-conceived agricultural activities. In 2010, they built "Mountain Misty School and Resource Centre" directly in the Abongphen to serve as a primary school for local children, who otherwise would have no access to education due to long distances to schools in the nearest villages. And it is also used as an education centre for local farmers in terms of education and training in sustainable agriculture, tree planting and bee-keeping.

Firstly, participatory observation, informal interview and focus group discussion with representatives were conducted in order to better understand local natural and socioeconomic conditions. Secondly, variables of semi-structured questionnaire were developed. They were based on other published studies dealing with similar issue (Doppler *et al*., 2006; Babulo *et al.*, 2008; Tesfaye *et al*., 2011; Cochard and Dar, 2013; Okene and Shittu, 2013; Zenteno *et al*., 2013; Ameha, Nielsen and Larsen, 2014), adapted to local conditions, discussed with local authorities and experts to ensure it is containing all the necessary aspects. Data on local household resources capacity and use as well as the most important livelihood strategies were obtained. Due to the wide spread illiteracy in target area, interviews were carried out in cooperation with local key-informant Peter Mbi. English was a main language for interviews, however, local language was used as well in the case of necessity. For the identification of tree and plant species, assistance of local botanists Kenneth Kumecha Tah and Ernest Vunan was required.

Furthermore, each farm in Abongphen was also marked by GPS coordinates to document the farm size and distance between household and the forest, which was used for carrying out a spatial analysis of livelihood strategies.

Table 1 Collected questionnaires

Ethnic group	Place	Altitude (masl)	Number of respondents
Kedjom Keku	Abongphen	1,855-2,121	30
Kedjom Ketinguh			11
Mbororo (Fulani)			7
Kedjom Keku	Big Babanki	1,220	15

The survey questions for the head of the households elicited both qualitative and quantitative information on the factors triggering on following:

(i.) human resources: age distribution, achieved education, farm, forest and off-farm activities

(ii.) natural or land resources: land ownership, farm size, farming practises, crops, livestock, use of farm products, identification of plant species used in forest

(iii.) household analysis: annual cash income from farm and off-farm activities, energy supplies

(iv.) livelihood strategies with respect to forest use: frequency of going to the forest, reasons to go there, benefits from the forest, importance of the forest, protection of the forest

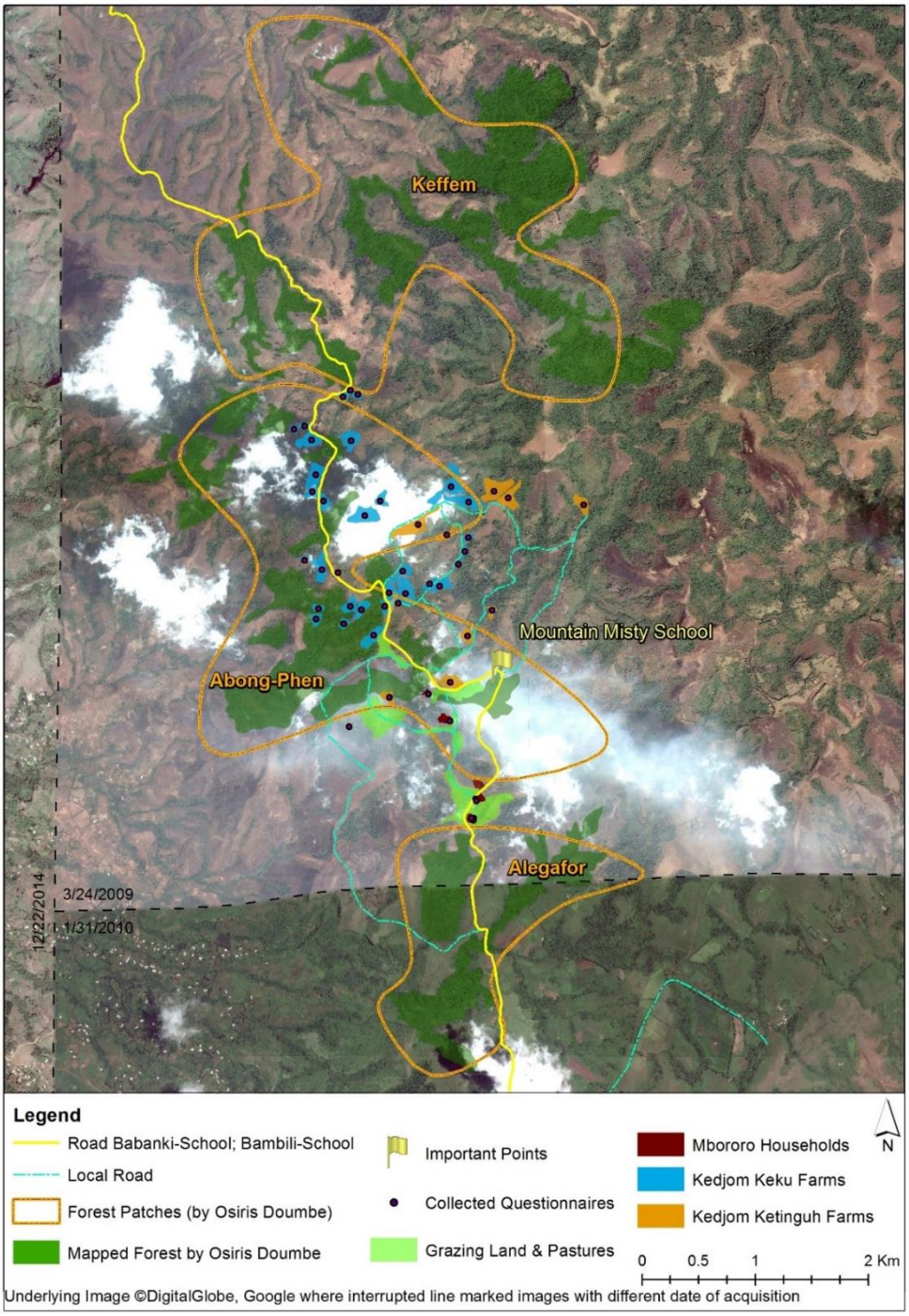

Figure 7 Targeted households in mountains area Abongphen

4.3 Data analyses

After the collection, data from questionnaires were further cleaned and transferred into the electronic data set and sorted out. Finally, data were evaluated and analysed using MS Office Excel®. As the main statistical analysis was applied descriptive statistics in order to characterize the researched population sample and to identify attitudes of targeted households towards forest utilization and conservation. For GPS data processing and creation of spatial analysis of the livelihood strategies and map of the whole research area was used ArcGIS 10.2.2.

5 Results

5.1 Resource analysis

5.1.1 Human resources analysis

Largest households were observed among farmers from Abongphen (8.9±2.8), followed by farmers from Big Babanki (8.3±3.1) and pastoralists from Abongphen (7.6±3.3). Based on our data, 62.53% of the farmers from Abongphen, 78.84% of the Mbororo pastoralists and 68.55% of the farmers from Big Babanki were in the working age (15-65 years). Dependency ratio represented 0.60, 0.27 and 0.46 respectively. Furthermore, vast majority of the farmers in Abongphen (74%) achieved only primary education, 12% secondary education and 14% did not visit any school at all. These values are significantly higher in comparison to the pastoralists from Abongphen, who in 64% cases have never visited the school and the rest achieved only primary or secondary education. The best situation in terms of education was documented in Big Babanki where only 13% from interviewed farmers have not acquired any education and the absolute majority (61%) visited the primary school, 21% secondary school and even 4% attended high school and 1% had university degree.

5.1.2 Land resource analysis

Two ways of ownership of the land resources were documented among interviewed households: land could be given by the local authority *fon* or inherited. First example was typical for Abongphen farmers as 70.73% of them received their land from the local authority *fon* and almost 30% of the farm land was inherited. Heritage represented the most common way of land ownership among pastoralists and farmers in Big Babanki.

We also documented the development of land-use systems in time (see Figure 8). Local households run their farm on the land that previously was used for farming purposes. This is evident particularly for Mbororo pastoralists (100%), Big Babanki (86.6%) and farmers in Abongphen (56.1%). Use of grazing lands or young bush dominated by Elephant grass (*Pennisetum purpureum*) represented another strategy how to get additional and/or new

farm land. This was evident particularly for Abongphen farmers (31.7% of their land). Farmers in Abongphen also spread their farm size to forest area (12.2% of interviewed households).

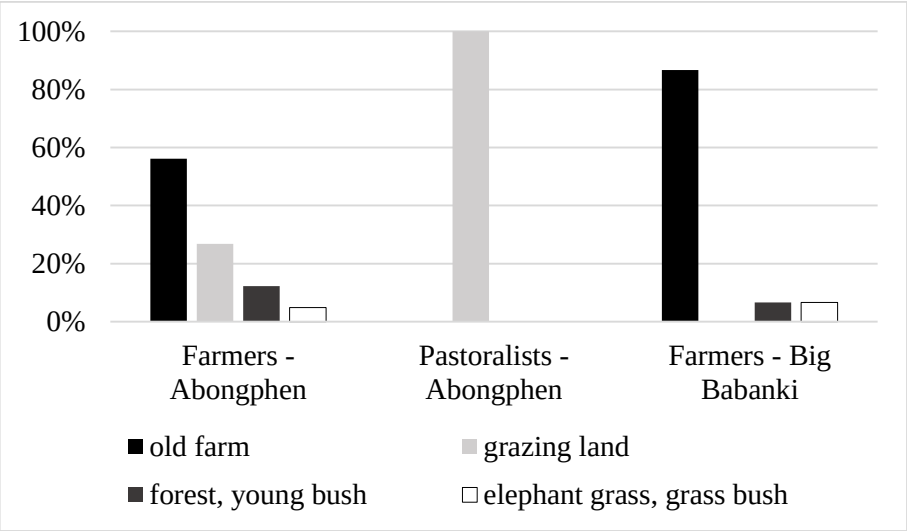

Figure 8 The cover of land at the time when farmers/pastoralists obtained the land

Average farm size ascertained according to the statements of the farmers (not directly measured by GPS) in Big Babanki was 3.6 ha. In mountains area Abongphen the average farm size was 1.44 ha (measured directly by GPS). Average age of the farm in Abongphen and Big Babanki was 12 years and 47 years respectively. On average, 45 years pastoralists from Abogphen occupied their grazing land. Opinion of farmers on land resources differ among interviewed households. Farmers in Abongphen was generally more satisfied with land quality, in terms of its fertility, compare to Big Babanki (see Figure 9).

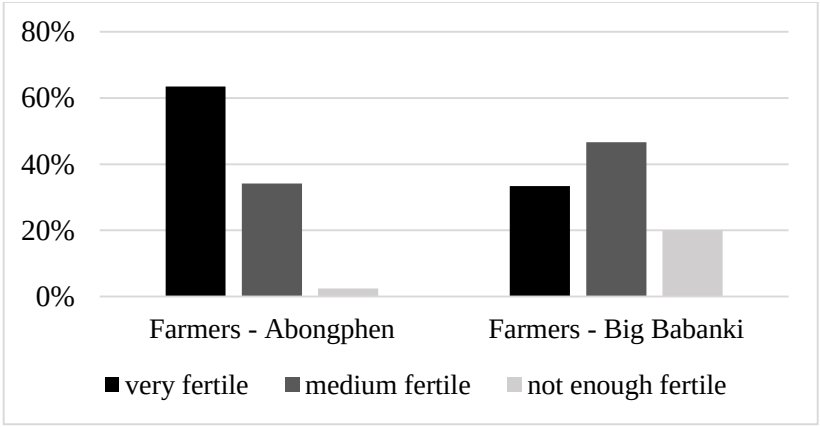

Figure 9 Perception of the farmers on soil quality at their farms

Furthermore, more than half of farmers in Abongphen (58.54%) consider the terrain of their farms as a moderate, which is comparable to Big Babanki (53.3%). On the other hand, in Big Babanki 40% the terrain of the farm size was perceived as hilly compare to 29.3% among Abongphen farmers. Only minor part of the households consider the terrain of their farms as flat (see Figure 10).

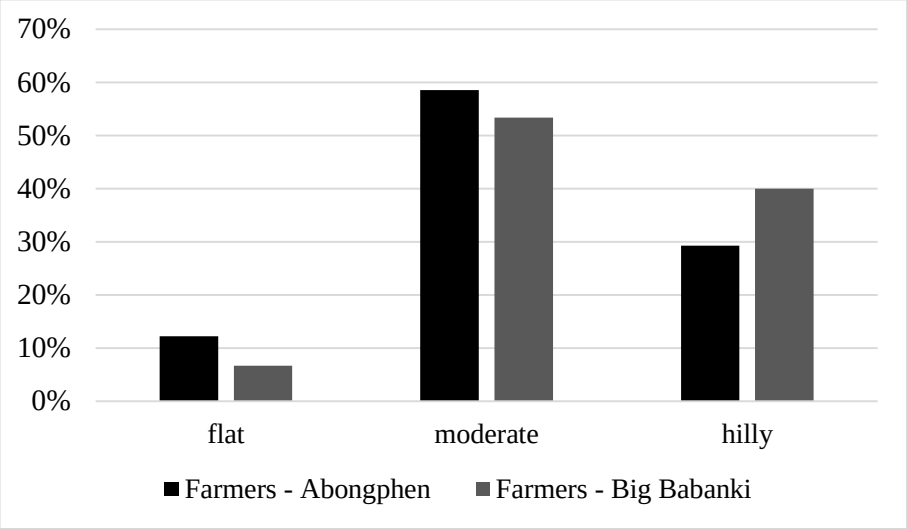

Figure 10 Slope of the farm according to the farmer´s opinion

5.2 Classification of focused farming systems

All three focused groups of farmers could be classified as combined farming systems with respect to market orientation. Vast majority of farmers in Abongphen (97.6%) and Big Babanki (93.3%) used their farm products for both subsistence and market purposes. This situation was similar to Bororo pastoralists who rely almost only on cattle production and all their farm products, such as milk, meat, cattle, they were selling to the market or used for the subsistence food supply as well. On average, each Mbororo household owned 202 head of cattle and 16 horses that are used for transportation, cattle grazing or carrying the goods from and to the market. Livestock such as chicken, pigs and goats also contributed to the cash income generation among farmers in Big Babanki, but only in less amount or they used to sell the livestock to cover household expenses, such as school fees. Kedjom Keku farmers from mountains area Abongphen sold their production at the market in Big Babanki (see its location in Figure 5), which is distance about 3.5 hours by walk from

Abongphen through mountain terrain and there is no possibility to use motor vehicles for the transportation. Kedjom Ketinguh farmers from Abongphen sold their production at the market in Small Babanki, which is distance about 1.5 hour by walk and there is also possibility to use motorbike for transportation. Mbororo pastoralists from Abonpghen sold their cattle products in Sabga and they usually used the horses for the transportation.

Crop production of targeted farming systems was generally based on annual crops, but perennial crops were also important, especially in Big Babanki. According to the farmers opinion as we can see the in the Figure 11 and 12, the most important and preferred crop species for subsistence and also for selling at the market were for both Abongphen and Big

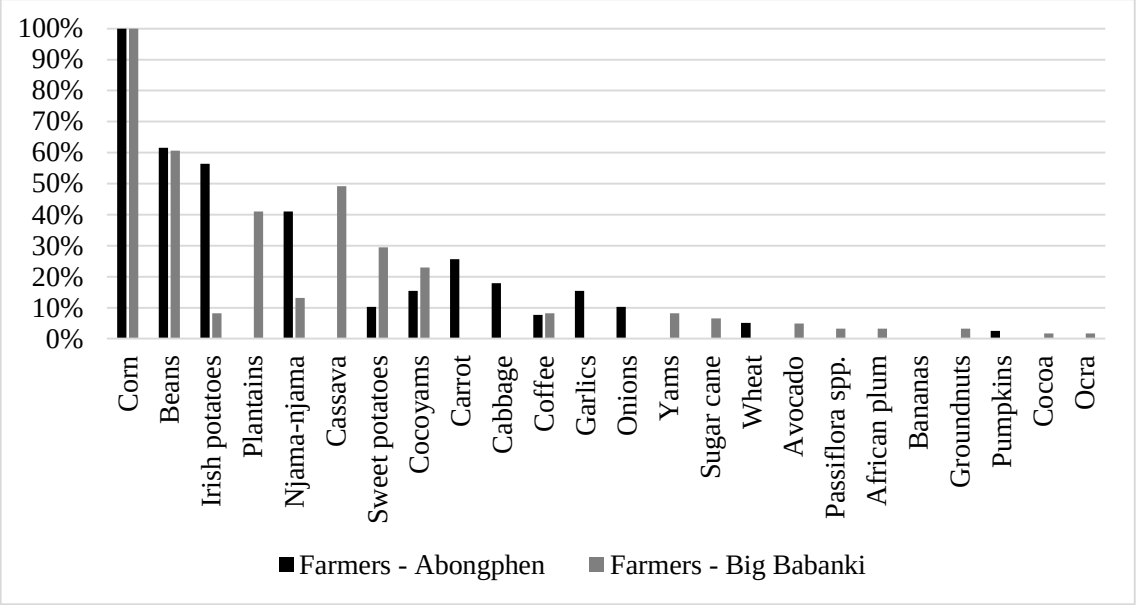

Figure 11 The most important and preferred crop species according to the farmer´s opinion in Abonpghen and Big Babanki

Babanki annual crops such as maize (*Zea mays*), beans (*Phaseolus* spp.), irish potatoes (*Solanum tuberosum*), njama-njama (*Solanum scabrum*), cassava (*Manihot esculenta*), sweet potatoes (*Ipomea batatas*), cocoyam (*Colocasia* esculenta) and perennial crops such as avocado (*Persea Americana*), cola nut (*Cola acuminata*), *Prunus Africana*, mango (*Mangifera indica*), passiflora (*Passiflora* spp.), coffee (*Coffea arabica*) or african plum (*Dacryodes edulis*). These preferred species mostly corresponded with the occurrence at the farms in Abongphen and Big Babanki.

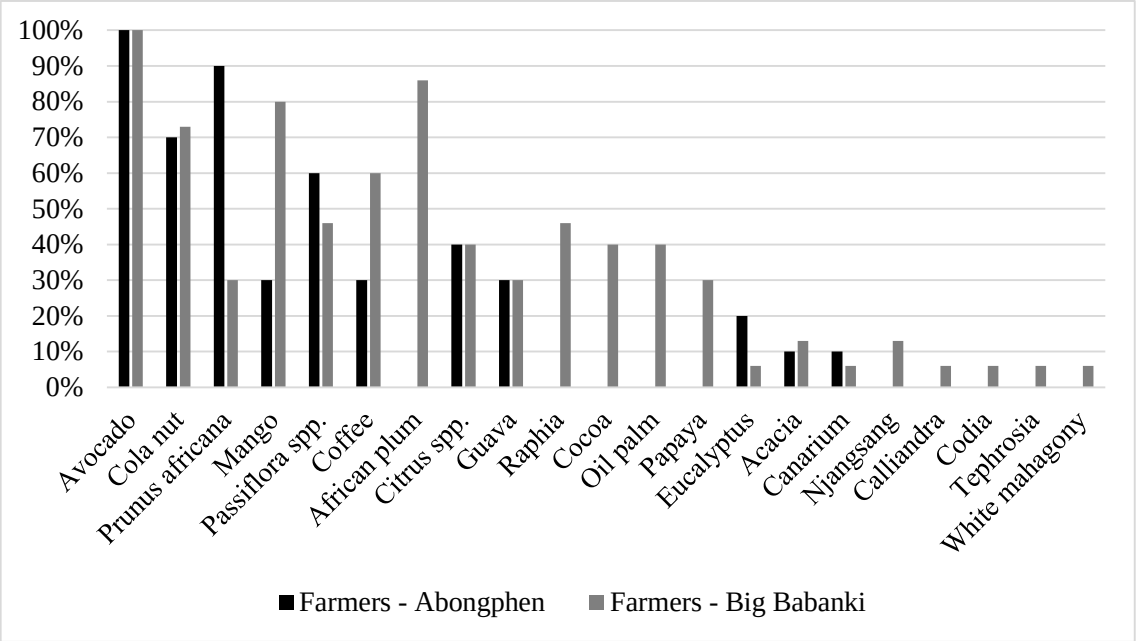

Figure 12 The most important and preferred tree and shrub species according to the farmer's opinion in Abonpghen and Big Babanki

5.3 Household analysis

Among all interviewed farmers, annual crops were the most important source of cash income generation, particularly in Abongphen (see Figure 14), where it is counted for 71% of the total household income. Perennial crops were also important source of cash income with share on total household income counting for 10% in Abongphen and 18% in Big Babanki. Cash income from livestock was certainly most important among pastoralists in Abongphen, counting for 84% of their total household income. Among farmers in Big Babanki, cash income from livestock counted only for 3% of their total household cash income and farmers from Abongphen had no income from livestock (see Figure 13).

Generally, among all interviewed groups of households, off-farm income also played a crucial role in cash income generation (see Figure 13). The most common off-farm activities among farmers from Abongphen and Big Babanki were building or construction works, wood curving and seasonal works at other farms such as land preparation, planting, harvesting or clearing grass bushes. In Big Babanki farmers were also involved in off-farm jobs such as selling of clothes, collecting and selling the antiquities, selling the food stuff

or running the restaurant. Main off-farm activities of pastoralists from Abongphen included the cattle trading and working as a cattle inseminator.

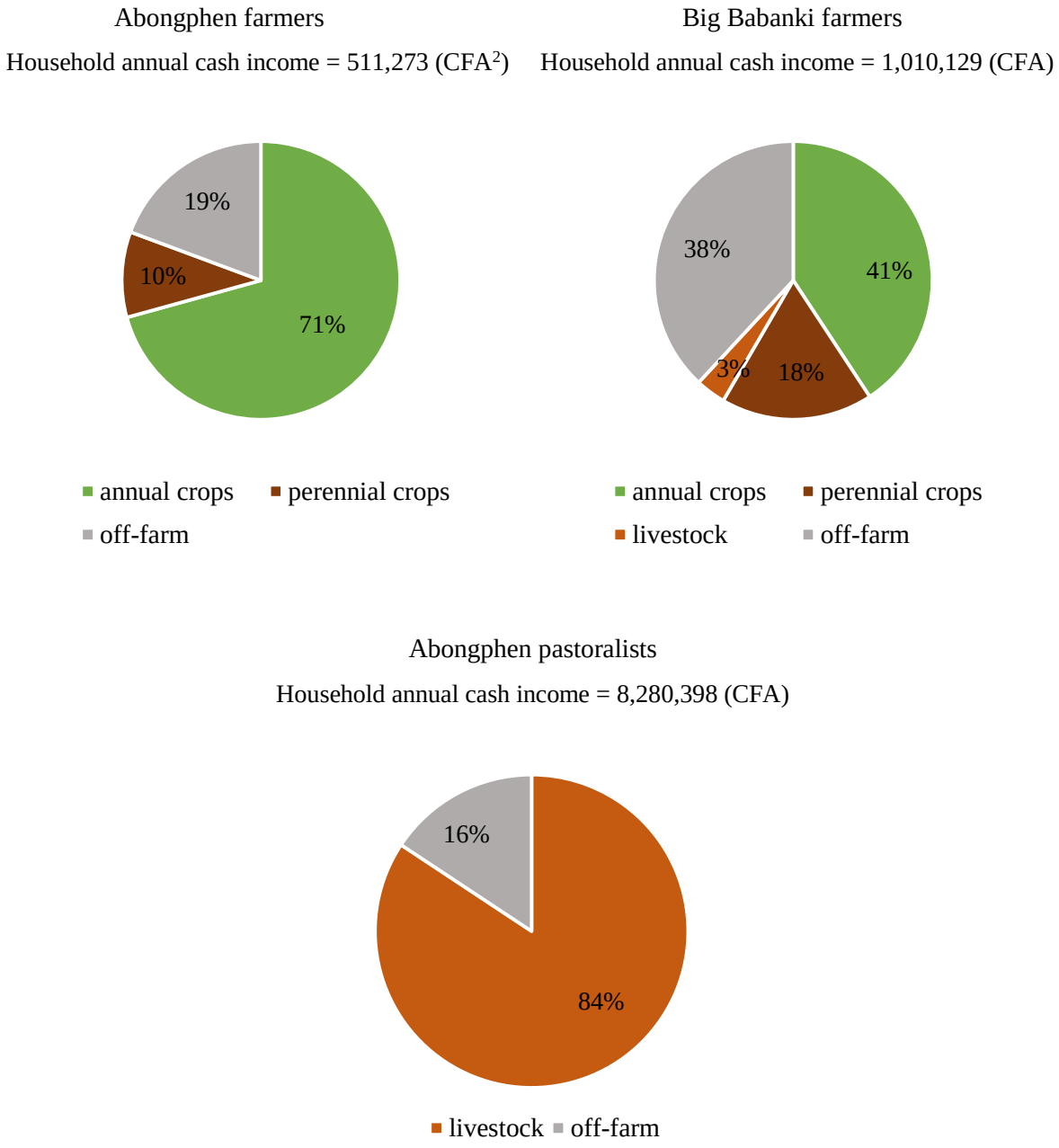

Figure 13 Household annual cash income diversification

[2] 1 CFA = 0.00165580 USD, 1 USD = 603.938 CFA, Source: www.xe.com

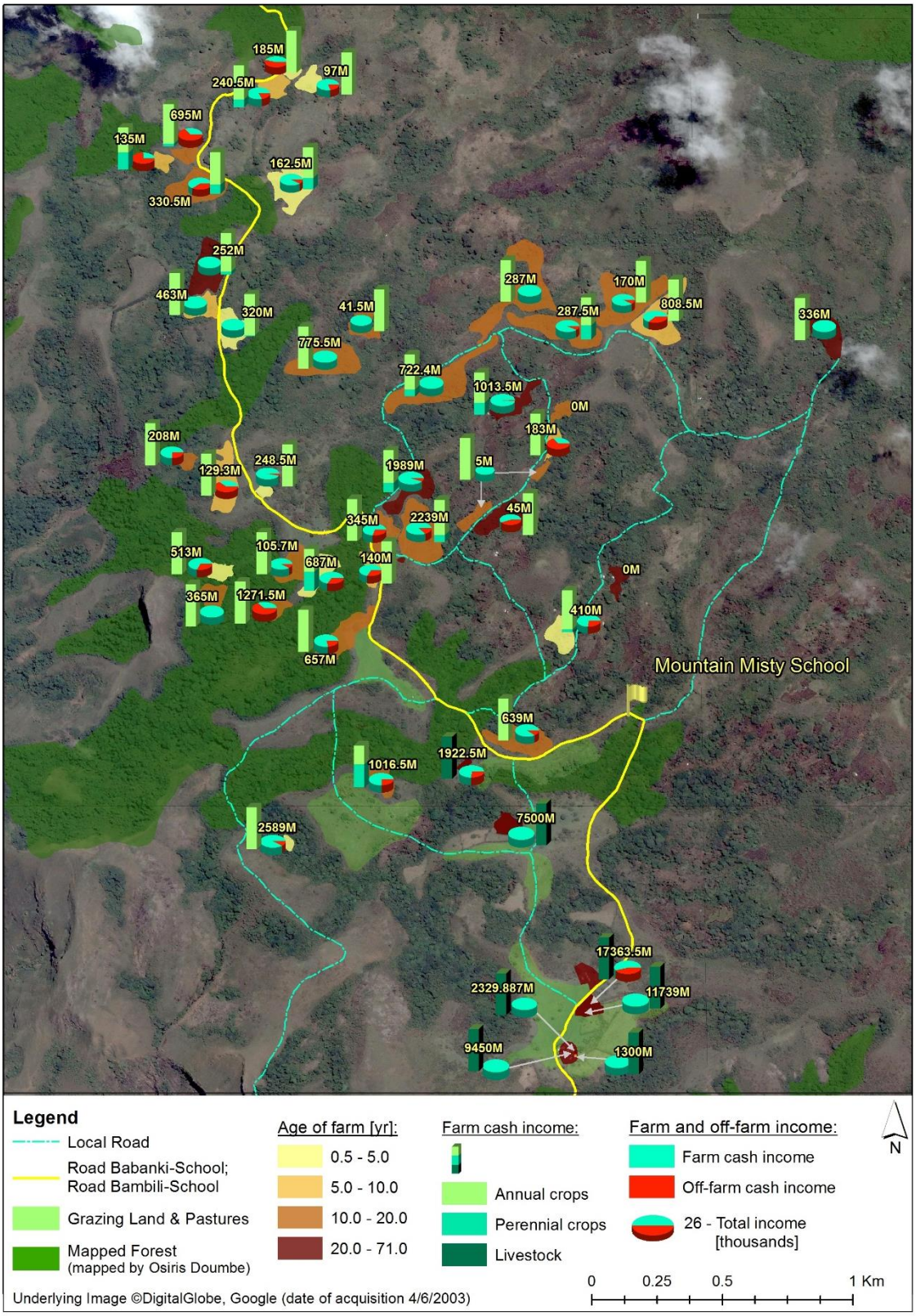

Figure 14 Distribution of farm and off-farm annual cash income (CFA) among targeted households in Abonpghen

5.4 Livelihood strategies and forest

5.4.1 Frequency of forest visits

Majority of the farmers (82.93%) and all pastoralists from the mountainous areas of Abongphen went to the forest 1-2 per week or 1-2 per month, 12.19% of the farmers from Abongphen went to the forest 3-4 per week, only 4.87% of them went to the forest very rarely (few times a year) (see Figure 15 and 17). Almost half of the respondents (40%) from farmers living in the village Big Babanki went to the forest very rarely (few times a year) and 40% went to the forest 1-2 per week or very 1-2 per month and only 20% of the farmers from Big Babanki went the forest 3-4 per week (see Figure 15).

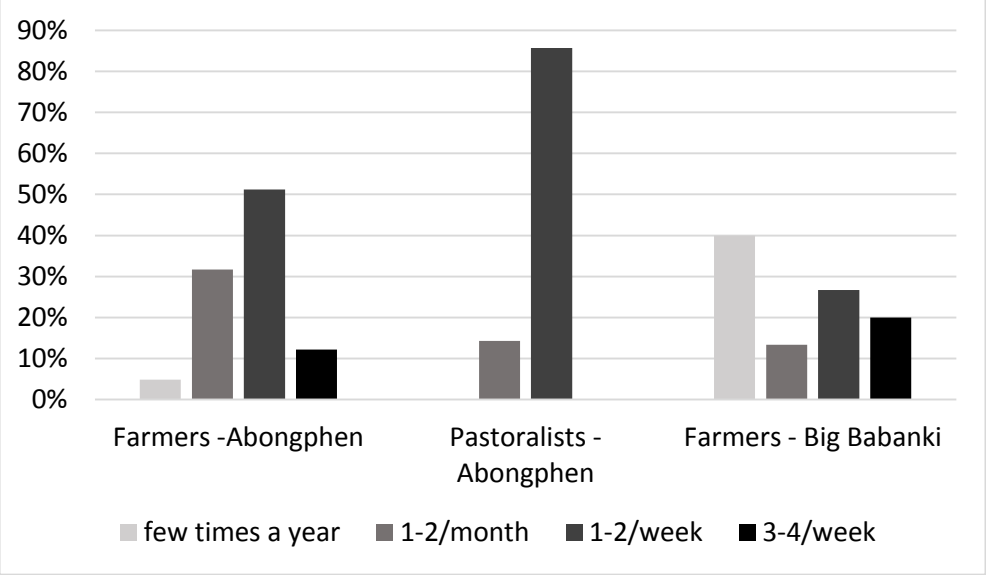

Figure 15 Frequency of going to the forest

5.4.2 Forest use

As shown in the Figure 16, firewood played an important role in energy supplies for both Abongphen (see Figure 17) and Big Babanki farming households. Nevertheless, Abongphen households used only firewood for heating, cooking and lighting. In the case of Big Babanki farmers, 46.0% of them used the firewood as the only energy supply and 53.3% used the firewood only for cooking and heating and the electricity for lighting.

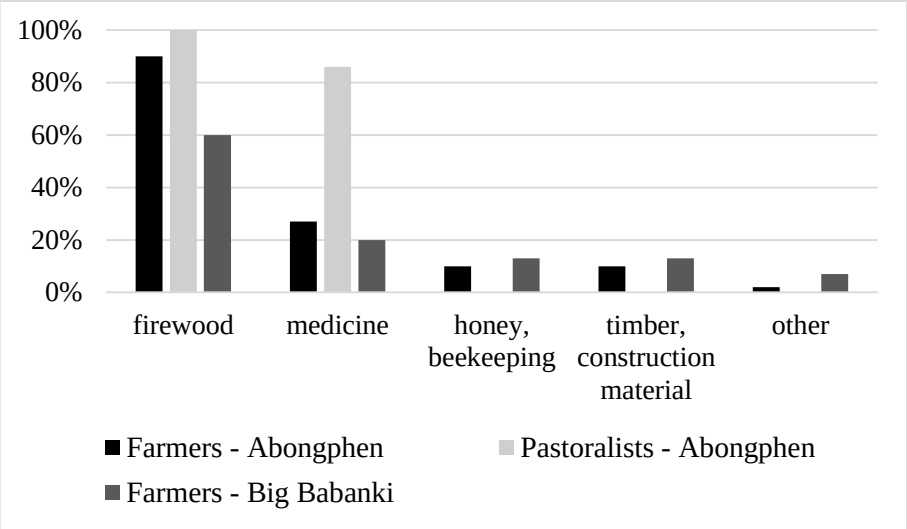

Figure 16 Reasons to go to the forest

Second most common reason regarding forest use was the collection of various medicinal plants against different illnesses, particularly those solving fever, gastrointestinal problems, malaria, various pains, headache or they were use in the spiritual context as the prevention from the ghosts and evil spirit. These responses correspond with the 18 medicinal plant species identified in the target area (see Table 2). Mbororo pastoralists also collected the medicine in the forest for men but more importantly as the treatment for the cattle. Only 9.76% of the farmers from Abongphen and 13.3% from Big Babanki went to the forest to collect honey or to beekeeping, 12.5% of all farmers went to the forest to obtain timber and construction material and 9% of all farmers visited the forest for other purposes (e.g. visit, monitoring or collection of the various seeds).

Tabel 2 Medicinal plants identified in the area and their use in traditional medicine

Name of the plant	Part of the plant used	For of the medicine	Local application
Aframomum melegueta	grains, stem	decoction	warming, digestive properties
Prunus africana	bark	decoction	malaria fever
Rauwolfia vomitoria	roots	decoction of powdered roots	malaria fever, nervous disorders, emetic and purgative, snakebite, jaundice or gastrointestinal disorders
Pittosporum viridiflorum	bark, leaves	decoction	gastrointestinal disorders, back pain
Ricinus communis	leaves, flowers	decoction	headache, convulsions, epilepsy, diarrhoea
Brillantaisia nitens	leaves	decoction	cardiovascular diseases, malaria
Cucumis metuliferus	roots	decoction	relief of pain after childbirth, gonorrhoea cure, spiritual context as prevention from the ghosts and evil spirit
Agauria salicifolia	bark and leaves	decoction	acute body pains, venereal diseases
Anona sengalensis	bark	decoction	worm infection, snakebite, gastrointestinal disorders
Aspilia africana	leaves	concoction	gastrointestinal disorders, wounds (juice of leaves)
Commelina benghalensis var hirsuta	stem and leaves	concoction	treatment of ringworm infection
Commelina africana var africana	stem and leaves	concoction	treatment of ringworm infection
Harungana madagascariensis	young leaves	decoction	diarrhoea, gastrointestinal disorders, malaria
Kalanchoe crenata	leaves	concoction	ear problems
Kigelia africana	fruits	decoction	kidney malfunctioning, wounds, piles, snake bites
Ocimum gratissimum	leaves	concoction/decoction	stomach disorder, urinary tract and gastrointestinal infections
Satureja punctate	leaves	decoction	heart related problems especially highblood pressure
Ageratum conizoides	leaves	concoction	spiritual context as prevention from the ghosts and evil spirit

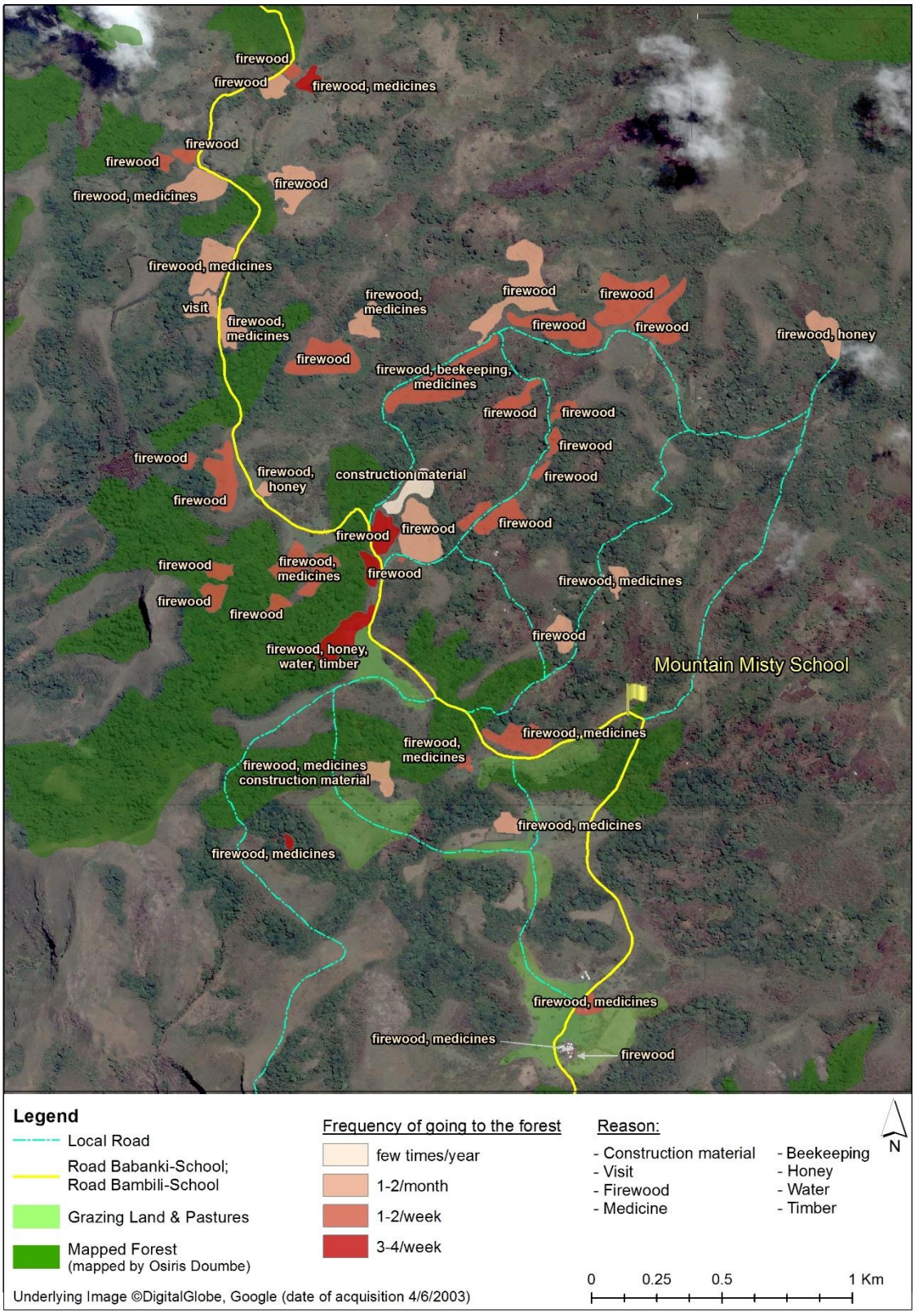

Figure 17 Frequency and reasons of going to the forest among targeted households in Abongphen

5.4.3 Overview of the forest benefits perceived by local households, perception towards domestication of forest species

Farmers and pastoralists perceived the importance of the forest for life from various perspectives (see Figure 18 and 19**)**. For the farmers living in Abongphen the most direct benefit what forest provides were provision of the water (46.3%) and leaves for soil fertility (43.9%), followed by firewood (26.8%), food (14.6%) and medicine (14.6%).

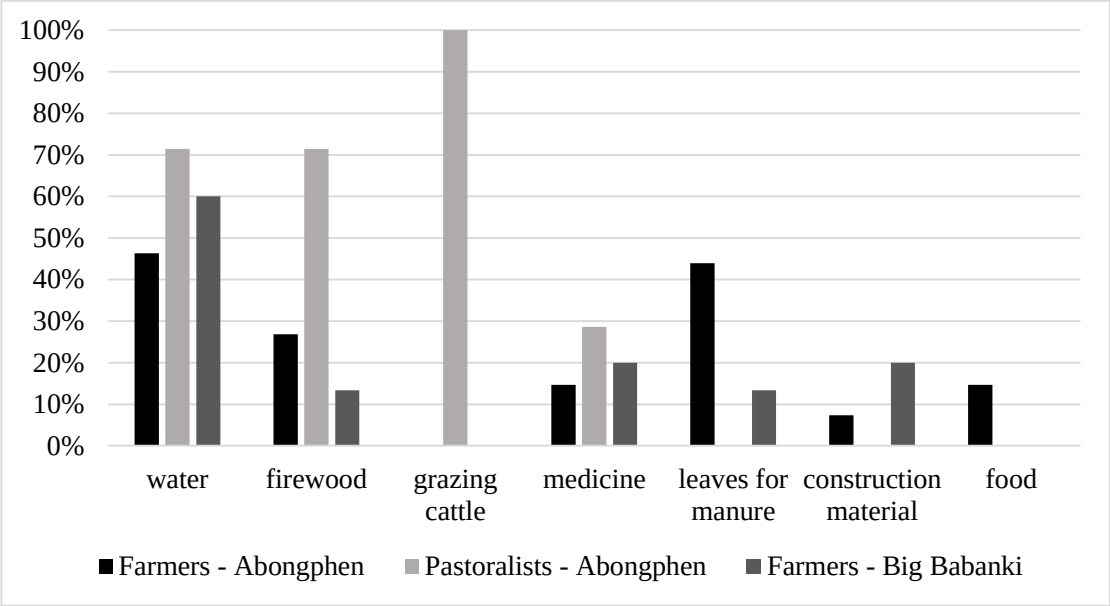

Figure 18 Importance of the direct benefits of the forest for life

For livelihood of all Mbororo pastoralists the most important value coming from the forest was the place for grazing the cattle, obtaining the firewood (71.0%), water (71.0%) and medicine (28.6%). Farmers from Big Babanki saw the water (60%) as the most important resource coming from the forest, provision of the construction material (20.0%), medicine (20.0%), firewood (13.3%) and leaves for soil fertility (13.3%). As the most important indirect benefit coming from the forest perceived by the farmers from Abongphen was the leisure and recreational role of the forest (48.8%). Almost 40.0% of them claimed that forest for them was important in the esthetical terms and as the provision of the fresh air, 12.2% of them appreciated cool climate and shady environment of the forest. Provision of the fresh air was from 71.5% appreciated by the pastoralists, followed by the esthetical value of the forest (60%). Leisure and recreation role was appreciated by 28.6% of the

pastoralists. Leisure and recreation role were perceived particularly by farmers from Big Babanki, which was followed by cool environment and esthetical value of the forest. Only 3.2% interviewed households from whole sample did not feel any importance of the forest for their life.

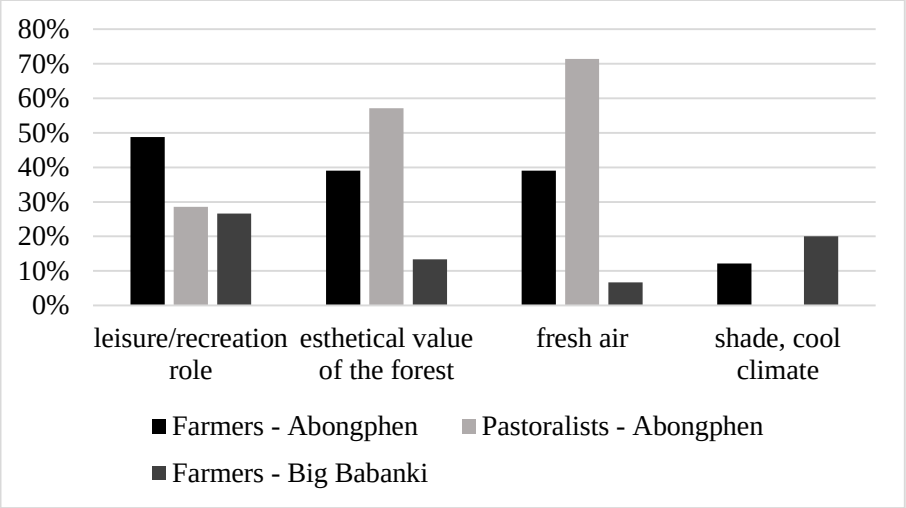

Figure 19 Importance of indirect benefits of the forest for life

There were identified 11 forest species for various uses that farmers perceived as an important one and would like to incorporate them more into their farms (see Figure 20). The most common future planting intension of the farmers in Abongphen (56.1%) and also in Big Babanki (20.0%) was to plant more *Prunus africana* trees at their farms, because the bark from this tree is considered as a valuable commodity at the local market and has medicinal uses as well. A lot of farmers from Abongphen (36.6%) as well as from Big Babanki (13.0%) would appreciate to plant trees against soil erosion, because most of the farms in the area have steep slopes and there is a problem with soil erosion, mainly during the rainy season. Some farmers from Abongphen (12.2%) would also appreciate plant more Raffia palms (*Raphia africana)* for tapping the palm wine which is common in every traditional event or meeting in the area, 7.3% of the farmers from Abongphen and 13.3% from Big Babanki would like to plant more Red mahogany trees (*Khaya ivorensis*) for timber and some of them also *Newtonia camerunensis*. More fruit trees such as such as *Mangifera indica, Persea americana, Cola nitida, Canarium schweinfurthi* would be apreciated by the farmers due to their nutritional value that stands as an important component of balanced diet, medicine and also create an additonal income. Also *Coffea*

arabica and beeloving trees such as *Acacia* and *Croton sylvaticus* would be also appreacited in some cases.

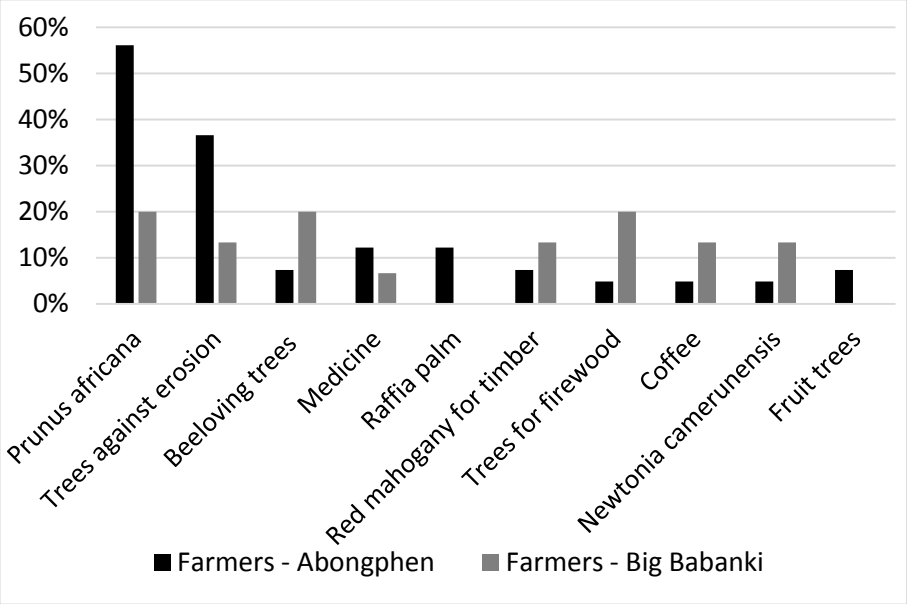

Figure 20 Perception of the farmers towards domestication of forest species

5.4.4 Households' perception of biodiversity dynamics and future role of the forest for their livelihood

The vast majority of all farmers and pastoralists perceived the protection of the forest in their surroundings as very important. Only 4.9% of the farmers from Abongphen claimed that it was not important, because wild animals from the forest destroy the crops at their farms. Most of the respondents inclined to the opinion that biodiversity has declined rapidly over the last couple of years (see Figure 21**)**.

In the Figure 22, we can see the expectation on the forest use in the future. About 44% of the farmers from Abongphen expected their future forest use will be at the same level as nowadays and 44.0% expected they will encroach more to the forest if they will have some benefit coming from forest, only 12.2% of the Abongphen farmers expected they will use the forest less than currently. Absolute majority (57.0%) of the Mbororo pastoralists

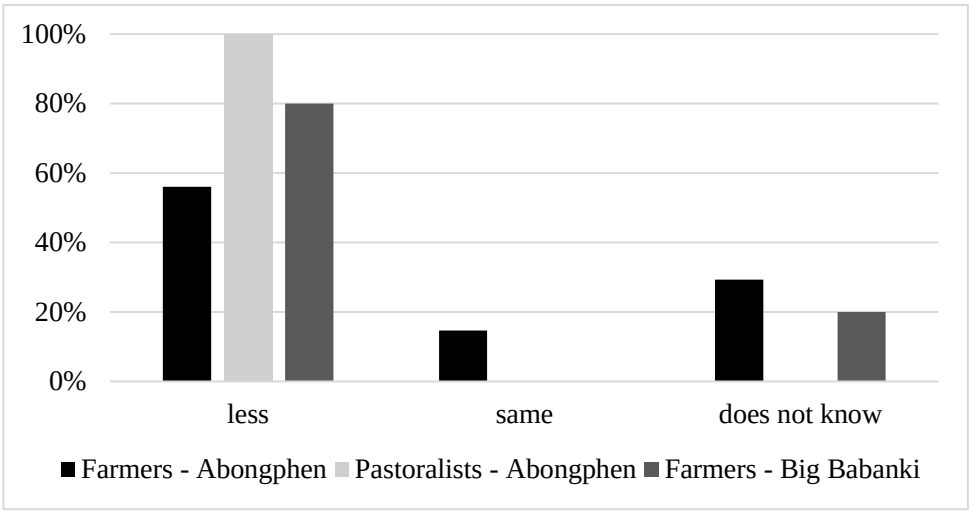

Figure 21 Perception on biodiversity dynamics in local forest during the last couple of years

expected they will use the forest at the same level as nowadays, 28.5% expected their utilization of the forest will decline in the future and only 14.3% of the pastoralists expected that if they will have some benefit, they will encroach to the forest more. Absolute majority (57.0%) of the Mbororo pastoralists expected they will use the forest at the same level as nowadays, 28.5% expected their utilization of the forest will decline in the future and only 14.3% of the pastoralists expected that if they will have some benefit, they will encroach to the forest more. 40.0% of the farmers in Big Babanki expected they will use the forest more if they will have some benefit from that, 33.3% expected their level of use of the forest will not change from current level and 26.6% even expected they will use the forest less than nowadays.

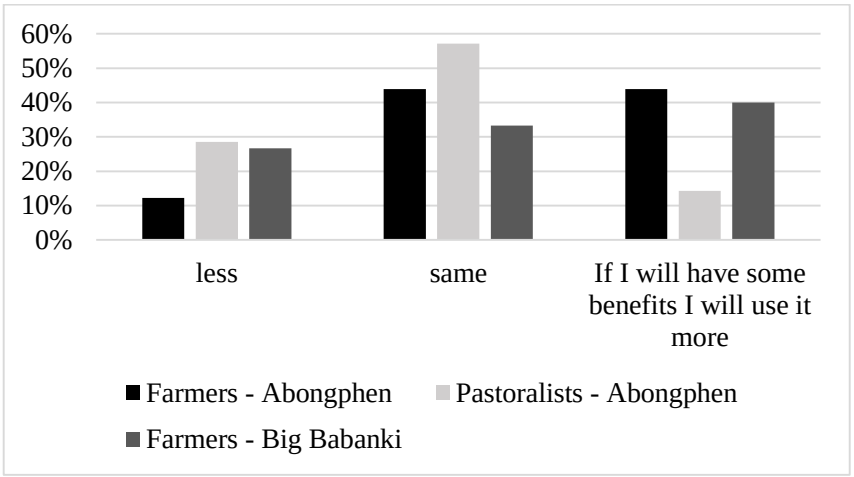

Figure 22 Expectation on the level of use of the forest in the future

As shown in the Figure 23, according to the perception of all farmers and pastoralists both in Abongphen and Big Babanki the most important reasons for forest protection in their surroundings was to preserve the forest for next generations (44.4%), followed by water and watershed function of the forest (33.3%) and for the protection of the environment and forest functioning as harbour of biodiversity (30.2%).

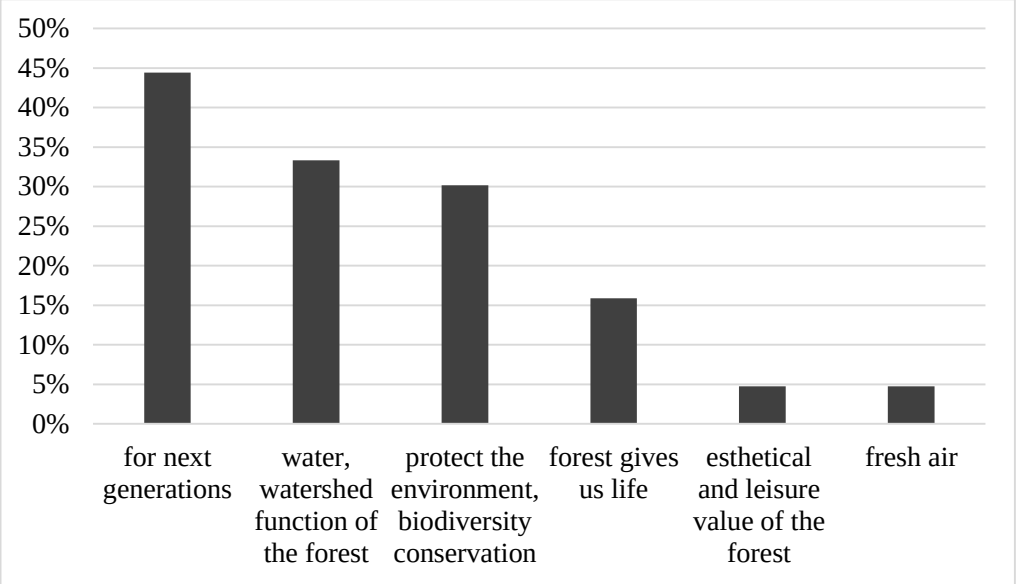

Figure 23 The most important reasons for forest protection in the surroundings according both farmers and pastoralists

6 Discussion

6.1 Main livelihood strategies documented

Our results documented that forest provides a wide range of resources and benefits, which represent an essential means for fulfilling livelihood strategies of targeted households. These findings fit the claims of other studies published on similar issue (Kaimowitz, 2003; Sunderlin *et al.*, 2005; Mamo, Sjaastad and Vedeld, 2007; Vedeld *et al.*, 2007; Babulo *et al.*, 2008; Babulo *et al.*, 2009; Tesfaye *et al.*, 2011; Hogarth *et al.*, 2013; Zenteno *et al.*, 2013). According to our results, there were identified three distinct livelihood strategies within the research area with slightly different relationship to the forest resources utilization.

6.1.1 Kedjom Keku farmers

First is maintained by farmers from Kedjom Keku, who lived in the village Big Babanki at lower altitudes around 1,220 masl. They were more market oriented due to the better market access, gained greater average annual cash income (see Figure 13), had higher income from perennial crops due to the better climatic conditions for its cultivation and used forest resources to a lesser extent in comparison to Abongphen farmers. It was apparently related to the fact that forest in their surroundings was already more degraded, more fragmented and more distant from their homes and therefore more difficult to reach. According Ndenecho (2010c), increasing monetization of the rural economy, urbanization and market orientation of livelihood activities during the last decades accelerated the forest degradation process. Moreover, in comparison to remote mountainous areas, village offers slightly more opportunities for off-farm activities, which is one of the key avenues out of poverty (Ruiz-Perez *et al.*, 2004). Farmers from Big Babanki had the largest share of off-farm income among targeted groups of respondents (38%) (see Figure 13). This is comparable with other studies from developing countries, which documented heavy dependency of rural households on off-farm income for their survival (35-50% share of off-farm income on household income), and is higher than documented average 28% for

sub-Saharan Africa (Haagblade, Hazell and Reardon, 2010). Targeted households from this area gained the best levels of education compared to the farmers and pastoralists from Abongphen, apparently due to the presence of schools directly in the village, which is not the case of Abongphen mountainous area[3]. Another important finding is that most of interviewed households inherited their land from their ancestors. Moreover, the average age of the farm equalled to 47 years and it was four times more compared to the situation in Abongphen. This indicates possibility of soil exhaustion in terms of fertility, which is consistent with opinions on the quality of the soil among our respondents (Figure 9). It seems to be one of the main reasons why farmers from the village migrate and/or looking for additional land resources up into the mountains in order to establish new farms.

6.1.2 Kedjom Keku and Kedjom Ketinguh farmers

Second group represents Kedjom Keku and Kedjom Ketinguh farmers from higher altitudes between 1,855 and 2,121 masl. Those households occupied the mountainous area of Abongphen and their livelihood strategies were more subsistence oriented. This finding is consistent with similar studies (Sunderlin *et al*., 2005, Ndenecho, 2010c, Babigumira *et al.*, 2014) showing that most of the farming systems in sub-Saharan Africa followed more of a subsistence logic, where the use of land is directed towards satisfying the basic household's needs, e.g. due to more limited market access. Farmers from this group gained lower total annual cash income in comparison from Big Babanki farmers (see Figure 13 and Figure 14). However, the share of annual crops on total cash income was the highest among documented farming systems, which was probably due to the higher altitudes which were not so suitable for growing perennial crops for the market, such as African plum (*Dacryodes edulis*), cocoa (*Theobroma cacao*), mango (*Mangifera indica*), pineapple (*Ananas comosus*), passiflora (*Passiflora* spp.) or citruses (*Citrus* spp.), which were frequently planted in Big Babanki. Additionally, these mountainous areas offer only few opportunities for off-farm employment. As a result, their livelihood strategies were more frequently linked with the closely lying forest, which makes them more dependent on forest resources compare to other documented farming systems in the study area (see

[3] Exception is Mountain Misty School established in 2010 by Kedjom Keku NGO, see its location in the Figure 5).

Figure 15 and Figure 17). In general, socio-economic pressure and decreasing of land fertility seem to be main driving forces for further land acquisition and, consequently, the main causes of deforestation (Epule *et al.*, 2014). This idea is supported by data gathered among targeted farming households who lived in the mountains area Abongphen. They came there either from the village Big Babanki (73%) or Small Babanki (27%) seeking for fertile available land and, according to their perception on the quality of the soil the farms in Abongphen, were more fertile compared to Big Babanki (see Figure 9).

6.1.3 Mbororo pastoralists

Last group were formed by Mbororo pastoralists living in the mountains area Abongphen, who relied mostly on cattle production for their livelihood. As a result, they reached the highest average annual cash income among observed groups of respondents (see Figure 13 and Figure 14). Nevertheless, there were identified the worst levels of education from the three targeted groups. This fact could be explained similarly to Abongphen farmers by former absence of the school in the mountains area and maybe also by a more nomadic lifestyle of pastoralists. They perceived forest mainly as the pasture for their cattle (see Figure 18), which were vitally dependent on. Due to the large number of cows, as observed among targeted households, overgrazing contributes significantly to the forest degradation and also raises farmer-graziers conflicts and land disputes. As was observed also among farmers elsewhere in Africa (Masika, Averbeke and Sonandi, 2000) vast majority of Mbororo pastoralists relied on the collection of medicinal plant in the forest for men but more importantly as the treatment for the cattle.

6.2 Perception of forest by local households

Based on our results we can conclude that African smallholder systems are complex, dynamic and spatially heterogeneous socio-ecological systems (Tittonell *et al.*, 2010). Furthermore, our study proved strong linkages between interviewed households and local forest. Comparing to other studies (Ngwa and Fonjong, 2002; Kaimowitz, 2003; Sunderlin et al., 2005; Mamo, Sjaastad and Vedeld, 2007; Blaser et al., 2011) it was revealed that the

most important direct benefits from the forest perceived by the farmers and pastoralists as the most important were the supplying household's demand for water and energy through the gathering water from nature streams and collection of firewood, respectively. Furthermore, practicing of traditional medicine, improving of the soil fertility, construction material and support of food security were other main important roles of forest documented among interviewed households. Using forest land as a pasture for grazing cattle was a specific role perceived, unsurprisingly, by pastoralists only (see Figure 18). Rural people in Tubah Upland Forest increasingly perceived water contamination and potable water shortages during the dry season, which is in correspondence with study of Ndenecho (2010c). Fetching or gathering of the firewood was especially important in mountainous area Abongphen among farmers and pastoralists, as it constituted the only energy supply for local households. This is again in correspondence with research done in the target area by Ndenecho (2010c), who documented annual fuelwood requirements per farming household in Tubah Upland Forest equal to 36 m^3. The fuelwood extraction represents one of the main causes of degradation in human-dominated tropical landscapes worldwide (Specht *et al*., 2015; Ndenecho, 2010c; Sonwa et al., 2012) thus, there is a need to set up the system that would regulate firewood collection in the target area. This is true particularly with regard to increasing profitability of firewood business, which supplies also growing urban population. This makes urban areas more reliant on wood from rural areas. In this regard, our findings corresponds with Belle, Sonwa and Tiani (2015), who stated that the dependence on energy supplies from forest, such as firewood, charcoal and other biomass, would increase together with growing prices for energy or frequent electricity shortages. Our results also showed relatively strong reliance of targeted households on the collection of various medicinal plants in the forest (see Figure 16). There were identified 18 medicinal plants across targeted households, which were commonly used in the traditional medicine and/or for the spiritual life (see Table 2). In this case, our study come up with similar findings as for example Topa *et al*. (2009) or Fokunang *et al.* (2011). Generally, use of forest resources by local households must remain sustainable as all activities we documented are usually considered as the most important factors causing deforestation in marginal areas of sub-Saharan Africa (Ndenecho, 2010c). Our results also document farmers' perception toward need of domestication of several forest species that could help them to improve their farm land, serve as the improvement of nutritional balance or as a source for additional cash income (see Figure 20), particularly

Prunus Africana, trees against erosion, bee-loving trees such *Acacia* spp. and *Croton sylvaticus* for honey production. Also medicinal plants, raffia palm (*Raphia africana*) for tapping palm wine, red mahogany for timber (*Khaya ivorensis*), coffee (*Coffea arabica*) for cash income generation, *Newtonia camerunesis* for timber and carving or fruit trees.

6.3 Biodiversity dynamics

Our research is consistent with other recent studies (Duraes *et al*., 2013; Seidler, 2013; Reddy *et al*., 2014; Belle, Sonwa and Tiani, 2015) on a perception of a loss of biodiversity, degradation and fragmentation of tropical forests. There were strong evidences from the respondents within the research area that biodiversity in the local forest declined rapidly over the last couple of years (see Figure 21). One elderly farmer from Abongphen said: *"When I was young, I used to watch a lot of monkeys and used to hearing many different voices coming from the bush. But now - nothing, I saw last monkey 25 years ago."* One of the other comments from local dweller regarding the loss of biodiversity in local forest was similar: *"Formerly, there were chimpanzees, many kinds of bush animals. Now there is less forest, less animals. For many years I have not seen almost anything."* Therefore, vast majority of all farmers and pastoralist perceived the protection of the forest in their surroundings as very important. The most relevant reasons for forest protection included the preserving the forest for next generations, supporting watershed function of the forest, protection of environment and biodiversity conservation, perception of the forest as a source of life, esthetical value of the forest and fresh air (see Figure 23). Expectation on the future use of the forest differed across households (see Figure 22). Great proportion of all targeted households expected their level of use of the forest will remain the same, but also a large number of households proclaimed that if they will have any additional benefit from the forest, they will use the forest more. In general, the invasion of Tubah Forest by both farmers and herders in recent years is resulting in social tensions, conflicts, inter-personal and inter-community skirmishes. The original vegetation of montane and sub-montane forest is fast disappearing and the biodiversity of the forest is being lost due to this destructive practices. Without any conservation status the forest is an open access resources facing "the tragedy of the commons" (Ndenecho, 2010c).

6.4 Current situation, recommendations and implications for further research

These are the main current causes that affecting the loss, degradation and fragmentation of Tubah Upland Forest: (i) population pressure resulting in invasion of upland forests by landless farmers, (ii) institutional weakness and inefficient extension service (iii) annual bush fires and poor farming methods, (iv) grazing encroachment and poor grazing methods, (v) excessive use of firewood and (vi) limited access to credit and training. Under the auspices of NGO Kedjom Keku[4] several activities towards the protection of Tubah Upland Forest have been currently taking place in the Abongphen area, such as preservation and restoration of mountain forest. Not only planting new trees, but also the protection of the remaining fragments of primary forests in the mountains is very important as well. To support future sustainability of forest use, particularly education of children from the mountains is necessary. Activities taking place in the Mountain Misty School could serve as a good example. Only through education and raising awareness the view of local people towards forest conservation can change. They themselves must change attitudes and realize why forest is important to be conserved. Current successful monitoring of endangered chimpanzees *Pan troglodytes ellioti* in the Tubah Upland Forest sparked the discussion in the circles of NGOs and even at the level of the Cameroon's Ministry of Forests and Wildlife, which starts negotiations and steps towards the establishment of nature reserve or rather the enlargement Mbi Crater Faunal Reserve, which is located about 10 km north of Abongphen and occupies an area of about 400 hectares (Birdlife International, 2015). There is also potential for agro tourism development. Furthermore, local communities should be more involved and more trained in sustainable farming practices and decision making processes within the area. Local household should be provided with the knowledge of the most suitable conservation practises, appropriate farming practices and sustainable livelihoods strategies that are based on mutual interaction with the forest. Habitats probably cannot be protected unless the local community draws benefits of biodiversity maintenance. Therefore, the alternative sustainable sources of livelihood should be included, such as environmentally benign agro-forestry and beekeeping (Leakey, 2012). Beekeeping offers an ideal income-generating

[4] Further informations about the projects available at www.kedjom-keku.com.

venture from natural resources without damaging them. Beekeeping also contributes to the maintenance of biodiversity by increasing pollination in the rainforest and also sustain agricultural by pollinating crops and thereby increase yields. When beekeepers will be supported and have access to good markets for their products, they will be motivated to support local conservation efforts. Thus beekeeping have the potential to become and integrated part of rural development and local economy (Machiara, Raina and Muli, 2010). This mountain area is very sensitive due to the ethnic tensions, farmer-grazier conflicts and land disputes and therefore the conservation and development activities should be proceed very carefully and diplomatically.

6.5 Study limitations

Our study should be viewed with certain limitations, connected generally with the data collection. Firstly, local culture and language barrier could cause some misinterpretations, despite the fact that during the interview and collection of questionnaires the local key-informant was present, who in the case of misunderstanding everything translated into the local language. Also there was an effort from our translator due to many cultural differences to refine the questions and responses perceived. This could lead to the data biases. Secondly, the results of the study are based on the information obtained from 63 households. Therefore, they cannot be generalized to the overall population of the target area. Due to the lack of time for the research in the village Big Babanki, the snowball sampling was applied during the data collection. This fact could slightly affect our results as well, as the spectra of farmers involved do not necessary cover all inner-village differences. Other possible limitation could be that no comparison with historical time series could have been done as there was only a short time contact with respondents hence only cross-sectional data were collected. Also the collection of the data during the highest peak of the rainy season could due to the reasons of poorly accessible mountain terrain slightly distort the measured sizes of the farms in Abongphen.

7 Conclusion

The purpose of the thesis was to identify potential linkages between household livelihood strategies and forest resources utilization in the area of Tubah Upland Forest in the Bamenda Higlands, Northwest Cameroon. Results showed that target households within the research area were strongly connected with the utilization of local forest for their livelihood strategies. Nevertheless, certain differences in livelihood strategies were documented among particular households. Farmers from lower altitude (1,220 masl) used forest resources to a lesser extent compared to the farmers from the mountains due to the greater degradation and fragmentation of the forest around the village. They had more off-farm income opportunities and acquired the highest levels of education. Quality of the soil was worse compared to the farms in Abongphen. They therefore often migrate further up the slopes to seek new available land. Farmers from higher altitude (1,855-2,121 masl) living in the mountains were more subsistence oriented and had only few off-farm employment opportunities. Within their livelihood strategies were more frequently in contact with the forest whereas their immediate proximity. Mbororo pastoralists living in the mountains relied mostly on cattle production for their livelihood so the forest for them was mainly important as the place for grazing the cattle. Among pastoralists, the highest average annual cash income was observed, but on the other hand the worst levels of education were identified. The most important direct benefits from the forest identified among targeted households included water, firewood, and place for grazing cattle, followed by medicine, leaves for soil fertility, construction material and food. The most important indirect benefits were leisure/recreational role of the forest, its esthetical value, fresh air and shade/cool environment. There were strong evidences from the respondents concerning the rapid declined of the biodiversity during the last couple of years. The vast majority of the dwellers perceived the protection of the forest as very important especially for the following reasons: for next generations, water/watershed function, protection of environment and biodiversity, source of life, esthetical value and fresh air. The perception on their future forest exploitation mostly depended on the level of benefits that will be able to afford from the forest in the future.

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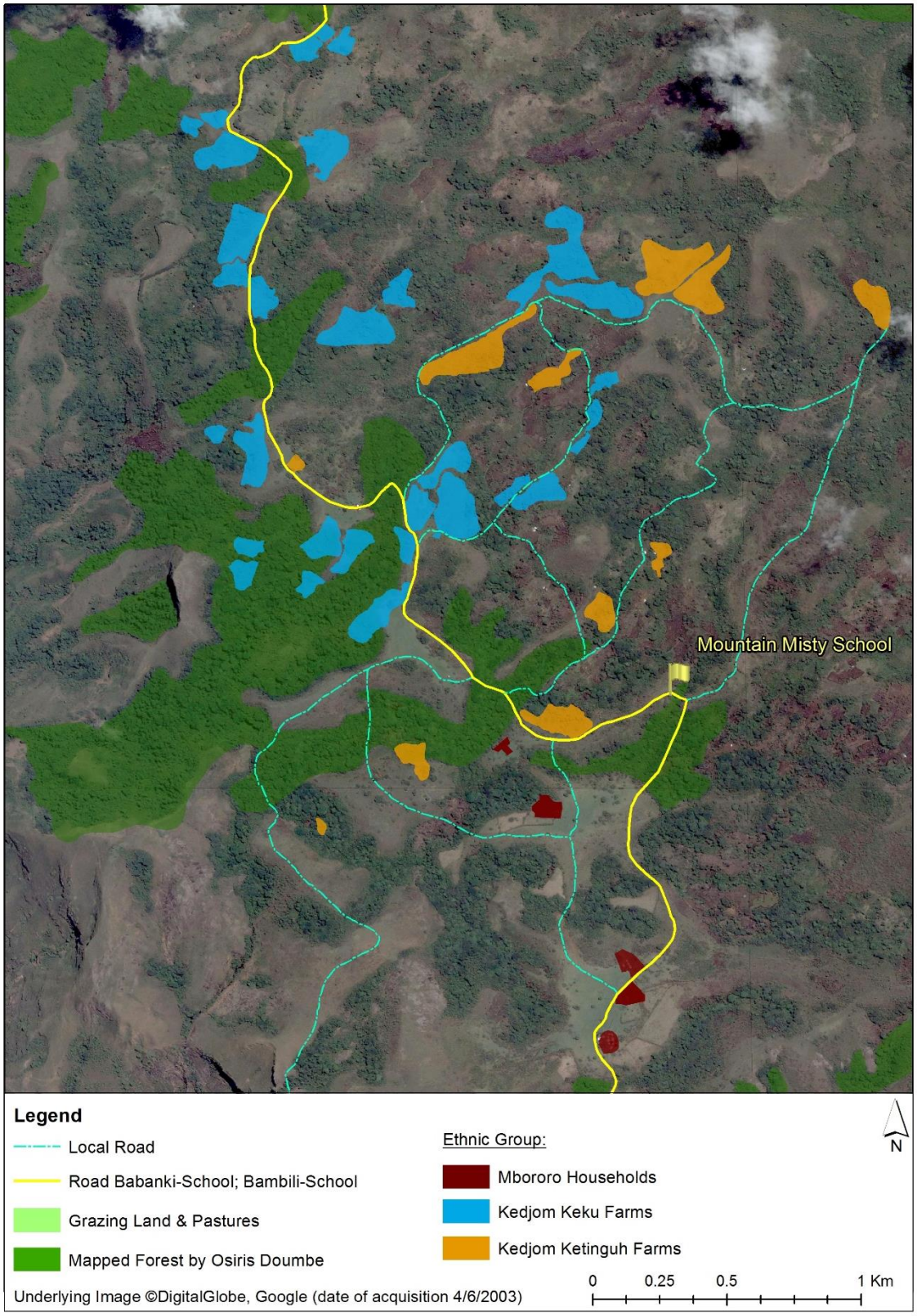
ANNEXES

List of Annexes

Annex 1 Targeted farms and households in mountains area Abonghen



Annex 2 Livelihood of Mbororo pastoralists from mountains area Abongphen, Photos: author´s archive (2014)

Annex 3 Livelihood of Kedjom Keku and Kedjom Ketinguh farmers from mountains area Abongphen, Photos: author´s archive (2014)








Annex 4 Livelihood of Kedjom Keku farmers from village Big Babanki, Photos: author´s archive (2014)






Annex 5 Data collection and botanical survey among farmers in mountains area Abonpghen with assisstance of local key-informant Peter Mbi, Photo: Anna Maňourová (2014)

Annex 6 Data collection among farmers in mountains area Abongphen with assistance of botanist Kenneth Kumecha Tah, Photo: Anna Maňourová (2014)

Annex 7 Monitoring of chimpanzees *Pan troglodytes ellioti* in Tubah Upland Forest with Martin Mikeš, Ernest Vunan, shaman Moses, Daniela Horáková and researchers from Cameroon´s Ministry of Forests and Wildlife, Photo: Martin Mikeš (2014)